Surviving the Cut: DoD Program Cancellations and Firm Strategic Capabilities in Complex Industries

by

Jeffrey Edwin Baker

BA in Mechanical Engineering (Aerospace), United States Military Academy, 1995

MA in Organizational Leadership, Chapman University, 2005

MA in Strategic Studies, United States Army War College, 2017

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This dissertation was presented

by

Jeffrey Edwin Baker

It was defended on

October 27, 2021

and approved by

John E. Prescott, Area Director of Organizations & Entrepreneurship and Thomas O'Brien Chair of Strategy, Joseph M. Katz Graduate School of Business

Susan K. Cohen, Associate Professor, Joseph M. Katz Graduate School of Business

Lingling Pan, Assistant Professor, Joseph M. Katz Graduate School of Business

Silas Martinez, Assistant Professor, Department of Command, Leadership, and Management (United States Army War College)

Dissertation Director: Ravi Madhavan, Professor, Joseph M. Katz Graduate School of Business

Surviving the Cut: DoD Program Cancellations and Firm Strategic Capabilities in Complex Industries

Jeffrey Edwin Baker, PhD

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The purpose of this study is to establish a theoretical and empirical link between the capabilities of firms that produce Complex Products and Systems (CoPS) in the U. S. defense industry and program cancellations. Using a capabilities theoretical lens, in which specific strategic capabilities impact the outcomes of a firm's programs, I theorize that firms with an increased capability to manage Mutually Reinforcing Portfolios reduce the likelihood of program cancellation. I also theorize that firms with greater Corporate Political Capability reduce the likelihood of program cancellation. Additionally, the study empirically tests the deeply held beliefs that cost overruns, schedule overruns, and program scope changes impact program cancellation in the Department of Defense. Using survival analysis, I analyzed 118 major defense acquisition programs from the United States Department of Defense during the 1982-2018 period. I found that cost overruns, schedule overruns, and program scope changes increased the likelihood of program cancellations. Additionally, I found that the capability to manage Mutually Reinforcing Portfolios attenuates the relationship between cost overruns and schedule overruns, but not between program scope changes and program cancellation. However, I found that a firm's Corporate Political Capability did not attenuate the relationship between cost overruns, schedule overruns, program scope changes, and program cancellation. The paper thus contributes to theory by conceptualizing and operationalizing the novel firm capabilities of managing Mutually

Reinforcing Portfolios and Corporate Political Capabilities and providing a deeper understanding of the strategies firms use to impact program cancellation.

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Preface

The views expressed in this article are those of the author and do not necessarily reflect those of the U.S. Army War College, the U.S. Army, or the Department of Defense. This document does not include any classified or sensitive information.

1.0 Introduction

Scholars have long accepted the idea that managerial actions and choices are critical to a firm's strategic outcomes (Chen & Miller, 2012; Grimm et al., 2006; Nag et al., 2007). One of the most observable representations of a firm's strategy consists of the firm's choices in product and project selection (Cooper, Edgett, & Kleinschmidt, 2001; Wiersema & Beck, 2017). This is especially true in industries that supply complex products and systems (CoPS) (Davies & Hobday, 2005).

For firms in the U.S. defense industry, these CoPS are called Major Defense Acquisition Programs (MDAPs) or just programs. Scholars define CoPS as "high-technology and high-value capital goods, such as telecommunications systems, flight simulators, high-speed trains, air traffic control systems, intelligent buildings, weapon systems, and baggage handling systems" (Davies & Brady, 2000). MDAPs in the U.S. defense industry include novel supply chains, involve many firms and sub-contractors, and require detailed systems integration. Due to the complexity required to supply the DoD with an MDAP, it is not possible for a single firm to develop the MDAP independently, so major defense contractors compete to be the prime or lead contractor (Depeyre & Dumez, 2009; Prencipe et al., 2003).

Complexity has been conceptualized in different ways such as Complex Adaptive Systems, systems that involve multiple elements that change or learn as they interact (Boisot & Child, 1999; Holland, 2006), complexity theory (Sharif & Irani, 2006), complexity and management (Allen et al., 2011) as well as CoPS (Davies & Hobday, 2005; Hobday, 2000). While all of these are interesting, this study focuses on the CoPS context as the U.S Department of Defense attempts to

conceptualize, build, and field the most novel and advanced weapon systems in the world (Galvin et al., 2018).

The Project Management Body of Knowledge Handbook (PMBOK) (2013) defines a project as "a temporary endeavor undertaken to create a unique product, service, or result" and programs as "a group of related projects, subprograms, and program activities managed in a coordinated way to obtain benefits not available from managing them individually." Since the U.S. Government allocates funding to programs and the unit of analysis of the U. S. defense enterprise is the program (Galvin, 2018), for consistency and clarity, I will refer to the products of the U.S. Defense industry as MDAPs or programs even though some of the literature uses the terms projects, products, and programs interchangeably (Kendall, 2015b; Pernin et al., 2012).

The programs are generated from requirements formulated by the United States Department of Defense (DoD) and are a central part of the firm's revenue (Bowlin, 1995). However, when these programs fail, they can cause severe problems for the firm, such as a loss of reputation (Cooper & Kleinschmidt, 1995), financial difficulties (Jefferson, 1991), and increased operational costs (Baum & Dahlin, 2007; Hu et al., 2017). Additionally, program failure has also been associated with a loss of market capitalization (Hu et al., 2017).

Surprisingly, the majority of the literature focuses on why these programs failed from the aspect of the DoD (Decker & Wagner, 2011; Kendall, 2015a) or faults the cumbersome process of the Defense Acquisition System (Kendall, 2016; McNicol & Wu, 2015) instead of focusing on the capabilities inherent in the firm that can lead to a successful outcome. This neglect is noteworthy as scholars have stressed the importance of buyer and supplier integration and the relationship between the two (Teece, Pisano, & Shuen, 1997).

