

Agile Software Development in the Department of Defense Environment

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Abstract

Many Department of Defense (DoD) information technology (IT) programs are plagued by immense bureaucracy, seemingly endless documentation, cost overruns, and poorly defined requirements that cause considerable delays in getting needed capabilities to the field. To facilitate the more efficient and timely delivery of capabilities to the warfighter, the DoD has emphasized finding ways to improve the acquisition of capabilities for the warfighter. One strategy is Agile software development. DoD's interest in Agile prompted policy updates and initiatives such as Better Buying Power that accentuate innovation, speed, and elimination of bureaucratic processes. However, lack of agility is still identified today as a persistent issue. This study examined the DoD acquisition framework to determine the extent to which it facilitates or hinders Agile IT software development. The qualitative investigation included a historical review of literature from industry and government. The review revealed six areas specific to the DoD acquisition process that presented challenges and constraints: acquisition oversight, contracting, cost estimation, information assurance, program cost and performance monitoring, and requirements management. Additionally, culture was highlighted by the Software Engineering Institute and others as a principal barrier to adopting Agile in the DoD. Agile should not be considered a blanket solution for all DoD IT programs. However, as MITRE asserted, it is a viable option for programs able to streamline their organizational structures to accommodate a process that emphasizes smaller, more frequent capability releases.

Chapter 1 – Introduction

Background

Historically, Department of Defense (DoD) programs have not generally been regarded as efficient, streamlined efforts that deliver timely capabilities to the warfighter. Many programs are plagued by immense bureaucracy, seemingly endless documentation, cost overruns, and poorly defined requirements that cause considerable delays in getting needed capabilities to the field. In a Defense Science Board (DSB, 2009) report tasked with examining DoD policies and procedures for information technology (IT) acquisition, DSB Chairman William Schneider, Jr. included a memorandum to the Under Secretary of Defense for Acquisition, Technology, and Logistics. In it, he wrote, “The fundamental problem DoD faces is that the deliberate process through which weapon systems and information technology are acquired does not match the speed at which new IT capabilities are being introduced in today’s information age. Consequently, the principal recommendation of the study is that the Department needs a new acquisition system for information technology” (para. 2).

The DoD is subject to a changing operational environment, budgetary constraints, the rapid evolution of technology that can accelerate obsolescence, and an increasing dependency on software in both weapon and business systems. Due to these circumstances, the DoD has placed additional emphasis on finding ways to improve the acquisition of capabilities for the warfighter. One strategy, which some DoD organizations have successfully implemented, and which has been used in the commercial sector for decades, is Agile software development. Several organizations within DoD have initiated efforts to integrate Agile concepts into the DoD acquisition framework (which is defined here as the laws, regulations, policies, and guidance that govern the acquisition process). For example, in 2012, DoD Chief Information Officer Teri

Takai provided a 10-point information technology modernization plan. Ms. Takai specified Point Four of the plan as enabling Agile IT through active user involvement and more frequent delivery of usable capabilities. DoD Instruction (DoDI) 5000.02 was also updated to include allowances for tailoring acquisition programs to support increased agility in delivering capabilities (DoD, 2017).

What Is Agile? There are many characterizations of the term “agile” within the context of the DoD. For the purposes of this paper, Agile is defined from the perspective of IT software development. Agile (big “A”) is the ability to produce and react to change, enabling success even in an environment of uncertainty and volatility. Agile software development is an overarching term for a set of practices and procedures for developing software. The Agile methodology enables requirements and solutions to evolve through the process of stakeholder collaboration, and it is characterized by functionally diverse, self-organizing teams (Agile Alliance, 2001). Simply put, Agile software development is a means to produce software in a more collaborative manner, in which the stakeholder is engaged throughout the entire development process. This constant communication and level of engagement is meant to ensure that the capabilities being produced are consistent with stakeholder needs, which can be refined over time. Agile also allows higher priority requirements to be addressed first and enables more frequent delivery of useful capability based on stakeholder feedback.

Problem Statement

DoD’s interest in Agile software development prompted updates to some policies and the creation of initiatives that emphasize innovation, speed, and elimination of bureaucratic processes to deliver capabilities more rapidly to the warfighter. Several government organizations and industry partners have conducted studies on the suitability of the Agile

methodology in the DoD environment. Some of the studies provided recommendations and best practices for adopting Agile approaches within the DoD. However, lack of agility in the defense acquisition environment is still identified as a persistent issue. The National Defense Authorization Act (NDAA), which specifies the DoD's budget and authorized expenditures, provides Congress's perspective on acquisition reform: "the conventional acquisition process is not sufficiently agile to support warfighter demands...the current process is so rigid and time-consuming that the Department is often unable to effectively tap into the innovation occurring in the commercial marketplace" (Conference Report to Accompany H.R. 1735, 2015, p. 153 of "Division A—Department of Defense Authorizations").

Agile software development has been recognized within the DoD as a viable means to improve and expedite the delivery of IT capabilities to the warfighter. Nevertheless, conditions may still exist that are impeding further adoption of Agile practices in the DoD environment. This study asserts that the DoD acquisition process is not properly structured for adoption of Agile software development.

Purpose of This Study

This study was intended to explore potential barriers in the DoD IT acquisition environment that may have obstructed greater Agile adoption across the DoD. Specifically, this study investigated current policies, processes, guidance, and governing laws and regulations to determine the extent to which they facilitate or hinder the execution of Agile software development for acquisition information systems. The study considered both government and industry perspectives on the applicability, as well as any challenges, of Agile software development in the DoD environment.

Significance of This Research

Tangible effort has been invested in acquisition reform and implementation of Agile initiatives within DoD. Previous research, such as that conducted by the Software Engineering Institute, has disputed the claim that DoD policy precludes the use of Agile (Lapham, Williams, Hammons, Burton, & Schenker, 2010). In fact, many DoD organizations have successfully implemented Agile processes to execute software development within their programs.

However, despite these efforts, agility is still highlighted as a significant challenge in today's environment. DoD programs are still challenged with delivering timely capabilities. This study synthesized numerous perspectives across government and industry to identify current roadblocks that continue to impede the successful implementation of Agile in the DoD. The ultimate goal of this study is to promote further discussion about the effectiveness of acquisition reform efforts to date and about what can be done to streamline the current DoD acquisition framework to enable greater adoption of Agile methodologies.

Overview of the Research Methodology

The strategy for this study was to perform a qualitative examination of available historical literature from both industry and government sources regarding Agile implementation in the DoD environment. This data was then further dissected to identify commonalities and differences in perspective to find potential focus areas within the acquisition framework that continue to create challenges for DoD adopters. The focus areas provided a solid baseline against which I could perform a comparative analysis with current DoD policy and guidance and examine the extent to which Agile is (or isn't) complementary.

More specifically, this study addresses the following question: does the Agile software development methodology complement the DoD acquisition process?

It is hypothesized that the DoD acquisition process impedes Agile adoption. While noticeable effort has been made in the DoD to implement Agile practices, additional effort must be made to reform the laws, regulations, and policies that guide the acquisition process to enable an Agile approach.

Based on previous studies completed by the GAO and other supporting organizations, I anticipated findings that would reveal complementary aspects of the Agile and DoD frameworks, as well as areas that still require refinement in terms of DoD implementation. My research is intended to highlight potential aspects within the DoD acquisition framework that require modification to eliminate barriers in achieving DoD Agile adoption.

Limitations

The scope of this research was limited to available literature from government sources and industry partners who have adopted Agile IT software development in the DoD environment, or have assessed the practicability of its adoption. This includes technical reports, news articles, and presentations, in addition to applicable DoD laws, regulations, policies, and guidance.

Confining the scope to the context of DoD may have introduced some limitations. For example, it eliminated numerous analyses conducted within the commercial sector on the effectiveness of Agile software development in non-DoD organizations. Given more time, the study could have included a general Agile software development assessment and leveraged findings and best practices from commercial organizations with considerably more Agile experience than DoD.

The primary assumption in conducting this research was that the DoD acquisition process is the main barrier to increased Agile adoption in the DoD. There may, however, be other conditions that hinder proper implementation of Agile software development.

Chapter 2 – Literature Review

This chapter provides a review of DoD laws, regulations, policies, and guidance; and briefings, articles, and technical reports completed by government organizations and industry partners on the adoptability of Agile practices within the DoD environment. The literature review analyzed available documentation and research to identify commonalities, differences, and gaps that may highlight current roadblocks within the DoD acquisition process that impede Agile adoption.

Laws, Regulations, Policy, and Guidance

1. Better Buying Power (BBP) 3.0 (Under Secretary of Defense for Acquisition, Technology, and Logistics, 2015). The BBP initiative originated in 2010 to address several persistent challenges across the DoD. These included lack of affordability, competition, uncontrollable costs, and significant bureaucracy that reduced productivity. Several of the BBP 3.0 focus areas align to the Agile software development methodology, such as achieving affordable programs, increasing innovation, and eliminating unproductive processes and bureaucracy.

