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Agile Methodologies in Postsecondary Curriculum Development

Clay Hess
Bethel University

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by

Clay Anthony Hess

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Approved by:

Advisor: Dr. Michael Lindstrom

Reader: Dr. John Addleman

Reader: Dr. Carl Polding

Abstract

This study examined the state of the curriculum development process within the two-year technical college environment. The paper looked at cost, quality, and satisfaction with the curriculum development process. The scope of the study was the Wisconsin Technical College System. The respondents were confined to curriculum office personnel and information technology faculty. Further, the study looked into Agile methodologies. The subject of Agile methodologies was broached to see the level of knowledge of Agile within the scope of the study. Additionally, the study looked into the possibility of Agile methodologies utilization within the curriculum development process. Studies on the curriculum development process were rare. Even rarer were studies that incorporate Agile. Agile has been used in the private sector for years. Private sector data will be used for correlation. This study can be used as a starting point for future studies on not only curriculum development status, but also Agile usage in other scopes of higher education. The results of this study deemed that change is needed and Agile may be the answer. While this is the current recommendation, further studies may alter this conclusion.

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Essential Terminology

ADDIE (Analysis, Design, Development, Implementation, and Evaluation) - a popular generic Instructional System Design (ISD) model for developing curriculum that is linear in nature (Culatta, 2018).

Boot Camp - an intensive, accelerated learning curricula with hands-on projects where students develop their own software programs, web apps, and other digital tools that can vary from six to 28 weeks or more in length (Stroud, n.d.).

Byte - a unit of computer information or data-storage capacity that consists of a group of eight bits and that is used especially to represent an alphanumeric character ("Definition of BYTE", n.d.).

Computer Bit (short for "binary digit") - the smallest unit of measurement used to quantify computer data. It contains a single binary value of 0 or 1 (Christensson, 2013).

Curriculum Currency - relates to the information within a course or program that is current and useful for the learner and their future employer.

Learning Management System (LMS) - a software application for the administration, documentation, tracking, reporting, and delivery of educational courses, training programs, or learning and development programs (Learning management system, 2019).

Megabyte (Mb) - 1024 kilobytes or 1,048,576 bytes ("Definition of MEGABYTE", n.d.).

Massive Open Online Course (MOOC) - an online course aimed at unlimited participation and open access via the web (Massive Open Online Course, n.d.)

Waterfall - a linear, sequential method to developing and delivering software (Agile & Waterfall methodologies – A side-by-side comparison, 2012).

Worldwide Instructional Design System (WIDS) - a performance-based instructional design system developed by a division of the WTCS Foundation, Inc., a not-for-profit organization (Worldwide Instructional Design System, 2018).

Chapter I: Introduction

It is an early Monday morning just prior to the beginning of the semester. An Information Technology (IT) faculty member walks into the two-year, technical college where he teaches. He is going to a meeting with his dean to discuss his teaching assignment for the year. They proceed to review what courses he will be teaching. They turn their attention to curriculum. As a part of his teaching assignment, he will be working on a curriculum project, which seems to be a never-ending task in IT. The instructor and dean discuss the curriculum budget. This discussion helps drive what courses need work. The faculty member and dean reach a strategic agreement as to what course will be developed/improved with a curriculum project.

The curriculum project begins with the signing of a contract prepared by the curriculum approval office. The contract outlines the development of the course modality along with a possible Credit for Prior Learning (CPL) exam. The modality selected drives the guidelines set by the curriculum approval office as to what is required for the curriculum project. The instructor follows given guidelines. The first hurdle, prior to the contract, has already been overcome, which is an institutional requirement that 50% of the content be new or requiring modification for the project to be considered.

The instructor begins the project utilizing the guideline documentation and instructions provided by the curriculum approval office. The first major step is to complete the WIDS (Worldwide Instructional Design System) profile (Worldwide Instructional Design System, 2018). The instructor finds this system difficult to work with as the interface is time consuming and awkward. To complete a task requires jumping in and out of several different screens. It takes several weeks to complete the initial phase of the process. It then goes to a peer reviewer,

who gives feedback. Once the peer review feedback is integrated, it goes to the curriculum development office for approval. The results of their review reveal that changes in the process have occurred since the inception of the project. The instructor performs the new changes in WIDS and re-submits the project for approval.

The next phase begins, which is the Learning Management System (LMS) section. The curriculum approval office supplies instructions and requirements to follow. The LMS also has a peer review process. Once the peer reviewer signs off, the curriculum approval office performs their review of the LMS. The curriculum approval office has made LMS process improvements. The instructor reviews these changes and begins to incorporate learning content revisions based on the new process requirements.

There is a new wrinkle, however. The instructor has learned that the information technology industry has made a change to some of the content. He goes back into WIDS and the LMS and makes those changes since the curriculum project is still open so that he does not have to do them later. This can save institutional dollars. The curriculum office reviews the project for final approval.

Both curriculum project phases (WIDS and LMS) are complete and the curriculum approval office gives their approval, which completes, and closes the curriculum project. A couple of weeks go by and the industry makes further changes that would necessitate yet another curriculum revision. The problem is that the project is closed and the instructor knows that he cannot go back to the curriculum approval office to have it re-opened due to costs because curriculum development can be expensive. Lewis (2012) reported that the curriculum development cost for a 36 hour course in the private sector could cost between $32,039 and $86,871. Additionally, it can take 12 to 18 months to complete the entire process. This begs the

question of the cost of curriculum development in higher education. The main studies surrounding the cost of curriculum development concerned Massive Open Online Courses (MOOCs) and were specific to eLearning. Hollands and Tirthali (2014) studied MOOCs and hypothesized that the cost savings is not as large as one would have thought. Beyond the personnel costs, eLearning courses require tedious closed-captioning work, high quality video production, and the cost of the platform and analytics. The costs in the Hollands and Tirthali (2014) study ranged from $38,980 at Teachers College, Columbia University to $325,330 at a large, unnamed Midwestern university. The course design and development (which does not include delivery, video production, etc.) is estimated to take 88-150 hours during the early stages of MOOCs (Hollands & Tirthali, 2014). Defelice (2018) asked how long it would take to develop one hour of online training. This can be difficult to ascertain depending on the level of the developed eLearning. The course could range from passive learning to real-time interactions. An eLearning course could take anywhere from 42 to 143 hours from inception to delivery depending on the level of interaction. There have been improvements over the years in development time ranging from 24% to 89% due to advances in technology (Defelice, 2018). The Defelice (2018) study is interesting in that having a static measurement of an hour allows for longitudinal comparisons. This past study has been performed two other times in 2003 and 2009. A learning development company called *Raccoon Gang* found their eLearning work took a little more than the Defelice (2018) study. An hour of eLearning work took them 100–160 hours and a cost range of $7,140 - $35,550 to complete (Raccoon Gang, 2017; How much does it cost…, 2017). While there are differences in the data and could be worthy of a study as to the reasons, what these studies do show is that it is expensive to develop courses and the lack of

studies seems to point to higher education not looking at this arena to control costs while providing quality.

The aforementioned fictional IT faculty member knows there has to be a better and more cost-effective manner to develop curriculum for the learner, institution, and staff. Fortunately, the IT instructor has experience in Agile methodologies and utilizes these principles in his development of curriculum to complete his work in a quicker, more efficient manner (Agile Alliance, 2018).

Statement of the Problem

Is the two-year technical college system delivering correct, current content to learners in a timely, cost-conscious manner? Further, are not only the students' needs being met, but also those of their employers? Information today is ubiquitous and the higher educational environment is as competitive as ever. Are curriculum development processes in higher education being developed in a cumbersome, time-consuming, and costly fashion? If so, the result is a curriculum that is out of date and insufficient to meet the needs of students and potential employers. The design and development of curriculum projects in higher education should use modern-day tools and processes that prove to be more collaborative, iterative, and cost-effective by private organizations. Collaborative and iterative methodologies may be the solution (Agile Alliance, 2018). Successful private organizations have utilized such techniques to reduce time-to-market and costs. Software Advice studied what industries have incorporated iterative methodologies in areas outside of Information Technology. They discovered that 48% of project managers did so for non-IT tasks and projects. When broken down by category, educational usage was only 2% (Leslie, 2015). Bradley (2015) addressed the cost savings of utilizing modern collaborative and iterative techniques. The Standish Group found that projects

which are managed in such a manner are six times more successful than traditional projects. They compared similar projects and discovered that modern, iterative project management was four times cheaper, produced higher user satisfaction, and broke even on application costs after two years compared to 20 years with traditional methods (Bradley, 2015).

JISC, a digital solution provider in the United Kingdom for education and research, provides a guide for the curriculum challenges facing organizations. JISC acknowledges learning provider's desire to enhance the curriculum development process, improve employability, reach new students, and develop curriculum for a purpose that is both high quality and supports innovation. Additionally, organizations have a desire to manage change, increase staff capacity to build and innovate, manage courses effectively, embed innovation throughout the college (Barrett, 2015).

Llamosa-Villalba, Delgado, Camacho, Paéz, and Valdivieso (2014) presented a paper at the 11th International Conference on Cognition and Exploratory Learning in the Digital Age. In the paper, they posited:

> Agile School is a system for innovation and deep transformation of University Institutions in which it starts with the identity and it ends at the self-governance and social responsibility, around satisfaction and transcendence by the outcomes at environment, resources and people. (p. 119)

The authors expounded upon this architectural concept as an approach to organizational structure.

Purpose of Study

The purpose of this dissertation was to evaluate curriculum development policies for IT programs at two-year technical institutions in Wisconsin to determine if the policies allow

faculty to provide current knowledge in a timely manner to meet the needs of the institutional constituency (employers and learners) in a cost-effective manner.

Significance of Study

In Western society, life is moving faster than ever. In a *New York Post* article, Dr. Stephanie Brown (2014) wrote about societal addiction to speed, overbooking, and an overall "chasing of life." Dr. Brown (2014) pointed out the need to slow down, reflect, and "unplug" and how that is difficult with technological advances and societal speed. Sheer informational gluttony alone can be overwhelming.

In 2011, our society took as many photographs in two minutes as the entire population of the globe took in the 1800s (Soojung-Kim Pang, 2011). Information across the board is at an all-time high and increasing in quantity, speed, and access. The inventor of the computer bit, Claude Shannon, estimated the largest amount of information that could be contained was 12,500 MB, which is the rough equivalent of the Library of Congress (Hilbert, 2012). Hilbert (2012) studied technologically mediated information in our society. With technological advances, the amount of information created and consumed has increased.

Information consumption has changed from a one-way system to 24-hour systems along with multiple channel exchange systems in the world of social media. If the amount of information exchanged electronically were converted to newspapers, each individual would receive 55 newspapers in 1986 and 175 in 2007 (Hilbert, 2012). Two-way communication (internet and telephone) has increased as well. In 1986, two-way communication was two pages worth of information. In 2010, two-way communication had increased to 20 newspapers per day (Hilbert, 2012). The majority of information is now stored digitally (94%) and two-way communication has been growing at an average annual rate of 28% per year over the previous 10

years. Hilbert (2012) reported there were 295 exabytes of information "floating" around. An exabyte is a one with 18 zeros after it. Using this definition, 295 exabytes of information is 295,000,000,000,000,000,000 pieces of information. If each piece of information were a second of time, 295 exabytes of time would equate to approximately 9,354,388,635,211 millennia.

While one could argue for the need to change this societal trajectory, higher education is in a position to interact with this information age. Learners and other constituency are coming into higher education having experienced this informational gluttony. How are these students being prepared to interact with this societal "norm"? This is particularly poignant in a two-year technical college system where the goal is to get an individual ready to enter and contribute to the workforce in two to three years.

If societal information is increasing at a breakneck pace, are our higher educational institutions, particularly two-year technical colleges, keeping their curriculum current with necessary information for both employer and future employee? Are there lessons that higher education can glean from iterative methodologies' management of change to maintain relevance and stave off the possible avalanche that Barber et al. (2013) predicted? Barber, at al. (2013) saw a major avalanche brewing under the surface of higher education. They list several contributing factors. The global economy is changing. Knowledge is ubiquitous and more countries are participating in global markets being spurred on by technological advances.

There has also been a rise in the cost of higher education beyond inflation causing the value of higher education to come into question. Barber et al. (2013) even share data about the value of a degree falling 1.6% annually since 2000. Additionally, competition in higher education has added to the weight of the coming avalanche, especially with the rise of MOOCs, boot camps and the like. One of the largest factors contributing to this is the availability of

knowledge. With today's internet access, finding a course online is relatively easy, especially with organizations such as Coursera and edX (Barber et al., 2013). It is this aspect of the prediction of Barber et al. (2013) that concerns this study. Do current curriculum practices prepare learners sufficiently for the changing economy?

Some in higher education have begun asking questions on a larger scale than the scope of curriculum. There are those beyond Barber et al. (2013) who foresee the "avalanche" coming to higher education. Anastasia Salter (2014) noted the need to make a change in higher education due to changes in culture and society. Salter (2014) asked if the right problems were being solved. During received training, Salter and her colleagues discussed the requests and needs of customers. Further, how organizations need to provide answers to the issues that customers are facing. Salter (2014) asked if the right problems are being solved in higher education to meet the needs of constituency. Salter (2014) posed the question on the validity of utilizing iterative methodologies in other areas of the higher educational system.

Salter (2014) posed the open question and Barber et al. (2013) posited that higher education does not have a choice to change. It will either transition willingly by embracing the change or be forced to do so by the culture and market (Barber et al., 2013). Barber at al. (2013) covered a broad spectrum of changes that are facing higher education, including the realm of content and curriculum. In today's world, information is ubiquitous. If learners wish to learn about a particular subject, all they need to do is look to a resource like Google. The growth in information is increasing exponentially. Barber et al. (2013) cited Google's Eric Schmidt who stated, "Every two days we create as much information as we did from the dawn of civilization up until 2003." The number of academic articles created in 1726 was 344 (Barber et al., 2013, Tracey, 2013). Scimago Lab (2017) stated that academics published 3,536,878 articles in 2017.

One key was the ubiquity of information affecting how educational institutions are no longer the sole disseminators of information to the culture. This leads to the availability and necessity of current curriculum. With the advent of competition, such as Massive Open Online Courses (MOOCS), curriculum has become a commodity (Barber et al., 2013; Tracey, 2013). Competition has driven down the value of the curriculum held by traditional higher educational institutions causing higher education to make a decision to go beyond developing standardized, basic curricula for basic courses to stay relevant (Barber et al., 2013).

Others corroborated these challenges within the industry. Gledic (2012) noted that sources, such as A. E. Levine, stated back in the year 2000 that the most successful higher educational institutions will be those that can respond to societal changes the quickest. As the Executive Dean of the College of Information Systems and Technology and School of Business for the University of Phoenix, Bonilla (2018) advocated for higher education keeping pace with industry. Bonilla sees the permeation of IT within various industries and the need to create coursework that aligns with industries. This will entail collaboration between higher educational institutions, businesses, and the workforce to close the skills gap (Bonilla, 2018). The UNESCO World Conference on Education in 2009 espoused that higher education should lead in this societal change (Gledic, 2012). Gledic (2012) advocated an application of modern, iterative principles at all levels of a higher educational organization. Gledic's (2012) observation of the desire to utilize these principles in higher education coincided with Michael Cusumano of the MIT Sloan School of Management, who stated that organizations need "the ability to quickly adapt to or even anticipate and lead change. This adaptability in the broadest form affects strategic thinking, operations, technology innovation and the ability to innovate in products, processes, and business models" (Kelly, 2015, para. 10). This is an ambitious advocacy. A

baseline needed to be established to see if modern, iterative methodologies are the solution to any of higher education's issues. Future studies should look at whether these methodologies would aid in other areas of higher education. Could modern, iterative principles aid in administration processes? Perhaps the registration and admissions processes would benefit. The scope of this study was curriculum development. There have not been many studies performed concerning the usage of modern, iterative methodologies in higher education. Hence the need to study curriculum development, which has a direct and major influence on the higher educational product itself. It is not without a precedent, however, as Gledic (2012) cited an event in Serbia which utilized iterative principles to reform foreign language studies. This was successful even though the majority of the more than 150 attendees did not have experience with the modern methodologies (Gledic, 2012).

This does not mean that new methodologies are the "cure-all." Modern, iterative methods are not without their challenges. The 11th Annual State of Agile Report (2017) mentioned several challenges organizations face while utilizing such methods. The top four items reported as the largest difficulties are company philosophy or culture at odds with core iterative values, lack of experience with methods, lack of management support, and general organization resistance to change (VersionOne, 2017). Higher education could face similar challenges if it were to adopt modern practices and principles.

Aspects of Agile Defined

This study utilized various technical terms. To insure against miscommunication, definitions prove useful.

Agile is the ability to create and respond to change in order to succeed in an uncertain and turbulent environment (Agile Alliance, 2015).

Business agility is the ability of an organization to sense changes internally or externally and respond accordingly in order to deliver value to its customers (Agile Alliance, 2018).

Epics are large user stories that cannot be delivered as defined within a single iteration or is large enough that it can be split into smaller user stories.

Incremental Development is when each successive version of a product is usable, and each builds upon the previous version by adding user-visible functionality (Agile Alliance, 2018).

Iteration is a timebox during which development takes place. The duration may vary from project to project and is usually fixed (Agile Alliance, 2018).

Iterative intentionally allows for repeating application development activities, and for potentially revisiting the same work products (Agile Alliance, 2018).

A Milestone Retrospective is a team's detailed analysis of the project's significant events after a set period of time or at the project's end (Agile Alliance, 2018).

Personas are synthetic biographies of fictitious users of the future product (Agile Alliance, 2018).

Planning Poker is an approach to estimation used by Agile teams. Each team member plays a card bearing a numerical value corresponding to a point estimation for a user story (Agile Alliance, 2018).

A product backlog is a list of the new features, changes to existing features, bug fixes, infrastructure changes or other activities that a team may deliver in order to achieve a specific outcome (Agile Alliance, 2018).

The product owner is a role created by the Scrum Framework responsible for making sure the team delivers the desired outcome (Agile Alliance, 2018).

A sprint backlog is the subset of product backlog that a team targets to deliver during a sprint in order to accomplish the sprint goal and make progress toward a desired outcome (Agile Alliance, 2018).

Sprint planning is an event that occurs at the beginning of a sprint where the team determines the product backlog items they will work on during that sprint (Agile Alliance, 2018).

The Stand-Up is a daily meeting and structured around some variant of the following three questions: What have you completed? What will you do next? What is getting in your way? (Agile Alliance, 2018).

A team in the Agile sense is a small group of people, assigned to the same project or effort, nearly all of them on a full-time basis (Agile Alliance, 2018).

A timebox is a previously agreed period of time during which a person or a team works steadily towards completion of some goal (Agile Alliance, 2018).

User stories are when in consultation with the customer or product owner, the team divides up the work to be done into functional increments (Agile Alliance, 2018).

Resource Utilization

While no studies were found on the usage of modern, iterative methods in curriculum development, methods, such as Agile, have been around in the private sector for many years; higher education is not without resources to determine issues and possible solutions. As an example, patterns within organizations have been a generally accepted concept. This allows an individual to recognize both good and poor patterns (anti-patterns) and apply possible solutions

based upon the pattern itself. An example of a pattern in Agile is the Iterate Pattern (Iterate, 2008). This pattern allows the handling of small pieces of work at specified, regular intervals. This is a core pattern of Agile. Iteration has the advantage of being able to support rapid change. Additionally, this capability to change as needed in shorter periods has led to less waste of resources. Linear processes, such as ADDIE have a limited capacity to support rapid changes. ADDIE is an attractive, systematic approach, but does not address a major aspect of the curriculum design of technical colleges, which is ensuring the learners have the skill sets required by employers (Albashiry et al., 2015). Higher education is in as competitive an environment as ever (Barber et al., 2013). Therefore, adaptability with as little waste as possible is necessary. How expensive is the curriculum process in the two-year technical college system? How much waste occurs that could be better spent elsewhere enhancing the learner experience while also leading to higher faculty satisfaction? Albashiry et al. (2015) advocated a relational approach to ensure the curriculum and its associated context is applicable to employers and thus benefitting the learner. This requires a high level of collaboration between the technical college faculty and the curriculum stakeholders (Albashiry et al., 2015).

Peeters (2016) experienced this during an experiment of developing curriculum utilizing Agile methodologies. Even though there are minimal formal studies, some individuals have tried iteration and collaboration. Peeters (2016) and her colleagues conducted an experiment of working on a curriculum project together with students and stakeholders. While there was a learning curve, the final results were a greater partnership within the workplace and with students, workflow improvement and efficiencies, and a deep level of collaboration. Ultimately, they were successful in completing a project they had desired for years in an innovative manner. Their plan is to continue to use Agile processes (Peeters, 2016).

Utilizing modern, iterative methodologies has the potential to get product (curriculum – competencies and objectives) to market (learners' learning environment) quicker, with higher quality, and at a lower cost. Modern Agile roots go back to 1968 and Conway's Law, which stated, "Any organization that designs a system (defined more broadly here than just information systems) will inevitably produce a design whose structure is a copy of the organization's communication structure" (Agile Alliance, 2015, Agile practices timeline - agile alliance, para. 1). Throughout the 1970s, the industry implemented tools and processes, such as Planning Poker, but they were not under a single methodology as Waterfall was still the process of choice. The 1980s began to think through the process and human element of application development. Questioning of Waterfall began. In the 1990s as technology increased, more tools and processes emerged that were Agile in nature and organizations began altering Waterfall to make development quicker. By the mid-90s, the "founders" of modern Agile methodologies began aggregating processes and procedures and combining them under a single "umbrella" process (Agile Alliance, 2015).

Learning Curves and Culture Changes

There is a learning curve when it comes to implementing modern, iterative methodologies. Faculty and administration might be reluctant due to the current workloads. Once people understand these methods, such as Scrum, and learn that they are simple to understand, yet difficult to master, then they begin to buy-in as they experience the benefits.

Figure 1: Scrum Values. Figure displays the core values and principles of Scrum (Scrum, 2017).

"Even badly implemented Scrum works" (Rowe, 2013, 24:01). Scrum founders based Scrum theory upon empirical process control theory. Empirical process control theory asserted that knowledge comes from experience and knowledge leads to the best decisions. This is why Agile Scrum is iterative and incremental. Agile Scrum requires transparency, inspection, and adaptation (Schwaber & Sutherland, 2014). Undergirding all of this is communication and trust. Each individual involved with the team has responsibilities and needs to maintain transparency and open communication with others as the team self-regulates and holds each other accountable. This is a vastly different structure than many higher educational institutions that are not

Figure 2. Scrum Principles. Figure displays the core values and principles of Scrum (Scrum, 2017).

distributed, self-organizing, limber teams, but rather, committee-driven, bureaucratic structures. This also differs from those higher educational environments wherein instructors consider themselves in the role of independent contractors rather than a part of a collective. This represents a major culture change needing to occur, especially in regard to the values and principles embodied by Scrum (Figures 1 and 2; Scrum, 2017).

If major changes do not occur within higher education, institutions might find themselves buried in the avalanche (Barber et al., 2013). Small pockets, such as Peeters (2016) curriculum development journey experimented with the learning curve and associated cultural changes in implementing iterative processes.

Limitations

This study had bias and drawbacks. The population was only instructors and curriculum offices within the two-year technical college system in Wisconsin. Some of the results and analysis may not apply in other environments. For example, a four-year, liberal arts institution might experience varying results if the same study were conducted in that environment. Further, this study focused on IT instructors. Other educational majors might have differing results. Perhaps other industries and content areas do not move at the same pace as IT. Readers and future researchers should keep this in mind and perhaps use these shortfalls to add to the body of knowledge with their own research.

Another possible drawback was a lack of knowledge of Agile methodologies. IT faculty knowledge concerning Agile was not an assumption. Additionally, perhaps, individuals that work in curriculum approval offices did not have Agile knowledge. An explanation of the basics of Agile in the survey to ensure all respondents have the same basis of information was used to mitigate possible lack of awareness bias.

The study was conducted with an emailed Qualtrics survey. The target participants were IT faculty and curriculum approval office personnel in the Wisconsin Technical College System (WTCS). There was a concern over participation since an online survey is easy to ignore. The results could contain bias and issues depending on the participation rate. A low participation rate could lead to analysis issues. The data gathered by Qualtrics was downloaded. Qualtrics, Jeffrey's Amazing Statistics Program (JASP) and Microsoft Excel were utilized to analyze the data results. For statistical analysis, quantitative related measurements were utilized. The two groups of participants, which were IT instructors and curriculum development personnel, were categorized nominally for analysis. Percentages were used. To ensure a proper understanding of

the data, contingency tables for relationship comprehension were utilized as well as an indication of the number of respondents (n). To aid in accepting or rejecting the hypothesis, a chi-square calculation was utilized to ensure a result less than .05. Since there was a faction of the study pertaining to cost and efficiencies as well as satisfaction, which were put in numeric form, analysis of differences was performed. Descriptive statistics of mean and standard deviation was calculated for each group and the overall participants. The study had two participant groups (faculty and curriculum office personnel). Additionally, in looking at a relationship between the interval variables of each group, a correlation coefficient was computed. This shed light on whether there was a direct or inverse relationship between the two groups. In this study, the independent variable was the currency of curriculum, which was measured via a Likert scale. The dependent variables were quality, cost, and satisfaction.

Also of concern was the purposive sampling of Wisconsin Technical College IT faculty. Each state has its own organizational structure for their state system schools. In Wisconsin, the technical college system is a separate entity from the four-year University of Wisconsin system. This structure could affect the study in a different manner than a state where the technical college system is combined with the four-year institutions. Subsequent studies are encouraged to perform the same analysis in such an environment. This may lead to differing results, which must be considered during data analysis and interpretation. The selected sample allowed the study to be conducted within the available scope. This sample structure may mean that the results and analysis may not apply to other populations.

Research Questions

This study attempted to answer the following research questions.

RQ_1: How do the current curriculum development practices within the Wisconsin two-year technical college environment meet the needs of the constituency in the rapidly moving IT industry?

S_1: What is the status of Agile principles adoption within the IT faculty and curriculum development offices of the WTCS?

S_2: What is the state of the current cost(s) of curriculum development?

S_3: What is the state of the process to get current knowledge to the market (implemented)?

S_4: What is the satisfaction level of teachers and curriculum approval offices with current curriculum development processes?

Summary

Today's society is moving faster than ever and the pace seems to be increasing. Today's student might be involved in a career that has yet to be envisioned. Higher educational institutions have traditionally been the source of knowledge and preparation for learners to improve themselves and their position in life. In recent years, this has changed. Technology has made knowledge ubiquitous. Higher educational institutions need to examine the role they play in society. Learners are looking toward their future with more of a consumer mindset and competition in education is high. With tighter budgetary constraints, cultural changes and technological advances, higher educational institutions need to reflect on their processes, procedures, and offerings. One of the main "products" they offer students is curriculum. Is higher education providing learners with current curriculum to prepare them for the careers of tomorrow? What is the current state of curriculum? What current processes are being utilized?

Could higher education learn from the private sector when it comes to getting “product” to market quickly and in a high quality manner?