The purpose of this paper is to contribute to the capabilities literature by establishing a theoretical and empirical link between the capabilities of firms that produce CoPS in the U. S. defense industry and program cancellation. Establishing this link is critical as the demand for the products of the firms in the U.S. defense industry is increasing, and the resources of the U.S. Federal Government, the customer, are facing increased pressure due to increased non-discretionary government spending and a growing desire to reduce the federal deficit (Chaplain, 2014; Mullen et al., 2016). In addition, the number of firms in the defense industry capable of building a complex program required by the U. S. Department of Defense has declined significantly over the past 34 years from over 75 to only five firms (Depeyre & Dumez, 2009; Driessnack & King, 2004), and the United States DoD cannot build these complex systems internally (Depeyre & Dumez, 2009). If this trend of reduced Governmental spending continues, the remaining firms in the defense industry may choose different CoPS as their focus and leave the industry. The reduction of firms in the U.S. Defense industry will significantly impair the ability of the U.S. Government to purchase the CoPS required for the defense of the nation. In addition, it is a long-held assumption by DoD acquisition professionals, DoD decision-makers, and industry professionals that cost overruns, schedule overruns, and program scope changes are the primary drivers of program cancellation in the DoD; however, this belief has not been empirically tested (Kleinschmidt et al., 2007).

The lack of scholarly attention on the firm's side of the monopsony (Depeyre & Dumez, 2009; Mcnicol, 2017; McNicol & Wu, 2015), the massive consolidation of the defense industry, the untested beliefs by experts in the defense industry, as well large portion of the U.S. federal budget allocated to these programs further motivated my research question, *How does the interaction of program characteristics and firm capabilities affect program cancellation?*

I approach the research question in the following manner. I focus my theoretical and empirical attention on the capabilities of firms in the defense industry. I theorize that a firm's capability of managing mutually reinforcing portfolios reduces the likelihood of program cancellation if a program experiences a cost overrun, a schedule overrun, or a program scope change. I also theorize that a firm's corporate political capability to influence powerful external stakeholders, such as the U.S. Congress, is another firm capability that attenuates the likelihood of program cancellation if a program experiences a cost overrun, a schedule overrun, or a program scope change. This approach is consistent with both the capabilities literature as well as the defense acquisition literature.

I use a dataset of 118 DoD programs listed in the Defense Acquisition Management Information Retrieval (DAMIR) database. Of these 118 programs, 26 programs were canceled. I use survival analysis to analyze these data (Motulsky, 2018). I found support for my hypotheses indicating that the interaction between the capability to manage mutually reinforcing portfolios and cost and schedule overruns attenuated the relationship with program cancellation. However, I did not find support for my hypotheses indicating that a firm's increased corporate political capability would attenuate the relationship of cost overruns, schedule overruns, and program scope changes, and program cancellation. Figure 1 illustrates my model.

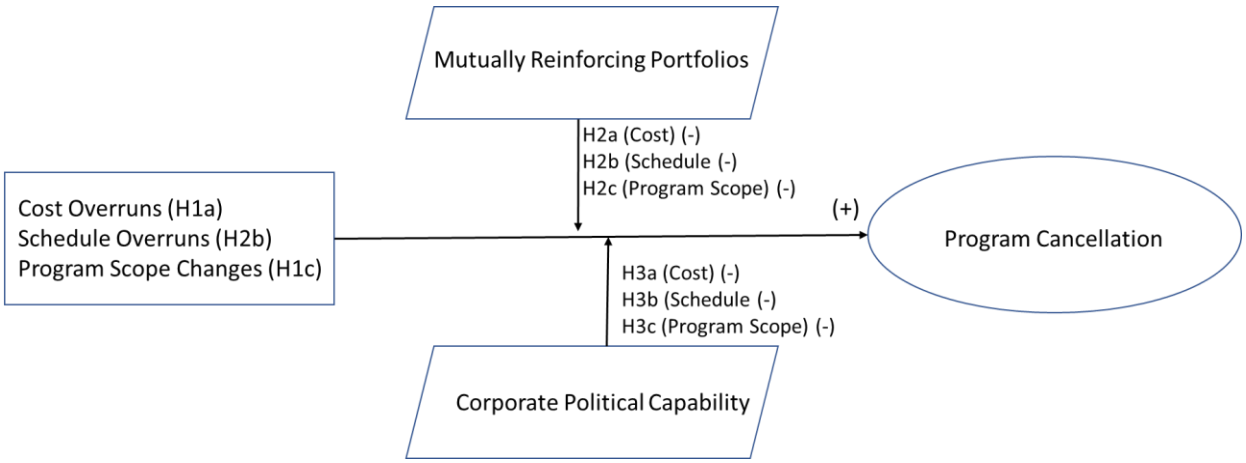

Figure 1. Research Model

I contribute to the literature in two main ways. The first modest contribution is in accordance with (Makadok et al., 2018)'s taxonomy of theoretical contributions of level three. I extend theory by establishing where the theory is relevant by applying the existing theory to a new context, specifically the complex context of the U.S. Department of Defense and the defense industry. Next, I introduce novel moderators to the existing theory in Makadok et al., (2018)'s level five to define further what we are theorizing about. While it is well established that firms in the CoPS industry have to take program level capabilities such as system integration (Depeyre & Dumez, 2009; Institute, 2013), program scope management (Davies & Brady, 2000; Institute, 2013; Khan, 2006), time management (Munns & Bjeirmi, 1996; Olsson, 2006), bidding and cost management (Institute, 2013; Kwak & Ibbs, 2002) seriously (Davies & Brady, 2000; Davies & Hobday, 2005), my contribution lies in establishing the link between program level capabilities and strategic capabilities such as organizational capabilities (Gelhard & von Delft, 2016; Gold et al., 2001) and strategic decision making (Eisenhardt & Martin, 2000). Studying firm capabilities deepens the understanding of both practitioners and scholars as well as assists the defense industry and the DoD in developing complex products critical to the defense of the United States.