2. Department of Defense Directive (DoDD) 5000.01: The Defense Acquisition System (DoD, 2007). DoDD 5000.01 highlights five policies governing the Defense Acquisition System: flexibility, responsiveness, innovation, discipline, and streamlined and effective management. At first glance, these policies seem similar to Agile concepts, which emphasize efficiency and flexibility in adapting and responding to stakeholder needs. However, this directive has not been updated since 2007. Additional analysis was required to determine whether this policy document has kept pace with increased emphasis on agility in the DoD.

3. DoDI 5000.02: Operation of the Defense Acquisition System (DoD, 2017). DoDI 5000.02 describes in detail the processes and procedures that drive the business of the Defense Acquisition System. This version of the instruction encourages milestone decision authorities to tailor regulatory requirements and procedures as needed to achieve programmatic objectives. The instruction incorporates many of the tenets and policies of the collective BBP initiatives (Kobren, 2015), which may better facilitate adoption of Agile software development in the DoD. Several models are provided for software-dominant and software-intensive programs that would benefit from an incremental development approach, similar to the Agile concept.

4. DoDI 8510.01: Risk Management Framework (RMF) for DoD Information Technology (IT) (DoD, 2016). This directive provides an information security framework, including cybersecurity, for the DoD. DoDI 8510.01 replaces the DoD's Certification and Accreditation Process, commonly known as DIACAP. This source was used to evaluate findings identified in other sources regarding the compatibility of the information security framework with Agile practices.

5. Federal Acquisition Regulation (DoD, 2005a). The Federal Acquisition Regulation (FAR) is the governing document for the DoD acquisition process and is used by all federal agencies to acquire services and supplies. One source states that, while the FAR does not explicitly preclude the use of Agile, it may present significant impediments to collaborative methods such as Agile software development (Lapham et al., 2010). The FAR was used to further examine the area of contracting, a category that was consistently highlighted in many of the sources as a potential challenge for Agile adoption.

Government Perspective

6. “Top-Down IT Approach Too Slow to Meet Threats” (Schoeni, 2015). This article was written by an Air Force (USAF) officer serving the Judge Advocate General Corps. Schoeni’s article discussed the challenges associated with cyber warfare and the snail’s pace at which the DoD acquires solutions to combat it. Schoeni declared there is an “arsenal of democracy” (para. 1) combatting the implementation of Agile approaches. This article was selected because it was one of only three sources found addressing cyber and the challenges associated with the acquisition process that constrain the use of Agile concepts. However, while the article highlighted a need to balance speed with security, the premise of this article was not that cyber policy is an inhibitor of Agile. Rather, Agile was suggested as a necessary enabler for securing solutions to cyber threats in a more timely manner. Therefore, although the article supports this study’s hypothesis, it was not further analyzed for inclusion.

7. “Report of the Defense Science Board Task Force on Department of Defense Policies and Procedures for the Acquisition of Information Technology” (DSB, 2009). In this report, the main conclusion provided by the DSB task force was that “the conventional DOD acquisition process is too long and too cumbersome to fit the needs of the many IT systems that require continuous changes and upgrades” (p. vi). The task force provided several recommendations to improve the DoD’s IT approach, including the creation of a new acquisition process specifically for IT. While the report was useful in understanding the constraints and challenges that existed in 2009, its age limited its applicability for today’s environment. For example, a primary recommendation to provide processes to accommodate incremental development approaches was addressed in the 2015 update to DoDI 5000.02. For this reason, this source was not further analyzed for inclusion.

8. “Air Force Puts 22 Companies on \$490M Agile Acquisition Contract” (McCaney, 2015). This article summarized the USAF’s effort to put in place an indefinite-delivery/indefinite-quantity contract, as part of its initiative to inject a greater level of agility in the USAF’s acquisition process. Contracting was highlighted in other sources as a potential barrier to realizing an Agile construct, but this article served to debunk possible myths about aspects of the contracting process that may be perceived as inhibitors. Additionally, the article identified potential lessons learned for other DoD organizations that are struggling with Agile in the context of contracting.

9. “DoD CIO’s 10-Point Plan for IT Modernization” (Takai, 2012). In 2012, DoD Chief Information Officer (CIO) Teri Takai shared a 10-point information technology (IT) modernization plan. Takai provided an overview of the state of the current DoD IT environment as a means to support her assertion that IT modernization is necessary. Some of the areas emphasized included increased demands for technology and the sluggishness of DoD IT programs in delivering capabilities to the warfighter. Point Four of the plan was to enable Agile IT through active user involvement and more frequent delivery of useful capabilities (Takai, 2012). This presentation presented Agile as only one component in a larger effort to streamline current processes, providing other aspects to consider in evaluating whether the DoD acquisition process is the primary obstacle to employing Agile concepts.

10. “Thinking About Agile in DoD” (Welby, 2013). This presentation by the Deputy Assistant Secretary of Defense for Systems Engineering was made at the 2013 summit, Agile for Government, held by the Association for Enterprise Information (AFEI). In the brief, Welby described software acquisition as “some of our toughest systems engineering challenges” (p. 4) for major defense acquisition programs (MDAP). While the basis of his assertion was MDAPs,

the focus of the presentation was software. Welby gave his viewpoint on the challenges posed by software acquisition, which include statutory and regulatory requirements. This perspective is consistent with the hypothesis of this study, and it provided additional insights into other areas of the acquisition process that may obstruct Agile methods. However, Welby's views may prove to be one-sided. The glaring bias in this presentation is that it was developed for the AFEI summit, the theme of which was to promote further adoption of the Agile methodology.

11. “DoD Looks to Agile to Solve Software Conundrum” (Lyngaas, 2015). This article discussed the DoD's efforts to implement Agile software development to enable adaptability to changing requirements and more rapid delivery of capabilities to the warfighter. Lyngaas quoted William LaPlante, the Assistant Secretary of the Air Force for Acquisition, who stated, “There's a lot of promise in agile; I think a lot of us are excited about it. The question is going to be how...to take advantage of it” (para. 2). Similar to Schoeni (2015), it specified challenges with cybersecurity caused by the sluggishness of the traditional acquisition process. However, it did not indicate compatibility issues between cybersecurity and Agile practices. Rather, Agile was seen as an enabler for rapidly securing the necessary tools to counter the cyber threat. While this source presented an interesting hypothesis, it deviates from the focus of this study, and was not investigated further.

12. “Software Development: Effective Practices and Federal Challenges in Applying Agile Methods” (Government Accountability Office [GAO], 2012). This report summarizes the GAO's assessment of Agile software development practices as a means to address many of the challenges facing IT programs. The report identified 14 potential roadblocks within the DoD related to adoption of Agile practices. Essentially, most of the challenges concerned team dynamics (collaboration and self-directed work, level of organizational commitment), customer

buy-in, requirements management, the inflexibility of federal reporting and documentation requirements, and an unclear understanding of Agile within the DoD.

Although the report identified many challenges in adopting Agile, it also provided best practices to implement Agile software development properly in the DoD/federal environment. GAO's report concluded with the recommendation for the Federal CIO Council to include Agile practices in its efforts to promote modular software development. This source supports the null hypothesis that, while the adoption of Agile in the DoD may pose challenges, there are no conditions that specifically preclude its implementation.

13. “DoD Acquisitions Reform: Embracing and Implementing Agile” (Oar et al., 2015). The scope of this white paper was limited to IT acquisition systems, and it asserted that the DoD must overhaul the acquisition process to enable execution of Agile principles. Additionally, the paper examined areas—such as business process re-engineering, training (or lack thereof), and contracting—that inhibit successful Agile implementation. The paper was consistent with this study's hypothesis and was helpful in providing the Air Force's perspective on changes that are needed to achieve success in the acquisition process.

Industry Perspective

MITRE Corporation. MITRE is a private, not-for-profit organization. The corporation operates federally funded research and development centers that provide technical support to many DoD and other government organizations (“MITRE Corporation,” n.d.).

14. “How Agile Development Can Transform Defense IT Acquisition” (Messina, Modigliani, & Chang, 2015). This briefing began with the declaration that “Defense acquisition processes do not match the speed of new IT capabilities” (p. 2). The declaration is similar to this study's hypothesis that the current DoD acquisition process is not flexible enough to enable

proper adoption of Agile software development across the DoD. However, the notable difference is flexibility versus speed. For the purposes of this study, flexibility is considered to be an enabler of speed, among other things (e.g. more frequent delivery of capability, potential reduction of paperwork and reviews, cost savings, etc.). The presentation summarized barriers to Agile adoption that may still exist in the DoD environment. This provided benefit in decomposing all of the sources into specific focus areas for the comparative analysis.