Chapter II: Review of Literature

As societal transitions have occurred at an ever-increasing pace, it has been a challenge for higher education to maintain current curriculum. Curriculum can be expensive to develop. The other side of this is the cost to the learner. If the learner is acquiring skills and knowledge that are not current, are they put at a disadvantage in the marketplace? A technical college, located in Wausau, Wisconsin, has seen an increase in enrollment among learners ages 18-24 where they now comprise 46% of the student body (Northcentral Technical College, personal communication, 2017). Anecdotal evidence pointed to a combination of reasons: 1) costs, 2) attitudinal changes towards the technical college system, and 3) a desire to get into the marketplace sooner. One employer cited the currency of knowledge for Information Technology students from two-year technical colleges versus four-year graduates as a reason for pursuing employees from two-year technical institutions (Sentry Insurance, personal communication, 2017). This leaves higher education in a predicament. It will be necessary to develop curriculum in a cost-effective manner at a rapid pace to fulfill constituency needs.

Wisconsin Technical College System Curriculum

Since the scope of this study was the Wisconsin Technical College System (WTCS), it is helpful to understand how the current curriculum system works. The WTCS requires the process be supported by employment needs. For example, to begin a program at an institution, the departmental advisory committee is required to give approval and even record that there is a job available. Further, the institution must provide job analytic data to the state. This data includes graduation rates, job placement rates, and expenses to run the program. Additionally, the program is to adhere to Technical Skills Attainment (TSA), which are outcome requirements for the program area (Mackey, 2017).

The WTCS sets course standards for the entire technical college system. The WTCS has identified five types of associate degree instruction and sets the credit granted based on said type (Table 1). As it pertained to curriculum, a district needed to acquire approval from the WTCS if the stated change was over 20% of the existing curriculum. Courses also required approval from the WTCS. Courses must also adhere to a calculation based on the type breakdown of the credits (Mackey, 2017).

Table 1

WTCS breakdowns of types of instruction

Type A	Instructional delivery scheduled through physical and electronic learning environments 1. Specifically planned learning experiences based on identified objectives. 2. Direct instructor involvement. 3. Instructional delivery scheduled through physical or electronic learning environments a. Presentations by instructor b. Demonstrations by instructor c. Discussion 4. Instructor - student contact: the equivalent of eighteen (18) - 50 minute potential periods of instruction per semester equals one (1) associate degree credit. 5. Student outside effort: two (2) hours for each potential period of instruction.
Type B	On-Campus Laboratory. 1. Specifically planned learning experiences based on identified objectives. 2. Direct instructor involvement with ongoing supervision. 3. On or off campus scheduled space. a. Demonstration

	b. Practice and/or skill development 4. Instructor - student contact: thirty-six (36) - 50 minute potential periods of instruction per semester equals one (1) associate degree credit. 5. Student outside effort: one (1) hour for each two (2) potential periods of instruction.
Type C	Individualized/Independent Instruction and Selected Clinical., Extended Laboratory and/or Shop Experiences. 1. Specifically planned learning experiences based on identified objectives. 2. Periodic evaluation check points and/or supervision by instructional staff. 3. On or off campus scheduled space. a. Mediated presentation and demonstration b. Limited discussion activities c. Practice and/or skill development on an individual/independent basis. 4. Instructor - student coordinated experience: fifty-four (54) - 50 minute potential periods of individualized/independent instruction or selected clinical per semester equals one (1) associate degree credit. 5. Student outside effort: none required. Included in instructor - student coordinated experience.
Type D	Simulated or Actual Occupational Experience. 1. Programs of activities with planned learning experiences identified jointly by instructor, student and, if appropriate, employer. 2. Periodic supervision and evaluation of performance by instructional staff. 3. On or off campus. a. Practice and/or skill development 4. Instructor coordinated experience: 72 hours of simulated or actual occupational experience equals one (1) associate degree credit.

	5. Student outside effort: none required.
Type E	On-the-job Experience (Limited Selected Programs). 1. Programs of work with non-specified learning experiences. 2. Supervision of work performance by the employer and minimal supervision by instructional staff. 3. Off campus. a. Practice and skill development (with or without student remuneration) 4. Instructor coordinated experience: 216 hours of job experience equals one (1) associate degree credit. 5. 5. Outside student effort: none required.

Agile Defined

In 2001, 17 software developers came together for a weekend retreat in the mountains of Utah to discuss the process of creating software applications (Beck et al., 2001). Each of the individuals came with their own agenda and experience with their respective application development processes. All 17 of the individuals began discussing their processes to learn from one another. The individuals discovered that there were commonalities among the processes. These became known as Agile.

This term, "Agile", is utilized many times within the application development world. It is important to begin with common ground to understand what is meant by the term, "Agile" to ensure mutual understanding. Agile is the "ability to create and respond to change in order to succeed in an uncertain and turbulent environment" (Agile Alliance, 2015, para. 1) When the software industry began, it needed processes to utilize in the manufacture of its product. A prime proponent of usage of the Waterfall process was Dr. Winston Royce (Royce, 1970). Royce advocated for getting the customer involved early, but that does not occur in his Waterfall

approach until step 5. Additionally, he advocated for robust documentation up front, with a large software project requiring approximately 1500 pages of documentation before programming begins (Royce, 1970). As the industry, and our world, has become more complex, it became evident to the industry that the linear, manufacturing-like methods would not function to the efficiency needed to remain competitive. This is what led to the Agile Manifesto.

Getting a group of opinionated developers to agree on processes is difficult. The Agile Manifesto team gathering might have been even harder since their processes were innovative. Their being able to leave the weekend with a philosophy of agreement that would span all of their processes was considered "ground-breaking." What emerged from this weekend retreat became known as "The Agile Manifesto" from Beck et al. (2001), which reads:

> We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:
>
> individuals and interactions over processes and tools
>
> working software over comprehensive documentation
>
> customer collaboration over contract negotiation
>
> responding to change over following a plan.
>
> That is, while there is value in the items on the right, we value the items on the left more.

This group of developers that were not only independent thinkers, but also sometimes competitors, became known as the "Agile Alliance." These individuals felt that the work from the retreat was less concrete and concerned with applications, but rather dealt with value and culture. Each of them wished to work in an environment that delivered good products and actually acted as if people were the most important asset of an organization. Each of them felt

privileged to work with a group of people who held compatible values of trust and respect for each other and promoting organizational models based on people, collaboration, and building the types of organizational communities in which people would want to work (Beck et al., 2001).

Agile History

Throughout the 1990s, many software companies began looking for alternative methodologies to use in their development processes to gain a competitive edge and improve their product offerings in a manner that kept pace with their constituency (What is agile software, 2015). While each of these various early methods had differences, there were commonalities amongst them.

The Agile Manifesto and its underlying principles laid the foundation for the concept of Agile Software Development, which is an umbrella term for a collection of methods, and practices based upon the Agile Manifesto and its principles. The base definition is the creation of solutions via collaboration between individuals and/or teams that are cross-functional and evolutionary in nature. Organizations looked to encourage closer collaboration between developers and stakeholders. There was also an increased interest in delivering business value in higher frequency. To accomplish these goals, organizations began to put together small, self-organizing teams to allow them to work quickly and deliver high quality programs (What is agile software, 2015). It was this general movement by various organizations that led to the Agile Manifesto.

Agile Sub-Philosophies

Agile is an umbrella term covering many other subset processes. Scrum is one of the more popular versions of Agile. Scrum is an Agile framework where people can address complex problems adaptively, while productively and creatively delivering products with the

highest possible value in the shortest amount of time (Schwaber & Sutherland, 2014). Agile, being large and pliable, has led to several sub-philosophies. These sub-philosophies are all Agile as they adhere to the Agile Manifesto and underlying principles, but each one provides further details and differing approaches to accomplish the same tasks. The two most popular sub-philosophies are Scrum (58–76% utilization depending how it is measured) and Kanban (5-13%) (VersionOne, 2017). Scrum, as defined by the Agile Alliance (2017), is a process framework used to manage product development and other knowledge work. Scrum is empirical in that it provides a means for teams to establish a hypothesis of how they think something works, try it out, reflect on the experience, and make the appropriate adjustments. Scrum is structured in a way that allows teams to incorporate practices from other frameworks that make sense for the team's context (Scrum, 2017). Kanban, as defined by the Agile Alliance (2017), is a means to design, manage, and improve flow systems for knowledge work. The method also allows organizations to start with their existing workflow and drive evolutionary change (What is Kanban?, 2017). This is especially helpful when policies and procedures are entrenched, and individuals are resistant to change.

Agile Benefits

In the private sector, information technology firms have been utilizing Agile and realizing its benefits for several years. Within a fast-moving industry, such as information technology, a successful organization will not adhere to policies that do not bring about substantial benefits and a solid return on investment. Agile is ideal for managing complex projects in a volatile environment. As society has been evolving faster as technology becomes pervasive within nearly every industry, other industries have begun to realize the benefits of Agile. The 11th Annual State of Agile Report (2017) described what industries utilize Agile and at what percentage Agile principles have saturated respective industries (Figure 3).

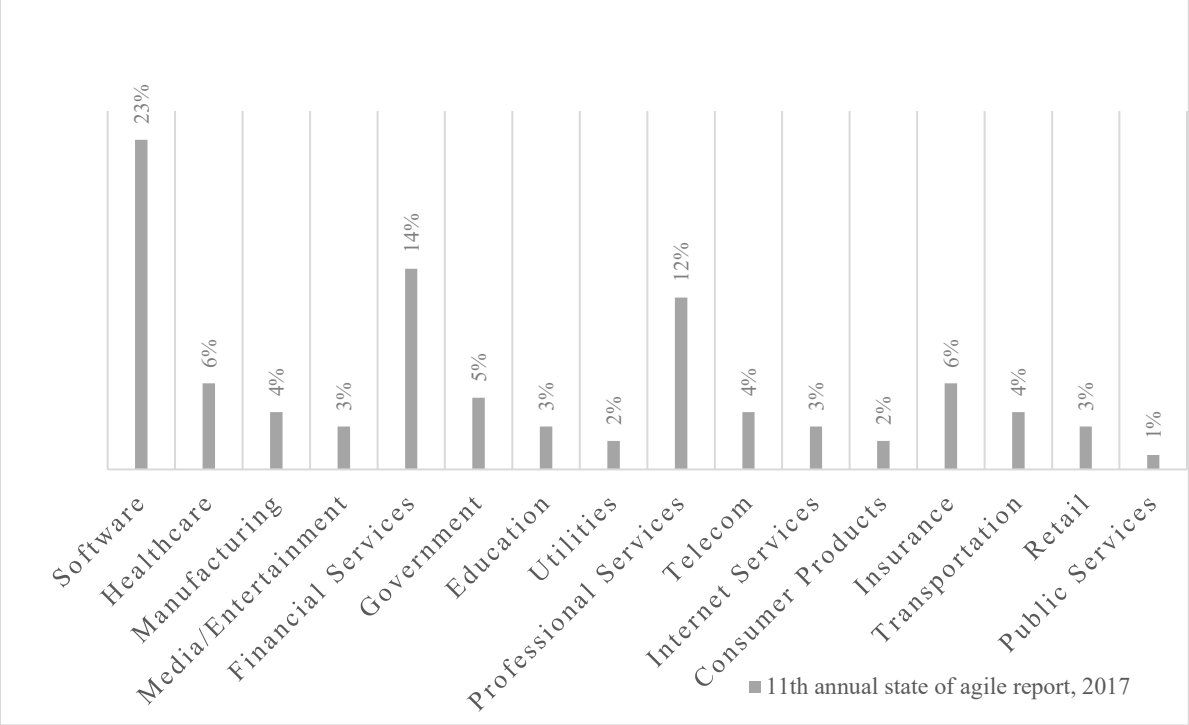

Figure 3. Agile Saturation by Industry. Figure displays the adoption of Agile principles by industry (VersionOne, 2017).

These industry respondents reported that the utilization of Agile methodologies and principles afforded them the benefits of the ability to manage changing priorities and project visibility, increasing team productivity, delivery speed/time to market, improving team morale,

greater business/IT alignment, higher software quality, project predictability, project risk reduction, engineering discipline, software maintainability, distributed teams, and project cost reduction (VersionOne, 2017).

The respondents reported achieving a 98% success rate with the utilization of Agile principles within their projects. The key is to understand how these organizations understood the definition of success for their organizations. The respondents' definitions of success were on-time delivery, business value, customer/user satisfaction, product quality, product scope, productivity, project visibility, predictability, and process improvement (VersionOne, 2017).

Agile in Higher Education

Salter (2014) addressed the need for Agile principles in higher education in the Chronicle of Higher Education. Their technology program brought in a trainer to teach their department Agile. She was struck by how the Agile principles could be utilized across the higher educational landscape by asking the right questions, solving the right problems, and failing early (Salter, 2014). Failing early in Agile addresses the issues of failure within a Waterfall project. Since Agile projects are developed within two to four week Sprints, any mistakes or misdirection can be corrected quickly. In the beginning of a project, the individuals involved know the least amount about the project itself. Mistakes and poor decisions are going to occur. Having shorter delivery times allows for corrections to be made with the least amount of cost. If a project is to be abandoned altogether, it is better that this occurs early on, rather than months or years into a Waterfall project (Agile Alliance, 2013). All of the Agile principles and more can be implemented in various fashions throughout a higher educational organization. Salter's (2014) big takeaway was the collaborative nature of Agile and the benefits it could bring to an institution (Salter, 2014). Salter's views were further supported by a case study from Gledic

(2012) which advocated Agile principles be implemented institution-wide. The study stated, "institutions must develop their capacity for change and transform their strategies from constructed beforehand to permanently in construction" (Gledic, 2012, slide 4). While these advocates of Agile in higher education are pushing for Agile to be adopted across an entire institution, Agile principles can be applied to curriculum so that it is "permanently in construction" to provide an evolutionary product for the learner and thus, the future employer. Gledic (2012) observed the usage of Agile methodologies in a project for the European Union wherein foreign language studies were harmonized at the master's degree level. One hundred and fifty individuals representing 18 institutions across six countries utilized Scrum and Kanban to accomplish the task. Most of the individuals were from traditional higher educational settings but achieved success in the Agile environment (Gledic, 2012). An additional case study with self-organizing students from student parliaments across Serbia had the goal to solve political conflicts (Gledic, 2012). Out of 34 items proposed, three were designated urgent and completed. This process is ongoing and aids in the supporting of the Bologna process (Gledic, 2012).

Agile is currently being introduced beyond the Information Technology classroom in areas such as the European Union and other arenas around the world where collaboration is being forced due to political climate changes. In the United States, this is occurring less. It is driven by individuals, such as those that are a part of the Agile in Education movement, rather than the institutions or political environment (Delhij et al., 2016).

Agile allows for the flexibility to manage items in a complex and unpredictable environment. This is the current and future state of higher education. MOOCs have turned curricula into a commodity. Higher education needs to move beyond simply developing standardized curricula content (Barber et al., 2013). Higher educational institutions should move

away from utilizing predefined, bureaucratic, and inflexibly structured curricula to customized curricula (Gledic, 2012). Simply providing traditional content can be achieved by MOOCs, but can MOOCs move to the next step and assess whether students are gaining wider skills applicable to the 21st century?

Faculty and administration alike can discover mutual satisfaction in the Agile collaborative process. A curriculum process rooted in Agile collaboration can change beliefs about design and development processes towards a more progressive system. Faculty gain a more holistic view and appreciation beyond their "silo" (Albashiry, Voogt, & Pieters, 2015a; Albashiry, Voogt, & Pieters, 2015b). These realized benefits are not without investment, however. Faculty and administration need to "buy-in" to the process and their respective skills and knowledge about collaboration and the Agile processes play key roles (Albashiry et al., 2015). When done properly and with proper support, collaborative, Agile curriculum processes resulted in higher levels of consistency and efficiency of curriculum for all stakeholders (Albashiry et al., 2015). Albashiry et al. (2015) went to the point of stating that the relational aspect of developing curriculum in a technical/vocational setting is crucial and that extensive collaboration is necessary to reach a consensus on the curriculum that satisfies stakeholders. This is especially important given the role of technical colleges in providing the needed skills to equip learners for a constantly changing marketplace (Albashiry et al., 2015).

Current higher educational Agile movements. There are already small pockets of Agile practices occurring in higher education. Chris Bustamante, former president of Rio Salado Community College stated, "Colleges must be more nimble and adaptable if they are going to serve their students" (Swanger, 2016, p. 45). An example of this innovation was the incorporation of data science into making students successful. Rio Salado utilized an algorithm

that can predict a student's success by the 8th day of class. A flag is triggered to launch support to help the student become successful (Swanger, 2016).

In the realm of Agile in higher education, Pope-Ruark (2017) has advocated the utilization of Agile principles throughout the faculty processes and responsibilities. For curriculum development, Pope-Ruark (2017) recommended the application of Agile principles to the curriculum development process. She advocated thinking of courses as Epics. Many higher educational institutions utilize a backwards design process to develop curriculum. Backwards design has parallels with Agile. In backwards design, desired student outcomes are developed. The next step is to determine the evidence needed to decide if the outcome desired has been achieved. The activities and assessments are designed to achieve the needed evidence desired to prove the student met the outcomes of the course and/or program (Pope-Ruark, 2017).

Another proponent of Agile methodologies in higher education advocated leaving ADDIE for Successive Approximation Model (SAM). Allen and Sites (2012) were advocates of ADDIE, but realized the deficiencies involved. Over their history in developing training programs, they had observed issues with projects exceeding budgets, missing due dates, and not delivering a high quality product. They also observed that ADDIE was a tightly defined process. This is positive from a management process, but does not allow for innovation and creativity. The tendency was to focus on content and accuracy, but not on the learning experience itself. Due to the nature of changes in highly volatile industries, many individuals found themselves subject to paralysis by analysis to mitigate loss. Additionally, they considered only factual data to present to the learner (Allen & Sites, 2012).

Today's higher educational learning can be complex and much is learned in not only the curriculum development process, but the delivery also. ADDIE is familiar, but the Waterfall

design does not allow for the application of the learning throughout the process. Many instructional designers have observed this and altered the ADDIE method to attempt to make it more iterative in nature. This has led to some improvements, but only slightly. Allen and Sites (2012) note that there are signs of clinging to a process, but recommends paying attention to discussions of those involved. These statements might indicate areas where the process has overtaken the possibility of innovation. If an individual states, "The faculty submits a form with the information that learners need. I am not sure if they are accurate, but there is a record." Perhaps someone might say, "Our training plans don't cover more than three items so that the instructional designers have necessary structure." The tenets of ADDIE have been essential to any learning experience. It is the process in question. This study has revealed the need to ask the question, "Why?" more often (Allen & Sites, 2012).

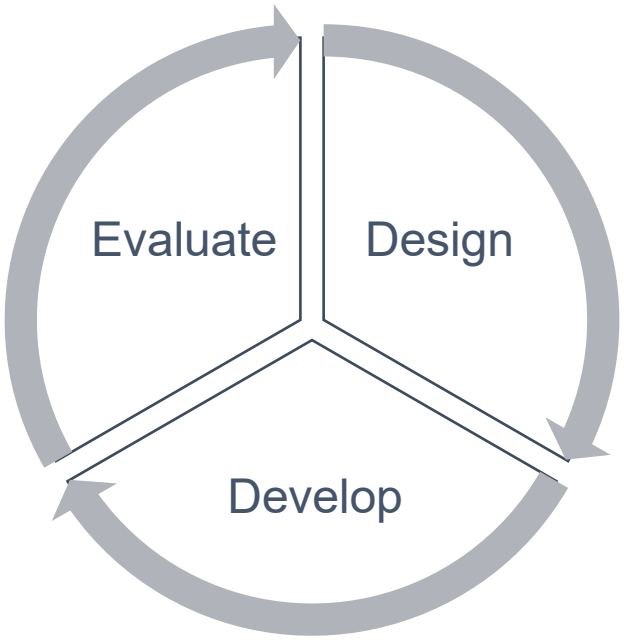

Figure 4: Successive Approximation Model. Shows iteration cycle of curriculum development process.

A good place to start for a higher educational institution is to examine their e-learning experiences. It is in these areas where deficiencies are exposed. In e-learning, there is not a live instructor, who is an expert in the content, to fill in the holes. Allen and Sites (2012) stated that e-learning should be meaningful, memorable, motivational, and measureable. They advocate the SAM process. It is based upon Agile methodologies. The criteria for their process are that it must be iterative, support collaboration, be efficient and effective, and be manageable. The SAM process begins with the evaluation process, then moves to the design stage and, finally, the develop stage (Figure 4). Each of these stages represents an iteration. Each iteration allows for incorporation and innovation from lessons learned from the previous step (Allen & Sites, 2012). Willeke (2017) encouraged this as she suggested getting a course to the bare minimum level to be able to deliver the content and refine from there. There is a danger in this process in that there is always a new idea. The point of Agile is not to develop in perpetuity, but rather develop

difficult projects in complex environments efficiently. Agile has the concept of a definition of done. This is where the team decides when a project is complete.

Allen and Sites (2012) have a more complex version of SAM that separated design and implementation into their own cycles, but the process fundamentals are the same. Note that the SAM process was geared toward the private sector training arena, but principles can still be applied to higher education.

Willeke (2017) advocated for what she calls Agile ISD, or Adaptive Learning. This process is four 2-week sprints that allows for adjustments across iterations. It was based upon Agile methodologies. Willeke (2017) is a proponent of getting learning to market as soon as possible and adjust from there. Her focus is not necessarily the content, but the learning experience (Willeke, 2017).

Curriculum Currency Issues

The European Commission, which is the executive of the European Union, had taken note of this trend in relation to their need for entrepreneurial education, especially as it related to technology (Kazakeviciute, Urbone, & Petraite, 2016). Kazakeviciute et al. (2016) noted the need to "borrow" lean principles, such as those found in Six Sigma, to allow validation of business ideas while building to save time and money. SixSigma utilizes what it terms as lean principles to quantitatively reduce defects in a product. It provides a measurable process for improvement. SixSigma uses two sub-philosophies DMAIC (define, measure, analyze, improve, control) and DMADV (define, measure, analyze, design, verify) to achieve its goals of process and product improvement (iSixSigma). These borrowed lean principles were in line with Agile methodologies (Agile Alliance, 2018). Additionally, the business world has increased in complexity and entrepreneurial education must help students solve complex and, sometimes, ill-

structured problems. Curriculum needs to be able to address these issues and transform with needed changes. Pedagogies need to be ever more innovative and cross disciplinarian in nature (Kazakeviciute et al., 2016). Students are going to face uncertainties and complexities upon graduation. Higher education needs to prepare them for these challenges. Unfortunately, it appears that higher education is reluctant to change from traditional practices (Kazakeviciute et al., 2016).

Curriculum Currency. Rapid technology change is only one reason curriculum currency is an issue. Creating, maintaining, and updating curriculum in today's environment is more complex due to cultural diversity, the application of multi-disciplinary approaches, and the increasing number of skills required to have the learners meet the necessary outcomes involved in a course (Kazakeviciute et al., 2016). Kazakeviciute et al. (2016) reference the innovation of Stanford University, University of Cambridge, and University of California, Berkeley in their entrepreneurial programs. Their success is girded by the constantly changing nature of the curriculum necessitating flexibility by the instructor, learner, and institution (Kazakeviciute et al., 2016). Unfortunately, this is more the exception than the norm. Most institutional curriculum processes are fraught with high costs and lengthy delivery times (Lewis, 2012).

In all of the successful entrepreneurial courses mentioned by Kazakeviciute, commonalities exist. Each program works closely with constituents (employers and learners) to provide current knowledge. The employers may even be guest lecturers. This provides the learner with not only current knowledge, but also gives the employer a "peek" into their future work force. Additionally, the topics covered are fundamental entrepreneurial topics that are standardly combined with technological changes (Kazakeviciute et al., 2016). It is the mapping

of technological changes with entrepreneurial topics that need constant attention within the curriculum.

It was also no coincidence that the majority of examples of Agile-like curriculum development took place in or near Silicon Valley. For example, San Jose State University hosted the "Silicon Valley Innovation Challenge," which was a business idea contest where students competed in team-based activities, design thinking, hypothesis testing, and pitching of a business idea (Kazakeviciute et al., 2016). These institutions were attempting to tackle the issues facing not just Silicon Valley, but society as a whole. Kazakeviciute et al. (2016) noted that the innovative institutions realized they cannot provide all of the learning solutions to a student and the learner gains a deeper knowledge when they expand beyond the university-provided learning environments. Could this be accomplished at other institutions with more Agile curriculum, while working closely with their constituency?

The assessments in each of the aforementioned programs were unique. The students' evaluation of the program and courses, plus their progress was given a significant amount of weight. This is in line with the Agile principle of working closely with the end user and incorporating their feedback. Underpinning the assessments was the need for deep communication, which is also a basic Agile principle (Kazakeviciute et al., 2016).

Kazakeviciute et al. (2016) noted that the lean (Agile) approach is not an easy one and requires a change of mindset. Instructors needed to be able to "let go" of their traditional views and even give up some control to that of the student and other constituents (Kazakeviciute et al., 2016).

Costs and Return on Investment (ROI). Many organizations have utilized Agile in an effort to reduce costs and provide an ROI of cost savings or benefits. The Federal Government's

IT department had been going through the transformation to Agile after realizing expenditures of $79.5 billion for fiscal year 2013. The Office of Management and Budget (OMB) recommended the move to Agile and the Government Accountability Office (GAO) put together leading practices to save costs (Innovategov.org, 2013).

What is beginning to be done in the public sector has been done in the private sector for many years. In a little over a decade, the IT industry has seen a decrease in transaction costs. When looking at transaction costs, a theory first put forth by Williamson (1981), an exchange between two parties comes with invisible costs, time, and effort. These costs were typically in

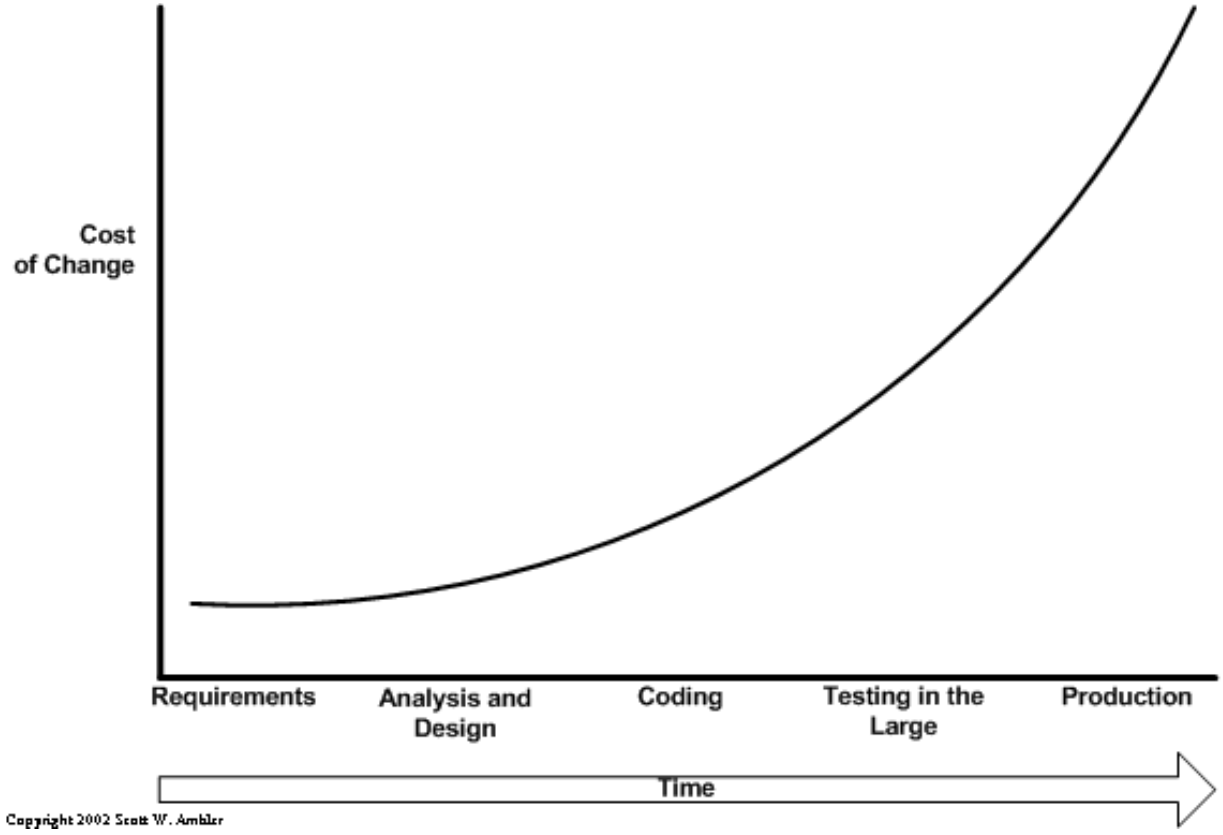

Figure 5. Waterfall Cost of Change. This figure displays the increase of cost as a product gets closer to release when utilizing Waterfall (Ambler, 2002).

three categories: information costs, contract costs, and monitoring costs. Van de Voort (2016) explained that Agile aids in reduction of these costs. Agile made contract negotiation easier and reduced monitoring costs (Van de Voort, 2016).