1.1 Department of Defense and Programs of Record

Firms in the U.S. defense industry rely on large government contracts called programs in the Department of Defense for their revenue. For example, in General Dynamics, revenue from the U.S. DoD accounted for $17.7B of their total revenue of $36.1B in 2018, over 51% (Novakovic, 2109). These programs are the unit of analysis in the U.S. defense enterprise (Galvin, 2018) and consist of large-scale contracts such as Boeing's C17 strategic lift aircraft, a $64 billion program (Mol, 2010). See Figure 2.

Figure 2 Boeing C17 Globemaster[1]

These programs make up the third-largest bucket of funding in the Department of Defense ($143B) behind Operations and Maintenance ($289B) and Personnel ($154B) (Comptroller/CFO, 2020b).

A typical path to becoming a program of record, defined as a program that has passed Milestone B in the Defense Acquisition process (for further information, see DoD Directive

[1] Picture from https://www.airforce-technology.com/projects/c17/

5000.01), is through the JCIDS, PPBE, and DAS triangle. See Figure 3 below.

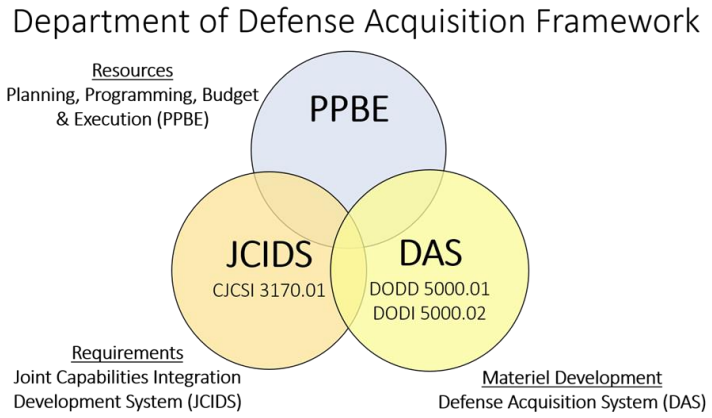

Figure 3 DoD Acquistion Framework

While an in-depth discussion of each of these complex processes is beyond the scope of this paper, a brief description follows. The Joint Capabilities Integration and Development System (JCIDS)[2] is primarily concerned with validating the requirement for the specific product or service requested from elements within the U.S. DoD (e.g., Army, Navy, etc.). The Planning, Programming, Budgeting, and Execution (PPBE)[3] is the process used by the departments in the DoD (e.g., Army, Navy) to allocate funding to support their activities and costs. The Defense Acquisition System (DAS)[4] is the acquisition process used by the DoD to build products in conjunction with firms in the defense industry.

[2] For an in-depth understanding of the JCIDS process, see CJCSI 3170.01I dated 23 January 2015.

[3] For an in-depth understand of PPBE, see DoDD 7045.14 dated 29 August 2017.

[4] For an in-depth understanding of the DAS, see DoD Instruction 5000.02 dated 23 January 2020

2.0 Theory and Hypotheses

2.1 Program Cancellation

Program cancellation is an important aspect to consider in science and engineering organizations since individuals learn more from failure than success (Baum & Dahlin, 2007; Popper, 1959; Sitkin, 1992). Previous research has shown multiple reasons that programs undertaken by firms fail. For instance, Munns & Bjeirmi (1996) found that even if a program met the time requirements and stayed at or under the cost, organizations consider programs a failure if the program no longer meets the organization's needs. Other scholars have found that several broad categories that contribute to program failures such as financial issues (James, 2006; Khan, 2006), poor quality (James, 2006; Mirza et al., 2013), a lack of alignment of expectations with outcomes (James, 2006) and external factors such as the environment (Dumont et al., 1997; James, 2006). Additionally, scholars have suggested that failure becomes more likely when firm capabilities and resources are misaligned with the environment (Amit & Shoemaker, 1993), and when firms don't change based on the realities of their new environment either due to a lack of leadership (Helfat & Martin, 2015; Rosenbloom, 2000), a lack of resources (Kleinschmidt et al., 2007) or a failure to shift the firms' strategic direction (Helfat & Martin, 2015). Scholars have also noted that younger firms may lack the decision making processes to know what activities they should be undertaking (Jovanovic, 1982), or the firm may lack the specific capability or resource needed to implement their strategy (Lussier, 1995; Thornhill & Amit, 2003; Venkataraman et al., 1990). However, to establish my baseline hypothesis, I will focus on the three areas that are

consistently mentioned in the literature as possible reasons for program cancelation, cost overruns, scheduling overruns, and program scope changes.

In the empirical context of DoD major defense acquisition programs, program cancellation can occur for various reasons. Since the decision to cancel a program of record will not come from the firm in the defense industry and only from the United States Government, I will provide a brief overview of how and where these cancellation decisions can occur. First, the cancellation decision can originate in the Department of Defense. If the DoD decides that the program no longer meets its needs due to a shift in strategy or a changing environment, it can cancel the program.

Second, the U.S. Congress can also effectively cancel a program. All money for the DoD is annually approved and appropriated by the U.S. Congress. If Congress decides that a program of record is no longer necessary, they can fail to provide funding for the program, which effectively cancels the program. The primary way that Congress implements this ability is through the annual National Defense Authorization Act (NDAA) (Schwartz, 2013).

Additionally, the Presidential administration can cancel DoD programs. The DoD submits its budget request to the administration annually. The administration then packages the DoDs request along with the other federal entities, and the Budget and Accounting Act of 1921 requires the President to submit the budget to Congress by the first Monday in February each calendar year.[5] The President may choose to eliminate some programs at this time. An example of why this may occur is when President Obama announced a "Rebalancing" toward Asia, which changed budget priorities, prioritizing naval funding over army funding (Manyin et al., 2012).

[5] For a more in-depth description, see the GAO's (1966) The Budget and Accounting Act.