15. “Defense Agile Acquisition Guide: Tailoring DoD IT Acquisition Program Structures and Processes to Rapidly Deliver Capabilities” (Modigliani & Chang, 2014). The purpose of this guide was to demonstrate ways in which the DoD acquisition framework could be modified to take advantage of Agile best practices. The guide’s intent implied that acquisition processes, in their current state, are not complementary to Agile methods. However, tailoring is consistent with policies such as DoDI 5000.02, which explicitly encourages it. Further analysis of this source was conducted to understand what areas would require tailoring for Agile to be successfully implemented. For example, while cultural change could be considered a barrier to Agile adoption, it is not necessarily a function of the acquisition process.

Software Engineering Institute (SEI). SEI has published several articles and technical reports in support of DoD’s efforts to evaluate and implement Agile software development across its various programs. The literature search identified several technical reports related to the Agile software development methodology, most of which were completed on behalf of the USAF.

16. “Agile Methods: Selected DoD Management and Acquisition Concerns” (Lapham et al., 2011). This technical note was a follow-on study to the 2010 Lapham et al. paper, which is discussed below. The note focused on other aspects that could be potential

barriers for Agile implementation, such as managing and contracting for Agile programs, change management, performance measurement, and technical milestone reviews. This information was helpful in identifying patterns or common themes across each of the sources, which were then further analyzed to determine their most recent validity.

17. “Agile Methods in Air Force Sustainment: Status and Outlook” (Regan, Lapham, Wrubel, Beck, & Bandor, 2014). This technical note was completed in consultation with individuals from the USAF, SEI, Boeing, Agile & Lean Education Associates, and others. The note investigated how Agile techniques are applied on USAF programs in the area of software sustainment. The paper did indicate the existence of potential barriers to using Agile methods and examined how those in the USAF sustainment community may have overcome them. However, nothing specific was noted in this source related to DoD acquisition policy that would disqualify the use of Agile for sustainment programs.

18. “Considerations for Using Agile in DoD Acquisition” (Lapham et al., 2010). In this technical note, the authors presented findings based upon observations and interviews with practitioners of the Agile methodology. They analyzed DoDD 5000.01 and an earlier version of DoDI 5000.02 to identify considerations for DoD program offices before embracing Agile. The authors concluded that while the documents support Agile, they also recognize challenges and constraints in its use. For example, the DoD directive identifies challenges in the areas of cost, affordability, and cost realism. According to the technical note, “the policy requires the program to determine the total cost of ownership which seems to be based on knowing all requirements at a detailed level up front. Agile does not necessarily support this concept well because all of the requirements are not known at a detailed level up front” (p. 23).

In addition to DoD acquisition policy, Lapham and her colleagues (2010) examined several other areas to answer the question of why Agile was not used more prevalently in the DoD. Conclusions included lack of Agile expertise within DoD, organizational culture (the DoD has historically used a traditional, waterfall approach for acquiring systems and services), and oversight requirements that are incompatible with Agile (e.g., earned value). Other areas of concern included stakeholder management, integration and testing (traditional DoD approach is not consistent with Agile), and lack of an effective program structure to support Agile implementation. This technical note was helpful in identifying other potential issues that may present greater challenges than the DoD acquisition process.

19. “Contracting for Agile Software Development in the Department of Defense: An Introduction” (Wrubel & Gross, 2015). This technical note discussed DoD contracting in the context of Agile software development and addressed concerns that have been expressed regarding the inflexibility of the contracting process when Agile development is desired. It was intended to assist those in the DoD contracting community, specifically contracting officer representatives, in understanding Agile concepts. This source promoted the use of Agile software development in the DoD and provided insight into how certain contracting processes, policies, or the Federal Acquisition Regulation could support the implementation of Agile methods.

20. “DoD Information Assurance and Agile: Challenges and Recommendations Gathered Through Interviews with Agile Program Managers and DoD Accreditation Reviewers” (Bellomo & Woody, 2012). In this technical note, Bellomo and Woody examined the DoD’s Information Assurance Certification and Accreditation Process in the context of Agile development. They concluded that “while DoD certification and accreditation processes don’t prohibit the use of Agile, use of them does introduce some challenges related to delivering

software features rapidly and/or incrementally” (p. 4). Since this technical note was published, the DoD has transitioned from the DIACAP to the Risk Management Framework (DoD, 2016). Further investigation was conducted to determine whether the challenges postulated in this source are still valid today.

21/ “Potential Use of Agile Methods in Selected DoD Acquisitions: Requirements Development and Management” (Nidiffer, Garcia-Miller, & Carney, 2014). This technical report described a qualitative investigation of the requirements process, including requirements generation and management. Because the report was limited to requirements only, it was not illuminating, but it added detail about how the acquisition requirements process may complement or contradict current processes.

Summary

The selected references offered insight, from differing viewpoints, into the state of the DoD acquisition process, as well as potential areas within the acquisition framework that may provide challenges for Agile adopters. Some of the references were notably older than others, and some presented one-sided views of the use of Agile, having been designed specifically to promote Agile adoption in the DoD. Others provided a broader perspective on the pros and cons of Agile software development. Further examination of all sources revealed common themes used to examine the extent to which Agile is (or isn't) complementary based on current DoD laws, regulations, policy, and guidance.

Chapter 3 – Research Methodology

This chapter defines the research methodology and processes used in the study, in an effort to determine the degree to which the DoD and Agile frameworks are complementary. Specifically, this paper conducts a qualitative assessment of previous research findings to identify commonalities, differences, and gaps, in order to find focus areas to evaluate against current DoD acquisition processes.

Research Hypothesis

For this research project, the null hypothesis is that acquisition processes are not an inhibitor for adoption of agile development. The alternative hypothesis is that the DoD acquisition process impedes Agile adoption. While noticeable effort has been made in the DoD to implement Agile practices, additional effort must be made to reform the laws, regulations, and policies that guide the acquisition process to enable an Agile approach.

Research Design

The approach for this study was to perform a qualitative investigation through a combination of causal-comparative and historical research. Historical information was collected from publicly available resources, retrieved from online data repositories. These sources were further analyzed against current DoD acquisition processes to determine the extent to which Agile is (or isn't) complementary.

The design selected for this study was two-fold. The first phase included a historical review of multiple sources, from varying perspectives, focused on Agile IT software development in the DoD environment. The review revealed similarities and differences, shedding light on potential gaps to explain why Agile adoption is still an issue in today's environment. This information was then be used to develop specific focus areas, establishing a

benchmark for the second phase. Preliminary analysis revealed the following areas, at minimum, that were considered for the second phase: acquisition oversight (including performance measurement, reviews, and documentation), requirements management, and contracting.

The second phase included a comparative analysis of the specified focus areas against applicable DoD laws, regulations, policies, and guidance. The goal of this phase was to determine the degree to which current acquisition processes may hinder Agile adoption within these areas.

The design of this study was limited by the nature of the selected research strategies, which may have introduced some error in the findings. All of the data used was static (i.e., historical) and did not take advantage of the dynamic nature of continued research in this area. Since this study began, government organizations and industry partners continue to assess ways in which the DoD acquisition process can evolve to accommodate further adoption of the Agile methodology. Therefore, the body of knowledge continues to grow, making it impossible to include all perspectives and progress in this analysis. Consequently, it is conceivable that the selected literature did not include one or more of the issues surrounding Agile adoption in today's DoD environment.

Bias and Error

The researcher of this study previously supported a non-ACAT (acquisition category) IT program within the U.S. Army, which has implemented the Agile software development methodology to develop and sustain its collection of IT business solutions. This researcher has no experience with implementing Agile methods for an ACAT program. However, she understands some of the general challenges associated with transitioning from a traditional development approach (e.g., waterfall) to an Agile construct. This transition requires significant

flexibility in areas such as stakeholder collaboration, leadership buy-in of Agile principles, and requirements management. Because of this author's personal experience, biases may have been introduced regarding the benefits of Agile adoption and the perceived level of flexibility of the DoD acquisition process in terms of achieving Agile objectives.

Additionally, because data used in this study was historical in nature, there was no opportunity to interview the authors for clarification, or to advance this author's comprehension of their findings. As a result, assumptions were made regarding the validity of the information, based upon this author's interpretation and personal biases regarding the credibility of those sources.

It is anticipated that this study will provide a reasonable framework for future research. Specifically, the study offers a basis for others to assess DoD's progress with implementing Agile concepts and the extent to which acquisition processes are evolving to accommodate Agile approaches.

Chapter 4 – Findings

The previous chapter described this study's research methodology as a two-pronged approach to investigate the hypothesis that the DoD acquisition process impedes Agile adoption. This chapter presents the results of the investigation. Numerous sources were reviewed that identified both complementary aspects and potential conflicts between Agile IT software development and the DoD acquisition framework. The conflicting areas were then further analyzed to determine the extent to which they may still obstruct wider adoption of Agile practices within the DoD.