The cost of change, which is inevitable, was another consideration when considering processes to utilize in managing such change. In a traditional Waterfall model, the cost of change inclined steeply as time passed (Figure 5). To reduce costs, it is necessary to perform as much work and change early in the process, which is when the least is known about the project. In Agile, due to smaller time periods for deliverables and higher communication with feedback loops, the cost of change curve was drastically shallower (Figure 6). Additionally, this was due to the empirical aspects of the project. As time passes, more is learned and adjustments can be made at a lower cost to complete the project in light of circumstances (Ambler, 2002). This aligned with the Pareto Principle, which stated that 20% of an application is used 80% of the

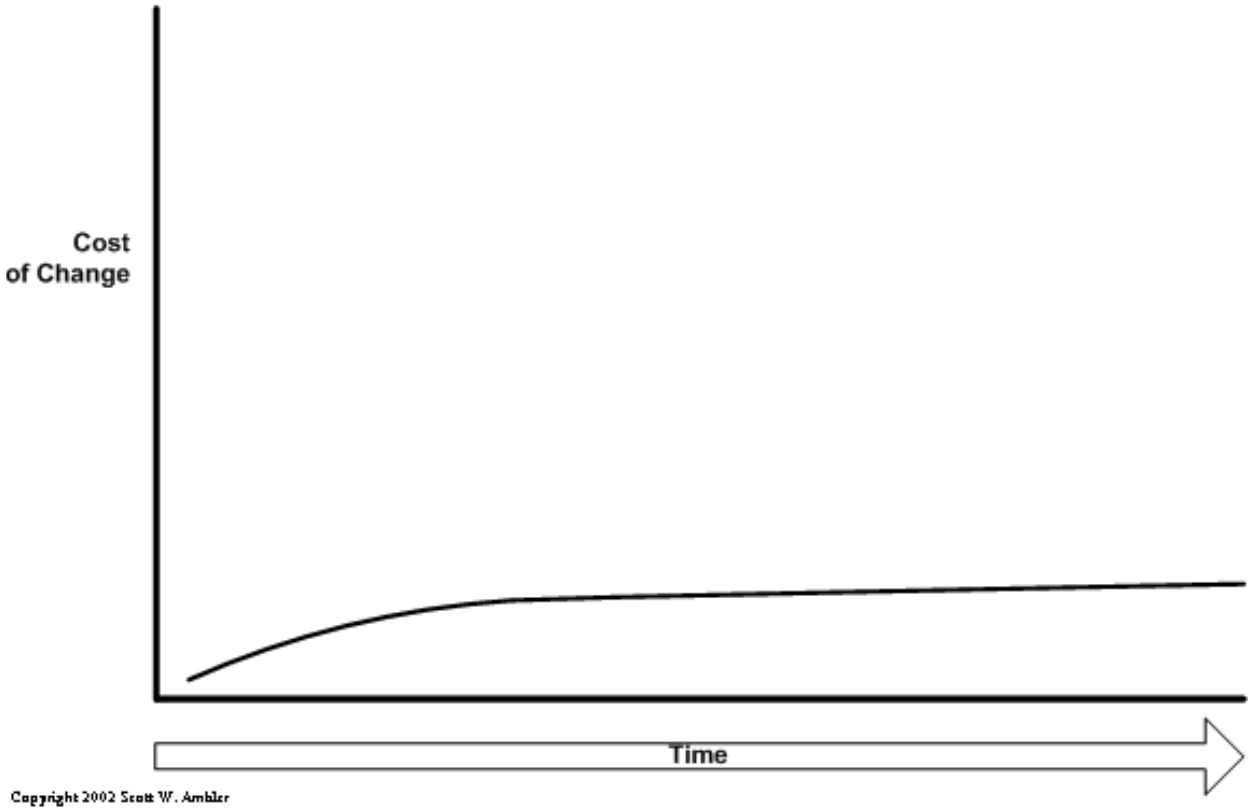

Figure 6. Agile Cost of Change. This figure displays the increase of cost of a product over time when utilizing Agile (Ambler, 2002).

time (DZone, 2009). Could this also be true of our curriculum? Yahya and Mansor (2011) found that cost estimation with Agile resulted in a more accurate result while reducing effort,

time, and cost. Agile methodologies, when compared to traditional methods have resulted in an increase in ROI also. Studies have provided a range of 10% to 100% increase in ROI in the areas of cost-effectiveness, productivity, quality, cycle-time reduction, and customer satisfaction (Goran & Angelina, 2012). Rico, Sayani, and Sone (2009) found that the ROI on Agile projects was four times that of projects utilizing traditional methodologies. Further, they discovered that Agile utilizes successful concepts from traditional methods, but "packages" them in a different manner that allows ease of change, lower costs, and higher ROI. This resulted in Agile projects having a 200% better performance than traditional methodology projects (David, Hasan, & Saya, 2009).

Employer Needs. By the year 2020, there will be one million more jobs in IT than individuals to fill the roles. This is based on estimates from the U.S. Bureau of Labor Statistics and of college graduation rates by the National Science Foundation (Swartz, 2017). Within the IT industry, there appeared to be a skills gap with only 11% of employers believing that colleges are very effective in preparing students for the workforce. Additionally, the survey reported that 62% were unprepared. The trend appears to be on the increase as organizations expect an increase in these positions. For example, 59% of companies surveyed anticipate an increase in data analysis needs. This has led IT firms, such as Facebook, to work with educational institutions to provide a flow of IT graduates. There were approximately 570,000 IT jobs open in the United States and only 49,000 IT graduates in 2017 (Swartz, 2017). This was not a new problem as was found in 2001 by Woratscheck and Lenox. Their study showed that due to the constantly changing nature of IT, educators needed to be in constant contact with employers. There appeared to be a need to have currency of knowledge in both hard and soft skills to prepare graduates for employment adequately (Woratscheck & Lenox, 2001).

An issue existed in the IT fields where higher education not only had to prepare graduates for jobs that do not exist, but seemed to be disconnected from the skills employers' desire. Some employers that used to require a four-year degree are no longer requiring such. Employers are looking for specific technical skills. IBM stated that one-third of their employees have less than a four-year degree but have technical skills filled by vocational programs (Kasperkevic, 2018). Two-year technical colleges need to ensure that they are delivering what companies like IBM need.

Some companies, such as Google, have taken creative steps to fulfill employee needs. In January of 2018, they collaborated with Coursera to offer an online program for beginners to prepare them for entry-level IT jobs in eight to 12 months. The cost of the program was $49 per month and attracted many enrollees without a college degree. Within three months, more than 18,000 people had enrolled and almost half of them did not have a college degree. After the six required courses, the student could apply to organizations such as Google, Bank of America, and Walmart. The program was attracting approximately 1,000 applicants per day (Upson, 2018). Could this be the future for curriculum development? Does higher education need to be flexible to the point of deep collaboration with employers to meet their needs?

Wisconsin Employer Needs. While nationwide there were over 570,000 open computer jobs, in 2017, only just over 49,000 computer science students graduated. STEM has been a focus of higher education for a while, but computer science falls short because 58% of all STEM jobs are in computing, but 8% of STEM graduates are in computer science. As of 2017, there were approximately 7,900 IT job openings in Wisconsin. In 2017, Wisconsin had just over 900 computer science graduates (Code.org, 2018). These numbers point to the need to increase the

number of graduates in IT and provide the skills that employers are lacking by having unfilled job openings.

Curriculum History

While there were many variations on how curriculum is developed at various institutions, the majority of the processes utilized are rooted in the ADDIE model, which stands for Analysis, Design, Development, Implementation, and Evaluation (Figure 9). ADDIE is a popular generic Instructional System Design (ISD) model for developing curriculum (Culatta, 2018). The ADDIE model is akin to the Waterfall method of building software. Waterfall is the precursor to Agile and is linear in nature (Agile & Waterfall methodologies – A side-by-side comparison, 2012).

The ADDIE model begins with the Analysis phase. This is where the instructional problem is clarified. Questions are asked about the environment, the learner, delivery options, etc. The next step is the Design phase where construction begins. Storyboards are created, user interface questions are addressed, visual strategies, and prototypes are created. The Development phase is where the assets created during the design phase are congregated. This is where the actual curriculum product is constructed. The Implementation phase is where the curriculum product completed in the development phase is delivered to the learners. The last phase is the Evaluation phase. In this phase, feedback is sought from the learners as well as the instructors who delivered the curriculum to improve the product during the next phase of curricula development (Culatta, 2018). In this structured process, the curriculum developer holds the roles of designer, developer, decision maker, and expert. Albashiry et al. (2015) viewed this as a downfall for technical educational fields as they advocated for the curriculum

developer to act as a facilitator that works in collaboration with stakeholders. ADDIE does not allow for this in an easy manner.

ADDIE has served the educational industry very well throughout the years but is not flawless. This has led to variations of the ADDIE model. Many have noted shortcomings of ADDIE (Willeke, 2017). In ADDIE, typical processes required unrealistically comprehensive up-front analysis. It ignored some political realities. ADDIE storyboards are ineffective tools for creating, communicating, and evaluating design alternatives. Detailed processes become so set that creativity becomes a nuisance. ADDIE does not allow accommodations for dealing with faults or good ideas throughout the process. Learning programs are designed to meet criteria that are measured. They fail to focus on identifying behavioral changes. Lastly, Posttests provided little useful information to assist in improving instruction (Culatta, 2018).

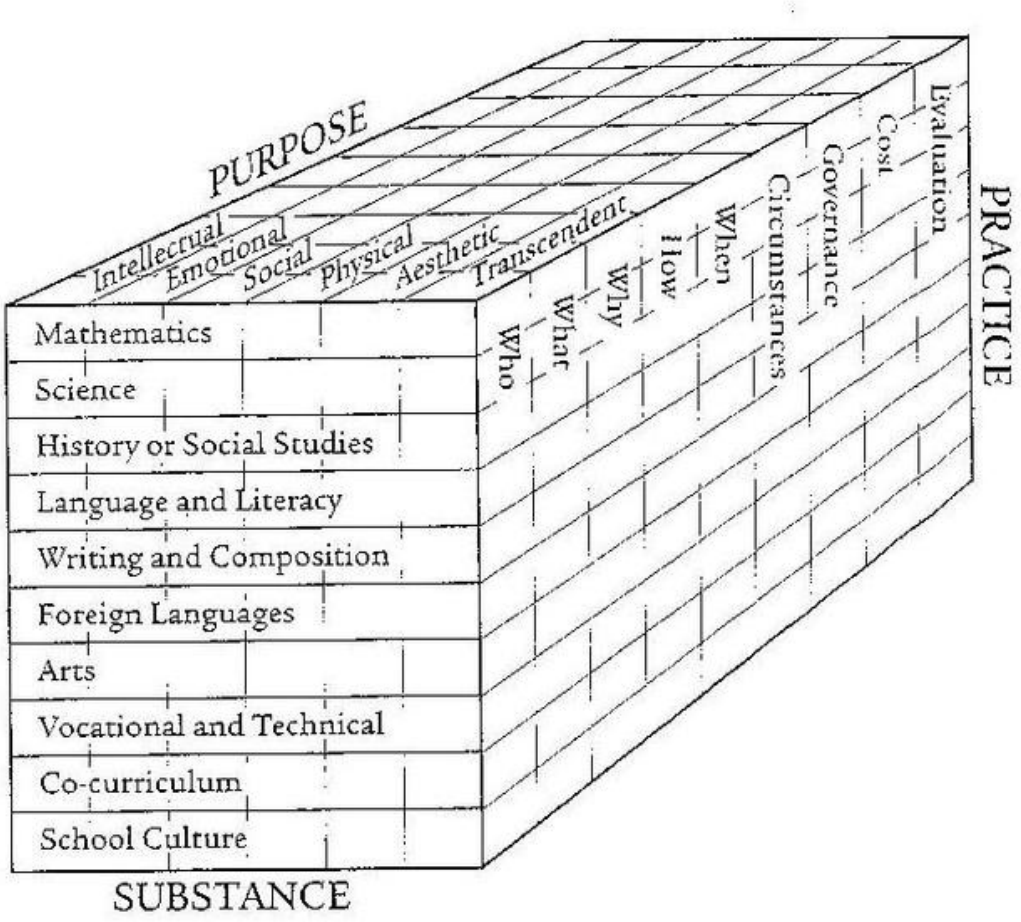

Figure 7. Foshay's Curriculum Model. Figure shows Foshay's matrix defining curriculum (Deets, 1998).

State of Curriculum

Curriculum is a term that can be difficult to define. This study examined the meaning of curriculum to the participants. The meaning of curriculum and curriculum development had a direct impact on not only this study, but also the status of curriculum and the learner's return on investment (ROI) as a whole. Deets (1998) suggested utilizing Foshay's curriculum model, which is a matrix (Figure 7). A model such as Foshay's is helpful in defining and ensuring all parties are on common ground in understanding curriculum. The difficulty is that it created boundaries. A tightly defined model may inhibit creativity and curriculum development that could provide an invaluable experience to the learner (Deets, 1998). To counteract this downfall,

Foshay and Deets (1998) encouraged crossover within the matrix in ways that might not have been considered previously.

Cost. Deets (1998) spoke to the cost of curriculum beyond the "raw costs". Foshay's model is used to encompass the meaning of curriculum and the associated costs (Deets, 1998). Deets (1998) admited that is difficult to discuss curriculum development and costs because they can be defined differently. For example, the development of a 'curriculum widget' that costs $50 in Wisconsin might cost $75 in California. So, what is the true cost? Curriculum developed at various higher educational institutions might have differing costs. Additionally, there are costs beyond the raw dollar amount that some might not consider, such as the cost of instructional delivery of said curriculum. Deets (1998) pointed out that there is a myriad of meanings to cost and that the simple dollar amount is the easy, controllable definition. Higher education needs to look beyond the simple costs and investigate the "soft" costs of curriculum development (Deets, 1998). There is the time of the people involved, which has a cost. There is the student's cost for what they need to invest to learn the curriculum. There is also a cost to the employer based upon whether the curriculum delivers what they need in an employee. Curriculum costs need to be understood in institutional and societal terms (Deets, 1998). This study looked at both the definition of curriculum and the investment of the faculty and institution.

Foshay's matrix (Figure 7) is comprised of three aspects: Purpose, Practice, and Substance (Deets, 1998). Each of these three pieces is comprised of several sub-aspects. For example, Foshay states that for a learner to develop their full humanity, they need to mature in their intellectual, emotional, social, physical, aesthetic, and transcendent aspects. The practice portion is concerned with the implementation of curriculum. How is the learning conducted?

Who is the audience? The substance piece is the actual content the institution offers (Deets, 1998).

Curriculum Development in Higher Education

The concept of developing curriculum using a rapidly iterative process was relatively new. The current literature was mostly from the private sector. Within the private sector, change to products and even instruction has had to be completed rapidly to meet market needs and generate profits.

As information access has grown, along with societal changes, needs of higher educational constituency has as well. The literature in higher education in regards to curriculum development was sparse other than relating older concepts, such as ADDIE. The literature that has been reviewed was concerning the current costs of curriculum development as well as the time involved in a curriculum project.

Since the concepts of Agile methodologies in curriculum development have not been studied in-depth in higher education, literature from the private sector was utilized as a proof of concept to examine techniques and processes. Correlations from the private sector with similar issues that are faced in the realm of higher education curriculum development were made.

Some newer iterative processes (Agile) were being used in "pockets" of higher education in Europe and Southeast Asia. This literature was used to draw upon experiences within higher educational environments.

Agile Methodologies in Private Sector

The extended outcome of the Agile Manifesto was an adoption of Agile methodologies throughout the software industry. As of 2017, 98% of software industry organizational teams were using Agile methodologies. Of these software organizations, 58% had less than half of

their teams operating in an Agile manner. This meant that 40% of organizations were practicing Agile methodologies on a regular basis (VersionOne, 2017). This inundation of the Agile processes into information technology meant the end of the Waterfall methodology era. In 2015, 19% of respondents reported that they were utilizing Agile for less than a year, while 15% reported the same in 2016. The numbers showed that organizations were moving away from Waterfall, linear methodologies and toward Agile, iterative methodologies every year (VersionOne, 2017). The result of the adoption of Agile methodologies has meant an increase in available technology and its further permeation of various industries. The most advanced sector digitally was the information and technology sector (Gandhi et al., 2016). Of the 22 industries measured, education ranked 14th (Gandhi et al., 2016). Harvard Business Review (2016) cited that the most advanced industries are those that are knowledge-intensive sectors. It did not rank education among those sectors (Gandhi et al., 2016). Usage dropped further among public sector organizations (Gandhi et al., 2016). The result was that a public sector educational institution was behind the Agile adoption bell curve. This begged the question, How is higher education getting learners prepared for their futures if it is lagging behind in the adoption of technologies and information age? Of the organizations surveyed in the 11th Annual State of Agile Report (2017), educational organizations only comprised 3%. This spoke to the low level of Agile adoption within education. Of these respondents surveyed from around the globe and from various industries, 98% have achieved success with Agile (VersionOne, 2017). While the Agile Manifesto lays out the building blocks of Agile, which has been adopted in large measure by the information technology sector and others, not many have looked to its usage in the higher

education industry. Higher education will have to seek out information from other resources to see its usage in other industries.

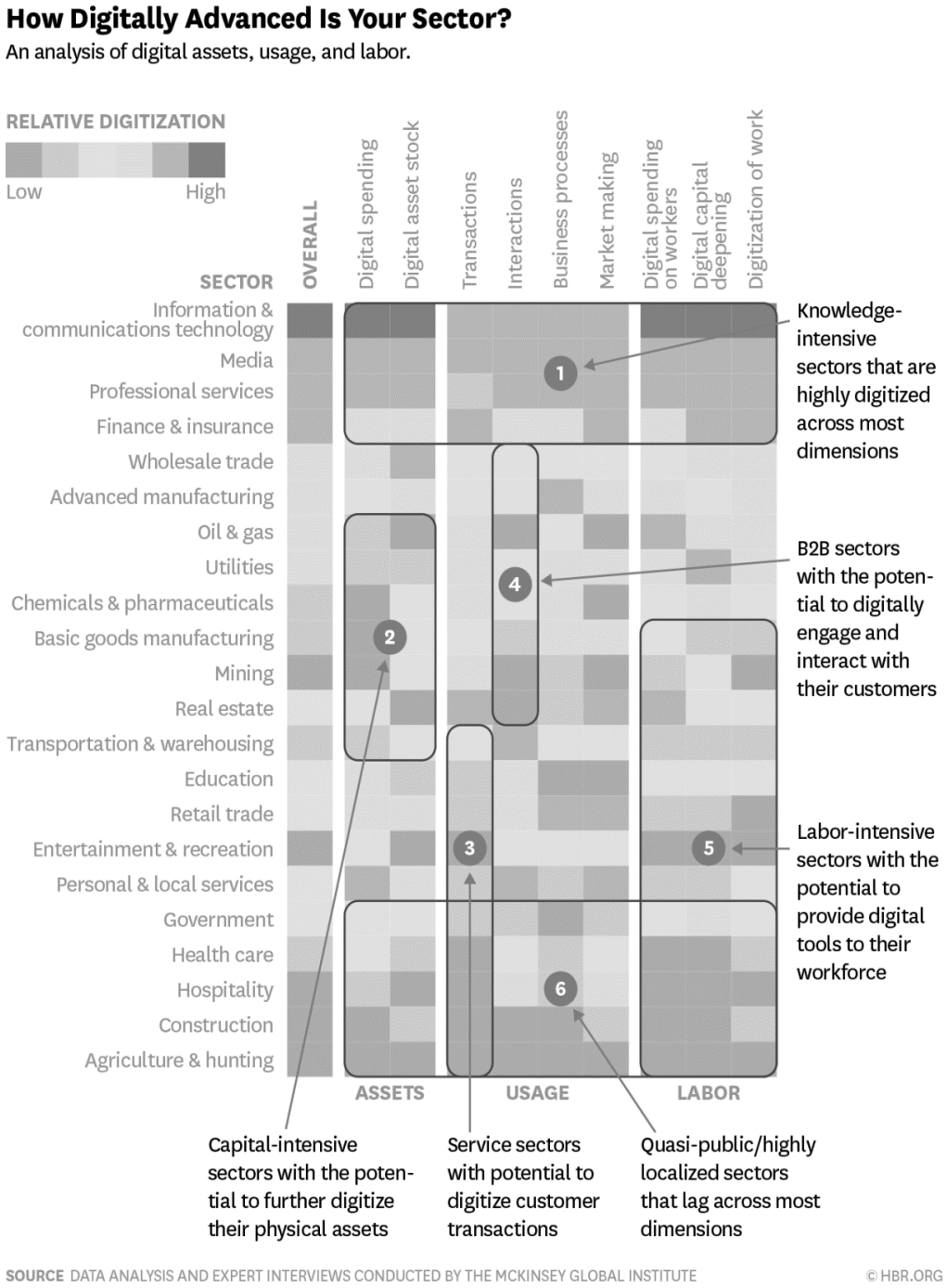

Figure 8. Digitization of Industry. Figure displays how advanced an industry sector is digitally (Gandhi, Khanna, & Ramaswamy, 2016).

It is important to understand what private enterprises did to ensure the success of their Agile efforts. According to the 11th Annual State of Agile Report (2017), the keys to successful implementation of Agile were executive sponsorship, consistent process and practices, implementation of common tools across teams, and Agile consultants. This would appear to translate to higher education needing "buy-in" from administration, a sharing of processes; plus, tools and training to become Agile.

Private sector educational providers began to see the need to enhance their curriculum development processes. An anecdotal example is IBM and their internal training division. They were being asked to deliver training on Agile methodologies to some of the IBM employees. Their primary stakeholder was dissatisfied with their turnaround time and challenged the team to move away from their linear usage of ADDIE and move towards an iterative processes framework (Groves, Rickelman, Cassarino, & Hall, 2012). The IBM training team took on the challenge. The challenge was being asked to deliver content incrementally, collaborate with stakeholders and finish on time. The team noted the main constraints were the short delivery time requested along with constantly changing requirements. The team realized that ADDIE's sequential processes were insufficient to meet their needs, but that did not mean throwing ADDIE out altogether, but rather re-incorporating the ADDIE principles in an iterative manner, rather than sequential. The team realized several benefits such as, providing extensive solutions to stakeholders, increased collaboration and buy-in across the organization, and seeing more immediate results of their training activities since they were applied quicker to more real-time scenarios (Groves et al., 2012).

Informational Speed

As culture has sped up with technology being intertwined in nearly every industry, each industry and individual within our society have looked for ways to keep up with the change, such as utilizing smart phone technology (Brown, 2014). Taiga, which is a company that produces project management software, discussed this aspect in a blog post (Tiwari, 2015). Even though this anecdotal blog post was biased, as Taiga sells project management software, this has been reinforced with other literature. Allan Kelly (2015) from Agile Connection asked if Agile works outside of software. Kelly (2015) explored the need to be adaptable and agile in modern business, but wondered if there was evidence beyond the anecdotal. If modern businesses are required to be adaptable and agile to succeed in the modern business environment, should higher education need to adopt similar processes to succeed as well? Is higher education setting students up for failure by not preparing them for the modern, agile business? Kelly (2015) admits that the majority of cases were inside the software development community, but they are increasing externally. Kelly (2015) noted that Agile had its roots outside of software in that it pulled from other principles. Kelly (2015) cited a case study where Martin Rowe utilized Agile Scrum methodology to deliver a computer science degree (agileonthebeach, 2013).

Rowe (2013) described how he used Agile aspects and methods. He held stand-up meetings, which is a daily meeting to bring everyone up to date on items completed and obstacles, and utilized a scrum board, which is a task board divided into three columns labeled "To Do", "In Progress", and "Done". He also utilized a product backlog, which is a list of tasks necessary to complete a project and a burndown chart, which is a large graph relating the quantity of work remaining and time elapsed since the start of the project (Agile glossary, 2018). Rowe (2013) admitted that the work was not done to the level of their expectations, but that

"even badly implemented scrum works." Rowe (2013) recorded his presentation wherein he stated the need to adapt quickly within education to the changes occurring in society (agileonthebeach, 2013). Some have seen this as standing in contrast to ADDIE which has been utilized as a foundational methodology to developing curriculum for many years (Culatta, 2018).

Agile Versus ADDIE

Instructionaldesign.org (2013) states that deficiencies of the ADDIE model have led to alterations. ADDIE is the instructional design model of which most curriculum development processes are spin-offs. Instructionaldesign.org noted how behaviorism and cognitive theories play a role in the various methodologies (Culatta, 2018).

Initially the scenario can be seen as Agile versus ADDIE. This is understandable as ADDIE is sequential and can be equated to Waterfall within the software developer community (Huhn, 2013). Waterfall is a sequential method to developing and delivering software. Waterfall requires that each phase be well defined and outlined prior to beginning the development process. Once a step is completed, the project cannot go backwards. Often the end product did not align with the needs of the consumer (Agile & Waterfall methodologies – A side-by-side comparison, 2012). Due to the speed of change and depending on the form that ADDIE takes, these same results could afflict curriculum. Huhn (2013) stated that, similar to the IBM training team, ADDIE is not contrary to Agile and that Agile is a "repackaging" of ADDIE process and principles in a more efficient manner, such as attempts to make them iterative. Huhn (2013) goes on to discuss how this realigning of ADDIE concepts into Agile process methodology has advantages of getting the needed learning competencies into the hands of the end learner faster, which was one of the main goals of Agile in the private sector. It also

encouraged more client and/or learner interactions earlier throughout the process that resulted in an end product that was closer to the needs of the client and/or learner (Huhn, 2013).