2.1.1 Cost Overruns

There is a substantial literature on program cost overruns from both the project management literature (Cooper & Edgett, 2003; Munns & Bjeirmi, 1996) and the Department of Defense Acquisition literature (Gholz & Sapolsky, 2018; Kendall, 2016). The following discussion pulls from the literature common reasons why cost overruns in programs occur, some mitigation methods for cost overruns, and negative consequences of cost overruns.

2.1.1.1 Why They Happen

Cost overruns in firms can occur from a myriad of value-destroying reasons such as internal transaction costs as well as high levels of bureaucracy that increase coordination and governance costs in diversified firms (Palich et al., 2000). However, there are several broad categories of areas that contribute to cost overruns in programs. Managerial factors (Loo, 2002, 2003; Munns & Bjeirmi, 1996), lack of interpersonal skills (Loo, 2002), organizational inhibitors (Martinsuo & Lehtonen, 2007), program strategy misalignment (Artto et al., 2008), and sub-optimal technical competencies (Institute, 2013; Keil et al., 2000) have all been cited as avenues for cost overruns to occur. See Table 1. Additionally, scholars state that firms that operate in highly uncertain environments have increased costs due to the increased information processing requirements by managers (Bergh & Lawless, 1998).

Table 1 Sources of Cancellation

	Why They Occur	Mitigation/Countermeasures	Negative Consequences
Cost Overruns	Poor Managerial Skills (Munns & Bjeirmi, 1996) Deficient Interpersonal Skills (Loo, 2002) Organizational Inhibitors (Martinsuo & Lehtonen, 2007) Program to Strategy Misalignment (Artto et al., 2008) Deficient Technical Competencies (Keil, Mann, & Rai, 2000) Uncertainty (Bergh & Lawless, 1998)	Program Process Controls (Khan, 2006) Improving Managerial Skills (Loo, 2003) Identifying and Reducing Organizational Inhibitors (Martinsuo & Lehtonen, 2007)	Increased Program Oversight (Schwartz & Conner, 2016) Negative Firm Impressions (Bergh & Lawless, 1988) Executive Turnover (Hoskisson & Hitt, 1994) Layoffs (Bergh & Lawless, 1988) Program Cancellation (Decker & Wagner, 2011)
Schedule Overruns	Poor Program Manager Training (Schwartz, Francis, & O'Connor, 2016) Optimistic Schedule Development (Institute, 2013) Program Complexity (Kendall, 2015) Poor Managerial Skills (Cooper & Kleinschmidt, 1995) Resource Competition (Cooper & Edgett, 2003) Poor Planning (Schwartz & Conner, 2016) Technological Challenges (Mikkola, 2001) Lack of Organizational Flexibility (Olsson, 2006) Escalation of Commitment (Desai & Chulkov, 2009)	Effective Project Planning (Kwak & Ibbs, 2002) Trade-off analysis tools (Khan, 2006) Initial Understanding of Program Requirements (Chaplain, 2014) Commitment to Process Improvement (Howell & Koskela, 2000) Organizational Flexibility (Olsson, 2006) Conservative Estimates (Kendall, 2016)	Negative Firm Impressions (Bergh & Lawless, 1988) Increased Program Oversight (Schwartz & Conner, 2016) Executive Turnover (Hoskisson & Hitt, 1994) Layoffs (Bergh & Lawless, 1988) Program Cancellation (Clowney et al., 2016)
Program Scope Changes	Substandard Initial Documents (Gilmore, 2009) Lack of Program Understanding (Mirza et al., 2013) Substandard management abilities (Loo, 2002) Overestimating Technological Advances (Mikkola, 2001) Uncertainty (Olsson, 2006) Instability of Customer Requirements (Mills et al., 2011) Pressure to Succeed (Kendall, 2016)	Program Scope Change Document Management (Dumont et al., 1997) Dedicated Management Procedures (Kwak & Ibbs, 2002) Planning Processes (Love, Irani & Edwards, 2003) Initial Understanding of Program Requirements (Kwak & Ibbs, 2002) Organizational Learning (Olsson, 2006) Flexibility (Baccarini, Salm, & Love, 2004)	Program Failure (Mirza et al., 2013) Program Cancellation (Khan, 2006) Personnel Turnover (Hoskisson & Hitt, 1994) Increased Program Oversight (Fageha & Aibinu, 2013) Financial Consquences (Cooper et al., 2001) Reputation Damage (Cooper & Kleinschmidt, 1995)

2.1.1.2 Countermeasures/Mitigation

Scholars have found that firms with higher levels of ambidexterity and absorptive capacity mitigate cost overruns in complex programs (Fernhaber & Patel, 2012). Additionally, effective program planning, trade-off analysis, and dedicated change control processes have been cited as

mitigation methods for reducing program costs (Khan, 2006; Kwak & Ibbs, 2002). However, a substantial portion of the literature is dedicated to addressing the broad categories of areas that contribute to program cost overruns, such as improving managerial skills (Loo, 2002, 2003; Munns & Bjeirmi, 1996) and reducing organizational inhibitors (Martinsuo & Lehtonen, 2007).

2.1.1.3 Negative Consequences

The U.S. DoD has a statutory requirement under the Nunn-McCurdy Act to report Major Defense Acquisition Programs that experience cost overruns. The law allows powerful stakeholders like Congress to oversee the defense acquisition process (Schwartz & Connor, 2016). This reporting requirement brings increased attention and scrutiny from senior leaders in the DoD, members of the press, as well as powerful members of Congress and causes managers in the DoD to evaluate the viability and need of the program (Schwartz, 2013; Schwartz & Connor, 2016).

Scholars also suggest that the negative consequences of increased program costs are negative impressions of firm viability and sustainability (Bergh & Lawless, 1998). Additionally, increased costs can lead to executive turnover, layoffs, and negative public perceptions (Bergh & Lawless, 1998; Hoskisson & Hitt, 1994). Cost overruns have also been cited as one of the major contributors to program cancellation in the defense acquisition literature. A survey of professionals in the Department of Defense and the Defense Industry concluded that cost overruns were one of the three most likely causes for program cancellation (Clowney et al., 2016). Further, scholars state that although there are many reasons for program cancellations in the DoD, one of the factors that are present in almost all canceled programs is cost overruns (Decker & Wagner, 2011).