Collected Data

A historical review of the sources identified in Chapter 2 revealed similar findings in terms of potential areas within the acquisition framework that may provide challenges for inexperienced DoD adopters. A common deduction found in multiple sources was that a primary barrier to adopting Agile in the DoD may be cultural (Lapham et al., 2010). Other sources pinpointed specific areas, such as contracting, that should be considered while reforming the acquisition process (Wrubel & Gross, 2015). In their technical note, Lapham et al. (2010) presented findings based on interviews with practitioners of the Agile methodology. They also performed an assessment of the DoD 5000 series directives and instructions to provide considerations for program offices before embracing Agile. The authors concluded that the documents support Agile, but also identify challenges and constraints in its use (Lapham et al., 2010).

Multiple areas were emphasized as potential barriers for implementing Agile practices within DoD. While many of these areas fell directly within the realm of the DoD acquisition

framework, some of them did not (e.g., culture). A summary of the identified areas by source appears in Table 1.

It is important to note that the table is not intended to demonstrate whether the sources agree or disagree with one another. Many of the sources were limited to discussing specific areas such as contracting or requirements. Rather, the table's sole purpose is to identify those references that highlighted certain areas as potential obstacles for Agile adoption.

Table 1 – Identified Conflicts Between Agile and DoD

Literature Review Source	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Specific to DoD Acquisition Framework																
Acquisition Oversight							X			X			X			X
Contracting			X	X	X		X	X		X	X			X		X
Cost Estimation					X					X			X			
Information Assurance															X	X
Program Cost & Performance Monitoring					X					X			X			X
Requirements Management					X		X	X	X	X						X
Not Specific to DoD Acquisition Framework																
Culture													X			X
End User Involvement				X	X		X						X			
Infrastructure (establishing / maintaining technical environment)				X			X									
Management Commitment							X						X			X
Team Organization				X	X		X			X			X			
Training / Lack of Guidance				X	X		X	X		X			X	X		X

For the purposes of this study, areas categorized as not specific to the DoD acquisition framework are not discussed further. While the DoD’s culture and organizational construct, for example, may be valid obstacles for Agile adoption, they are not directly attributable to existing acquisition policy, law, or regulation.

Particular findings identified within the other areas are discussed in detail below.

Acquisition Oversight. The DoD acquisition framework is articulated in a series of directives and instructions that mandate a certain level of oversight for acquisition programs. This includes milestone reviews and associated documentation that identify system requirements,

design, and test readiness to inform decisions along the acquisition life cycle. The GAO (2012) published a report pinpointing 14 challenges that DoD programs may encounter when attempting to apply Agile practices. Among them were conflicts between the perceived rigidity of the traditional oversight structure and foundational Agile concepts highlighting the need for flexibility in how efforts are managed and documented. The report noted the difficulty of integrating compliance reviews into the fairly short development iterations inherent in Agile projects. “Compliance reviewers queued requests as they arose and...the reviews could take months to perform. This caused delays for iterations that needed such reviews within the few weeks of the iteration” (GAO, 2012, p. 19).

Furthermore, other sources highlighted documentation challenges when aligning Agile with the traditional oversight construct. Agile documentation is deliberately kept to a minimum, and it evolves over time (updated with each increment), which may not be adequate for milestone reviews such as a critical design review (CDR; Lapham et al., 2010).

As noted in two of the sources, implementation of Agile practices in the sustainment of software systems has proven successful with respect to project execution, cost estimation, and contracting. Sustainment programs are not subject to the design and requirements volatility of development programs. Also, contracting vehicles are often service based, facilitating a more accurate estimation of required support resources (Lapham et al., 2011). As Lapham and her colleagues (2011) noted, “the biggest difference in sustainment is that an architecture for the system has been defined and implemented” (p. 64).

Analysis. DoDD 5000.01 (DoD, 2007) highlights five policies governing the Defense Acquisition System: flexibility, responsiveness, innovation, discipline, and streamlined and effective management. The first three are integral characteristics of the Agile methodology

(Lapham et al., 2010). Regarding flexibility and streamlined management, the directive encourages program managers (PMs) and milestone decisions authorities (MDAs) to tailor documentation and oversight requirements as appropriate, subject to applicable regulations and laws. In its emphasis on the importance of flexibility, the directive affirms that “there is no one best way to structure an acquisition program to accomplish the objective of the Defense Acquisition System. MDAs and PMs shall tailor program strategies and oversight, including documentation of program information...to fit the particular conditions of that program...” (DoD, 2007, p. 3).

DoDD 5000.01 (DoD, 2007) also promotes incremental development to facilitate greater responsiveness in delivering capabilities. Incremental development is compatible with the iterative nature of Agile IT software development. And while documentation does evolve incrementally in Agile development, proper planning can be done beforehand to ensure that documentation completion and delivery schedules are sufficient to meet CDR and other milestone review requirements (Lapham et al., 2010).

DoDI 5000.02 (DoD, 2017) includes acquisition program models specifically designed for software-intensive programs. Model 3 accommodates the iterative development nature of many software programs, whereby capabilities are delivered incrementally. “Each deployment will result from a specific build and provide the user with a mature and tested sub-element of the overall incremental capability. Several builds and deployments will typically be necessary to satisfy approved requirements for an increment of capability” (p. 13). The instruction states the importance of properly structuring these types of programs so they are not “overwhelmed with frequent milestone or deployment decision points and associated approval reviews...multiple

activities or build phases may be approved at any given milestone or decision point, subject to adequate planning, well-defined exit criteria, and demonstrated progress” (p. 14).

DoDI 5000.02 (DoD, 2017) also encourages the tailoring of milestone documentation as appropriate. Explicitly, “documents prepared in support of the decision process (e.g., Acquisition Strategy, Systems Engineering Plan (SEP), Test and Evaluation Master Plan (TEMP), Life-Cycle Sustainment Plan (LCSP)) should generally not be prepared solely for staff review and approval, but be intended primarily for use within the program as planning and management tools that are highly specific to the program and tailored to meet program needs” (p. 4).

Contracting. Several sources noted challenges specifically in the area of contracting. These included staffing and monitoring contractor performance (GAO, 2012), developing requests for proposal (RFPs; Lapham et al., 2010), and a common perception within the DoD that the contracting process is fundamentally inflexible. The GAO (2012) noted that federal procurement practices do not enable the level of flexibility required to ramp up resources when needed for Agile projects. Challenges are incurred when “changing contractor staff in time to meet iteration time frames and that accommodating task changes from one iteration to the next is challenging because contracting officers require cumbersome traditional structured tasks and performance checks” (p. 18).

With respect to RFP development, traditional proposals customarily require a series of contract data requirements lists (CDRLs), which document contractor progress/performance (Lapham et al., 2010). Lapham and her colleagues asserted that “this level of documentation is contrary to Agile precepts of creating ‘just enough’ documentation” (p. 13). The authors rationalized that it is feasible to develop a more streamlined set of deliverables, while still complying with regulatory requirements, with the proper amount of coordination and

collaboration between the contractor and government. However, they also noted that “the Federal Acquisition Regulations (FARs) impose significant obstacles to collaborative endeavors. In fact, since the system tries to encourage competition...in many cases users are actually prevented from collaborating with system developers until late in the acquisition life cycle” (p. 27).

In a MITRE report, Modigliani and Chang (2014) asserted that “the current contracting environment does not encourage Agile approaches” (p. 33), and identified specific areas in which traditional contracting practices and Agile do not align. The areas included long contracting timelines, emphasis on technical solution versus technical capability, the fact that requirements are essentially locked in at award (requiring contract modifications if changes are needed). Also highlighted were a less collaborative contractor-government relationship and centralized (versus embedded) contracting support that cannot respond rapidly to needed contracting actions. While the authors underscored challenges, they also offered potential solutions such as establishing contract vehicles at the enterprise level, instead of at the program level, in order to reduce contracting timelines. “Contract vehicles suitable for Agile development have pre-established contract pricing, terms and conditions, and pre-vetted qualified vendor(s). This allows task orders to be issued in a matter of weeks versus months” (p. 36).

In contrary to the challenges, other sources highlighted successful contract implementations supporting Agile software development and offered best practices/lessons learned in the areas of contract strategy selection and oversight. One source posited that the difficulties incurred when implementing Agile contracting practices in the DoD are predominantly caused by lack of awareness/training (Wrubel & Gross, 2015). Because Agile is intrinsically different from traditional software development, contracting officers who lack Agile experience and training may have difficulty adjusting to new methods (Oar et al., 2015).

Wrubel and Gross (2015) also pointed to a lack of Agile-related education opportunities in the DoD for contracting officers. Additionally, the authors determined that “future work is needed to collect more examples and approaches for effective contracts. This information can help form a body of practice for government organizations to approach software development work, using the Agile values and principles” (p. 44).