Willeke (2017) delved into the advantages of Agile instructional design and denoted several downsides to ADDIE (Figure 9). Willeke (2017) stated there are two major reasons for looking toward Agile methodologies for solutions to ADDIE shortfalls; 1) within ADDIE instructional design, since it is a linear, sequential methodology, nothing is delivered until the end of the development process, 2) ADDIE is prescriptive in nature. This prescriptive nature forces the instructor to be moving forward within the process only leading to waste or failure with the end product (Willeke, 2017). Willeke (2017) encouraged the usage of Agile Scrum

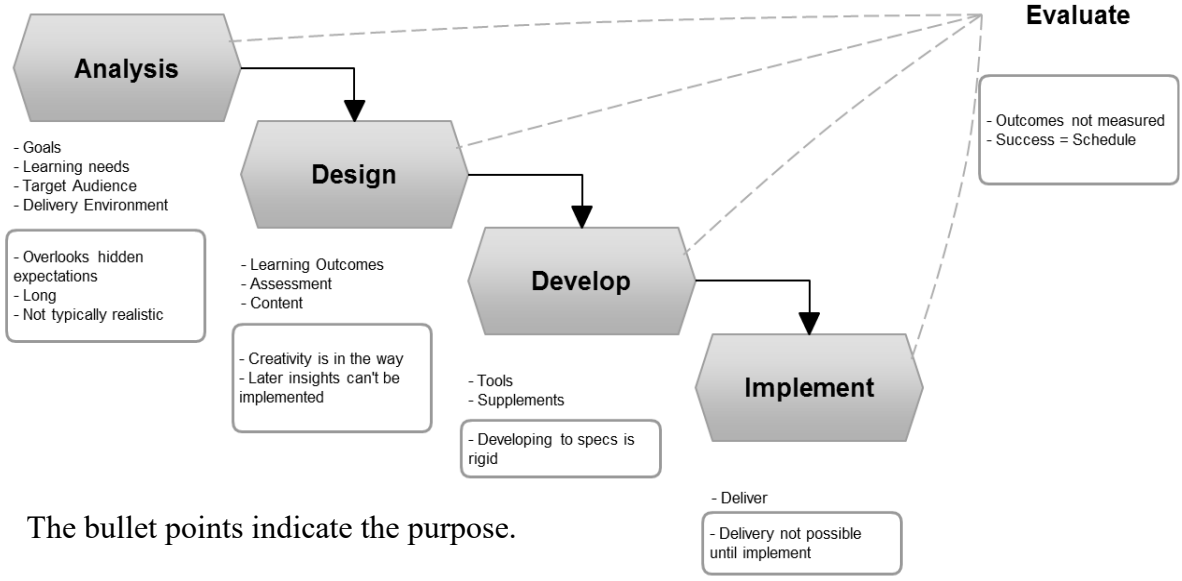

Figure 9. ADDIE Steps. Figure shows steps of ADDIE curriculum development process and possible downfalls (Willeke, 2017).

methodologies along with Rapid Prototyping, which is the idea of developing learning experiences in a continual design-evaluation cycle that continues throughout the life of the

project (Culatta, 2018). Incorporation of learner feedback within the iterative process ensured a better product at the end of each iteration. She encouraged the minimum development of a course to be able to offer it, and then begin the iterative process based upon the feedback, which is vastly different from ADDIE. Willeke (2017) advocated for several items integrated into the Agile Instructional Design process; 1) framework that is deliverable by the content expert, 2) active learning flow, 3) utilization of educational technology to make delivery easy, and 4) delivery is scalable and repeatable (Willeke, 2017).

Agile in Education

The Agile outside of Information Technology movement had led to the educational industry beginning a grassroots effort of educators using Agile methodologies. The Agile in Education group attempted to mimic the work of the software developers who drafted the Agile Manifesto. Several educators gathered in Orlando, Florida in April of 2016 and used the Agile

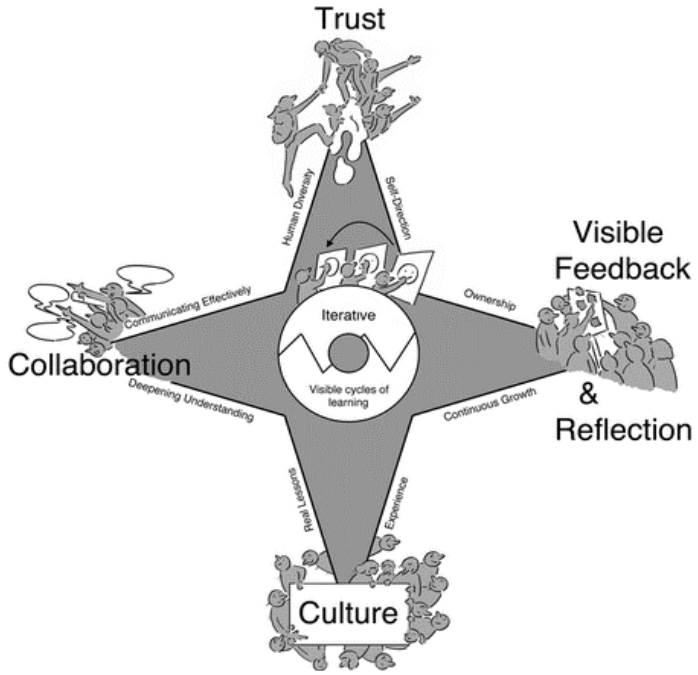

Figure 10. Agile in Education Manifesto. Figure displays the Agile in education manifesto blueprints and beliefs (AgileInEducation.org, 2016).

Manifesto as a blueprint to draft the Agile in Education version (AgileInEducation.org, 2016). Agile in Education (2016) made several observations within education that were issues that Agile can aid in solving (Figure 10). They saw this as an iterative journey broken down into several key categories. The first category was moving from prescriptive to iterative by making intentions explicit and visible to foster partnership and collaboration resulting in relevant educational change. The second observation was to move from content to culture as the educational community begins to ask why and draft the story of education. The third aspect was moving from evaluation to visible feedback and reflection as this can cultivate lifelong learning as a journey of continuous growth. A fourth observation was to move from control to trust to foster freedom of discovery within the arena of human diversity and self-direction. Lastly, the thought of moving from competition to collaboration by developing an environment of shared learning, which would aid in developing social intelligence, problem solving, and communication (AgileInEducation.org, 2016). The aforementioned categories were admirable and educators would laud them. So why has no one studied the usage of Agile methodologies in curriculum development in higher education? Perhaps the answer was to take a step back to see if there is an issue in the first place. After all, higher educational institutions have existed for centuries and weathered cultural changes while maintaining traditional approaches. Is there even an issue within higher education and curriculum development? Is change needed?

Summary

The WTCS has a rich history of preparing learners for the workforce. As the workplace changes rapidly with the help of technological advances, are they providing employees their employers require? Private sector technological developments have been progressed with the aid of Agile methodologies. Agile has allowed for high quality, complex products to be delivered

quickly to a massive audience. Curriculum has traditionally been developed in a linear fashion, rather than iteratively. Curriculum tends to be expensive to develop and maintain. It also might take a while to become a deliverable. There are currently pockets of individuals using Agile methodologies in education outside of Wisconsin. Some are using it for their curriculum, some in the classroom and some even advocate for entire institutions to become Agile. With the speed of societal changes, higher education finds themselves in a difficult position. They have to prepare learners for jobs that might not even exist yet. Technical colleges are in an even tighter position with the need to prepare the graduate in two years. With the successes that some are achieving using Agile in small areas of education, the WTCS could look toward Agile methods to deliver current knowledge, in the timeframe needed by both employee and employer when needed and at a high quality with less cost. It was necessary to see if this is truly the case and if there even is an issue. This study examined curriculum development within the WTCS in the IT realm.

Chapter III: Methodology

The design of the study was quantitative in nature. Qualtrics was utilized to survey the target demographic. A survey was sent to IT instructors at technical colleges that are a part of the Wisconsin Technical College System (WTCS). As of the time of this study, there were approximately 210 IT faculty throughout the WTCS. Additionally, each institution's curriculum office was surveyed. There were approximately 44 curriculum office personnel in the WTCS. Wisconsin was selected to scope the study and was purposive in nature. The Wisconsin system provided a baseline for further studies in other systems. The sample of the population (N = instructors and curriculum office staff) was selected due to the nature of the IT industry and the speed of change involved. As other industries speed up, they can look to IT to learn lessons. The goal was to establish a baseline of processes, procedures, and costs involved for curriculum development within a two-year technical college system. Perhaps this baseline will be used for future studies in differing industries and areas of higher education.

In Wisconsin, the WTCS is separate from the University of Wisconsin system. The WTCS has a centralized office responsible for the oversight of each college within the system. Procedures were established as guidelines that each institution must follow as a part of the system. Since there is a central oversight office, access was gained to both IT faculty and curriculum office personnel from a single source. Assistance from the WTCS head office was sought in sending out the survey to the IT faculty and curriculum office personnel so it came from a single, authoritative source

Conceptual Framework

The framework for this study was the Agile Scrum framework put forth by Schwaber and Sutherland (2014). Scrum is an Agile framework for developing, delivering, and sustaining

complex products. Scrum allows people to address complex, adaptive problems, while delivering products of the highest possible value. Scrum is simple to understand but difficult to master. The Scrum framework contains several processes and techniques that allow for continuous improvement to the product, team, and organization (Schwaber & Sutherland, 2014).

Scrum theory was founded upon empirical process control theory. Empiricism states that knowledge comes from experience and the best decisions are based on what is known. Scrum utilizes an iterative, incremental approach to optimize deliverables and control risk. When a project is begun, the least is known. In a traditional project, the majority of decisions are placed at the beginning of the project, when the project participants are the least knowledgeable. Scrum's empirical process allows for decision-making in an incremental fashion when the most knowledge is available (Schwaber & Sutherland, 2014). This ensures that the project target is

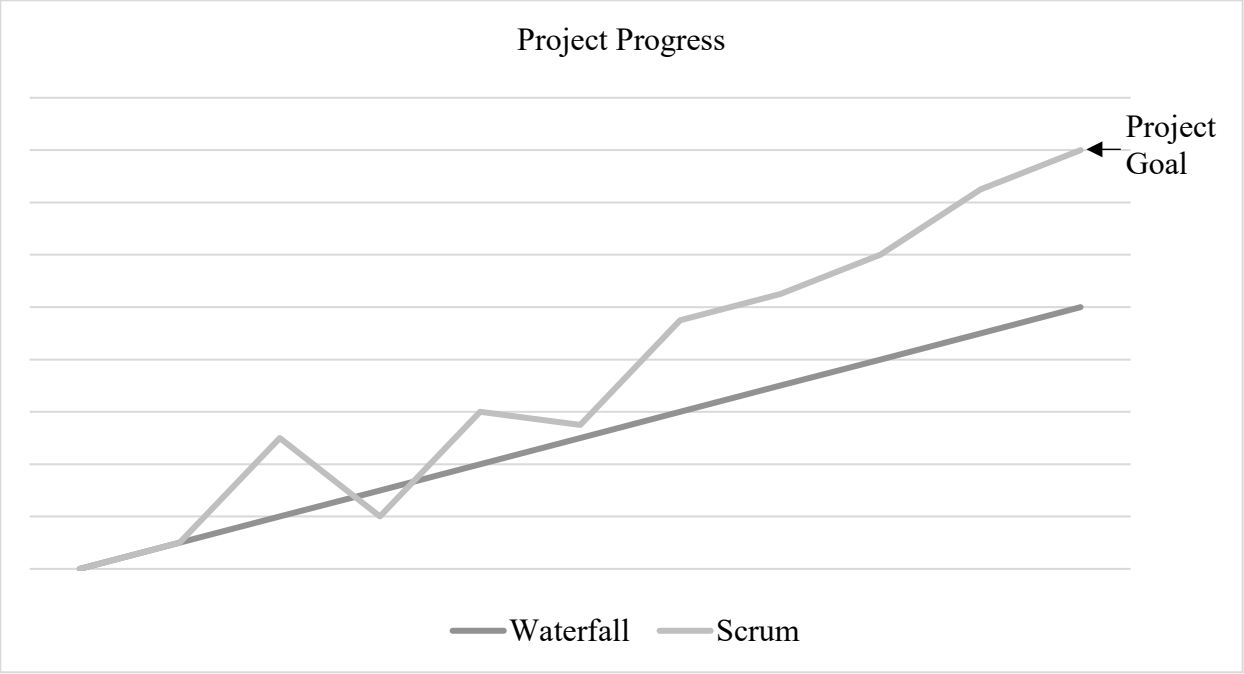

Figure 11: Waterfall Versus Scrum. Figure displays a representation comparing the project processes of Waterfall versus Scrum in achieving their goals.

attained with the least amount of waste and cost as opposed to traditional linear methods, such as Waterfall (Figure 11).

Undergirding the Scrum empirical process theory are three principles. The three principles are transparency, inspection, and adaptation. Transparency means that all participants share common definitions and aspects of the process are observable by all who are responsible for the project. Inspection is about ensuring that the Scrum Sprint goal is achieved. Scrum artifacts are inspected to ensure progress and detect variances needing correction. If inspection reveals that an unwanted variance has occurred, then adaptation needs to occur. The team involved must make the necessary changes to correct course (Schwaber & Sutherland, 2014).

Quantitative Survey Design

This study utilized a Qualtrics online survey as the instrument of choice to conduct the study. The questionnaire consisted of questions and directed design based upon the answers of the respondents. See Appendix A for the entire survey.

Using a survey allowed for ease of access to the entire target population. It would be difficult to access the entire population in another manner. Sending out an email with a link to the survey was a low cost, targeted approach. This also had a disadvantage, as emailed surveys are easy to ignore. To aid in offsetting this occurrence, the survey was sent from the WTCS office on behalf of the researcher. It came from the head of curriculum approval for IT programs for all 16 colleges in the WTCS.

Leading practices for survey design and implementation were sought. For example, poor questions, such as loaded and leading questions, were avoided. Usage of Likert scale designed questions along with other quantitative styled questions was utilized. For example, yes/no questions and assignment of numeric values to responses were used. An example was the

assignment of a numeric value to the role of the respondent. This allowed for quantitative analysis. In a quantitative study, a survey is a common, acceptable instrument to utilize. Creswell (2014) made this point by adding that a survey in a quantitative study provides a way to examine trends, attitudes, and opinions of a population by surveying a sample of said population. Creswell (2014) continued by describing how to construct a survey to ensure validity and reliability.

Additionally, the usage of a survey allowed for anonymity of the respondent. The survey did not gather names or other identifying information. This was to encourage truthful responses without fear of repercussions.

Field Testing

Prior to the actual survey, a field test was conducted within the researcher's institution to ensure the validity and reliability of the instrument. First, Institutional Review Board (IRB) approval was obtained. Once the IRB process was complete, the survey was disseminated to five individuals who were not a part of the population to be studied. The feedback from these individuals was incorporated into the instrument to improve the validity and reliability.

Hypothesis

This study attempted to show that current curriculum practices result in higher cost, lower quality, and lower satisfaction. Quality was defined as skill sets employers and employees need for employment. Agile methodologies were explored. Utilizing Agile Methodologies gets product (curriculum – competencies and objectives) to market (learners' learning environment) quicker, with higher quality, and at a lower cost.

$H1_a$: Agile methodologies are being utilized inside and/or outside of the IT classroom.

$H1_o$: Agile methodologies are not being utilized inside and/or outside of the IT classroom.

$H2_a$: Current curriculum practices result in higher cost than an Agile approach.

$H2_o$: Current curriculum practices do not result in higher cost than an Agile approach.

$H3_a$: Current curriculum practices result in lower quality than an Agile approach.

$H3_o$: Current curriculum practices do not result in lower quality than an Agile approach.

$H4_a$: Current curriculum practices result in lower satisfaction than an Agile approach.

$H4_o$: Current curriculum practices do not result in lower satisfaction than an Agile approach.

Research Questions

This study attempted to answer the following research questions.

RQ_1: How do the current curriculum development practices within the Wisconsin two-year technical college environment meet the needs of the constituency in the rapidly moving IT industry?

S_1: What is the status of Agile principles adoption within the IT faculty and curriculum development offices of the WTCS?

S_2: What is the current cost(s) of curriculum development compared to an Agile approach?

S_3: What is the quality of the current process to get current knowledge to the market (implemented) compared to an Agile approach?

S_4: What is the satisfaction level of teachers and curriculum approval offices with current curriculum development processes?

Population

The target population for this study was IT instructors along with curriculum approval office personnel. There were approximately 210 IT faculty and approximately 44 curriculum office personnel in the WTCS. This was the target population due to the scope being the WTCS. IT faculty work within a fast moving industry that requires curriculum work quite often. Curriculum office personnel were included due to their knowledge of institutional curriculum practices and possible knowledge of budgetary numbers.

The goal was to achieve a confidence level of 95%. This would ensure that the respondents accurately reflect the responses of the population. With a margin of error of 5%, the study should have had 137 faculty responses. The 5% is considered acceptable deviation. Achieving a confidence level of 95% would result in a z-score of 1.96. A z-score is the number of standard deviations from the mean. To achieve the same goals for the curriculum office personnel, the response goal should have been 40. With the small population size, there was a concern with achieving these response rates and having a statistically significant sample size. Assistance from the WTCS head office was sought in urging responses.

Study Sample Data Collection and Analysis

Another possible drawback was a lack of knowledge of Agile methodologies. Respondents' knowledge concerning Agile was not an assumption. An explanation of the basics of Agile in the survey to ensure all respondents have the same basis of information mitigated possible lack of awareness bias.

An online Qualtrics survey was the instrument used via an email link. Access to the participants was available to the researcher due to the researcher being an employee of an institution within the Wisconsin Technical College System (WTCS). A list of IT faculty email

addresses from each institution was available. There are 16 colleges in the WTCS. Permission was sought from each of them with the assistance of the researcher's own institution.

There was a concern over participation since an online survey is easy to ignore. The results could contain bias and issues depending on the participation rate. A low participation rate could lead to analysis issues. Participants received a secondary request seven days after the initial request. Two weeks following the reminder, a "last call" communication was sent to encourage participation. Once the survey closed, the data gathered by Qualtrics was downloaded. Qualtrics, Jeffrey's Amazing Statistics Program (JASP) and Microsoft Excel were utilized to analyze the data results. For statistical analysis, quantitative related measurements were used.

The two groups of participants, which were IT instructors and curriculum development personnel, were categorized nominally for analysis. Since this study focused on curriculum in fast moving industries, Information Technology instructors were used along with their respective curriculum office personnel. Percentages were used. To ensure a proper understanding of the data, contingency tables for relationship comprehension were utilized as well as an indication of the number of respondents (n). To aid in accepting or rejecting the hypothesis, a chi-square calculation was utilized to ensure a result less than .05. Since there was a faction of the study pertaining to cost and efficiencies as well as satisfaction, which were put in numeric form, analysis of differences were performed. Descriptive statistics of mean and standard deviation were calculated for each group and the overall participants. The study had two participant groups (faculty and curriculum office personnel). Additionally, in looking at a relationship between the interval variables of each group, a correlation coefficient was computed. This shed light on whether there was a direct or inverse relationship between the two groups. In this study,

the independent variable was the curriculum development approach, which was measured via a Likert scale. The dependent variables were cost, curriculum quality, and satisfaction.

The study population was a purposive sampling of Wisconsin Technical College IT faculty. Each state has its own organizational structure for their state system schools. In Wisconsin, the technical college system is a separate entity from the four-year University of Wisconsin system. This structure affected the study in a different manner than a state where the technical college system is combined with the four-year institutions.

Ethical Issues

A natural bias might have occurred due to the researcher being an IT instructor in an institution within the WTCS. There was a strong likelihood that many of the participants knew the researcher. This might have led to some intentional or unintentional bias in their responses along with their willingness to participate in the study. It may have even been subconscious in nature. This was an ethical consideration. A concerted effort was taken to eliminate as much of this bias as possible. For example, ensuring the responses are confidential in nature might have aided in curbing any bias whether intentional or unintentional. Prior to the performance of the study, the IRB process was followed for all 16 institutions involved. An IRB application was completed for the researcher's own institution before the field study. The other institutions' applications were completed before the survey was distributed. The WTCS head office, along with the researcher's institution, agreed to assist in this process. The researcher was the only individual who had access to the data. The data did not contain any personal participant information. The results were kept in Qualtrics and in a protected folder on Google Drive to which only the researcher had access. The only time that the data resided outside of these areas was when the researcher was working on the data analysis. When this occurred, the data was on

the researcher's computer. The researcher was the only individual who had access to the computer.

Summary

In this chapter, the topic of the conceptual framework of Agile methodologies was examined. Agile Scrum provides the basis for Agile project management utilized in the private sector. This study used a quantitative approach. A survey was delivered via Qualtrics to IT faculty and curriculum development office personnel within the WTCS. The goal was to see if current curriculum development processes are delivering the needed content at the requisite time for graduates and employers in a cost-effective manner. Further, an examination of Agile as a possible solution to the potential problem was researched. Now that the data from the WTCS population sample was gathered, attention can turn towards the results to see if the hypothesis can be accepted or rejected.

Chapter IV: Results

The survey was disseminated via a link from Qualtrics. It was sent with the assistance of the WTCS state education director for the IT programs across all 16 technical colleges. A week after the initial email, a reminder email was sent. A week later, a last call email was sent to the population surveyed. A week after that, the survey was closed.

One of the concerns with the survey was the limited population available. The scope of the population was IT faculty and curriculum development office personnel across all 16 WTCS colleges. There were approximately 210 IT faculty and approximately 44 curriculum office personnel in the WTCS. This small population size was a concern prior to the study. To achieve a confidence level of 95% with a confidence interval of +/-5 would have required that 153 individuals responded. This required response level would have resulted in a 60% response rate. A 60% response rate is much higher than what is typically expected with an online survey.

The study survey resulted in a total of 84 responses. However, not all responses were complete. Only 47 responses were completed surveys. This result was an 18.5% return for completed surveys. These 47 responses were the majority of the data analyzed. Having this small sample size could lead to analysis issues and further studies should be conducted to ascertain faults within this current study.

Research Questions Revisited

As the results were revealed, a revisit to the research questions was prudent. This study attempted to answer the following research questions.

RQ_1: How do the current curriculum development practices within the Wisconsin two-year technical college environment meet the needs of the constituency in the rapidly moving IT industry?

S_1: What is the status of Agile curriculum principles adoption within the IT faculty and curriculum development offices of the WTCS?

S_2: What is the current cost(s) of curriculum development compared to an Agile approach?

S_3: What is the quality of the current process to get current knowledge to the market (implemented) compared to an Agile approach?

S_4: What is the satisfaction level of teachers and curriculum approval offices with current curriculum development processes?

Hypothesis Revisited

This study attempted to show that current curriculum practices result in higher cost, lower quality, and lower satisfaction. Quality was defined as skill sets employers and employees need for employment. Resultant acceptance or rejection of hypotheses is listed in Table 2.

$H1_a$: Agile methodologies are being utilized inside and/or outside of the IT classroom.

$H1_o$: Agile methodologies are not being utilized inside and/or outside of the IT classroom.

$H2_a$: Current curriculum practices result in higher cost than an Agile approach.

$H2_o$: Current curriculum practices do not result in higher cost than an Agile approach.

$H3_a$: Current curriculum practices result in lower quality than an Agile approach.

$H3_o$: Current curriculum practices do not result in lower quality than an Agile approach.

$H4_a$: Current curriculum practices result in lower satisfaction than an Agile approach.

$H4_o$: Current curriculum practices do not result in lower satisfaction than an Agile approach.

Table 2

Hypotheses

$H1_a$: Agile methodologies are being utilized inside and/or outside of the IT classroom. $H1_o$: Agile methodologies are not being utilized inside and/or outside of the IT classroom.	Failed to Reject the Null
$H2_a$: Current curriculum practices result in higher cost than an Agile approach. $H2_o$: Current curriculum practices do not result in higher cost than an Agile approach.	Failed to Reject the Null
$H3_a$: Current curriculum practices result in lower quality than an Agile approach. $H3_o$: Current curriculum practices do not result in lower quality than an Agile approach.	Rejected the Null
$H4_a$: Current curriculum practices result in lower satisfaction than an Agile approach. $H4_o$: Current curriculum practices do not result in lower satisfaction than an Agile approach.	Failed to Reject the Null

As the results are reported, context is important. The survey asked the curriculum office personnel the number of curriculum projects completed over the past three years. The results ranged from 1-5 to 41 or more (Figure 12). The number of curriculum projects completed has a direct impact on the student experience along with incurred costs to the institution.

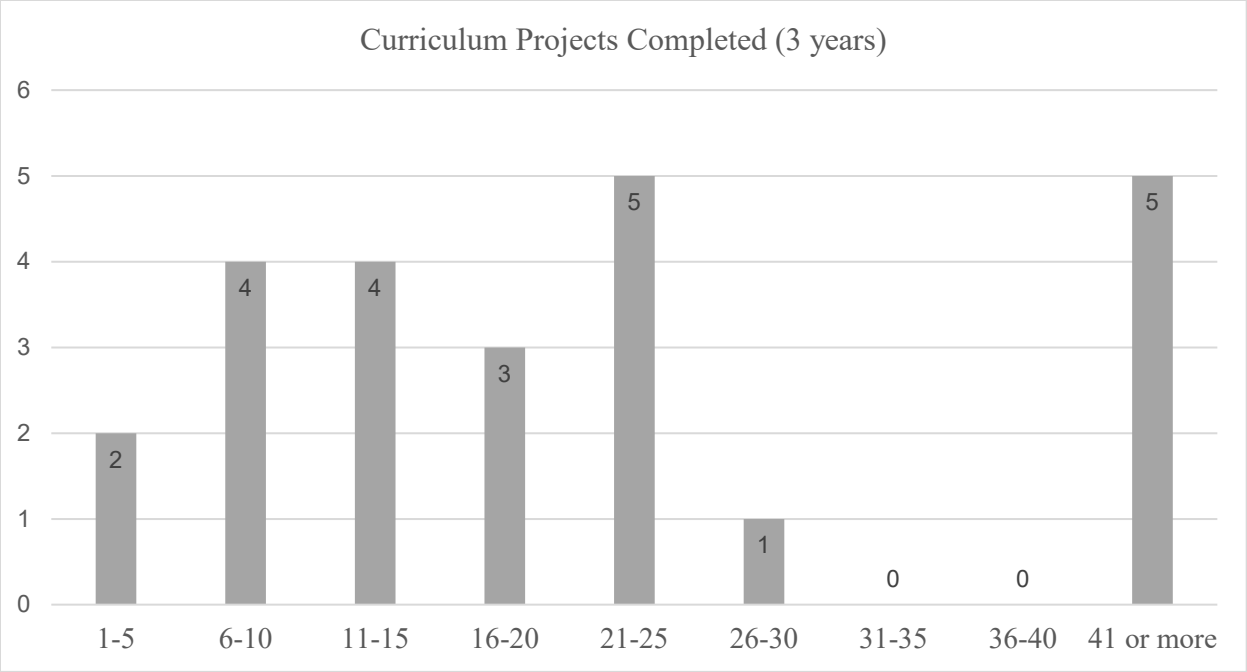

Figure 12: Curriculum Projects Completed. Displays number of projects completed in the past three (3) years as reported by curriculum office personnel.

The spectrum of responses could speak to the definition of curriculum and its variances, or that curriculum is not being updated at the same rate at each institution. Either way, there was a vast difference. Cost, quality, and satisfaction are impacted greatly, especially in those institutions that reported 41 or more curriculum projects completed.