Therefore, leveraging the extensive literature, I propose my first baseline hypotheses of:

H1a. Cost overruns increase the likelihood of program cancellation.

2.1.2 Schedule Overruns

Similar to program cost overruns, there is also a substantial literature on schedule overruns from both the project management literature (James, 2006; Olsson, 2006) and the Department of Defense Acquisition literature (Gholz & Sapolsky, 2018; Kendall, 2015a). The following discussion pulls from the literature common reasons why schedule overruns in programs occur, some mitigation methods, and their associated negative consequences.

2.1.2.1 Why They Happen

In a similar vein to cost overruns, the literature on schedule overruns in program management details specific reasons why these overruns can occur, such as lack of program manager training (Schwartz et al., 2016). However, most of the literature can be categorized into broad categories. These categories include unrealistic schedule development (Institute, 2013), program complexity (Kendall, 2015a), management challenges (Cooper & Kleinschmidt, 1995; Cooper & Edgett, 2008), resource competition (Cooper & Edgett, 2003), poor prior planning (Blickstein et al., 2011; Schwartz & Connor, 2016), technological challenges (Mikkola, 2001), and lack of organizational flexibility (Olsson, 2006).

In the U.S. Department of Defense Acquisition Literature, scholars suggest that program schedule overruns can occur because DoD Program managers face intense pressure to get the product completed as quickly as possible, which might lead to initial timelines that are unrealistic for defense contractors to meet (Decker & Wagner, 2011). DoD Program Managers also feel pressure to underestimate their initial estimates resulting in unrealistic schedule timelines at Milestone B (Kendall, 2016). Since the success of many of these DoD program managers is directly related to the success of the program that they manage, these unrealistic timelines could

lead to an escalation of commitment to a course of action that is not viable. Escalation of commitment has previously emerged as a major explanation for the propensity of some programs to exceed their anticipated schedule (Desai & Chulkov, 2009; Staw, 1976).

2.1.2.2 Countermeasures/Mitigation

Similar to mitigation methods for controlling cost, effective project planning, trade-off analysis, and dedicated change control processes have been cited as mitigation methods for reducing program schedule overruns (Institute, 2013; Khan, 2006; Kwak & Ibbs, 2002). Additionally, clearly understanding the program requirements at the outset of the program has been shown to mitigate the risk of schedule overruns (Chaplain, 2014; Mirza et al., 2013), as well as developing management methods that remove unnecessary processes from the program (Howell & Koskela, 2000). Organizational flexibility is also widely acknowledged as reducing program schedule overruns (Olsson, 2006). Organizations that make conservative estimates on new technology also mitigate the likelihood of having schedule overruns (Kendall, 2016).

2.1.2.3 Negative Consequences

Program schedule overruns exhibit similar consequences to cost overruns. Negative impressions of firm viability and sustainability (Bergh & Lawless, 1998), increased stakeholder attention (Blickstein et al., 2011; Schwartz & Connor, 2016), executive turnover, layoffs, and negative public perceptions have all been linked to program schedule overruns (Bergh & Lawless, 1998; Hoskisson & Hitt, 1994). In the defense acquisition literature, schedule overruns have been listed as one of the major contributors to program cancellation by a survey of practitioners (Clowney et al., 2016). Program failure is also listed as an expected outcome of programs that exceed their initial schedule (Decker & Wagner, 2011; Wheatcraft, 2011).

Therefore, leveraging the extensive literature, I propose the baseline hypotheses of:

H1b. A program exceeding the scheduled completion time increases the likelihood of program cancellation.

2.1.3 Program Scope Changes

2.1.3.1 Why They Happen

The extensive literature on program scope changes identifies several broad categories of reasons why these changes occur. Scholars suggest that poorly written initial program documents (Gilmore, 2009; Mills et al., 2011), unclear understanding of program requirements (Mirza et al., 2013), poor definitions (Fageha & Aibinu, 2013), poor program management abilities (Cooper et al., 2001; Loo, 2002, 2003), program complexity (Kendall, 2016; Schwartz, 2013; Schwartz, Francis, & O'Connor, 2016), overestimating technology advances (Mikkola, 2001) as well as environmental uncertainty (Olsson, 2006; Turner, 1976) all contribute to program scope changes.

One of the major contributors to significant changes in program scope for DoD programs is the instability of customer requirements (Mills et al., 2011). Additionally, DoD program managers face intense pressure for their programs to succeed. Some program managers justify changes to the program's scope that reduce the performance of the final product, especially early in the program's life, to ensure that the program continues (Chaplain, 2014; Kendall, 2016). Self-justification is a part of the reason that managers are unwilling to admit that their initial allocation of resources to the chosen course of action was faulty (Brockner, 1992). Some DoD program managers also do not have adequate training before managing these complex programs, leading to some program instability and program scope changes (Meier, 2010; Schwartz, 2013).

2.1.3.2 Countermeasures/Mitigation

The literature, similar to cost and schedule overruns, focuses on specific actions that firms can take to mitigate program scope changes to process changes that the firm can take. However, these changes can be grouped into broad buckets such as scope change document management (Dumont et al., 1997), program scope management procedures (Institute, 2013; Kwak & Ibbs, 2002), planning processes (Love et al., 2003), increased scrutiny on founding documents (Kwak & Ibbs, 2002), organizational training (Klingebiel & Rammer, 2014) organizational learning (Olsson, 2006), and adapting to change and uncertainty (Baccarini et al., 2004; Olsson, 2006).

2.1.3.3 Negative Consequences

Some of the significant outcomes of program scope changes are program failure (Mirza et al., 2013), failure to meet the needs of the customer (Munns & Bjeirmi, 1996), as well as program cancellation (Khan, 2006). However, increased costs (Jeffery & Leliveld, 2004), personnel turnover (Hoskisson & Hitt, 1994), increased stakeholder scrutiny (Fageha & Aibinu, 2013), financial consequences (Cooper et al., 2001), and damage to the firm's reputation (Cooper & Kleinschmidt, 1995) have also been suggested as consequences of program scope changes.