Analysis. Collaboration and flexibility are key components of Agile (Lapham et al., 2010), which are both emphasized in DoDD 5000.01 (DoD, 2007). According to the directive, MDAs and PMs are permitted to tailor program documentation as needed and within the bounds of relevant laws and regulations. It is plausible to assume that CDRLs fall within this category.

Collaboration and innovation are encouraged in the FAR (DoD, 2005a), the guiding document for contracting goods and services in the DoD acquisition environment. Subpart 1.1 defines an empowered acquisition team permitted to determine the most suitable approaches for managing their contracts, subject to limitations of the FAR and other applicable laws, regulations, and policies. The FAR further states that “if a policy or procedure, or a particular strategy or practice, is in the best interest of the Government and is not specifically addressed in the FAR, nor prohibited by law (statute or case law), Executive order or other regulation, Government members of the Team should not assume it is prohibited. Rather, absence of direction should be interpreted as permitting the Team to innovate and use sound business judgment that is otherwise consistent with law and within the limits of their authority” (p. 1.1-2).

Cost Estimation. Cost estimation occurs throughout the entire life of DoD programs, including generating a life-cycle cost estimate prior to Milestones A and B (Lapham et al., 2010). “The program life cycle cost estimate (PLCCE)...is presented to the program’s Milestone Decision Authority (MDA) at each milestone. The PLCCE must look forward from the current

program state to the end of the system’s life, and assess the cost of the product or system over its entire life” (p. 47).

According to an SEI technical report, DoDD 5000.01 requires that programs provide total ownership costs up front (Lapham et al., 2010), which presumes that requirements are well defined at the start of a program. Additionally, the Program Stability policy in DoDD 5000.01 (DoD, 2007) states that programs are generally not fully funded until the system design has been chosen. Because of the evolving nature of both the requirements and design in an Agile context, realistically estimating life cycle costs may prove challenging.

Moreover, some would argue that because the design changes over time, Agile does not support the Program Stability policy (Lapham et al., 2010). As a workaround to the design challenge, the authors offered that Agile does support an overall architectural framework that may enable policy compliance. However, this approach would need to be coordinated with the MDA, who is the ultimate decision authority.

The GAO (2012) noted that “traditional oversight requires detailed artifacts in the beginning of a project, such as cost estimates...requiring these artifacts so early was challenging because it was more worthwhile to start with a high-level cost estimate and vision to be updated as the solution was refined through iterations, rather than spending time estimating costs and strategies that may change” (p. 20).

MITRE’s analysis determined that “estimating costs in an Agile environment requires a more iterative, integrated, and collaborative approach than in traditional acquisition programs. While a program can develop rough order of magnitude estimates in the beginning, it cannot gain an understanding of costs and schedule with any true fidelity until the development teams are in a rhythm” (Modigliani & Chang, 2014, p. 41).

Analysis. DoDD 5000.01 (DoD, 2007) defines several policies related to cost affordability and realism that may not entirely align to the Agile framework. The Program Stability policy states that “DoD Components shall develop realistic program schedules, long-range investment plans, and affordability assessments, and shall strive to ensure stable program funding. The MDA shall determine the appropriate point at which to fully fund an acquisition program, generally when a system concept and design have been selected...capability needs have been approved, and system-level development is ready to begin” (p. 9). In an Agile context, the policy may be supportable, depending on the type of system, the level of detail needed to support a decision, and the position of the MDA (Lapham et al., 2010).

The Cost and Affordability Policy in DoDD 5000.01 (DoD, 2007) discusses cost as an independent variable and fiscal constraints. “To the greatest extent possible, the MDAs shall identify the total costs of ownership, and at a minimum, the major drivers of total ownership costs. The user shall address affordability in establishing capability needs” (p. 5). The challenges of this policy are not necessarily unique to Agile efforts, as many traditionally structured programs face affordability challenges. However, not having fully defined requirements up front is arguably a disadvantage. The constantly evolving requirements mean that cost estimates are also continually refined over time, which introduces a degree of instability in terms of managing cost and affordability.

Information Assurance. Information assurance (IA) is defined broadly as “the technical and managerial measures designed to ensure the confidentiality, possession or control, integrity, authenticity, availability and utility of information and information systems” (“Information Assurance,” n.d.). Cybersecurity is considered a subset of IA, and is defined in DoDI 8510.01 (DoD, 2016) as the “prevention of damage to, protection of, and restoration of computers,

electronic communications systems, electronic communications services, wire communication, and electronic communication, including information contained therein, to ensure its availability, integrity, authentication, confidentiality, and nonrepudiation” (p. 47).

Several sources emphasized the sluggishness of the DoD acquisition process as a primary challenge in delivering capabilities when needed. Specific areas noted were acquisition oversight, contracting, and the IA certification and accreditation process. Regarding IA, software continues to be an integral part of the DoD capability portfolio. As such, the pace of the acquisition process may not be able to keep up with the speed at which new information-security threats emerge (Modigliani & Chang, 2014).

In their assessment of the DIACAP against the Agile framework, Bellomo and Woody (2012) noted that while nothing within the IA process technically precludes incremental software development, “there are aspects of DIACAP that make incremental delivery of security requirements challenging” (p. 5). According to their SEI report, a source of this challenge is the IA review process. For example, while DIACAP does allow for iterative development, the series of review/approval gates inherent in the accreditation process are suited for a traditional project/program life cycle (i.e., waterfall). In the traditional model, security requirements are not evaluated until development is complete.

Bellomo and Woody (2012) also described a general perspective that “the information assurance accreditation delay is so extensive (often months to a year) that the DIACAP process almost negates the benefits gained through rapid development methods” (p. 5). Those who were interviewed for their study identified the following challenges associated with DIACAP:

- The lengthy accreditation testing phase causes delays in releasing capability.
- Security requirements must be prioritized differently due to risk.

- There is a lack of security engineering expertise in the DoD.
- The intent/purpose of many of the IA controls is not well understood.
- The reaccreditation process for iterative releases is unclear and confusing.
- Use of test case-driven verification approaches for IA validation is limited.
- Documentation requirements exceed what the Agile process normally produces (e.g., architecture views, security design documentation).
- Collaboration with accrediting authorities can be challenging.
- There is no incentive to develop security features in early Agile increments.
- DIACAP includes traditional milestone review artifacts that don't align to Agile.
- The joint services accreditation process is challenging

In addition to identifying challenges associated with DIACAP, Bellomo and Woody (2012) summarized recommendations to mitigate potential delays and address the foregoing issues. This included defining reaccreditation criteria up front and early, greater collaboration/coordination between the IA and Agile communities, and integrating security and Agile best practices.

Analysis. The 2017 update of DoDI 5000.02 includes an enclosure dedicated to cybersecurity. The new enclosure communicates the importance of incorporating cybersecurity across the entire life cycle of acquisition programs (DoD, 2017). The instruction also focuses on cybersecurity test and evaluation and on ensuring a strategy is fully addressed in the Test and Evaluation Master Plan. As a means to mitigate cybersecurity risks, the instruction provides guidance on designing for the cyber threat environment. Among others, PMs are directed to “ensure cybersecurity and related system security requirements, design characteristics, and verification methods to demonstrate the achievement of those requirements are included in the

technical baseline and maintain bi-directional traceability among requirements throughout the system life cycle” (p. 174). As mentioned earlier, some Agile projects do not incorporate security features until later iterations. However, this can most likely be adjusted to accommodate DoD guidance.

The RMF (DoDI 8510.01) mandates that the DoD “establish and use an integrated enterprise-wide decision structure for cybersecurity risk management” (DoD, 2016, p. 2) and comply with the governance process defined within the instruction. While it is fairly prescriptive in defining the required security controls, documentation, and reviews, it does make allowances for tailoring in some cases. For example, DoD organizations are allowed to tailor the set of security controls as appropriate when developing RFPs for IT services (DoD, 2016). This researcher could find nothing in this DoD instruction, or the other sources mentioned above, that would specifically disqualify the use of Agile IT software development.

Program Cost and Performance Monitoring. For the purposes of this study, program cost and performance monitoring include the mechanisms used by program offices to monitor contractor performance in executing the technical requirements of its contract. Specifically, programs use integrated master schedules (IMS) and contractor earned value management (EVM) systems to monitor progress. ACAT programs leverage EVM data to assess contractor performance against the contractor’s cost estimate (Lapham et al., 2011). The IMS is an integrated schedule consisting of all of the work activities (tasks, events, and accomplishments) used to manage an acquisition program on a daily basis (DoD, 2005b).

The dynamic nature of the Agile requirements and design processes requires a shift from the customary IMS construct. Schedules developed for non-Agile (waterfall) projects include detailed and relatively fixed work breakdown structures based upon specific phases and project

deliverables (e.g., requirements, design, development, test, etc.). In Agile projects, requirements constantly evolve, as can the scope of each iteration. This level of fluidity can complicate a program's ability to track performance via traditional EVM and to maintain an accurate IMS (Lapham et al., 2010).