Population Breakdown

One of the questions in this study asked whether the respondent was faculty or curriculum office personnel. This will allow for comparison analysis. Of the 47 complete responses, 24 were curriculum office personnel, while 23 were faculty. The positive aspect of this breakdown was that it showed an equal amount of complete responses between the two groups. The negative side of the breakdown was the percentage of each respective population represented. For the curriculum office personnel, having 24 out of 44 respond meant that 55% of said population participated. For faculty, 23 out of 210 responses meant that 11% of said

population participated. This difference in the participation rate by population meant that responses from the curriculum office personnel might be more representative of the larger curriculum population than the faculty. Looking at the confidence level and interval of the results of this breakdown, the faculty would require 136 responses for a confidence level of 95% with and interval of +/-5. The results led to a confidence interval of +/-19.5 with a confidence level of 95%. For curriculum office personnel, the results would have required 40 out of the 44 respondents to have participated. Having 24 out of 44 respond led to a confidence interval of +/-13.5 with a confidence level of 95%. Overall, the response percentage for the survey was 19.5%. With a confidence level of 95%, the confidence interval of the results was +/-13. While this response rate was not ideal, it is not uncommon with recent survey trends. Baruch and Holtom (2008) found that survey responses have been declining over time. In their study, they discovered that survey responses averaged 64.4% in 1975 and declined over time to a rate of 48.3% in 2005 (Baruch & Holtom, 2008). This trend combined with the study's small sample size led to the expectation of a low response rate. Further study is required to examine the study results.

Curriculum Adoption

The survey asked faculty if they teach Agile methodologies in their coursework. Of the 23 faculty respondents, nine (39%) responded in the affirmative. This may seem like a low number considering the rate of Agile adoption in the IT industry, but the remaining 61% (14) might not be tasked with teaching Agile concepts, but are aware of Agile methodologies.

The survey then asked if Agile methodologies were used outside of the classroom in other areas of the institution. Only nine respondents answered the questions. Of those nine, only three (33%) responded that Agile methodologies were utilized outside the classroom. Even

though the responses were a fraction of the total responses, this could point to the lack of usage of Agile methodologies in higher educational institutions. The survey provided a freeform response that might lend anecdotal support.

The survey asked respondents to describe how they used Agile outside the classroom. One respondent stated that they use Agile for their departmental meetings. They also utilize Agile for their own course improvements, but this is done outside of the curriculum process scope. Another respondent shared they use Agile for their special projects they are assigned during the school year, but did not reference curriculum.

Hypothesis. The study failed to reject the null hypothesis that Agile curriculum practices are not being utilized inside and/or outside of the IT classroom. It is necessary to note the low response rate. The results might differ with a higher rate of return. Perhaps a future study could increase the scope to achieve a higher response rate.

Curriculum Costs

The survey asked the respondents if they were knowledgeable concerning the costs involved in curriculum development. Of the 47 respondents, 27 of them (57.45%) stated they were aware of the costs involved in curriculum development. Additional questions related to the costs involved were asked of the respondents that reported in the affirmative that they were aware of curriculum costs.

Budget status. The respondents were asked if their curriculum budget was increasing, decreasing or remaining the same. The curriculum budget was decreasing for 11 out of 27 respondents (40.74%). The budget was increasing for seven out of 27 respondents (25.93%). The budget was remaining the same for nine out of 27 respondents (33.33%) (Figure 13).

When broken down by respondent role, the majority of the faculty saw the budget decreasing with five out of nine (55.56%) reporting a decrease (Figure 15). For curriculum office personnel, the responses were split evenly across each category with six out of 18 (33%) reporting their budget status of increasing, remaining the same or decreasing (Figure 14).

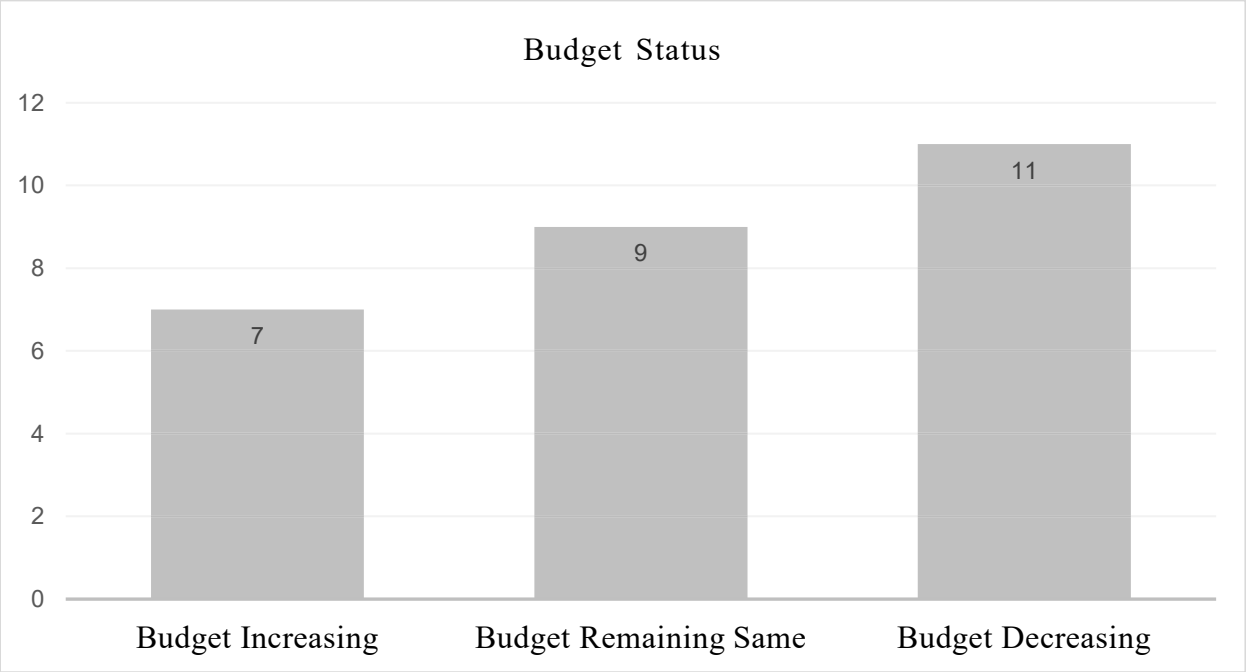

Figure 13: Budget Status. Respondents were asked whether their budget was increasing, decreasing or remaining the same.

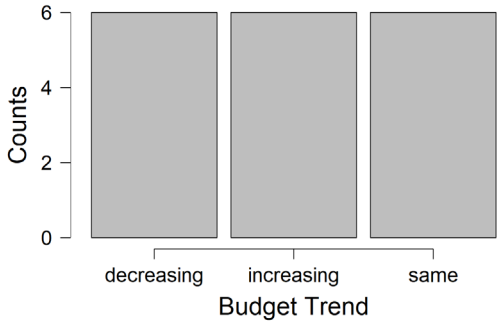

Figure 14: Curriculum Personnel Budget Trend Responses

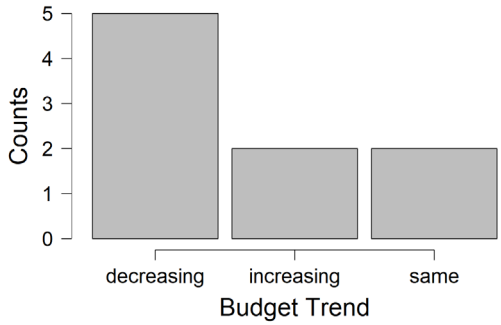

Figure 15: Faculty Budget Trend Responses

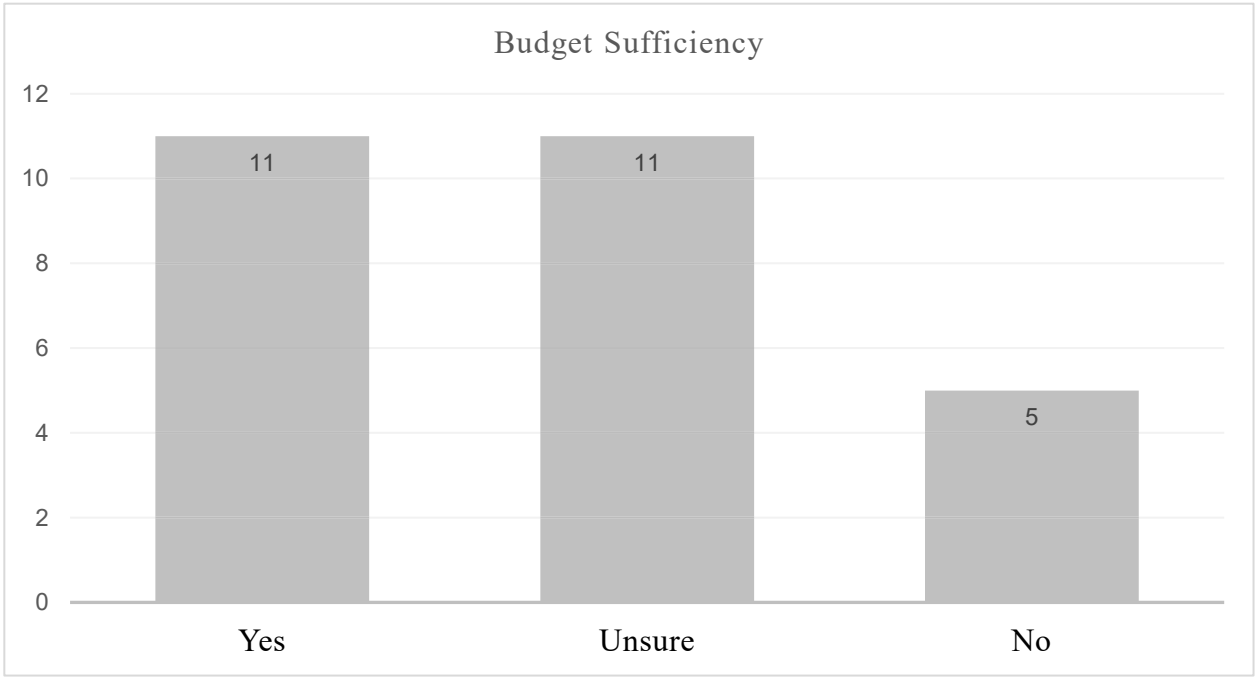

Figure 16: Budget Sufficiency. Respondents were asked if their budget was sufficiently meeting the curriculum needs of their institution.

Budget sufficiency. Each respondent was asked if their current budget was sufficient to meet their curriculum development needs. Of the 27 respondents who were aware of curriculum costs, 11 of them stated that their budget was sufficient to meet their curriculum needs (40.74%). Five of the respondents replied that their curriculum budget was insufficient to meet their curriculum needs (18.52%). Eleven of the respondents were unsure if their curriculum budget

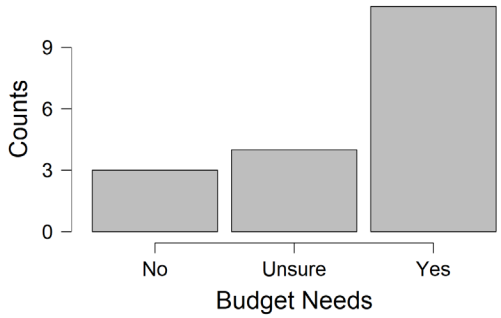

Figure 17: Curriculum Personnel Budget Sufficiency

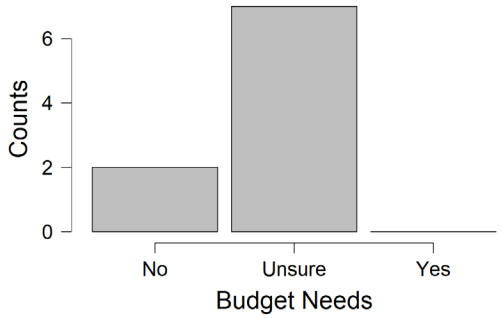

Figure 18: Faculty Budget Sufficiency

was sufficient enough to meet their institutional curriculum needs (40.74%) (Figure 16-18). Anecdotally, no faculty responded that the budget was sufficient to meet the curriculum needs.

Status versus Sufficiency. While it is interesting to see the breakdown of a curriculum budget and if curriculum needs were being met, it was good to compare these two responses. It is possible that an institution could reduce the curriculum budget and still meet the curriculum development needs (Figure 19). Per the reporting data, if a curriculum budget was increasing, two out of seven (28.57%) felt it was sufficient to meet their curriculum needs, while the same number (28.57%) reported that it was insufficient even though it is increasing. At the other end of the spectrum, for budgets that were decreasing, four out of 11 (36.36%) reported that their curriculum budget was still sufficient to meet their needs, while two out of 11 (18.18%) reported

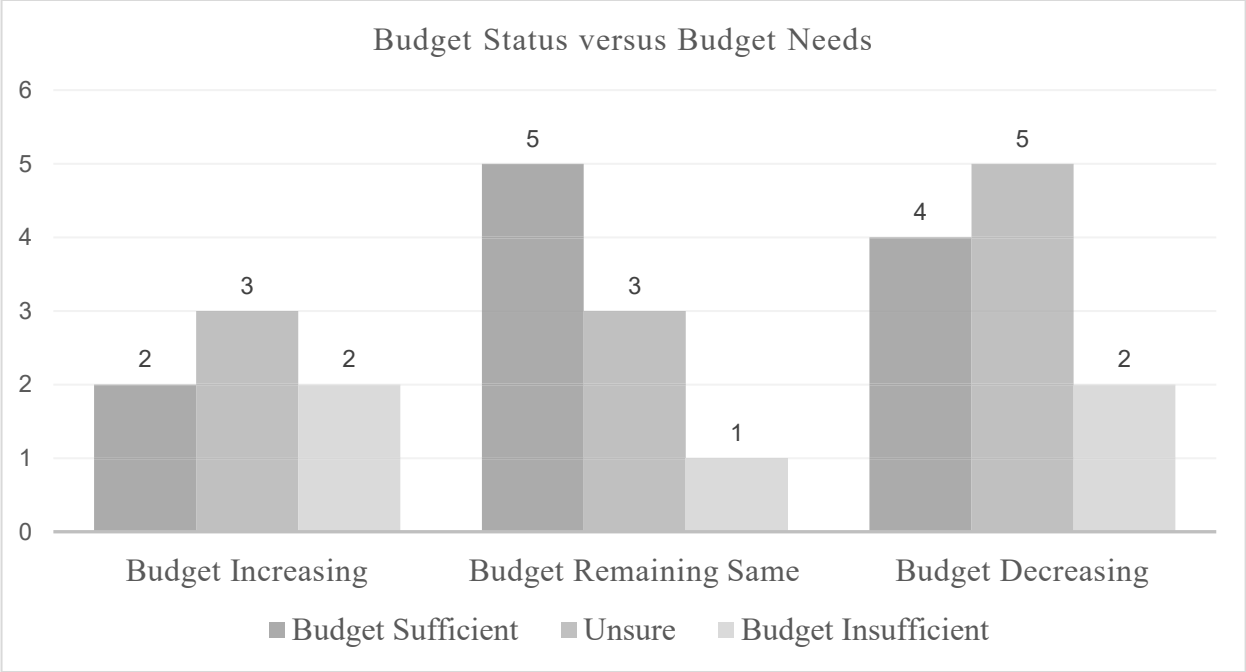

Figure 19: Budget Status Versus Needs. Comparison of curriculum budget status versus the curriculum needs of the institution.

that their budget was insufficient. For those institutions whose budgets were static, only one out of nine (11.11%) reported needs not being met.

Average Cost. The survey asked respondents for the average cost of a curriculum project and what was included in the budget. The respondents that replied their budget was increasing yet insufficient stated the average cost of a curriculum project was $3,000. When asked what was included in the reported cost, the results were the project only along with process costs. While these responses were somewhat vague, it does open up the possibility that not all costs are being captured. If a project budget is $3,000, is that covering the salary and benefits of all involved in the project? Does it include the cost to other items not being addressed due to curriculum time being spent? No respondents in any category mentioned anything relating to a Total Cost of Ownership (TCO) analysis or a Return on Investment (ROI) analysis. Can the question be answered as to the value of a curriculum project?

In looking at the other end of the spectrum for the budget-decreasing question, four (36.36%) respondents stated that their budget was sufficient to meet their curriculum development needs. On the surface, this appeared to be good news as one could surmise that budgetary excess has been trimmed. While this may be the case, there was an inconsistency in the response to the average costs and what is included in said costs. The average cost reported ranged from $1500 to $3500. Some reported that it depended upon the project details such as credits of the course. When asked what was included, there were a mixture of responses such as faculty benefits, process costs, project only, and faculty salary.

The responses indicated that there was a wide range of costs. The lowest reported cost was $600, while the highest was $24,500. Additionally, there was not a consensus on what was included in the costs of a curriculum project. Some respondents included just the stipend to the faculty, while others included the faculty salary, and process costs. There was no consistency in the responses.

Curriculum Time. The survey asked the respondents various questions related to the timing of curriculum revisions and currency. This can speak to both the quality and the costs involved in a curriculum project. The respondents were asked how long a curriculum project took until it was revised. Additionally, the survey asked how long it took to implement a topic requested from the advisory board. These two questions were asked because they were the two main sources that began a curriculum project. In IT, changes occur frequently. Curriculum needs to be updated to reflect these industry changes. In the WTCS, advisory boards drive the direction of a program. If an advisory board consensus wants a topic implemented into a program, the technical college is obligated to implement the request. Alternatively, updates due

to industry changes are approved by the advisory board. These two questions shed light on when a curriculum project begins after it is requested or needs revising.

The respondents were asked how long it takes to complete a curriculum project. In the WTCS, curriculum projects need approval from curriculum office personnel once the faculty member completed the project. The survey asked how long the approval process took to complete. Lastly, the respondents were asked how long a curriculum project remained current. It is at this point that a possible revision was discussed.

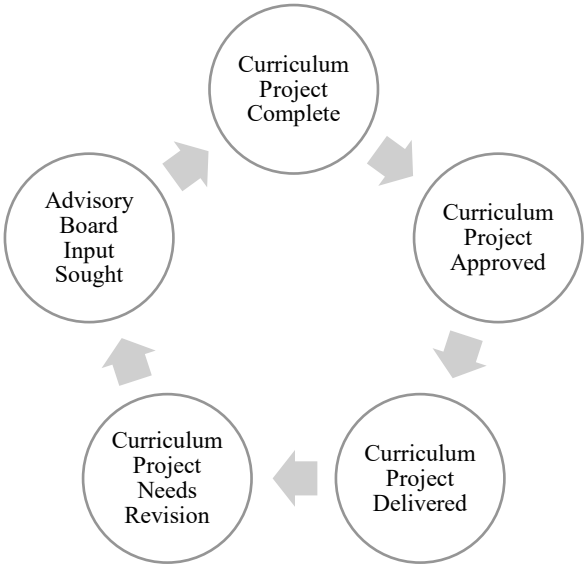

Figure 20: Curriculum Project Process. Figure shows example of curriculum project 'life' process

It was the aforementioned questions that gave a general timeline on the life of a curriculum project. A curriculum project is no longer current and needs revision. Depending on the revision, it may need to pass through the advisory board. The curriculum work is completed by the faculty member, and then it is up for approval by the curriculum office personnel. Note that sometimes steps are in various orders. For example, advisory board approval could be collected prior to noting the need for revision (Figure 20).

Table 3

Curriculum Revision Time

		Role		
		Curriculum	Faculty	Total
0-6 months	Count	1.00	2.00	3.00
	% of Total	0.02	0.04	0.06
6 months - 1 year	Count	1.00	0.00	1.00
	% of Total	0.02	0.00	0.02
1-2 years	Count	10.00	8.00	18.00
	% of Total	0.21	0.17	0.38
2-3 years	Count	6.00	8.00	14.00
	% of Total	0.13	0.17	0.30
3-4 years	Count	2.00	5.00	7.00
	% of Total	0.04	0.11	0.15
4-5 years	Count	2.00	0.00	2.00
	% of Total	0.04	0.00	0.04
5 years or more	Count	2.00	0.00	2.00
	% of Total	0.04	0.00	0.04
Total	Count	24.00	23.00	47.00
	% of Total	0.51	0.49	1.00

Table 4

Advisory Board Implementation Time

		Role		
		Curriculum	Faculty	Total
0-6 months	Count	4.00	2.00	6.00
	% of Total	0.09	0.04	0.13
6 months - 1 year	Count	15.00	10.00	25.00
	% of Total	0.32	0.21	0.53
1-2 years	Count	4.00	9.00	13.00
	% of Total	0.09	0.19	0.28
2-3 years	Count	1.00	2.00	3.00
	% of Total	0.02	0.04	0.06
Total	Count	24.00	23.00	47.00
	% of Total	0.51	0.49	1.00

In looking at the response average, the timeline of a current course revision was as follows: curriculum project needs revision (1-2 years) (Table 3), advisory board input collected (6 months to 1 year) (Table 4), curriculum project completed (6 months to 1 year) (Table 5), curriculum project approved (0–6 months) (Table 6), curriculum project delivered (1-2 years) (Table 7).

Table 5

Curriculum Completion Time

		Role		
		Curriculum	Faculty	Total
0-6 months	Count	10.00	6.00	16.00
	% of Total	0.21	0.13	0.34
6 months - 1 year	Count	10.00	14.00	24.00
	% of Total	0.21	0.30	0.51
1-2 years	Count	4.00	3.00	7.00
	% of Total	0.09	0.06	0.15
Total	Count	24.00	23.00	47.00
	% of Total	0.51	0.49	1.00

Table 6

Curriculum Approval Time

		Role		
		Curriculum	Faculty	Total
0-6 months	Count	16.00	11.00	27.00
	% of Total	0.34	0.23	0.57
6 months - 1 year	Count	7.00	10.00	17.00
	% of Total	0.15	0.21	0.36
1-2 years	Count	1.00	2.00	3.00
	% of Total	0.02	0.04	0.06
Total	Count	24.00	23.00	47.00
	% of Total	0.51	0.49	1.00

Table 7

Curriculum Currency Time

		Role		
		Curriculum	Faculty	Total
0-6 months	Count	2.00	1.00	3.00
	% of Total	0.04	0.02	0.07
6 months - 1 year	Count	6.00	3.00	9.00
	% of Total	0.13	0.07	0.20
1-2 years	Count	7.00	11.00	18.00
	% of Total	0.15	0.24	0.39
2-3 years	Count	7.00	6.00	13.00
	% of Total	0.15	0.13	0.28
3-4 years	Count	0.00	1.00	1.00
	% of Total	0.00	0.02	0.02
4-5 years	Count	1.00	0.00	1.00
	% of Total	0.02	0.00	0.02
5 years or more	Count	1.00	0.00	1.00
	% of Total	0.02	0.00	0.02
Total	Count	24.00	22.00	46.00
	% of Total	0.52	0.48	1.00

Taking the most predominant averages and calculating a best case/worst case scenario, resulted in the best-case scenario timeline for the life of a curriculum project was four years; two years to complete the curriculum project and two years of delivery of the curriculum to students. Taking the median curriculum cost average, the project cost was $2500. If this were the true number, the course would need to ensure it reached a sufficient number of Full Time Equivalents (FTEs) to have a return on investment. One of the revenue sources for institutions in the WTCS is FTE. The revenue comes from both the tuition the student pays and funds from the state. The WTCS operates on an outcomes-based funding model. There are multiple metrics used to determine the amount of funding each institution receives. FTE is a part of these metrics. FTE calculation is based on the assumption that the typical Full Time student takes 30 credits per year. The number of credits taken is divided by 30 to calculate. For example, if a student is taking twelve credits per semester, then the student's FTE is 0.8 (24/30). For a class, the calculation would be the number of credits for the course multiplied by the course enrollment divided by 30. As an example, if a class has twenty students and is a three-credit course, then the calculation would be 20 x 3 / 30. The course FTE would be two. FTE can be calculated from the individual student to the entire organization. Current FTE revenue is constant due to state regulations and controls. Each institution received $1700 in state aid and $3300 in tuition per FTE (C. Severson, personal communication, June 12, 2018). It is not a valid calculation to take the average cost of $2500 and think that one FTE would pay for a curriculum project. There are other obvious costs involved in running a higher educational institution beyond curriculum that would need to be calculated to figure a break-even point for a course. This was beyond the scope of this study. The lack of consistency and/or knowledge of curriculum costs possibly point to a need for a study.

The worst-case scenario utilizing the most predominant averages for curriculum lifetime was 5.5 years. It took 4.5 years to complete the curriculum project and 1 year for curriculum delivery. Again, the same cost figures could be used, but one could question the validity of the calculations spread across 5.5 years.

Lastly, time moves quickly in the IT industry. The average generation span in the IT world is approximately 18 months per Moore's Law. Gordon Moore, one of the founders of Intel, created Moore's Law based off his noting that the number of transistors in an integrated circuit doubles almost every two years (Moore's law). This observation has extended to other IT areas. Historically, a new version of software was released every 18 months to two years. Another example is computers themselves. They have doubled in speed, capacity, etc. every 18 months to two years. This has come to be known as a generation in the IT industry. If this held true for the best-case scenario, it took a little longer than a generation in IT to complete a curriculum project, while the worst-case scenario took more than two and a half times the average IT generation to complete. A possible future study could ask if changes were integrated along the way.

Lower Costs. A third aspect of the study asked the respondents about the costs of curriculum and if implementation of Agile methodologies would lower the costs. Of the 47 respondents, 46 answered the question. The question offered three possible answers of yes, no or maybe. No responses were 12 out of 46 (26.09%). Maybe responses were 28 out of 46 (60.87%). Yes responses were six out of 46 (13.04%). When broken down by role, the responses received were split evenly at 23 each for faculty and curriculum personnel. No responses for faculty were 10 out of 23 (43.48%), while curriculum personnel responses were two out of 23 (8.7%). When looking at the role breakdown for maybe responses, faculty were 10

out of 23 (43.48%) and curriculum personnel were 18 out of 23 (78.26%). For yes responses, faculty and curriculum personnel were both 3 out of 23 (13.04%) (Table 8-9 and Figure 21). The breakdown left room for interpretation due to the lack of knowledge on the true costs of curriculum development and possible lack of knowledge with Agile methodologies.

Table 8

Agile Lower Costs?

	Role		
	Curriculum	Faculty	Total
Yes	3	3	6
Maybe	18	10	28
No	2	10	12
Total	23	23	46

Table 9

Chi-Squared Tests

	Value	df	p
X^2	7.62	2	0.02
N	46		

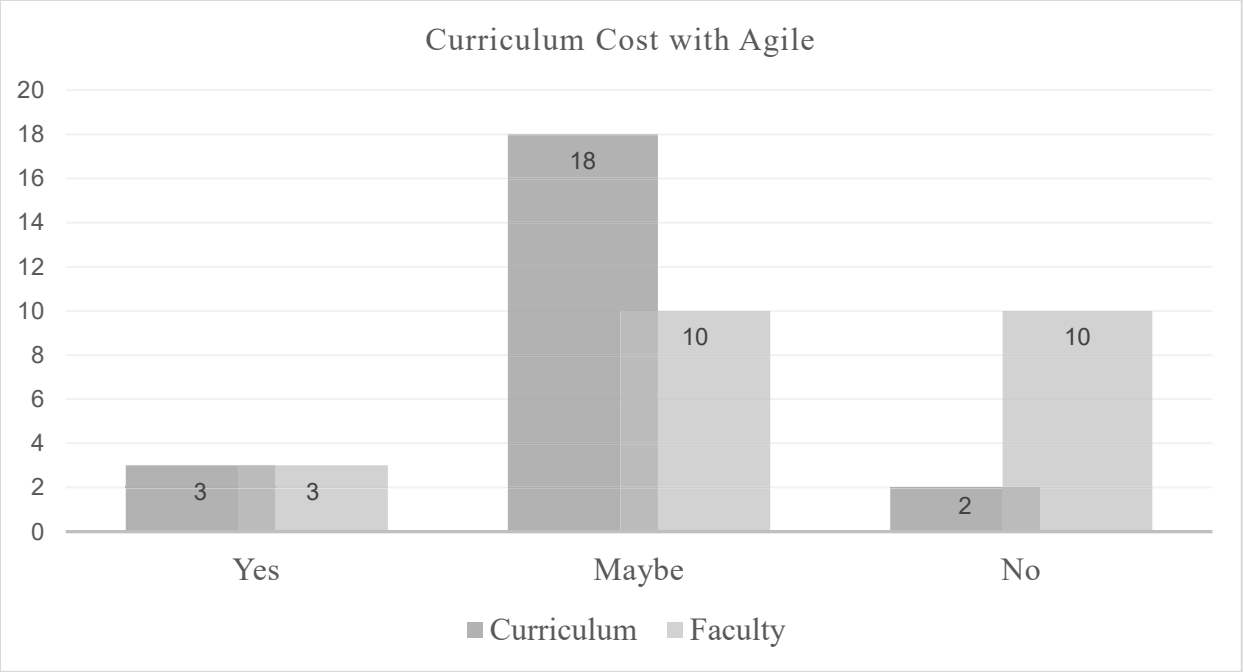

Figure 21: Curriculum Cost with Agile. Responses to whether Agile methodologies would lower curriculum cost.