Therefore, leveraging the extensive literature, I propose my final baseline hypotheses of:

H1c. Increasing changes to the program's scope increase the likelihood of program cancellation.

2.2 Capabilities

Capabilities are defined as "the subset of a firm's resources and are tangible and intangible assets that enable a firm to take full advantage of the other resources that it owns" (Barney & Hesterly, 2010). The field of capabilities is dominated by the notion of dynamic capabilities, which are defined as "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece, Pisano, & Shuen, 1997). However, the field also consists of broad categories of capabilities, such as functional capabilities, integrative capabilities, and strategic capabilities. There is a stream of research that defines functional capabilities as capabilities that allow a firm to improve or broaden its technological knowledge (Amit & Shoemaker, 1993; Grant, 1991; Hamel & Prahalad, 1990; Henderson & Cockburn, 1994) and consist of areas such as marketing (Fahy et al., 2000; Kamboj & Rahman, 2015) and operational capabilities (Cepeda & Vera, 2007). Integrative capabilities include the firm's ability to incorporate relevant knowledge external to the firm and apply that knowledge across different technical areas (Cohen & Levinthal, 1990; Henderson & Clark, 1990; Teece et al., 1997; Verona, 1999). Scholars have defined strategic capabilities as capabilities that allow the firm to deploy and develop its resources to achieve the desired output (Eisenhardt & Martin, 2000; Henderson & Cockburn, 1994; Mäkelä et al., 2012) and achieve a competitive advantage (Amit & Shoemaker, 1993; Barney, 1991). These include organizational capabilities (Gelhard & von Delft, 2016; Gold et al., 2001) and strategic decision-making (Eisenhardt & Martin, 2000).

Capabilities allow the organization to achieve new and innovative forms of competitive advantage (Leonard-Barton, 1992; Teece & Pisano, 1994; Teece et al., 1997). Furthermore, these capabilities can either be a tangible or intangible combination of resources, and firms that rely on the intangible capabilities typically outperform other firms (Barney, 2001; Robins & Wiersema,

1995). Two specific types of capabilities which are receiving increased attention are the capability to manage mutually reinforcing programs (Basu, 2010; Killen & Hunt, 2013; Wiersema & Beck, 2017) and corporate political capability (Hillman, Zardkoohi, & Bierman, 1999; Mellahi & Frynas, 2016; Schuler, 1996; Sutton et al., 2021).

The context of the U.S. defense industry has context-specific constructs that deserve attention, such as jointness (an acquisition program developed for two distinct U.S. armed forces such as the Army and the Navy) and foreign military sales (the decision to sell the output of a military program to a foreign country). Jointness is interesting because each military service has its own culture, funding stream, and development processes that impact the firms in the U.S. defense industry differently. Foreign military sales are not only an additional funding stream for firms in the U.S. defense industry, but foreign military sales are also part of how the United States government exercises all elements of its national power (diplomatic, informational, military, and economic (Galvin et al., 2018)). However, I focused on two theoretically interesting capabilities for this study, the capability to manage mutually reinforcing programs and a firm's corporate political capabilities. Those two strategic capabilities have been antidotally acknowledged by senior leaders in the U.S. Department of Defense (Gates, 2014) but have not been sufficiently theoretically or empirically explored.

A recent example of a firm attempting to leverage its capabilities in order to influence the Department of Defense's program acquisition process is Rheinmetall. Rheinmetall competed for a large U.S. Department of Defense Program to replace the Bradley, an armored vehicle introduced in the 1980s to the United States Army (Freedberg, 2020). Rheinmetall, along with all of the other competitors, could not meet the DoD requirement, and the DoD decided to cancel the competition. After the DoD reworked their requirements and reopened the competition, Rheinmetall attempted

to highlight their "proven components" from their other combat vehicles with the managing director of the company's US subsidiary stating, "the transfer of technology is one area that Rheinmetall really excels at." Rheinmetall partnered with Textron, which has been instrumental in 15 programs of record for combat vehicles and has highlighted the partnership to show that they now have a proven track record of success in building complex programs of record for the U.S. DoD. For example, Rheinmetall builds a mini-tank that the U.S. Army has already purchased for experimental use in the area of robotic-controlled vehicles (RCV). RCV is a requirement in which the Army's replacement vehicle is supposed to operate at least part of the time. Rheinmetall is heavily marketing its proven capability in the RCV arena to make them more competitive in the bidding process (Freedburg, 2020).

Rheinmetall is not only highlighting its capability of managing mutually reinforcing portfolios but also attempting to leverage its corporate political capability. Rheinmetall is highlighting its U.S. footprint based in Sterling Heights, Michigan. Between their Michigan location and their partner's location in Slidell, Louisiana, there is one Senator on the influential Armed Services Committee, Gary Peters, the second-highest-ranking Republican in the House of Representatives, Representative Scalise, and a member of the Appropriations Committee, Senator Kennedy (Sprenger, 2020). Senator Peters has the ability to influence the program's approval in the Armed Services Committee, and Senator Kennedy has the ability to influence the process to make the funds available to the DoD from the U.S. Treasury by his position on the Appropriations Committee. By highlighting their U.S locations to influential stakeholders, Rheinmettal hopes that this will give them the edge to produce the new combat vehicle for the U.S. Army (Freedburgh, 2020).