The GAO (2012) underscored a misalignment between traditional contractor status tracking and Agile practices. While the challenge associated with project status tracking was due to lack of experience, use of EVM was hampered by lack of guidance for projects of an iterative nature. One DoD official communicated that "changes were viewed as control problems rather than as revisions to be expected during an iteration" (p. 20).

In their assessment on the value of EVM in the Agile context, Modigliani and Chang (2014) concluded that "given the dynamic and iterative structure and processes of Agile, implementing an EVM system can pose a significant challenge with little value" (p. 48).

In SEI's technical note, the authors declared that EVM can be adapted for use on Agile programs. However, the process would require a significant amount of coordination between the government and contractor teams, and it could be labor intensive (Lapham et al., 2010).

Analysis. DoDI 5000.02 (DoD, 2017) provides guidelines regarding EVM applicability for programs. EVM applicability is determined by contract type, duration, and value. It is required for programs with a contract value greater than \$20 million, and applies "to cost reimbursable or incentive contracts, inclusive of options, with 18 months or greater period of performance and based on the nature of the work scope" (p. 79). According to the instruction, EVM is considered "one of DoD's and industry's most powerful program planning and management tools...normally used in conjunction with cost plus and fixed-price incentive contracts with discrete work scope" (p. 89).

Based on this guidance, not all contracts/programs are required to use EVM. For example, EVM does not apply to services contracts. “Services contracts are commonly used in the commercial sector for Agile development because of its flexibility, although they are not typically preferred in the DoD environment because the contractor is not necessarily incentivized to control costs” (Modigliani & Chang, 2014, p. 38). In addition, not all contract vehicles are suitable for Agile development programs. Modigliani and Chang (2014) noted that “the Agile development process is characterized by constant change and reprioritization of requirements. This makes it impractical to select an Agile development contractor using a contract type that locks-in requirements up front and defines end-state products on a completion-basis” (p. 35). The viability of EVM for Agile programs will depend on securing a suitable contract type that accommodates an Agile approach.

Requirements Management. The fluctuating nature of the requirements in an Agile framework has been discussed in many sections of this research paper. As such, it can be considered a broad area that affects other areas such as culture, contracting, and acquisition oversight. Not only can new requirements be identified as efforts progress, but requirements can move from one iteration to the next, or be deferred to subsequent increments/releases. This level of volatility can create challenges in managing these requirements.

SEI summarized the most significant issues identified in their investigation of implementing an Agile requirements methodology in the DoD: lack of “accepted DoD-level guidance for tracking progress, translating potential Agile measures of progress to earned value measures, a risk-averse acquisition culture, work breakdown structure as a tool to manage task assignments, effect of requirements change on contracts, and perception that reduced documentation is a cause for concern” (Nidiffer et al., 2014, p. 18).

The GAO (2012) identified requirements management as one of 14 challenges in implementing Agile in the DoD. “Teams had difficulty managing iterative requirements...one official reported that customers were initially challenged to validate and prioritize which requirements would be assigned to a release...The second official said they were challenged to accommodate new requirements within the fixed schedule for a product release” (GAO, 2012, p. 19).

Some sources emphasized the shortcomings of the acquisition process in accommodating requirements changes. Any changes may trigger “a very rigorous engineering change proposal process. The sheer amount of documentation required in this process causes schedule delays and is accompanied by a hefty price tag” (Oar et al., 2015, p. 3).

One advantage of the level of requirements flexibility inherent in Agile efforts is that capabilities are allowed to evolve based on user needs. Welby (2013) compared traditional and incremental planning processes for software development. The incremental planning approach in Agile efforts allows plans to “adapt to changes without causing rework, waste, and development cost growth” (slide 10).

A MITRE report described the concept of the IT Box model for information systems. This model is part of the Joint Capabilities Integration & Development System (JCIDS) process and is included in the JCIDS Manual published by the Joint Requirement Oversight Council. JCIDS implements the DoD requirements process, and “supports the Chairman of the Joint Chiefs of Staff (CJCS) and the Joint Requirements Oversight Council (JROC) in identifying, assessing, and prioritizing joint military capability needs as required by law” (“Joint Capabilities,” n.d.). The IT Box Model serves as a distinct advantage for IS programs: an Initial Capabilities Document (ICD) replaces the requirement for both a Capability Development

Document (CDD) and Capability Production Document (CPD). The benefit of the ICD is that it reduces the documentation requirement and complements the evolving nature of the requirements in Agile projects. “In lieu of CDDs and CPDs, programs can develop Requirements Definition Packages (RDPs) to capture a subset of the IS ICD scope...the requirements documents are designed for a smaller scope of work and approval at a lower level. This flexibility and streamlining of IT requirements enables Agile development within a DoD program” (Modigliani & Chang, 2014, p. 21).

Analysis. Based on the results of the historical review, some of the challenges identified are not necessarily attributable to constraints imposed by DoD acquisition law, regulation, or policy. For example, the issue of managing and prioritizing requirements, identified by the GAO, appears to be more a function of training and collaboration than DoD policy.

While programs are required to comply with DoD guidance, JCIDS appears to provide a reasonable amount of flexibility for information system programs that permit a more efficient approach to requirements management. “As long as the program operates within these four sides of the IT Box, they need not return to the JROC for approval or oversight” (Modigliani & Chang, 2014, p. 21).

Summary

The historical review revealed six areas specific to the DoD acquisition framework that were highlighted in at least one source as potential constraints to implementing Agile practices in the DoD environment:

- Acquisition oversight
- Contracting
- Cost estimation

- IA
- Program cost and performance monitoring
- Requirements management

These areas were then evaluated against available DoD policies, regulations, and laws to identify any conditions that would inhibit the successful propagation of Agile concepts in the DoD.

From an acquisition oversight perspective, the DoD 5000 series directives and instructions encourage MDAs and PMs to tailor program oversight and documentation as appropriate, in compliance with applicable law and policy. DoDD 5000.01 (2007) also promotes incremental development to facilitate greater responsiveness in delivering capabilities. Incremental development is compatible with the iterative nature of Agile IT software development.

The contracting process was heavily emphasized as posing significant challenges. Agile programs are susceptible to lengthy contracting timelines, and the administrative burdens of contract modifications for any changes to the requirements.

Based on the available data found within the sources, cost estimation and realism early in a program appeared to be a valid concern. DoD policy requires that life-cycle cost be estimated up front, and the Program Stability Policy states that programs are generally not fully funded until the system design has been chosen. These conditions can prove challenging for Agile projects, which are subject to requirements and design volatility.

Information assurance is a broad area in which policy and guidance continue to be established, particularly in the area of cybersecurity. Agile was described in some of the sources as a means to mitigate cyber threats by expediting the delivery of capabilities. Numerous

challenges were identified with the DIACAP process specifically, such as the lengthy accreditation timeline, unclear reaccreditation guidance for incremental capability releases, and lack of collaboration between with Agile and IA teams. However, The RMF (DoDI 8510.01) does not explicitly disqualify the use of Agile in the DoD.

Programs regularly use integrated master schedules and EVM (depending on contract type, size, and duration) to monitor contractor performance. Because requirements are subject to a significant amount of fluidity in Agile projects, programs may be challenged in maintaining an accurate IMS, or using traditional EVM to track performance. While not all programs are required to use EVM, it can be adapted for use on Agile programs. However, the process would need a significant amount of coordination between the government and contractor teams, and it could be labor intensive (Lapham et al., 2010).

The Agile methodology makes allowances for changes in requirements throughout a project's life cycle. One benefit of this level of requirements fluctuation is that capabilities are allowed to evolve based on user needs. However, the changes introduce difficulties with managing iterative requirements and prioritization by end users, and they may trigger contract modifications that are labor and time intensive. While some of the challenges associated with requirements management can be attributed to the relatively slow pace of the acquisition and contracting processes, some are related to other areas such as culture, end user involvement, and training.

A common conclusion found in multiple sources was that a primary barrier to adopting Agile in the DoD may be cultural (Lapham et al., 2010). Agile is not a blanket solution for all DoD IT programs. However, it is a viable option for programs that are able to shift the structures

within their programs to accommodate a more streamlined process that emphasizes smaller, more frequent, capability releases (Modigliani & Chang, 2014).

Chapter 5 – Interpretation

The intent of this study was to examine the extent to which the DoD IT acquisition framework impedes greater adoption of Agile IT software development across the DoD. Historical sources were evaluated against current DoD policies, processes, laws, and guidance to identify potential obstacles in implementing Agile practices. The alternative hypothesis is that the DoD acquisition framework impedes Agile. Based on the findings presented in the previous chapter, from this author's perspective, the original hypothesis has been invalidated. This chapter presents interpretations constructed from the historical review and comparative analysis, and provides recommendations for possible future research into Agile IT software development in the DoD environment.