Hypothesis. The study failed to reject the null hypothesis that current curriculum practices do not result in higher cost than an Agile approach. This was in part due to the inconsistencies reported by the respondents. It was difficult to either reject or fail to reject the null hypothesis when the respondents involved in the curriculum process did not know either the costs involved, or the range of cost items accounted. Perhaps a future study could delve deeper into the reasons for the inconsistencies in the cost accounting of curriculum projects.

Curriculum Quality

Another aspect of the study focused on quality. The survey asked respondents how they felt about the quality of their curriculum and its associated processes. Further, the survey contained questions on training provided by employers to their program graduates which were hired.

Quality. The study asked the respondents about the level of quality and if implementation of Agile methodologies would improve the quality level. Of the 47 respondents, 46 answered the question. The question offered three possible answers of yes, no or maybe. No responses were four out of 46 (8.7%). Maybe responses were 25 out of 46 (54.35%). Yes responses were 17 out of 46 (36.96%). When broken down by role, the responses received were split evenly at 23 each for faculty and curriculum personnel. No responses for faculty were 3 out of 23 (13.04%), while curriculum personnel responses were one out of 23 (4.35%). When looking at the role breakdown for maybe responses, faculty were 12 out of 23 (52.17%) and curriculum personnel were 13 out of 23 (56.52%). For yes responses, faculty were 8 out of 23 (34.78%), while curriculum personnel were nine out of 23 (39.13%) (Table 10-11 and Figure 23).

Table 10

Agile Improve Quality?

	Role		
	Curriculum	Faculty	Total
Yes	9	8	17
Maybe	13	12	25
No	1	3	4
Total	23	23	46

Table 11

Chi-Squared Tests

	Value	df	p
X^2	1.10	2	0.58
N	46		

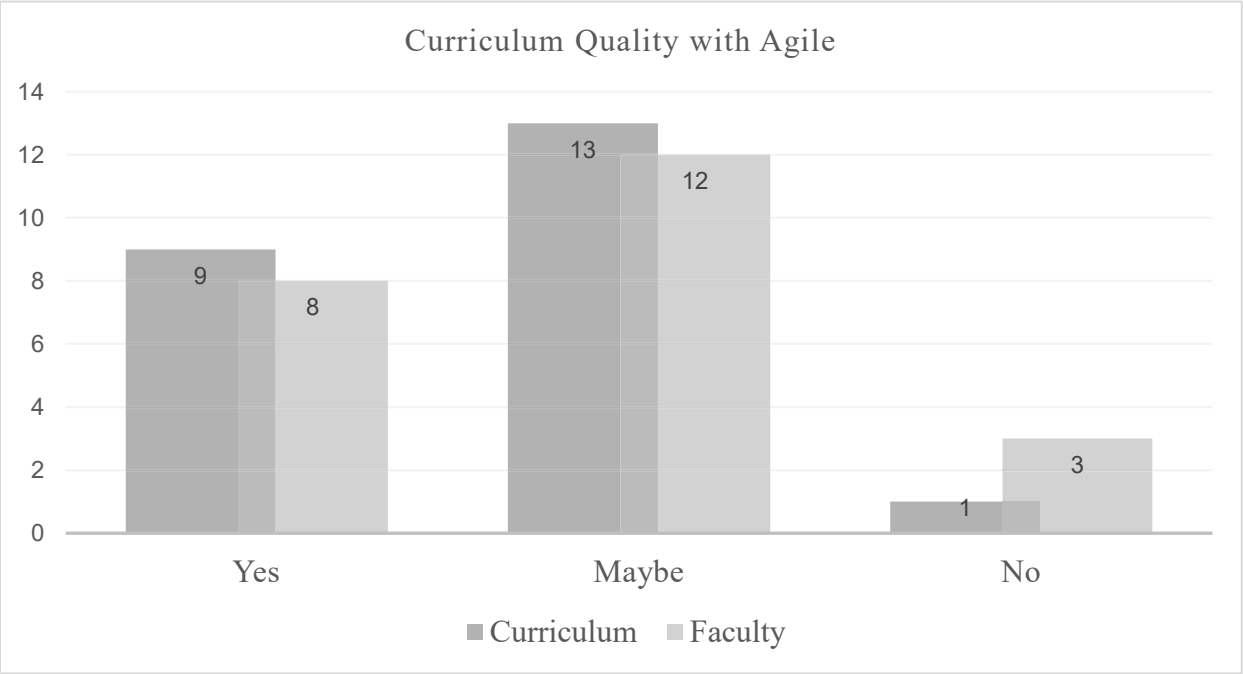

Figure 22: Curriculum Quality with Agile. Responses to whether Agile methodologies would improve curriculum quality.

Constituency need. The survey asked if any employers provided supplemental training to their graduates. Eleven of the 47 respondents (23.40%) reported that employers provided training in various formats to their graduates. When asked how many of the employers provided supplemental training, 10 out of the 11 (90.91%) reported four or more of their employers provided such training, while one respondent stated that one (9.09%) employer provided training. The format of such training was reported as various. Respondents reported that their

employers who provide training utilized boot camps, self-paced training, seminars, webinars, and mentors. It was out of the scope of this study as to the details concerning success, costs et. al. for the employer provided training. Since the role of the WTCS is the training and education of future employees, it does bring to light the question on whether curriculum projects were providing the current knowledge required by the employees and employers if supplemental training is needed. Perhaps this is a normal occurrence.

Hypothesis. The study rejected the null hypothesis that current curriculum practices do not result in lower quality than an Agile approach. With the number of responses reported in the affirmative, there appeared to be a willingness to try Agile methodologies and an awareness of possible improvement to quality.

Curriculum Satisfaction

The survey asked the respondents for their overall satisfaction for their institutional curriculum development process. The question provided a Likert scale with the following choices: Dissatisfied, Somewhat Dissatisfied, Neutral Somewhat Satisfied, and Satisfied. To analyze the responses, numeric values were applied to the choices with one being equal to dissatisfied up to five being equal to satisfied.

For curriculum personnel, the responses ranged the entire selection of choices. For faculty, no respondent selected dissatisfied. The curriculum personnel mean was 3.83, while the faculty mean was 3.48. Answers for each group were clustered with faculty having a standard deviation of 1.12 and curriculum personnel at 1.13. The skewness for the level of satisfaction was -1.42 (standard error of 0.47) for curriculum personnel and -0.05 (standard error of 0.48) for faculty. The curriculum personnel skewness indicated a departure of symmetry. This could be explained by a combination of the small sample size along with the respondent who felt

dissatisfied with the curriculum development process. Both groups displayed a negative skewness, which showed that they leaned towards satisfied with the curriculum process. Faculty were only slightly satisfied, while curriculum personnel reported as having greater satisfaction with the process. The kurtosis also spoke to the spread of the responses. Faculty were more evenly spread due to having lighter tails with a kurtosis of -1.34, while the curriculum personnel were heavy-tailed with a kurtosis of 1.85 (Tables 12-13 and Figure 24). For the two groups a significant difference was not found in the responses to their respective level of curriculum process satisfaction (chi-square = 8.73, df = 4, p = 0.07).

Table 12

Descriptive Statistics

	Satisfaction Level	
	Curriculum	Faculty
Mean	3.83	3.48
Std. Deviation	1.13	1.12
Skewness	-1.42	-0.05
Std. Error of Skewness	0.47	0.48
Kurtosis	1.85	-1.34
Std. Error of Kurtosis	0.92	0.93
Minimum	1.00	2.00
Maximum	5.00	5.00

Table 13

Contingency Tables

Satisfaction Level	Institutional Role		Total
	Curriculum	Faculty	
Dissatisfied	2	0	2
Somewhat Dissatisfied	1	6	7
Neutral	2	5	7
Somewhat Satisfied	13	7	20
Satisfied	6	5	11
Total	24	23	47

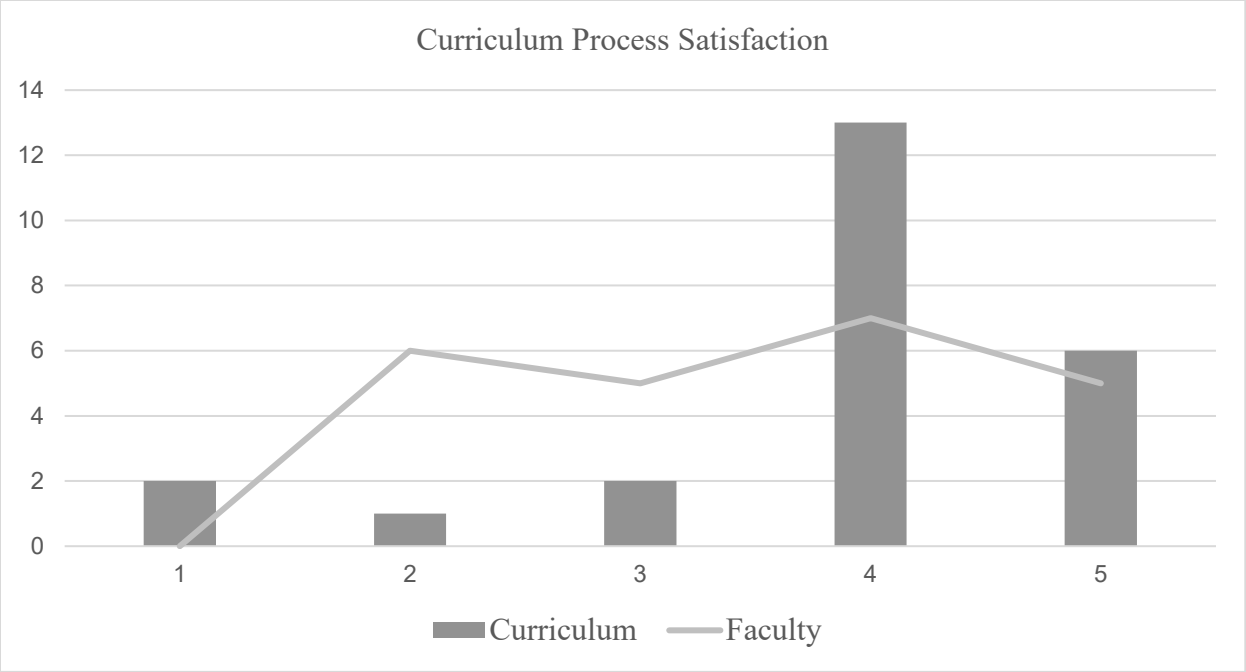

Figure 23: Curriculum Process Satisfaction. Measures the satisfaction with the curriculum process for faculty and curriculum personnel.

To compare and test the differences between the faculty and curriculum office personnel, independent t-tests were performed. Using the t-test, the study found an insignificant difference in the means of the two groups ($t = 1.08$, $df = 45$, $p = 0.29$). To measure the effect size, the study calculated Cohen's d. The Cohen's d effect size was 0.32. This indicated a modest effect (Table 14).

Table 14

Independent Samples T-Test

	t	df	p	Mean Difference	SE Difference	Cohen's d
Satisfaction Level	1.08	45.00	0.29	0.36	0.33	0.32

Note. Student's t-test.

To test for equality of variance, Levene's test was utilized. Using a significance value of 0.05, the study resulted in a low p value (p = 0.29) meaning that the variance between faculty and curriculum personnel did not differ (Table 15). While the faculty were less satisfied with the curriculum process, the satisfaction difference between faculty and curriculum personnel was not statistically significant.

Table 15

Test of Equality of Variances (Levene's)

	F	df	p
Satisfaction Level	1.17	1	0.29

Agile Satisfaction. One of the aspects of the study asked the respondents about their level of satisfaction and if implementation of Agile methodologies would improve their satisfaction level. Of the 47 respondents, 46 answered the question. The question offered three possible answers of yes, no or maybe. No responses were three out of 46 (6.52%). Maybe responses were 29 out of 46 (63.04%). Yes responses were 14 out of 46 (30.43%). When broken down by role, the responses received were split evenly at 23 each for faculty and curriculum personnel. No responses for faculty were two out of 23 (8.7%), while curriculum personnel responses were one out of 23 (4.35%). When looking at the role breakdown for maybe responses, faculty were 16 out of 23 (69.57%) and curriculum personnel were 13 out of 23 (56.52%). For yes responses, faculty were five out of 23 (21.74%), while curriculum personnel were nine out of 23 (39.13%) (Table 16-17 and Figure 25). Having the aggregate yes responses

at 30.43% may point to respondents being willing to look to Agile methodologies to improve curriculum satisfaction.

Table 16

Agile Improve Satisfaction?

	Role		
	Curriculum	Faculty	Total
Maybe	13	16	29
No	1	2	3
Yes	9	5	14
Total	23	23	46

Table 17

Chi-Squared Tests

	Value	df	p
X^2	1.79	2	0.41
N	46		

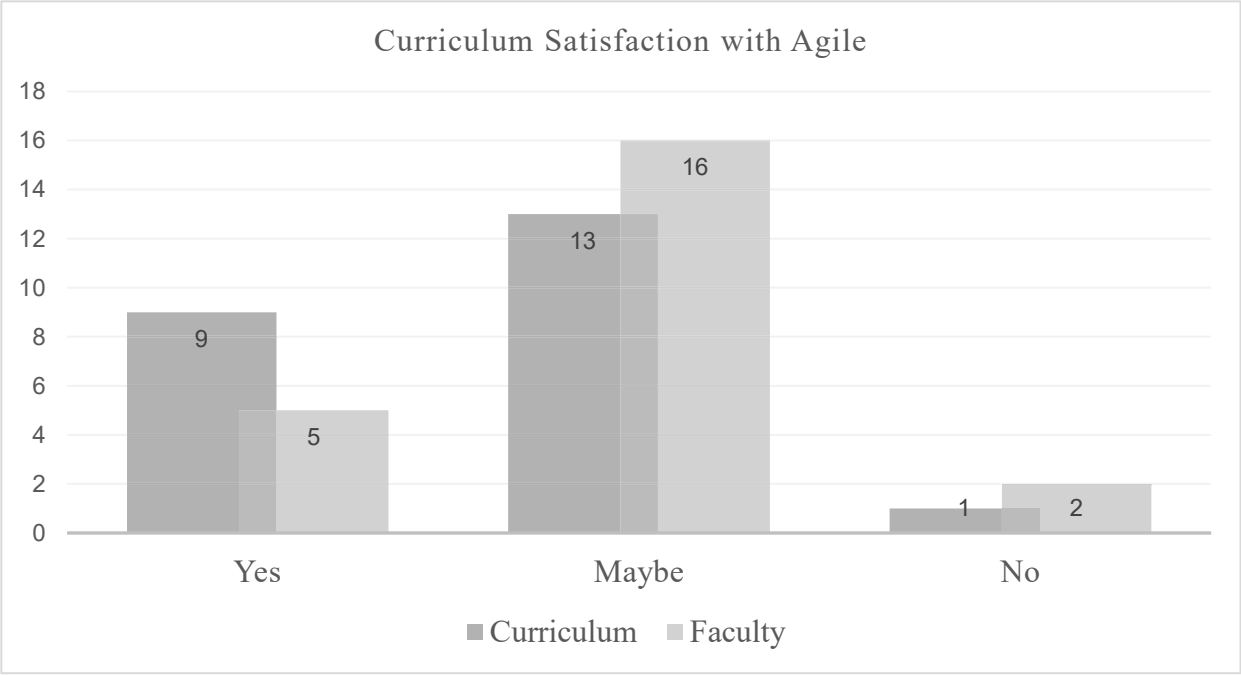

Figure 24: Curriculum Satisfaction with Agile. Responses to whether Agile methodologies would improve curriculum satisfaction.

Curriculum Grade. The survey asked the participants to grade two aspects of their respective curriculum processes. One question asked them to grade the quality of the curriculum process overall, while the other asked them to grade the process itself. The goal of the first question was to ascertain their opinion of the quality of the work within the current processes. The second question's goal was to assess their opinion of the process itself. It could be possible to have a great process and poor quality and vice versa.

The question asked them to assign a grade of A, B, C, D or F to each question. These were converted to ordinal values on a five-point scale with A = 4, B = 3, C = 2, D = 1 and F = 0. In looking at the entire result set, the overall quality of the curriculum process scored a 2.85 and the curriculum process itself scored a 2.55 (table 18).

Table 18

Curriculum Development Processes and Quality Descriptive Statistics

	Curriculum development processes		Quality of curriculum development process	
	Curriculum	Faculty	Curriculum	Faculty
Mean	2.58	2.52	2.75	2.96
Median	3.00	3.00	3.00	3.00
Mode	3.00	3.00	3.00	3.00
Std. Deviation	0.78	0.79	0.61	0.71
Skewness	-2.13	-0.08	0.16	-0.79
Std. Error of Skewness	0.47	0.48	0.47	0.48

Test of normality. To test the normality of the distribution, Shapiro-Wilks tests were performed. The results for curriculum process for faculty roles were w=0.87, p=5.79e-3; curriculum roles were w=0.61, p=7.12e-7. The results for curriculum process quality for faculty roles were w=0.78, p=2.05e-4; curriculum roles were w=0.76, p=7.71e-5 (table 19). The results spoke of a non-normal distribution as the data significantly deviated from a normal distribution represented by a bell curve, with the averages over both groups being lower than the median. A small sample size could adversely affect this test. Further research with larger sample sizes would be required or repeated studies performed to verify results. Another reason for a non-normal distribution was outliers combined with a small sample size. The smaller the sample

size, the more effect an outlier has in skewing the distribution curve. In this study, there was an outlier. In this study, instead of the traditional bell curve distribution, the distribution curve was slanted towards the right of the median. The respondents graded the curriculum development process and quality as higher than the median score.

Table 19

Test of Normality (Shapiro-Wilk)

		W	p
Quality of curriculum development process?	Curriculum	0.76	7.71e -5
	Faculty	0.78	2.05e -4
Curriculum development processes?	Curriculum	0.61	7.12e -7
	Faculty	0.87	5.79e -3

Note. Significant results suggest a deviation from normality.

Assumption checks. A Levene's test to check assumptions was performed. The results showed that equality of variances could be assumed for t-tests. The results for curriculum process quality were $F(1) = 0.36$, $p = 0.55$, while the curriculum process itself was $F(1) = 0.41$, $p = 0.52$ (table 20).

Table 20

Test of Equality of Variances (Levene's)

	F	df	p
Quality of curriculum development process?	0.36	1	0.55
Curriculum development processes?	0.41	1	0.52

Student T-Test. Using the t-tests, a significant difference was not found in the curriculum personnel and faculty. For the quality of the curriculum process, a t-test result of t = -1.08, df = 45.00, p(0.29) with a weak effect size, having a Cohen's d of -0.31. The curriculum process itself results were t = 0.27, df = 45.00, p(0.79) with a weak effect size, having a Cohen's d of 0.08 (table 21).

Table 21

Independent Samples T-Test

	t	df	p
Quality of curriculum development process?	-1.08	45.00	0.29
Curriculum development processes?	0.27	45.00	0.79

Note. Student's t-test.

Correlation. A Spearman's rank-order correlation was run to determine the relationship between the curriculum process itself and the quality (table 22). There was a strong, positive

correlation between the process and quality, which was statistically significant (r_s = .70, p = .035).

Table 22

Spearman Correlations

		Spearman's rho	p
Quality of curriculum development process?	- Curriculum development processes?	0.70***	5.78e -8

* p < .05, ** p < .01, *** p < .001

Hypothesis. The study failed to reject the null hypothesis that current curriculum practices do not result in lower satisfaction than an Agile approach. This could be due to the lack of usage of Agile methodologies (other than within a classroom environment) with the exception of personal faculty usage. It might be possible that respondents' lack of usage and/or knowledge of Agile did not give them the necessary experience to respond in the affirmative for Agile improving satisfaction. Of the respondents, only faculty answered the question about the usage of Agile outside the classroom. Of the responding faculty, only nine answered the question. Of the nine, only three (33%) responded that Agile was being used outside the classroom. While this sample size was small and from which it was difficult to draw concrete conclusions, it pointed to the lack of Agile usage as a possibility. When asked to grade their curriculum processes, the result was a 2.58 and a 2.52 for curriculum personnel and faculty respectively. The satisfaction levels for curriculum personnel and faculty were 3.83 and 3.48, respectively. It appeared from the data that quality curriculum was created in spite of the process

frustrations reported by the survey participants. Even though the study failed to reject the null hypothesis, with 14 out of 46 (30.43%) reporting yes concerning the question of Agile methodologies improving satisfaction, there seemed to be a willingness to try and a perceived need for improvement to process of curriculum development.

Curriculum Definition

One of the aspects of the research was the definition of curriculum itself. One of the goals of the research was to understand if there was a common definition for curriculum. If the curriculum process needed to be improved while controlling costs, it was necessary to have at least a baseline understanding of the definition of curriculum.

The survey asked the participants how they defined curriculum. They were given several options including Worldwide Instructional Design System (WIDS), Learning Management System (LMS), Competencies, Learning Objectives, Program Outcomes, and Other. Participants could select any of the choices and add their own via the 'Other' selection. The results were that there was no baseline definition among institutions or individuals (tables 23-28). There were several possible reasons for this. The WTCS might have a definition, but the individual institution might alter that definition. The institution might have a definition, but might not have communicated it clearly to faculty and/or curriculum office personnel. The individual institution might have a clear definition and clearly communicated the definition, but the definition might differ amongst institutions. Due to this, faculty within an institution might have a common definition, but not across institutions. Another possibility is that no clear definition has been communicated from the WTCS or the institution. In this scenario, the definition is left up to the faculty and/or curriculum personnel themselves. This might lead to questioning where the ownership of the definition of curriculum lies. In any case, the lack of a common response made

it difficult to use predictable management techniques within a complex and unpredictable environment. There was some agreement on the ingredients of a curriculum project, but disagreement on the amount of each ingredient. This might point to an opportunity for Agile since it was developed to manage complex and unpredictable project environments.

Table 23

Curriculum Definition Descriptive Statistics

	WIDS		LMS		Competencies		Objectives		Outcomes		Other	
	Curriculum	Faculty	Curriculum	Faculty	Curriculum	Faculty	Curriculum	Faculty	Curriculum	Faculty	Curriculum	Faculty
Valid	20	19	15	15	22	19	18	19	0	0	16	16
Missing	4	4	9	8	2	4	6	4	24	23	8	7

Table 24

Frequencies for WIDS

Role	WIDS	Frequency	Percent
Curriculum	WIDS	20	83.33
	Missing	4	16.67
	Total	24	100.00
Faculty	WIDS	19	82.61
	Missing	4	17.39
	Total	23	100.00

Table 25

Frequencies for LMS

Role	LMS	Frequency	Percent
Curriculum	LMS	15	62.50
	Missing	9	37.50
	Total	24	100.00
Faculty	LMS	15	65.22
	Missing	8	34.78
	Total	23	100.00

Table 26

Frequencies for Competencies

Role	Competencies	Frequency	Percent
Curriculum	Competencies	22	91.67
	Missing	2	8.33
	Total	24	100.00
Faculty	Competencies	19	82.61
	Missing	4	17.39
	Total	23	100.00

Table 27

Frequencies for Objectives

Role	Objectives	Frequency	Percent
Curriculum	Objectives	18	75.00
	Missing	6	25.00
	Total	24	100.00
Faculty	Objectives	19	82.61
	Missing	4	17.39
	Total	23	100.00

Table 28

Frequencies for Other

Role	Other	Frequency	Percent
Curriculum	Other	11	45.83
	Other (Actual Lessons)	0	0.00
	Other (Assessments and Learning Plans)	1	4.17
	Other (Capital Requirements)	1	4.17
	Other (External Resources)	0	0.00
	Other (External Standards)	1	4.17
	Other (Industry Input and Assessment (program / course / credentials))	1	4.17
	Other (Statement of Need)	1	4.17
	Missing	8	33.33
	Total	24	100.00
Faculty	Other	14	60.87
	Other (Actual Lessons)	1	4.35
	Other (Assessments and Learning Plans)	0	0.00
	Other (Capital Requirements)	0	0.00
	Other (External Resources)	1	4.35
	Other (External Standards)	0	0.00
	Other (Industry Input and Assessment (program / course / credentials))	0	0.00
	Other (Statement of Need)	0	0.00
	Missing	7	30.43
	Total	23	100.00

In looking at the totals, there was some agreement on some of the components of curriculum. It appeared that most respondents agreed that WIDS (39), competencies (41), objectives (37), and the LMS (30) are all included in a curriculum project. The disagreement came in how much of each one and the other (32) category. There was a significant number in the other category, which meant that there was a significant amount of additional work as defined by each individual and the institution (Figure 25).

To measure if there were differences in curriculum definition responses between the two groups (faculty and curriculum personnel), chi square tests were run. It was interesting to note that there appeared to be agreement in the factors involved in a curriculum project, except when it came to the 'Other' category (Tables 29-38).

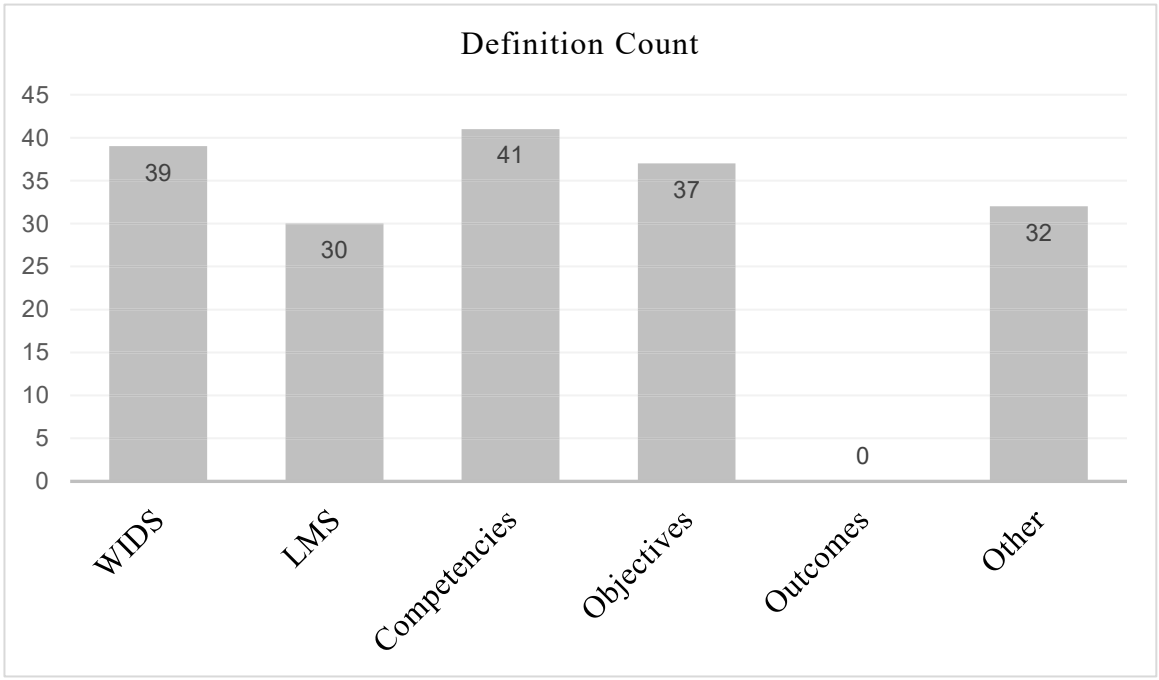

Figure 25: Definition Count: Chart shows counts of responses on the definition of curriculum.