2.2.1 Mutually Reinforcing Portfolios

A firm's ability to achieve a competitive advantage from the capability to manage mutually reinforcing portfolios is derived from two elements. The first is selecting a portfolio of programs that align with a firm's strategy (Cooper et al., 2001; Eggers, 2012). The second is aligning the organizational and managerial process of the various programs so that the sum of the portfolio is greater than the performance of the individual programs (Eggers, 2012; Henderson, 1994; Teece et al., 1997). Program management is a necessary but insufficient condition for a firm to achieve a competitive advantage (Biedenbach & Müller, 2012; Hamel, 2006; Martinsuo & Lehtonen, 2007; Shrivastava, 1995). Firms should pay attention to portfolio management practices, which have been linked with firms' economic success (Cooper & Edgett, 2008; Eggers, 2012; Henderson, 1994; Killen & Hunt, 2013; Robins & Wiersema, 1995). Consistent with previous scholars, I define program portfolio management as a dynamic decision process that allows firms to select, prioritize and evaluate products and programs and make resource allocation decisions in an uncertain environment by multiple decision-makers across the firm to align the portfolio's goal with the firm's strategy (Cooper, Edgett, & Kleinschmidt, 2001; Eggers, 2012; Fernhaber & Patel, 2012; Goold & Luchs, 1993).

Previous research on portfolio management has been primarily qualitative or survey-based (Martinsuo & Lehtonen, 2007). However, in the corporate strategy literature, research has shown that related diversification outperforms unrelated diversification (Palich et al., 2000). Additionally, scholars have shown that portfolio management can increase efficiencies (Aversa et al., 2017), improve firm performance (Henderson, 1994; Killen & Hunt, 2013), and align program choices to a firm's strategy (Robins & Wiersema, 1995; Wiersema & Beck, 2017). Firms that exhibit increased performance are firms that have developed explicit procedures for portfolio

management, the top management commits to those procedures, and the firm routinely applies the procedures across all programs (Cooper et al., 2001; Cooper & Kleinschmidt, 1995; Martinsuo & Lehtonen, 2007). At the program level, the capability for effective portfolio management improves firm performance when the firm builds a portfolio that is a balance of the programs that align with the firm's goals (Cooper & Edgett, 2008; Fernhaber & Patel, 2012), and the programs have a high degree of interaction across the organization (Floricel & Ibanescu, 2008; Killen & Hunt, 2013). However, scholars have suggested that these capabilities can't be bought, and firms must develop these capabilities over time (Barney, 1991; Cooper et al., 2001; Eisenhardt & Martin, 2000; Killen & Hunt, 2013).

Prior research has suggested methods for effective portfolio management to achieve a competitive advantage (Goold & Luchs, 1993; Killen & Hunt, 2013). These include resource agility, which is the ability of a firm to effectively relocate resources by canceling or slowing down programs that are performing poorly to free up resources for programs that have more potential for economic gain (Cooper & Edgett, 2003, 2008; Henderson, 1994; Killen & Hunt, 2013), developing managerial decision making (Eggers, 2012), evaluating program choices (Cooper & Edgett, 2008; Henderson, 1994), and ensuring the portfolio is aligned with the firm's strategy (Goold & Luchs, 1993; Robins & Wiersema, 1995). In addition, practitioners believe that maintaining a balanced portfolio and managing the portfolio pipeline increase a firm's performance (Killen & Hunt, 2013).

Economies of scope are when the sum of all outputs for an organization or firm the cost of the joint operation is less than the cost of producing each output independently (Gimeno & Woo, 1999; Panzar & Willig, 1981). Scholars have stated that firms achieve economies of scope by combining resources to develop products for multiple markets (Bailey & Friedlaender, 1982),

using indivisible resources for more than one market (Teece, 1980), and when markets share intangible resources (Gimeno & Woo, 1999). Firms that develop the capability to manage multiple programs take advantage of shared activities, risk reduction, as well as multipoint competition to achieve a competitive advantage (Barney & Hesterly, 2010). In addition, firms develop capabilities to achieve a competitive advantage through their processes, resources, and historical paths (Killen & Hunt, 2013; Teece et al., 1997). Since these resources are valuable, rare, inimitable, and not easily substitutable, firms that develop the capability to manage mutually reinforcing portfolios have a sustained competitive advantage (Barney, 1991; Wernerfelt, 1984).

2.2.1.1 Cost

Scholars have long acknowledged that capabilities, such as accumulated technical knowledge, can be an antecedent (Helfat, 1997; Tripsas, 1997; Verona, 1999) as well as a moderator (Ulrich et al., 2019; Verona, 1999). See Table 2. While the capability of a firm to manage mutually reinforcing portfolios can be both an antecedent and a moderator, for the purposes of this study, it makes sense to look at this capability as a moderator since I am interested in the impact that the capability has after a firm incurs a cost overrun.

Table 2 Antecedent vs. Moderator

	Antecedent	Moderator
Cost	Accurate cost forecasts Select appropriate suppliers	Reputation-proven track record of similar prog Expert judgment Shift resources Economies of scope
Schedule	Accurate schedule forecasts Expert Judgement	Shift resources from similar programs Benchmarking ID best practices Generate ideas for improvement
Scope	Expert judgment Statement of scope development	Expert judgment Corrective actions Increased Defect repair processes Stakeholder communication

As scholars have stated that Porter's (1985) value chain and the resource based view (Barney, 1991) are complementary (Sheehan & Foss, 2009), it makes sense to look at why the capability to manage mutually reinforcing portfolios moderates the impact of cost overruns in terms of the value chain as the lower portion of the value chain has a direct impact on the competitive advantage of firms. In the areas of inbound logistics and operations, firms can leverage their experience and knowledge by selecting appropriate suppliers (Porter, 1985). Additionally, firms experience economies of scope by investing in technology to develop lower-cost processes, facilitate automation, and develop low-cost designs (Porter, 1985). The upper portion of the value chain provides benefits as well, specifically by providing economies of scope. For example, the cost of the infrastructure can be spread across multiple programs. A firm's human resource management can provide expert judgment in the areas of inbound logistics, operations, outbound logistics, marketing and sales, and service. Firms can spread technology development costs spread across multiple similar programs. Procurement costs can be reduced and shared in

inbound logistics and operations in the form of materials and energy consumption. Firms can also leverage their outbound logistics in terms of their expertise and experience in their transportation services. Additionally, firms can also leverage their marketing and sales to provide similar messaging about related programs. Economies of scope can be obtained in the area of services in terms of personnel recruiting, manual development and procedures, spare part management, and service representatives (Porter, 1985).