Conclusions

The problem statement defined in this study was that, while efforts such as acquisition reform and BBP have emphasized the need for speed and flexibility within the DoD, lack of agility in the defense acquisition environment is still identified today as a persistent issue. The rigid and laborious nature of the DoD acquisition process was noted in the NDAA (2015) as a key impediment to delivering timely capabilities in the DoD environment. This study aimed to reveal enduring conditions in the DoD environment that continue to impede further Agile adoption. Specifically, this study addressed the following question: does the Agile software development methodology complement the DoD acquisition process?

The investigation revealed that the primary obstacle to increased adoption of Agile practices in the DoD is not fundamentally policy or process related, nor unbendingly restricted by law or regulation. The DoD 5000 series directives and instructions actually encourage flexibility in tailoring program oversight and documentation requirements to reduce

administrative bureaucracy. In reality, the principal limitation identified in multiple sources was largely cultural. Like many sources, Modigliani and Chang (2014) identified cultural change as a critical component in successfully moving the DoD into greater adoption of Agile. The authors supported Agile as a means to improve capability delivery and provided insight into ways that the DoD acquisition framework could be tailored to accommodate effective Agile implementation. The report also offered detailed recommendations for adopting Agile for specific acquisition functional domains, including requirements, systems engineering, contracting, cost estimation, metrics, testing, and deployment/sustainment. In summary, the authors postulated that while Agile is not the panacea for all DoD IT programs, it is a feasible alternative for programs that are able to embrace Agile practices to enable a streamlined development approach.

While the DoD acquisition framework does not prevent the implementation of the Agile software development methodology, many factors may present challenges in doing so effectively. However, based on the findings presented in several sources, these challenges can be mitigated if those who are implementing Agile practices can plan ahead and adjust accordingly (Modigliani & Chang, 2014).

Acquisition Oversight. From an acquisition oversight perspective, nothing was noted within the DoD 5000 series directives and instructions that explicitly restricts the use of Agile IT software development. In fact, tailoring of oversight and documentation is encouraged (DoD, 2007). Acquisition program models were developed specifically to accommodate incrementally structured, software-intensive programs (DoD, 2017). Flexibility, responsiveness, and innovation are all policies highlighted in DoDD 5000.01 (DoD, 2007) and are considered to be essential characteristics of the Agile methodology (Lapham et al., 2010).

The root of the concerns identified in the literature review may simply be an issue of misinterpretation or limited awareness. Lack of communication between the MDAs and PMs regarding the degree of tailoring that is allowable for each program may be a prime source of misinterpretation. Additionally, program offices may not possess the necessary knowledge and training to properly streamline individual programs and implement Agile practices, while still complying with applicable laws and policies.

Contracting. The contracting process can be prohibitive in terms of required documentation (i.e., CDRLs; Lapham et al., 2010), collaboration challenges between the contractor and government (Modigliani & Chang, 2014), lengthy contracting timelines, and the administrative burdens of contract modifications for any changes to the requirements. This can negatively impact a program's ability to ramp up on resources, or quickly respond to requirements changes when needed (GAO, 2012).

The FAR is certainly a complex and lengthy document. This author does not disagree with the assertion by some sources that the contracting process could benefit from reform. However, the FAR empowers the government to collaborate, innovate, and use sound judgment to determine the most suitable approaches for managing their contracts, consistent with applicable laws, regulations, and policies (DoD, 2005a).

The fundamental issue in the contracting area is two-fold. First, there appears to be a lack of Agile knowledge and training opportunities in the contracting community (Wrubel & Gross, 2015). Second, there seems to be a lack of awareness of existing guidance and best practices related to executing contracts suitable for Agile development. Workarounds can be leveraged to reduce timelines, such as selecting the right contract vehicle to expedite task order delivery, and establishing contract vehicles at the enterprise level (Modigliani & Chang, 2014). However,

those in the contracting community must be properly educated on Agile concepts and best practices, and work collaboratively with programs to enable an Agile approach.

Cost Estimation. Based on the historical review and comparison to existing DoD policy and guidance, cost estimation and realism early in a program is a valid constraint/challenge. DoDD 5000.01 provides challenges in terms of requiring life-cycle cost estimates up front. The Program Stability Policy (DoD, 2007) requires a determination of the system design before a program is fully funded. These conditions do not necessarily align with the evolving nature of requirements/design in an Agile context, as noted in SEI's technical report (Lapham et al., 2010).

This obstacle can be overcome if programs properly coordinate with the approving authority (MDA) to provide an alternative solution that still meets the requirement. For example, to address the Program Stability Policy, Lapham et al. (2010) noted that Agile can accommodate an overall architectural framework to a final system design up front. Additionally, high-level cost estimates can be provided early, with the understanding that these estimates will be refined over time as a solution is iteratively developed (GAO, 2012).

Information Assurance. IA is a broad area in which policy and guidance continue to be established. DoDI 5000.02 only recently added provisions for cybersecurity. Several sources identified the cumbersome and time-intensive nature of the DoD acquisition process as a roadblock for countering cyber threats (Modigliani & Chang, 2014). Agile IT software development was identified as a potential means to mitigate cyber threats by expediting the delivery of capabilities. On the other hand, expediting software development could potentially introduce defects that leave capabilities vulnerable to attacks (Schoeni, 2015). IA and cybersecurity are areas that should be explored further to identify potential benefits and threats.

Program Cost and Performance Monitoring. Requirements fluidity is inherent in Agile development projects, introducing complications in maintaining an accurate IMS. (Lapham et al., 2010). Additionally, EVM is not applicable for all contracts (depends on type and value), but can present challenges for Agile development programs that are required to use it. Based on the findings gathered from the historical review, many of the challenges from EVM and IMS accuracy are not insurmountable (Lapham et al., 2010). However, EVM challenges are not unique to Agile programs. This author speculates that EVM policy and guidance should be re-evaluated for all DoD programs for clarity and from a value-proposition perspective.

Requirements Management. As mentioned previously, a key difference between Agile development and traditional development is the nature by which requirements are defined. In a traditional development effort, requirements are defined and essentially locked in up front. In an Agile context, requirements are allowed to evolve over the course of the project life cycle and as a result of close collaboration with stakeholders. While requirements fluidity can create challenges in terms of contract changes, performance monitoring, schedule, and other areas identified in Chapter 4, there are also benefits to an iterative requirements process. This allows plans to adapt based on user need and without creating rework (Welby, 2013).

Based on the findings, the DoD acquisition framework does not restrict the use of an iterative requirements approach inherent in the Agile methodology. There are workarounds to mitigate challenges associated with changing requirements, such as a contract strategy that accommodates this condition (see previous section on contracting). The DoD 5000 series directives and instructions encourage incremental development and provide a framework for software-intensive programs. The JCIDS model and IT Box Model also accommodate an iterative approach. The ICD reduces the documentation requirement, which can be broken down

into a series of requirements definition packages to capture smaller, more discrete scopes of work (Modigliani & Chang, 2014, p. 21).

Recommendations

The DoD should place greater emphasis on providing the necessary education, training, and guidance to members of the DoD community involved in enabling, executing, and overseeing Agile development initiatives.

This author also recommends that the DoD leverage industry analyses and best practices wherever practicable to understand key considerations before attempting to implement an Agile approach.

The DoD has expended considerable energy toward reforming the acquisition process, and organizations continue to execute Agile software development programs. Future research is encouraged to evaluate the extent to which the DoD is ultimately successful in its efforts to inject greater agility into how capabilities are developed and delivered. Such research should generate additional lessons that can be used to improve Agile implementation in the future.

Limitations of the Study

The scope of this research was initially limited to accessible literature from government sources and industry partners who adopted, or assessed the practicability of adopting, Agile IT software development in the DoD environment. However, the amount of available documentation in this area was underestimated. Additional sources continued to be discovered over the course of this study. In the interest of time, not all sources could be considered, introducing the likelihood that other critical factors affecting Agile implementation in the DoD were not identified.

The interpretations provided in this study are based on the assumption that the references were credible and not overly biased in terms of the DoD acquisition process or Agile software development. There was no opportunity to interview the authors for clarification, or to validate this author's comprehension of their findings.

The ultimate goal of this study was to invoke further dialogue about the effectiveness of acquisition process and the DoD's efforts to reform it. Through this qualitative investigation, historical perspectives on potential barriers for Agile in the DoD were evaluated against the most current DoD policies, laws, regulations, and guidance available. Based on the findings, this author concludes that the DoD acquisition process does not fundamentally impede Agile adoption. Many of the challenges associated with adopting Agile are not specific to the acquisition framework. A primary challenge can be attributed to culture. There appears to be a hesitancy to adopt a development approach that is not widely understood in the DoD community and is counter to the traditional, waterfall methodology. Granted, the DoD acquisition framework is sorely in need of reform, and it can prove to be overly rigid in some cases. However, there are aspects of DoD policy and guidance that complement, and facilitate implementation of, Agile software development. While some areas such as cost estimation, the traditional structure (and documentation requirements) of the milestone review process, and contracting can present challenges and potential constraints, many of these obstacles can be overcome with the proper planning and open communication. Those in the acquisition community and their industry partners must work collaboratively to address potential barriers up front and early to ensure that implementing an Agile framework is successful.