WIDS Chi Square

Table 29

Contingency Tables

		Role		
		Curriculum	Faculty	Total
WIDS	Count	20.00	19.00	39.00
	% within row	0.51	0.49	1.00
Total	Count	20.00	19.00	39.00
	% within row	0.51	0.49	1.00

Table 30

Chi-Squared Tests

	Value	df	p
X^2	0.03	1	0.87
N	39		

LMS Chi Square

Table 31

Contingency Tables

		Role		
		Curriculum	Faculty	Total
LMS	Count	15.00	15.00	30.00
	% within row	0.50	0.50	1.00
Total	Count	15.00	15.00	30.00
	% within row	0.50	0.50	1.00

Table 32

Chi-Squared Tests

	Value	df	p
X^2	0.00	1	1.00
N	30		

Competencies Chi Square

Table 33

Contingency Tables

		Role		
		Curriculum	Faculty	Total
Competencies	Count	22.00	19.00	41.00
	% within row	0.54	0.46	1.00
Total	Count	22.00	19.00	41.00
	% within row	0.54	0.46	1.00

Table 34

Chi-Squared Tests

	Value	df	p
X^2	0.00	1	1.00
N	30		

Objectives Chi Square

Table 35

Contingency Tables

		Role		
		Curriculum	Faculty	Total
Objectives	Count	18.00	19.00	37.00
	% within row	0.49	0.51	1.00
Total	Count	18.00	19.00	37.00
	% within row	0.49	0.51	1.00

Table 36

Chi-Squared Tests

	Value	df	p
X^2	0.03	1	0.87
N	37		

Other Chi Square

Table 37

Contingency Tables

Other		Role		
		Curriculum	Faculty	Total
Other	Count	11.00	14.00	25.00
	% within row	0.44	0.56	1.00
Other (Actual Lessons)	Count	0.00	1.00	1.00
	% within row	0.00	1.00	1.00
Other (Assessments and Learning Plans)	Count	1.00	0.00	1.00
	% within row	1.00	0.00	1.00
Other (Capital Requirements)	Count	1.00	0.00	1.00
	% within row	1.00	0.00	1.00
Other (External Resources)	Count	0.00	1.00	1.00
	% within row	0.00	1.00	1.00
Other (External Standards)	Count	1.00	0.00	1.00
	% within row	1.00	0.00	1.00
Other (Industry Input and Assessment (program / course / credentials))	Count	1.00	0.00	1.00
	% within row	1.00	0.00	1.00
Other (Statement of Need)	Count	1.00	0.00	1.00
	% within row	1.00	0.00	1.00
Total	Count	16.00	16.00	32.00
	% within row	0.50	0.50	1.00

Table 38

Chi-Squared Tests

	Value	df	p
X^2	7.36	7	0.39
N	32		

Agile

The survey asked the respondents if they taught Agile in the classroom. Of the 23 faculty who responded, nine out of 23 (39.13%) faculty members taught Agile in the classroom. While this may seem low due to the pervasiveness of Agile in the IT industry, this could simply reflect that the respondents were not responsible for teaching Agile methodologies.

A survey question asked the respondents if Agile methodologies were used in any other areas of the institutional processes. Only faculty responded to this question. Of the faculty, only nine responses were received. Of the nine, 3 (33%) reported that Agile methodologies were used in other areas of the institution.

Anecdotally, when asked how they utilized Agile methodologies, the responses were confined to personal usage. For example, a faculty member used Agile to organize their course improvements. Another mentioned using Agile for their special projects. No respondents reported using Agile outside of the IT faculty arena.

Anecdotes

While not quantitative in nature, the survey gave the respondents the opportunity to provide open-ended feedback. This feedback is reported in Appendix B. Some interesting responses were as follows:

“Our 152 - IT-Software Program is already doing this. We seldom submit an application for curriculum updates to the curriculum office unless it is a major change in the direction of the course. We modularize all of our competencies and update them as needed. The curriculum process is too clumsy and time consuming to make it worth our time. The curriculum office gave us rights to update competencies and learning objectives in our courses any time we see fit. We lose money this way but it is the nature of our industry.”

“I'm not really sure how an agile approach would even be utilized in the curriculum process. Most of the instructors update their content on a semester-by-semester basis as is, and every so often, we get a curriculum project to update the "official" curriculum. If we had to also update WIDS every time we made a change in the course, I feel that most people would be less likely to actually make changes, as the whole WIDS process and approvals is a nightmare to deal with. We would need different software other than WIDS if an agile approach were to work. Given how change-averse our college is, I don't believe this would be likely to happen. Agile would be a "bolt-on" to what we do now, it wouldn't truly be an agile process, and it would likely be a giant disaster with even more steps and checks than happen now, which would actually increase the time it would take to get a project approved, and increase costs.”

“I think agile is an interesting concept, but how do we hold it true for our students. Can we be flexible in our requirements so whatever will work for them, will work for us? Rapid prototyping and education seems to be a disconnect, but it is truly what I believe we need.”

“In my experience it is the state approval process and restrictions on how often competencies may be changed that make for inflexible curriculum development and updating. The IT division is excellent at proposing new courses and skills requested by our industry

advisory board. It is the slow approval process at the state that can cause our coursework to lag behind industry needs. We also can barely change a course in a 3-year period."

"I don't know if Agile is the solution. I am most frustrated with having to update WIDS and the LMS. I don't use WIDS to deliver my course content so when updating curriculum, I make updates to the LMS. This makes WIDS out-of-date. It is a waste of time and resources to keep them synced."

"I can see it being difficult to come up with a compensation model for curriculum development using a strict Agile approach."

"The idea of agile being utilized in curriculum development is interesting, but my personal opinion is that it would not be necessary if the pursuit is cost savings and/or curriculum quality. My experience in the process is that it is structured in a way where agile wouldn't make a significant difference. The real roadblock I see in the length of time the development process takes is the time spent waiting for approvals once the WIDS work is complete. My normal experience is to wait four weeks or more for my WIDS to be approved by both curriculum department and the administrator. If I pester each party enough, it can be approved in as little as two weeks. This wait pertains to when we first draw up the Course Outcome Summary for approval for Work In Progress and after the content has been created and needs final approval into 'active' status. The length of time given for curriculum to be written is typically a semester (fall, spring, or summer)."

Chapter V: Discussion, Implications, Recommendations

The purpose of this study was to delve into the status of curriculum development within the two-year postsecondary arena. The scope was the Wisconsin Technical College System (WTCS) Information Technology (IT) programs. The study surveyed the IT faculty and the curriculum office personnel across all 16 WTCS institutions.

This survey may serve to promote other studies within the same vein. There have not been many studies within higher education concerning the curriculum development process. In particular, this study examined the cost, quality, and satisfaction of the curriculum development process. The objective was to see if the current state of the curriculum development process was efficient in a fast-moving industry, such as IT, in getting current knowledge in the hands of the constituents of a program. Basically, are students gaining the knowledge necessary to be successful in the market in an effective manner?

Since many studies have not been performed in this area, one of the aims of this study was to provide a baseline starting point. Hopefully, this will begin a discussion for curriculum efficiencies. As knowledge gains more and more ubiquity, the role of faculty and curriculum is changing. With the current speed of change, the technical college system is in a position to be a leader in these changes, especially with the need to prepare a graduate to be productive in employment in a 2-3 year time period.

This was a limited-scope study. The entire sample polled was 254 individuals (210 faculty and 44 curriculum office personnel). There were 47 complete survey responses, which was 18.5%. It is recommended that another study be completed in the future with a larger population to determine congruency or divergence from this study's results.

Research Questions

As the recommendations are discussed, a revisit to the research questions is prudent. This study attempted to answer the following research questions.

RQ_1: How do the current curriculum development practices within the Wisconsin two-year technical college environment meet the needs of the constituency in the rapidly moving IT industry?

S_1: What is the status of Agile principles adoption within the IT faculty and curriculum development offices of the WTCS?

S_2: What is the current cost(s) of curriculum development compared to an Agile approach?

S_3: What is the quality of the current process to get current knowledge to the market (implemented) compared to an Agile approach?

S_4: What is the satisfaction level of teachers and curriculum approval offices with current curriculum development processes?

Hypothesis

This study attempted to show that current curriculum practices result in higher cost, lower quality, and lower satisfaction. Quality was defined as skill sets employers and employees need for employment. Resultant acceptance or rejection of hypotheses is listed in Table 3.

$H1_a$: Agile methodologies are being utilized inside and/or outside of the IT classroom.

$H1_o$: Agile methodologies are not being utilized inside and/or outside of the IT classroom.

$H2_a$: Current curriculum practices result in higher cost than an Agile approach.

$H2_o$: Current curriculum practices do not result in higher cost than an Agile approach.

$H3_a$: Current curriculum practices result in lower quality than an Agile approach.

$H3_o$: Current curriculum practices do not result in lower quality than an Agile approach.

$H4_a$: Current curriculum practices result in lower satisfaction than an Agile approach.

$H4_o$: Current curriculum practices do not result in lower satisfaction than an Agile approach.

Conclusions

Overall, the theme of the results was change is needed. The questions are what changes need to be made and where? What processes need to be addressed? Where can efficiencies be gained? Can higher education curriculum development processes be modified in such a manner to allow higher educational institutions maintain relevancy and provide for the needs of their constituency?

Research Question 1 (S_1): Agile Adoption. This term, 'Agile', is utilized many times within the application development world. It was important to begin with common ground to understand what is meant by the term, 'Agile' to ensure mutual understanding. Agile is the "ability to create and respond to change in order to succeed in an uncertain and turbulent environment" (Agile Alliance, 2015, para. 1) When the software industry began, it needed processes to utilize in the manufacture of its product. As the industry, and our world, has become more complex, it became evident to the industry that the linear, manufacturing-like methods would not function to the efficiency needed to remain competitive.

Agile Concepts

The adoption of Agile methodologies has led to numerous terms being defined and/or redefined as the process has evolved and grown. There are main concepts that are crucial to

understanding the basics of Agile defined by the Agile Alliance. User stories are used in consultation with the customer or product owner. The team divides up the work to be done into functional increments called "user stories." Each user story is expected to yield a contribution to the value of the overall product. The daily meeting, or stand up meeting, occurs each day at the same time. The team meets to bring everyone up to date on the information that is vital for coordination. They review any completed contributions and obstacles that stand in their way. Incremental development ensures that each successive version of the product is usable and builds upon the previous version by adding user-visible functionality. Iterative development states that agile projects are iterative as they intentionally allow for repeating software development activities, and for potentially revisiting the same work products. Team, in the Agile sense, is a small group of people assigned to the same project or effort on a full-time basis. Milestones, or sprint retrospectives, occur once a project has been underway for some time, or at the end of the project. These sprint retrospectives allow for a review of the work completed and may even include possible process and procedure reviews. All of the team's permanent members (not just the developers) invest from one to three days in a detailed analysis of the project's significant events. Personas aid in guaranteeing that the user experience is a major factor in project outcomes. The team constructs detailed biographies of fictitious users of the product, which represent the target demographic (Agile Glossary, 2018).

In the WTCS, the adoption of Agile is likely not occurring outside of the IT classroom and isolated portions of IT faculty processes. The loudest argument for this is that no curriculum office personnel defined Agile or stated that they used Agile. In the comments of the survey, one curriculum office person stated plainly that they were not familiar with Agile and, therefore, could not respond to the benefits. Even within the faculty respondents, there were some who

were unaware of Agile. One faculty member commented that this survey was the first time they were learning about Agile. This was interesting in light of the Agile adoption rate in the IT industry per VersionOne (2017) being 94%. Only three survey respondents (6%) mentioned using Agile outside of the classroom.

Agile usage appeared to be confined to two areas. The first area was within the classroom. This usage made sense, as knowledge of Agile methodologies is a necessity for IT graduates. Are faculty practicing what they preach in terms of the utilization of Agile? It appears the answer would be no as the usage of Agile outside of the classroom was confined to a small contingent in a siloed fashion. As it pertained to curriculum development, only one faculty mentioned using it in their curriculum development processes. These were not "official" processes. The faculty member remarked that they use Agile methodologies to maintain their courses. Since Agile methodologies were not being utilized in a large fashion, it is recommended that some professional development is required to educate on the Agile processes. Whether Agile is adopted wholeheartedly or not, there could be process efficiency gains in areas of the WTCS, even within an IT department/school. Another point to remember is the possible bias issues due to low population response rate. An additional study could reveal whether the Agile adoption rate is higher or lower.

Even with the possible sampling bias and the possibility of Agile not being adopted in a conclusive fashion, the gains made would be positive based upon the literature. In the 11th Annual State of Agile report, 98% of the respondents utilizing Agile were realizing successes. They were achieving increases in productivity, product delivery was being accelerated, and the ability to manage changing priorities was being enhanced (VersionOne, 2017). Higher education

could benefit from each of these achievements. Imagine curriculum being delivered quicker and in a more productive manner.

Without looking for ways to innovate in the current and future environment in which higher education finds itself, an institution might find themselves stagnating to obsolescence. In the marketplace, individuals need to constantly be improving their skillset to maintain relevancy in their respective markets. Is higher education any different? Mark Pegrum, an Associate Professor at UWA stated, "The days of going to college for four years and working afterwards are changing. Students now have jobs before college or in parallel to college. They therefore have a different perspective on education than the traditional cohort of 20 years ago." (Barber et al., 2013). An interesting study would be to examine the number of students in the technical college system who have jobs prior to graduation and how the curriculum impacts their work performance.

Hypothesis. The study failed to reject the null hypothesis that Agile curriculum practices are not being utilized inside and/or outside of the IT classroom. It is necessary to note the low response rate. The results might differ with a higher rate of return. Perhaps a future study could increase the scope to achieve a higher response rate. Only nine individuals answered the question about Agile methodologies being used outside the classroom. Of those nine, only three stated that Agile methodologies were being used outside of the classroom. Taken as a whole, having only three of 47 (6.38%) respondents state in the affirmative to the usage of Agile outside of the classroom points to a failure to reject the null.

$H1_a$: Agile methodologies are being utilized inside and/or outside of the IT classroom.

$H1_o$: Agile methodologies are not being utilized inside and/or outside of the IT classroom.

Research Question 2 (S_2): Costs. The study revealed that the real cost of curriculum development is largely unknown. When asked if they were aware of the costs involved, 27 (57%) respondents replied in the affirmative. That may seem like a solid number, but digging deeper, those respondents' thoughts on the costs of curriculum development varied greatly. Many respondents stated an exact figure, but the figure was a hard cost. What this means is that 13 of the 27 (48%) stated that they included only the project costs in the cost of curriculum development. Is this the true cost? Different institutions have differing methods in how they compensate for curriculum projects. Some institutions paid a flat rate per credit of the developed curriculum. Others broke it down for the particular deliverable developed. They allowed an amount for the Worldwide Instructional Design System (WIDS), another amount for the learning management system (LMS), etc. This was an understandable method as it allowed for ease of calculation. However, this does beg the question if it captured the real cost.

In looking at the typical curriculum development process at an institution for an average course, there were several pieces to the process. The project is deemed necessary to be performed. This could be a new course or a required revision. Each institution has some process and paperwork that is required, which includes input from an advisory board. The faculty member performs the necessary work in WIDS, which then needs curriculum office approval. This approval might be in the form of a single person. It might be from a committee. A dean might also need to sign off. The faculty member also performs the necessary work in their respective LMS, which also requires approval. Some institutions have attempted to achieve efficiencies with automated forms processing and submittals. Some institutions employed instructional designers to aid the faculty in the curriculum development process.

The study revealed that the average reported cost for curriculum development for a single 3-credit course was $2809.98. It was interesting to note that one outlier stated that their curriculum cost was $24,500. With this cost removed, the average dropped to $1906.23. In looking at the process and costs involved, an examination was required to determine whether $1906 was sufficient. Since most respondents reported that they pay for project only, it is assumed that not all costs are accounted for within the process. In the IT industry, a total cost of ownership (TCO) is performed to understand what the true cost of a project and/or software is to the organization. When performing a TCO analysis, the easy costs are the hard costs, such as the cost of the software. This can be compared to the cost of the project only. This would equate to the $1906 paid to the faculty for the project itself. However, there are other costs to consider. The faculty member was paid a salary. So were all other individuals involved. Additionally, each individual received benefits. There was a cost for the WIDS system that was utilized in the WTCS process. Each institution had an LMS, which had a cost.

Walk-through scenario. This walk-through will make some assumptions. These assumptions were necessary for illustrative purposes and were beyond the scope of the study. This could point to the need for a future study. The first items to consider were salary and benefits. For this illustration, the amount of $62.50 per hour was used. This number assumed that an average IT faculty member's salary plus benefits was $100,000. In considering 1600 hours per year work time (assuming 40 weeks times 40 hours per week), the $100,000 broke down to $62.50 per hour. Understandably, this was an estimation as most people work more than 40 hours and salaries vary. The study asked the respondents about the length of time various stages took to complete in the curriculum development process. This included the length of time to complete, and the length of time for advisory board approval along with curriculum

office approval. What was not asked is the amount of time actually working on the project. It can be assumed faculty were working on their curriculum project at various times throughout their work schedule. For the purposes of this analysis, it was assumed faculty spent a total of 60 hours working on a curriculum project. This meant the amount of salary and benefits cost was $3750. When added to the average reported cost paid to faculty, the average cost rose to $5656. Each institution had a curriculum approval process. Some institutional approvals included the deans, while others had curriculum office approval personnel and/or instructional designers. For the purposes of this scenario, it was assumed that an average of three hours was spent in the approval process by the aforementioned individuals. This would result in a cost of $150 (assuming one individual at $50 per hour for a 50-week annual work calendar), which brought the total to $5806. If the advisory board was a part of the process, the faculty member, dean, and curriculum office personnel might be in the advisory board meeting to seek approval. An hour of involvement was assumed. Considering three individuals (dean, faculty curriculum personnel) could be involved, this added another $162.50, which brought the total to $5968.50.

Another cost to consider was the software utilized in the process. There might be miscellaneous software used, such as Microsoft Word that could be counted. For the purposes of this scenario, WIDS and the LMS was the focus. Each institution utilized these types of applications in their processes. The cost of the WIDS system licensing was $7500 annually. The survey asked curriculum approval offices how many projects on average they have approved over the last three years. Taking these responses and calculating a weighted average resulted in an average of 21 curriculum projects per year. Dividing this into the WIDS cost, resulted in a cost per curriculum project of $357. Incorporating this into our previous curriculum project costs bumped the curriculum project cost to $6325.50.

For the LMS calculation, the researcher utilized an average institutional LMS cost for illustrative purposes. The cost of the licensing of a current LMS was $45,000 per year. Again, utilizing the average of 21 curriculum projects per year resulted in a per project cost of $2143. When added to our running cost calculation, the updated cost of the curriculum project rose to $8468.50.

With the estimated cost of $8469, a curriculum project itself would require a Full Time Equivalents (FTE) student count of 1.5 to have a return on investment. This did not include other institutional costs. One of the revenue sources for institutions in the WTCS is FTE. The revenue comes from both the tuition the student pays and funds from the state. The WTCS operates on an outcomes-based funding model. There are multiple metrics that are used to determine the amount of funding each institution receives. FTE is a part of these metrics. FTE calculation is based on the assumption that the typical Full Time student takes 30 credits per year. The number of credits taken is divided by 30 to calculate. For example, if a student is taking twelve credits per semester, then the student's FTE is 0.8 (24/30). For a class, the calculation would be the number of credits for the course multiplied by the course enrollment divided by 30. As an example, if a class has twenty students and is a three-credit course, then the calculation would be 20 x 3 / 30. The course FTE would be two. FTE can be calculated from the individual student to the entire organization. Current FTE revenue is constant due to state regulations and controls. Each institution receives $1700 in state aid and $3300 in tuition per FTE (C. Severson, June 12, 2018). The aforementioned illustration was very basic in nature and a future study that delves deeper in the costs is recommended. There are other unaccounted costs that should be brought into the analysis. The point of the illustration was that curriculum development costs more than individuals and institutions believe it did. Taking the reported

average of 21 curriculum projects per year along with the average reported cost of $1906, the annually average budget for curriculum development for an organization would be $40,026. Given the aforementioned scenario, which resulted in a cost per project of $8469, the annual average budget would be $177,849. This resulted in a difference of $137,823 or an increase of 444%.

Hypothesis. The study failed to reject the null hypothesis that current curriculum practices do not result in higher cost than an Agile approach. This was in part due to the inconsistencies reported by the respondents. It is difficult to either reject or fail to reject the null hypothesis when the respondents involved in the curriculum process do not know either the costs involved, or the range of cost items accounted. Perhaps a future study could delve deeper into the reasons for the inconsistencies in the cost accounting of curriculum projects.

$H2_a$: Current curriculum practices result in higher cost than an Agile approach.

$H2_o$: Current curriculum practices do not result in higher cost than an Agile approach.

Research Question 3 (S_3): Quality. The study asked the respondents about the level of quality and if implementation of Agile methodologies would improve the quality level. The yes responses were 17 out of 46 (36.96%). When broken down by role, the responses were split evenly at 23 each for faculty and curriculum personnel. No responses for faculty were three out of 23 (13.04%), while curriculum personnel responses were one out of 23 (4.35%). For yes responses, faculty were eight out of 23 (34.78%), while curriculum personnel were nine out of 23 (39.13%). Considering more than a third of the respondents replied that Agile methodologies would improve quality, this denoted at least a partial desire to see improvement. This was even more telling when the majority of respondents were not familiar with Agile. Perhaps the need for some type of change is seen, but what change to take is unknown?

The survey asked the respondents to grade the process and the quality of the curriculum. The grade for the quality of the curriculum process was 2.85, while the process itself was 2.55. Both of these were on a four-point scale. This spoke to the desired need for improvement. While a grade of a 4.0 was unlikely, as it would have meant there could be no improvement, a 71% (2.85 out of 4) is probably not where faculty, curriculum personnel, and the institutions themselves desire to see the perceived quality of their curriculum and processes.

With the perceived quality being at 2.85, the concern is the quality of graduate turned out by the WTCS. If the quality of the curriculum and processes was in the low 70% range, was the student and their future employer set up for success? It might be a worthwhile study to examine the connection between a student's performance with the curriculum and their success in the workplace. This was beyond the scope of this study, but the study did address employer training. The study asked the number of employers who provided training to recent graduate hires and in what form. While most employers probably provide some training, the goal of the question was to touch on the possibility that the training by employers was needed because the curriculum was not keeping up with the needs of their constituency. Eleven of the 47 respondents (23.40%) reported that employers provided training in various formats to their graduates (boot camps, self-paced training, seminars, webinars, and mentors). When asked how many of the employers provided supplemental training, 10 out of the 11 (90.91%) reported four or more of their employers provided such training, while one respondent (9.09%) stated that one employer provided training. Since the role of the WTCS is the training and education of future employees, it does bring to light the question of whether curriculum projects are providing the current knowledge required by the employees and employers if supplemental training is needed. Perhaps a future study is warranted?

Hypothesis. The study rejected the null hypothesis that current curriculum practices do not result in lower quality than an Agile approach. When asked if they thought if Agile methodologies would improve the quality of curriculum, the percentage of responses reporting in the affirmative were 36.96%, while the negatives were 8.7%. There appears to be a willingness to try Agile methodologies and an awareness of possible improvement to quality.

$H3_a$: Current curriculum practices result in lower quality than an Agile approach.

$H3_o$: Current curriculum practices do not result in lower quality than an Agile approach.

Research Question 4 (S_4): Satisfaction. This study revealed that faculty and curriculum development personnel were only somewhat satisfied with the curriculum development process. Respondents were asked to rate their satisfaction level on a Likert scale with the following choices: Dissatisfied, Somewhat Dissatisfied, Neutral, Somewhat Satisfied, and Satisfied. Numeric values were attached from one to five, with one being dissatisfied to five being satisfied. Grading the curriculum process itself at a 3.66 (3.83 for curriculum personnel and 3.48 for faculty) on a five point scale was somewhat telling regarding the satisfaction level of the participants. It was understandable that curriculum personnel are more satisfied with the process than faculty as they were typically responsible for the maintenance of said process to a point. It is interesting that there was not much of a difference. A faculty member's dissatisfaction with a process over which they have little control was understandable, but why would curriculum office personnel be only somewhat satisfied if they oversee the process? Could an argument be made that curriculum personnel actually controlled less of the process than what faculty believe they controlled? Their process may be mandated by the WTCS and their respective institutions. This spoke to a possible lack of ownership of the process and a disconnect between administration and curriculum office personnel over the curriculum process. The data seemed to point to the

desire and need for change, but an inability to change. This inability could have been one of ignorance and not knowing what to change, or one of hindrance where they were not allowed to change. It is quite telling that no faculty respondents rated their satisfaction level as dissatisfied (1 point), but a curriculum office respondent did so. Yes, this could have been considered an outlier. The responses did beg the question of whether curriculum office personnel, and consequently, faculty, were being given the freedom, responsibility (and accountability) to alter the process for efficiencies and satisfaction.

What appeared to be happening, based upon survey results and free text anecdotal evidence, is a rogue process had appeared. In some instances, curriculum development was handled differently in IT instructional areas than other instructional departments from the perspective of the curriculum office personnel. Some faculty members were following a personal continuous improvement process to improve their courses. Other departments were following their own internal processes for curriculum development and hardly ever submitting a request for an official curriculum project. One respondent stated that they were given the ability to update their course competencies and learning objectives anytime they saw the need to do so. The faculty responded that they realize they lost money, due to not being paid for an official project, but the process was so cumbersome for them, that it was not worth the dollars lost.

Another rogue aspect was concerning WIDS. According to participants, it appeared WIDS was being updated as little as possible. Responses indicate it was updated when a project was initialized for the first time and when changes reached a level where it was deemed necessary. It did appear that neither curriculum personnel, nor faculty, appreciated WIDS and both would rather not use it. One respondent stated that the LMS is kept current and changes made frequently to improve the courses, but WIDS was avoided as the “WIDS process and

approvals is a nightmare to deal with." A concern was shared that Agile might hinder the process due to WIDS. The respondent saw it as added to the current process and one more "hoop" to jump through, especially with WIDS involved.

Study data seemed to display a disconnect between the curriculum process and faculty competence with said process. This could also speak to the satisfaction level. To attempt to gain efficiencies, curriculum office personnel have taken on more responsibility for the process itself. What this meant is that faculty were making improvements to their courses, but performing less of the approval process. This resigned the curriculum personnel to the administrative tasks, such as updating WIDS. The issue with this was, while it may have seemed to gain efficiencies, it treated a symptom and not the underlying problem. The process itself was still inefficient. An additional issue could be a disconnect between faculty and curriculum office personnel as they may work less together having separated the processes in the curriculum development "assembly line".

Hypothesis. The study failed to reject the null hypothesis that current curriculum practices do not result in lower satisfaction than an Agile approach. This could have been due to the lack of usage of Agile methodologies (other than within a classroom environment) with the exception of personal faculty usage. It may have been possible that respondents' lack of usage and/or knowledge of Agile did not give them the necessary experience to respond in the affirmative for Agile improving satisfaction. Of the respondents, only faculty answered the question about the usage of Agile outside the classroom. Of the responding faculty, only nine answered the question. Of the nine, only three (33%) responded that Agile was being used outside the classroom. While this sample size was small and from which it was difficult to draw concrete conclusions, it pointed to the lack of Agile usage as a possibility. When asked to grade

their curriculum processes (on a Likert scale of A. B. C. D, and F), the result was a 2.58 and a 2.52 for curriculum personnel and faculty, respectively. Their satisfaction levels (on a Likert scale ranging from 1-low to 5-high) for curriculum personnel and faculty were 3.83 and 3.48. It appeared from the data that quality curriculum was created in spite of the process frustrations reported by the survey participants. Even though the study failed to reject the null hypothesis, with 14 out of 46 (30.43%) reporting yes concerning the question of Agile methodologies improving satisfaction, there seemed to be a willingness to try and a perceived need for improvement to process of curriculum development.

$H4_a$: Current curriculum practices result in lower satisfaction than an Agile approach.

$H4_o$: Current curriculum practices do not result in lower satisfaction than an Agile approach.

Implications for Practice

Agile training needed. With the satisfaction grade being 3.66 on a five-point scale, it seemed that there was a perceived need to change, but did this mean a desire to do so? Overall, 14 of the 47 (30%) responses felt that Agile would improve their level of satisfaction. When asked if Agile would improve quality and cost, the responses were 17 out of 47 (36%) and six out of 47 (13%) respectively. A yes response average across all three categories was 13 out of 47 (26%). What was so telling was the lack of knowledge pertaining to Agile methodologies. Based upon the perceived need to make changes with the affirmative responses to Agile, it would seem that training in Agile methodologies would be pertinent. In the private sector, VersionOne (2017) reported that 94% of the respondents of their survey were practicing Agile. While that is high, the survey results reported that 60% of the responding organizations had less than half of their teams practicing Agile regularly. The majority (80%) stated their organization was still

maturing. It appeared that there was a lot of room for growth in the private sector. What this also pointed out was that the private sector's utilization of Agile was outpacing the WTCS, which means the opportunity for Agile growth in higher education might be greater.

Agile training recommendations. To incorporate Agile methodologies, training of essential personnel would be required. Agile is a continuous improvement project management process. This training would be initial in nature. A plan for continued learning within the organization would be recommended. It is important that any Agile implementation process receive administrative support. Agile brings along culture change and would require administrative level buy-in. In the 11th Annual State of Agile Report (2017), the top three reasons for Agile failure were culture at odds with Agile values (63%), lack of experience with Agile (47%) and lack of management support (45%). Agile training would satisfy the lack of experience issue. The other two top reasons would be satisfied with administrative support. Culture change could be championed by administration. It is a recommendation that at least one top member of administration go through Agile training initially to provide proper knowledge and perspective to the higher levels of the organization.

Agile professional development. Cohn (2010) lists five activities to ensure successful and long-lasting Agile Scrum (the most popular version of Agile) implementations summarized by the acronym ADAPT. Those five items are Awareness that the current processes are not working, Desire to adopt Agile as a solution, Ability to succeed with Agile, Promotion of Agile through sharing experiences, and Transfer of implications of Agile usage throughout the organization.

Successful Agile Implementation. To ensure a successful implementation of Agile, there are specific recommendations. Cohn (2010) recommends running a pilot project. This should be

a project where the participants are trained in Agile and metrics are being gathered. In the scope of this study, 30.43% stated they felt Agile usage would improve satisfaction and 36.96% reported that Agile would improve quality, perhaps a pilot group consisting of IT faculty and curriculum office personnel would be advisable. Communication of results and experiences could be shared. Another way to encourage Scrum adoption is align incentives with the project. These incentives should be team-based to encourage collaboration.

There are two basic approaches to starting Agile adoption. An organization could start small. A small team and project could be selected. This would almost ensure success, probably have easier metrics and be less expensive than an all-in approach. An all-in approach could be used if the organization wishes to transition more quickly, not have conflicts between traditional versus Agile teams and try to reduce resistance (Cohn, 2010).

Organizations can decide how to communicate the transition. An organization could use a stealth approach and communicate successes afterwards. The opposite method would be to announce the transition, which would mean casting a vision of the change. This could force the organization to implement Agile (Cohn, 2010).

Current higher educational Agile recommendations. Pope-Ruark (2017) correlates specific Agile pieces with curriculum development aspects. A Project can equal a program curriculum. An Epic would equal a course. A Story is a course outcome. A Sprint is a time-delimited section of a course wherein students work towards goals and outcomes. Acceptance Criteria can be assessment criteria that prove an outcome has been achieved. A Review can be a deliverable that can assess whether the student has achieved a course outcome. A Retrospective can be a reflection practice by the student and/or faculty on the learning process itself (Pope-

Ruark, 2017). This could be a portion of the professional development required to educate faculty and curriculum personnel on the usage of Agile within curriculum development.

Further correlations can be made within professional development opportunities. In Agile, User Stories follow a specific formula. When developing an application, a team discusses questions about application capabilities and what the end users desire. These discussions lead to functionality within the application. The formula used is: As a user, I need to be able to be able to do something so that I can accomplish some goal. In a curriculum development project, this could be altered to read: As a <type of student>, I want to be able to <know/do something> so that I can <accomplish some goal> after completing this course (Pope-Ruark, 2017).

Agile has a concept known as acceptance criteria for user stories. A product owner accepts the user story as complete when it is deemed to meet the acceptance criteria. This is usually a yes/no answer. As a part of professional development, faculty and curriculum development personnel could learn that in a course, a user story could be a course competency/outcome. Approaching it with acceptance criteria allows the curriculum developer to answer the yes/no question. What assessments would prove that the student meets the user story outcome? This could speak to competency-based education, but that is beyond the scope of this study.

While there were a few pockets advocating and practicing Agile in higher education, there are several options. This study does not reveal a specific alternative. What is important is to look into Agile principles and methodologies as over a third of the study participants were willing to do. The institution can look into each of these Agile processes and develop an Agile curriculum development process that works for them. The important thing is that the process is Agile. In Agile, even the process itself is subject to change at regular iterations.

Institutional process scenario. While many more studies are recommended to confirm this study's findings, an institutional process might be as follows (from a high level):

Cease WIDS usage. The first item that the study revealed was that ceasing WIDS usage should be considered. Since many respondents were not in favor of WIDS usage and it was not being kept current, the value could be questioned. Perhaps it was the structure of WIDS itself that needs to change to allow its incorporation to be easier. In this hypothetical scenario, WIDS was not used.

Organizational structure. A restructuring of responsibilities and accountability for curriculum development should be considered. Responsibility for curriculum might be managed more efficiently at the individual school level instead of the organizational level. This would fall in line with the Agile principle of self-organizing teams with responsibility. Since each department has different curriculum needs, budgetary constraints can be managed by the learning division and each individual dean. Current curriculum office personnel could become instructional designers that partner with each department/individual school to support the curriculum development process. A curriculum development team could be made up of two instructors, an instructional designer, and the dean. One instructor would act as the main developer of the content, while the other could be a secondary developer and peer reviewer. The instructional designer would aid in the process and creation of the course itself. The instructional designer could be acting in the role of Scrum Master. The dean would be in the role of the Product Owner and work with the team periodically to provide direction and guidance. If an institution has departmental heads, they could act in this role. Throughout the entire process, Agile methodologies and principles would be followed to continue to improve the process, maintain budgetary constraints and improve the learning experience.

Compensation structure. The manner in which faculty are compensated for curriculum projects should be addressed so as to not punish faculty and discourage their adoption of a new process. Each organization had their own payment processes. As one respondent stated, "The curriculum office gave us rights to update competencies and learning objectives in our courses any time we see fit. We lose money this way but it is the nature of our industry." A new process should not be punitive to the very individuals who are key to the process itself. Another respondent stated, "I can see it being difficult to come up with a compensation model for curriculum development using a strict Agile approach." The manner in which curriculum development projects are paid to developers is beyond the scope of this study, but should be seriously considered if a switch to Agile processes is decided.

Curriculum Definition. This study revealed that there was no common definition of curriculum. This speaks to the complexity of curriculum development. Agile was created for this situation. Agile excels at managing projects in a complex and unpredictable environment. This would eliminate the need to come to a common definition for curriculum. Each institution could manage their definition of curriculum, in a different fashion. Differences could even exist within an institution.

Recommendations for Future Research

Costs. It is recommended to perform a deeper study on curriculum development costs. This study showed that the knowledge of the true costs associated with curriculum development are both complex and unknown. This left the ability to manage these costs in doubt.

Investigate why employee supplemental training is needed. This study revealed that employers provided training to their newly hired graduates from WTCS institutions. The question remains as to why this training was given. It could be that most employers offer

training as a normal course of onboarding a new hire. Conversely, training could be provided to fill gaps in the new hire's learning. Could this gap be filled by higher education?

Student work during college and curriculum impact. An interesting study would be to examine the number of students in the technical college system who had jobs prior to graduation and how the curriculum impacted their work performance.

Duplicate this study. It is recommended that this study be duplicated within both a similar and different environment. The concern with this study was its limited scope and size. It is possible that a duplicate study might reveal different results. Performing this study in a four-year institution could also yield different results. It is also recommended to study curriculum development in a different discipline. IT changes rapidly, which necessitates utilizing processes that work within a fast-moving context. Perhaps other disciplines would not need different processes due to not needing to accommodate change as quickly.

Cautions

Data usage. Usage of the data revealed in this study is cautioned. The data was limited in size and scope. This study had potential bias and drawbacks. The population only included instructors and curriculum offices within the two-year technical college system in Wisconsin. Some of the results and analysis may not apply in other environments. For example, a four-year, liberal arts institution might experience varying results if the same study were conducted in that environment. Further, this study focused on IT instructors. Other education majors might have differing results. Perhaps other industries and content areas do not move at the same pace as IT. Readers and future researchers should keep this in mind and perhaps use these shortfalls to add to the body of knowledge with their own research.

Another drawback was the lack of knowledge of Agile methodologies. IT faculty knowledge concerning Agile was not assumed. Additionally, most individuals that work in curriculum approval offices did not have Agile knowledge. Perhaps a future study could investigate the knowledge of Agile methodologies and any possible professional development required.

The study was conducted via an emailed Qualtrics survey. The target participants were IT faculty and curriculum office personnel in the WTCS. There was a concern over participation since an online survey is easy to ignore. The results could contain bias and issues due to a low participation rate. A low participation rate could lead to analysis issues.

Also of concern was the purposive sampling of Wisconsin Technical College. Each state has its own organizational structure for their state system schools. In Wisconsin, the technical college system is a separate entity from the four-year University of Wisconsin system. This structure may affect the study in a different manner than a state where the technical college system is combined with the four-year institutions. Subsequent studies are encouraged to perform the same analysis in such an environment. This may lead to differing results. This sample structure may mean that the results and analysis do not apply to other populations.

Agile cure-all. While the study shows a need for some changes and Agile could be the answer, Agile is not a panacea. Even Agile advocates reveal that while Agile is easy to understand, it is difficult to do (Schwaber and Sutherland, 2014). Proponents do state that even poorly done Agile is better than the Waterfall alternative (Rowe, 2013). The point is that even though Agile is achieving broad success, it does come with difficulties and hurdles to overcome.

Concluding Comments

This study revealed that there were issues with the current IT curriculum development process within the two-year WTCS. As the literature suggested, higher educational institutions need to make changes to how they operate to maintain viability and relevance. Agile methodologies could be the possible solution to some of this conundrum. Agile Scrum (or a hybrid) was already being used in 76% of private institutions using some sort of Agile methodologies. They were achieving various levels of success in an ever-changing marketplace. Should public higher education be any different?

Education is in a state of flux. The WTCS is no exception. One respondent reported, "It is the slow approval process at the state that can cause our coursework to lag behind industry needs. We also can barely change a course in a 3-year period." An expansion of educational offerings has taken place in the market for some time. Boot camps are being offered and large organizations are partnering with firms such as Coursera, to offer training for future and current employees. Another respondent stated, "The real roadblock I see in the length of time the development process takes is the time spent waiting for approvals once the WIDS work is complete." With knowledge ubiquity, traditional higher education will have to go beyond standard curriculum development processes to maintain relevancy. Higher education is in a position to offer value but will have to raise the grade level on curriculum development beyond the reported 2.55. Higher educational institutions are not just delivering knowledge, but can deliver experiences to mold the learner to position them for success in the marketplace.

Hurlimann, March and Robins (2013) referenced that curriculum development requires a faculty champion, a curriculum facilitator, a plan to be kept on track while allowing acknowledgement of diverse views, the use of data and continuous improvement. They found

that specific factors hindered curriculum development. The factors were emotions associated with change, budgetary constraints, politics, governance, and cultural issues (Hurlimann, March & Robins, 2013). Any changes to curriculum development processes would be hindered by these. Agile methodologies have ways to specifically address each of these concerns.

It is encouraged that higher educational institutions look to Agile since more than a third of respondents reported they were willing to try Agile methodologies. Professional development would be required and administration would need to be aware of the support needed for Agile implementation, including a willingness to change. The Scrum Alliance, which is a part of the Agile Alliance, puts out a State of Scrum Report. The 2017 State of Scrum Report quotes Tiago Garcez, who is a Scrum coach and trainer, who stated, "Scrum is not difficult to implement. The discipline, commitment, and capabilities required to be good at delivering real value, frequently and often, are hard to master. It takes a lot of work. Teams and organizations suffer from technical and cultural debt. The difficulty is not really Scrum. It's the technical and cultural debt. In these cases, Scrum is doing one of the things it's great at - making a team's problems transparent" (Scrum Alliance, 2017, p.11).

Administrative support is crucial to any change, but especially to one that engages and alters the culture as Agile does. Understandably, administrations have a lot of changes and decisions to manage, but curriculum is a key cog for the students' success. In the State of Scrum Report (2017), executives responded that Agile Scrum brings value by delivering value to their constituency, allows flexibility, and provides quality and transparency (Scrum Alliance, 2017).

In allowing a change such as this, administration might be concerned with maintaining consistency across the organization. This concern of maintaining consistency might be sacrificing innovation. In the State of Scrum Report (2017), Michael Sahota, who is an Agile

leadership educator, stated, “We are educated that consistency is a good thing. It’s not. Diversity is needed for high performance – the right solution for each challenge.” (Scrum Alliance, 2017, p. 30). Per the study results, such innovation was occurring in a stifled fashion. As one survey respondent stated:

> Most of the instructors update their content on a semester-by-semester basis as is, and every so often, we get a curriculum project to update the "official" curriculum. If we had to also update WIDS every time we made a change in the course, I feel that most people would be less likely to actually make changes, as the whole WIDS process and approvals is a nightmare to deal with.

While further study is recommended, this study revealed need for change at some level within the WTCS organizations for the curriculum development process. It is encouraged that an institution look at their processes and culture to examine themselves and if changes are needed to maintain viability in the 21st century. While knowledge is becoming ubiquitous with time, higher educational institutions provide value. The need to re-evaluate the value they provide and the manner in which it provides value as it is necessary for institutional survival.

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Appendix A: Consent Form and Survey

Q1.1

Agile Methodologies in Postsecondary Curriculum Development

Thank you for your willingness to participate in this study.

The following survey is meant to examine the current state of curriculum development in postsecondary technical education. The focus is on cost, quality, and satisfaction. Please fill out the following questions concerning curriculum development processes at your institution.

This survey is anonymous and personal Information will not be collected.

Note: Participation in this study is completely voluntary. You may choose to not participate or stop the survey at any time.

Q1.2 **Informed Consent**

You are invited to participate in a study of Agile Methodologies in Postsecondary Curriculum Development.

This study will investigate the costs, quality and satisfaction of current curriculum practices versus adoption of an Agile approach. You were selected as a possible participant in this study because you are either an IT faculty member or work within the office responsible for curriculum approval at your institution. This research is for a dissertation to complete an Ed.D.

If you decide to participate, I am the only individual who will have access to the data. The data will not contain any personal participant information. The results will be kept in Qualtrics and in a protected folder on Google Drive to which only the researcher has access. The only time that the data will reside outside of these areas is when the researcher is working on the data analysis. When this occurs, the data will be on the researcher's computer. The researcher is the only individual who has access to the computer. No demographic information is collected. The

study is only concerned with your views on curriculum as it pertains to your role at your institution.

Any information obtained in connection with this study that can be identified with you will remain confidential and will not be disclosed. In any written reports or publications, no one will be identified or identifiable and only aggregate data will be presented.

Your decision whether or not to participate or discontinuing participation at any time will not affect your relationships with your institution, the WTCS and/or Bethel University.

This research project has been reviewed and approved in accordance with Bethel's Levels of Review for Research with Humans. If you have any questions about the research and/or research

participants' rights or wish to report a research-related injury, please call Clay Hess (715.803.1731) or his advisor, Dr. Michael Lindstrom (612.209.1739).

You may receive a copy of this form to keep. If you desire a copy, please call Clay Hess (715.803.1731).

You are making a decision whether or not to participate. Your completion of the survey indicates that you have read and agree with the information provided above.

Q1.3 How do you define a curriculum project? (select all that apply)

- ☐ Worldwide Instructional Design System (WIDS)
- ☐ Learning Management System (LMS)
- ☐ Course Competencies
- ☐ Learning Objectives
- ☐ Program Outcomes

Q1.4 Please describe your institutional curriculum process?

_____

Q1.5

Curriculum Development Cost

The following questions concern the cost of curriculum development at your institution.

Q1.6 Do you know the costs involved in curriculum at your institution?

- ○ Yes
- ○ No

Display This Question:

If Do you know the costs involved in curriculum at your institution? = Yes

Q1.7 What is the average cost of a curriculum project at your institution?

_____

Display This Question:

If Do you know the costs involved in curriculum at your institution? = Yes

Q1.8 What items do you include in the costs of a curriculum project at your institution?

- [ ] Faculty salary
- [ ] Faculty benefits
- [ ] Curriculum office staff salary
- [ ] Curriculum office staff benefits
- [ ] Payment for curriculum project only
- [ ] Curriculum modification process costs

Display This Question:

If Do you know the costs involved in curriculum at your institution? = Yes

Q1.9 Please select the current trend of the curriculum development budget at your institution.

- ○ Budget Increasing
- ○ Budget staying the same
- ○ Budget decreasing

Display This Question:

If Do you know the costs involved in curriculum at your institution? = Yes

Q1.10 Is your current curriculum budget sufficient to meet the needs of your constituency?

- ○ Yes
- ○ No
- ○ Unsure

Q1.11

Curriculum Quality

The following questions pertain to the quality of the curriculum at your institution.

Q1.12 What grade would you give the quality of your institution's curriculum process?

- ○ A
- ○ B
- ○ C
- ○ D
- ○ F

Q1.13 Your current institutional curriculum development processes enhance the quality of curriculum.

- ○ Agree
- ○ Disagree

Q1.14 At your institution, how long does it take to complete a curriculum project? (on average)

- ○ 0-6 months
- ○ 6 months - 1 year
- ○ 1-2 years
- ○ 2-3 years
- ○ 3-4 years
- ○ 4-5 years
- ○ 5 years or more

Q1.15 At your institution, how long does it take for a curriculum project to be approved?

- ○ 0-6 months
- ○ 6 months - 1 year
- ○ 1-2 years
- ○ 2-3 years
- ○ 3-4 years
- ○ 4-5 years
- ○ 5 years or more

Q1.16 On average, how long does a curriculum project stay current?

- ○ 0-6 months
- ○ 6 months - 1 year
- ○ 1-2 years
- ○ 2-3 years
- ○ 3-4 years
- ○ 4-5 years
- ○ 5 years or more

Q1.17 Once a curriculum project is complete, how long, on average, until it is revised?

- ○ 0-6 months
- ○ 6 months - 1 year
- ○ 1-2 years
- ○ 2-3 years
- ○ 3-4 years
- ○ 4-5 years
- ○ 5 years or more

Q1.18 How long does it take to implement a topic from advisory board input into the curriculum?

- ○ 0-6 months
- ○ 6 months - 1 year
- ○ 1-2 years
- ○ 2-3 years
- ○ 3-4 years
- ○ 4-5 years
- ○ 5 years or more

Q1.19 How many of your employers provide training to new employees (your graduates) to supplement their knowledge from your institutional program(s)?

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4 or more
- ○ Don't Know

Display This Question:

If How many of your employers provide training to new employees (your graduates) to supplement their... = 1

Or How many of your employers provide training to new employees (your graduates) to supplement their... = 2

Or How many of your employers provide training to new employees (your graduates) to supplement their... = 3

Or How many of your employers provide training to new employees (your graduates) to supplement their... = 4 or more

Q1.20 In what form is the training delivered?

- ○ Self-Paced
- ○ Bootcamp
- ○ In-House Seminar
- ○ Webinar (Lynda, Pluralsight, etc.)
- ○ Mentor

Q1.21

Curriculum Satisfaction

The following section relates to satisfaction with curriculum development.

Q1.22 What 'grade' would you give your current institutional curriculum development processes?

- ○ A
- ○ B
- ○ C
- ○ D
- ○ F

Q1.23 What is your level of satisfaction with your institutional curriculum process?

- ○ Satisfied
- ○ Somewhat Satisfied
- ○ Neither satisfied nor dissatisfied
- ○ Somewhat Dissatisfied
- ○ Dissatisfied

Q1.24

Agile

The questions that follow involve the topic of Agile. For the purposes of this study, Agile is defined as the ability to create and respond to change in order to succeed in an uncertain and turbulent environment. Specifically, Agile refers to the technical term utilized in application development. This term, 'Agile' encompasses subsets such as Scrum and Kanban. Further, this term, 'Agile' derives from the Agile Manifesto.

Q1.25 What is your role in your institution?

(Your response to this question will determine which of the following questions you are shown)

- ○ Faculty
- ○ Curriculum Office

Display This Question:

If What is your role in your institution? (Your response to this question will determine which of t... = Faculty

Q1.26 As a faculty member, how many curriculum projects have you completed in the past three years?

- 1
- 2
- 3
- 4
- 5 or more

Display This Question:

If What is your role in your institution? (Your response to this question will determine which of t... = Faculty

Q1.27 Do you teach Agile methodologies within your coursework?

- Yes
- No

Display This Question:

If Do you teach Agile methodologies within your coursework? = Yes

Q1.28 Do you utilize Agile methodologies in other areas of your institution outside of the classroom?

- ○ Yes
- ○ No

Display This Question:

If Do you utilize Agile methodologies in other areas of your institution outside of the classroom? = Yes

Q1.29 Please describe how you use Agile methodologies?

_____

Display This Question:

If Do you teach Agile methodologies within your coursework? = Yes

Q1.30 How do you define Agile?

_____

Display This Question:

If What is your role in your institution? (Your response to this question will determine which of t... = Curriculum Office

Q1.31 As a curriculum approval office, how many curriculum projects have you completed in the past three years?

- ○ 1-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ 21-25
- ○ 26-30
- ○ 31-35
- ○ 36-40
- ○ 41 or more

Q1.32 Do you feel that implementation of Agile processes into your curriculum development process would improve your level of satisfaction?

- ○ Yes
- ○ Maybe
- ○ No

Q1.33 In your opinion, would utilizing Agile methodologies in the curriculum development process improve curriculum quality?

- ○ Yes
- ○ Maybe
- ○ No

Q1.34 In your opinion, do you believe that utilizing Agile methodologies in curriculum development would lower costs?

- ○ Yes
- ○ Maybe
- ○ No

Q1.35 If you have any comments/feedback you would like to provide, please fill out the comment box below.

_____

Appendix B: Participant Comments

The following comments were left as free form comments from the respondents.

"Interesting survey. Since I am not that familiar with the Agile methodology, etc., I cannot adequately respond to whether using this methodology would truly be helpful or beneficial to our processes."

"Our 152 - IT-Software Program is already doing this. We seldom submit an application for curriculum updates to the curriculum office unless it is a major change in the direction of the course. We modularize all of our competencies and update them as needed. The curriculum process is too clumsy and time consuming to make it worth our time. The curriculum office gave us rights to update competencies and learning objectives in our courses any time we see fit. We lose money this way but it is the nature of our industry."

"You need a "Back" button so I could go back and read the Agile Manifesto again. This is the first time I have learned about the Agile concepts."

"Curriculum development is handled differently in different departments, depending on subject matter changeability, instructor professionalism, changes in outside certification requirements, etc. Personally I follow a philosophy of "continuous improvement" so I am constantly adjusting my in-class labs and projects every semester."

"I'm not really sure how an agile approach would even be utilized in the curriculum process. Most of the instructors update their content on a semester-by-semester basis as is, and every so often, we get a curriculum project to update the "official" curriculum. If we had to also update WIDS every time we made a change in the course, I feel that most people would be less likely to actually make changes, as the whole WIDS process and approvals is a nightmare to deal

with. We would need different software other than WIDS if an agile approach were to work. Given how change-averse our college is, I don't believe this would be likely to happen. Agile would be a "bolt-on" to what we do now, it wouldn't truly be an agile process, and it would likely be a giant disaster with even more steps and checks than happen now, which would actually increase the time it would take to get a project approved, and increase costs."

"My only comment is that the curriculum developers content wise are really not all that well trained on the administrative side with forms and it's been my observation that it is a hindrance to their teaching. Some people just are not good at forms but they are excellent instructors. Strange but true as you probably know."

"I think agile is an interesting concept, but how do we hold it true for our students. Can we be flexible in our requirements so whatever will work for them, will work for us? Rapid prototyping and education seems to be a disconnect, but it is truly what I believe we need."

"In my experience it is the state approval process and restrictions on how often competencies may be changed that make for inflexible curriculum development and updating. The IT division is excellent at proposing new courses and skills requested by our industry advisory board. It is the slow approval process at the state that can cause our coursework to lag behind industry needs. We also can barely change a course in a 3-year period."

"I don't know if Agile is the solution. I am most frustrated with having to update WIDS and the LMS. I don't use WIDS to deliver my course content so when updating curriculum, I

make updates to the LMS. This makes WIDS out-of-date. It is a waste of time and resources to keep them synced."

"I can see it being difficult to come up with a compensation model for curriculum development using a strict Agile approach."

"The idea of agile being utilized in curriculum development is interesting, but my personal opinion is that it would not be necessary if the pursuit is cost savings and/or curriculum quality. My experience in the process is that it is structured in a way where agile wouldn't make a significant difference. The real roadblock I see in the length of time the development process takes is the time spent waiting for approvals once the WIDS work is complete. My normal experience is to wait four weeks or more for my WIDS to be approved by both curriculum department and the administrator. If I pester each party enough, it can be approved in as little as two weeks. This wait pertains to when we first draw up the Course Outcome Summary for approval for Work In Progress and after the content has been created and needs final approval into 'active' status. The length of time given for curriculum to be written is typically a semester (fall, spring, or summer)."

"You have at least one wording error in your items. Some of your forced choices don't allow for more accurate responses."