References

- Agile Alliance. (2001). *Agile 101*. Retrieved from <https://www.agilealliance.org/agile101/>
- Bellomo, S., & Woody, C. (2012). *DoD information assurance and agile: Challenges and recommendations gathered through interviews with agile program managers and DoD accreditation reviewers* (Acquisition Support Program No. CMU/SEI-2012-TN-024). Pittsburgh, PA: Carnegie Mellon University. Retrieved from https://resources.sei.cmu.edu/asset_files/TechnicalNote/2012_004_001_34089.pdf
- Conference Report to Accompany H.R. 1735, Report No. 114-??? [sic] (2015). Retrieved from <http://docs.house.gov/billsthisweek/20150928/CRPT-114hrpt270.pdf>
- Defense Science Board. (2009). *Report of the defense science board task force on department of defense policies and procedures for the acquisition of information technology*. Retrieved from <http://www.dtic.mil/get-tr-doc/pdf?AD=ADA498375>
- Department of Defense. (2005a). *Federal acquisition regulation*. Retrieved from <https://www.acquisition.gov/?q=browsefar>
- Department of Defense. (2005b). *Integrated master plan and integrated master schedule preparation and use guide*. Retrieved from http://www.acq.osd.mil/se/docs/IMP_IMS_Guide_v9.pdf
- Department of Defense. (2007, Nov. 20). *The defense acquisition system* (DoD Directive 5000.01). Retrieved from <http://dtic.mil/whs/directives/corres/pdf/500001p.pdf>
- Department of Defense. (2016, May 24). *Risk management framework (RMF) for DoD information technology (IT)* (DOD Instruction 8510.01). Retrieved from http://www.dtic.mil/whs/directives/corres/pdf/851001_2014.pdf

- Department of Defense. (2017, Feb. 2). *Operation of the defense acquisition system* (DOD Instruction 5000.02). Retrieved from http://www.dtic.mil/whs/directives/corres/pdf/500002_dodi_2015.pdf
- Government Accountability Office. (2012, July). *Software development: Effective practices and federal challenges in applying Agile methods* (Publication No. GAO-12-681). Retrieved from <http://www.gao.gov/assets/600/593091.pdf>
- Information Assurance. (n.d.). In *PCMag*. Retrieved from <http://www.pcmag.com/encyclopedia/term/44936/information-assurance>
- Joint Capabilities Integration & Development System (JCIDS). (n.d.). In ACQuipedia. Retrieved from <https://dap.dau.mil/acquipedia/Pages/ArticleDetails.aspx?aid=12227505-ba29-41c0-88f0-682a219d5bbc>
- Kobren, B. (2015, January 12). *New DoD instruction 5000.02 “Operation of the defense acquisition system”* [Web log post]. Retrieved from <https://dap.dau.mil/career/log/blogs/archive/2015/01/12/new-dod-instruction-500002.aspx>
- Lapham, M. A., Garcia-Miller, S., Nemeth-Adams, L., Brown, N., Hackemack, B. L., Hammons, C.,...Schenker, A. (2011). *Agile methods: Selected DoD management and acquisition concerns* (CMU/SEI-2011-TN-002). Pittsburgh, PA: Software Engineering Institute. Retrieved from <http://www.sei.cmu.edu/reports/11tn002.pdf>
- Lapham, M. A., Williams, R., Hammons, C., Burton, D., & Schenker, A. R. (2010). *Considerations for using Agile in DoD acquisition* (CMU/SEI-2010-TN-002). Pittsburgh, PA: Software Engineering Institute. Retrieved from <http://www.sei.cmu.edu/reports/10tn002.pdf>

- Lyngaas, S. (2015, October 6). *DoD looks to Agile to solve software conundrum*. FCW. Retrieved from <https://fcw.com/articles/2015/10/06/dod-agile-software.aspx>
- McCaney, K. (2015, August 21). *Air Force puts 22 companies on \$490M Agile acquisition contract*. *Defense Systems*. Retrieved from <https://defensesystems.com/articles/2015/08/21/air-force-agile-acquisition-contract-elgin>
- Messina, A., Modigliani, P., & Chang, S. (2015). *How Agile development can transform defense it acquisition* [PowerPoint slides]. Retrieved from <http://docplayer.net/2824462-How-agile-development-can-transform-defense-it-acquisition.html>
- MITRE Corporation. (n.d.). In *SourceWatch*. Retrieved from http://www.sourcewatch.org/index.php/MITRE_Corporation
- Modigliani, P., & Chang, S. (2014). *Defense Agile acquisition guide: Tailoring DoD IT acquisition program structures and processes to rapidly deliver capabilities*. Retrieved from <https://www.mitre.org/sites/default/files/publications/MITRE-Defense-Agile-Acquisition-Guide.pdf>
- National Defense Authorization Act for Fiscal Year 2016. H.R. 1735, 114th Cong. (2015). Retrieved from <https://www.congress.gov/114/plaws/publ92/PLAW-114publ92.pdf>
- Nidiffer, K., Garcia-Miller, S., & Carney, D. J. (2014). *Potential use of Agile methods in selected DoD acquisitions: Requirements development and management* (CMU/SEI-2013-TN-006). Pittsburgh, PA: Software Engineering Institute. Retrieved from <http://repository.cmu.edu/cgi/viewcontent.cgi?article=1787&context=sei>
- Oar, A. R., Fitzsimmons, J. P., Guthrie, J. P., Hoffman, R. A., Metzger, A. J., Nelson, C. J., ... Postupack, M. J. (2015). *DoD acquisitions reform: Embracing and implementing*

- Agile*. Retrieved from http://www.au.af.mil/au/afri/aspj/digital/pdf/articles/2015-Nov-Dec/DoD_Acquisitions_Reform.pdf
- Regan, C., Lapham, M. A., Wrubel, E., Beck, S., & Bandor, M. (2014). *Agile methods in Air Force sustainment: Status and outlook* (CMU/SEI-2014-TN-009). Pittsburgh, PA: Software Engineering Institute. Retrieved from http://resources.sei.cmu.edu/asset_files/TechnicalNote/2014_004_001_312766.pdf
- Schoeni, D. E. (2015, August 24). *Top-down IT approach too slow to meet threats*. *Defense One*. Retrieved from <http://www.defenseone.com/ideas/2015/08/top-down-it-approach-too-slow-growing-threats/119387/>
- Takai, T. (2012). *DoD CIO's 10-point plan for it modernization* [PowerPoint slides]. Retrieved from <http://dodcio.defense.gov/Portals/0/Documents/ITMod/CIO%2010%20Point%20Plan%20for%20IT%20Modernization.pdf>
- Under Secretary of Defense for Acquisition, Technology, and Logistics. (2015). *Implementation directive for Better Buying Power 3.0* [Memorandum]. Retrieved from [http://www.acq.osd.mil/fo/docs/betterbuyingpower3.0\(9Apr15\).pdf](http://www.acq.osd.mil/fo/docs/betterbuyingpower3.0(9Apr15).pdf)
- Welby, S. (2013). *Thinking about Agile in DoD* [PowerPoint slides]. Retrieved from http://www.acq.osd.mil/se/briefs/2013_11_21-AFEI-Agile-Summit-Welby-Final.pdf
- Wrubel, E., & Gross, Jon. (2015). *Contracting for Agile software development in the Department of Defense: An introduction* (CMU/SEI-2015-TN-006). Pittsburgh, PA: Software Engineering Institute. Retrieved from http://resources.sei.cmu.edu/asset_files/TechnicalNote/2015_004_001_442515.pdf

Glossary of Acronyms and Terms

ACAT.....	acquisition category
AT&L.....	Acquisition, Technology, and Logistics
CIO.....	Chief Information Officer
CDD	Capability Development Document
CDRL.....	contract data requirements list
CPD.....	Capability Production Document
DAU	Defense Acquisition University
DIACAP.....	Department of Defense Certification and Accreditation Process
DoD.....	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
EVM.....	earned value management
FAR.....	Federal Acquisition Regulation
GAO	Government Accountability Office
IA	information assurance
ICD.....	Initial Capabilities Document
IMS	integrated master schedule
IT.....	information technology
JCIDS	Joint Capabilities Integration & Development System
JROC.....	Joint Requirements Oversight Council
MDA	Milestone Decision Authority
NDAA.....	National Defense Authorization Act

PLCCEprogram life cycle cost estimate

PM.....program manager

USAFUnited States Air Force

USD(AT&L)..Under Secretary of Defense for Acquisition, Technology, and Logistics

Author Note

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