Porter's (1985) value chain also provides additional ways to look at the capability as a moderator. For example, suppose a firm experiences a cost overrun. In that case, the firm can reduce the impact on operations by shifting or leveraging expert judgment already in place at other programs (shift resources or capabilities). Suppose a need arises in a program for technology development. In that case, firms with higher levels of the capability to manage mutually reinforcing portfolios will have the ability to develop new testing procedures faster by tapping into expert judgment across programs. In procurement, if a cost overrun occurs, firms can lean on suppliers to reduce costs. Additionally, firms can mitigate the impacts of that cost overrun by using their marketing and sales to highlight their reputation as a proven provider of similar CoPS (Davies & Hobday, 2005).

2.2.1.2 Schedule

Firms with the capability to manage mutually reinforcing portfolios can conduct benchmarking, which involves comparing processes and operations to comparable programs to identify best practices, generate ideas of improvement, and provide a basis for measuring performance (Institute, 2013). Following Porter's (1985) value chain concept, firms with this capability will also leverage their capability to shift resources such as technical experts and common parts between programs to mitigate the impacts of a schedule overrun. Additionally,

firms will draw on their expert knowledge and judgment to identify the best practices in problem mitigation and process improvement when scheduling shifts occur.

2.2.1.3 Program Scope Changes

Firms with the capability to manage mutually reinforcing portfolios that experience a program scope change to their program can draw from their vast reservoir of expert judgment (Institute, 2013), which will mitigate the impacts of the changes and reduce the likelihood of program failure. Expert judgment often comes from other programs within the firm and internal and external subject matter experts (Institute, 2013). Firms develop higher levels of expert judgment by increasing their portfolio of similar programs (Biedenbach & Müller, 2012). Firms that select the programs that best align with their strategy (Eggers, 2012) and with the rest of their portfolio of programs (Cooper & Kleinschmidt, 1995) exhibit higher levels of expert judgment that can reduce the likelihood of program cancellation (Biedenbach & Müller, 2012)

In addition, expert judgment can come from many sources, including other units within the organization, consultants, stakeholders (including customers or sponsors), professional and technical associations, industry groups, and internal subject matter experts (Institute, 2013). Firms with higher levels of the capability to manage mutually reinforcing portfolios mitigate the impacts of scope changes by taking corrective actions that intentionally realign the performance of the program work with the program management plan. Additionally, the firm can take preventive action that ensures that the future performance of the program is aligned with the program plan.

Finally, the firm can identify and conduct defect repairs that modify a non-conforming program or program component (Institute, 2013). Firms with higher levels of this capability will also be able to mitigate the impacts of program scope changes by identifying the impacts to other organizational areas, identify impacts to entities inside or outside the organization such as suppliers

or critical stakeholders, as well as have established procedures for stakeholder communication and reporting requirements (Institute, 2013).

Therefore:

H2a: In programs that experience cost overruns, a firm's increased capability of managing mutually reinforcing portfolios decreases the likelihood of program cancelation.

H2b: In programs that experience schedule overruns, a firm's increased capability of managing mutually reinforcing portfolios decreases the likelihood of program cancelation.

H2c: In programs that experience program scope changes, a firm's increased capability managing of mutually reinforcing portfolios decreases the likelihood of program cancelation.

2.2.2 Corporate Political Capability

Not all capabilities are dedicated to influencing the markets in which firms compete. One form of an intangible capability employed outside a firm's typical market is a firm's ability to influence key stakeholders. In the context of the Department of Defense and the U.S. defense industry, influencing key stakeholders in government by firms in the defense industry has long been a source of concern (Dunlap, 2011). Other key leaders have viewed the capability of firms in the defense industry to influence key stakeholders as an important part of the firms' strategy to impact program performance (Gates, 2014).

Powerful stakeholders in the firm's sphere can significantly alter the decision-making and strategies of the firm (Freeman, 1984). Influential stakeholders are also an essential aspect of the firm's external environment (Oliver & Holzinger, 2008). Two such examples of powerful stakeholders are governments and institutions. Strategy scholars have long-held beliefs that these two entities are important elements for all firms to consider (Hillman, Zardkoohi & Bierman, 1999;

Pfeffer & Salancik, 1978; Teece et al., 1997) and are a salient part of a firm's strategy (Hillman & Hitt, 1999; Oliver & Holzinger, 2008; Porter, 1990).

For firms to be successful, they need capabilities to effectively operate in their traditional business markets and capabilities to manage their non-market influences such as governments, interest groups, activists, and public sentiment (Baron, 1995; Oliver & Holzinger, 2008). In addition, the actions firms take must be specifically tailored to the issue, government, or institution where their interests lie (Baron, 1995; Baron, 1997). For instance, scholars have stated that it is almost impossible for industry managers to understand the complex inter-workings of the government, and these managers need access to government insiders to understand the political process; otherwise, the firms will expend significant resources for even minor gains (Hillman, Zardkoohi & Bierman, 1999). Since governmental strategies and policies can significantly influence firms strategies and profitability (Hillman & Hitt, 1999; Murtha & Lenway, 1994; Porter, 1990), firms must have the capability to absorb external influences from the environment and adapt their portfolios in accordance with the new developments to be effective (Biedenbach & Müller, 2012; Cooper et al., 2001).

Scholars suggest that managers typically understand the challenges associated with markets better than those of non-market forces such as the government (Baron, 1995). However, firms that develop a capability to implement a corporate political strategy of interaction with governments are more likely to achieve a competitive advantage and create value from the interaction with the government (Hadani et al., 2021; Hillman & Hitt, 1999; Holburn & Zelner, 2010; Makadok, 2001; Oliver & Holzinger, 2008; Schuler, 1996) since firms that rely on interactions with governments' must engage in the form of political action to be successful (Yoffie, 1988).

As the programs of firms in the defense industry experience cost overruns, schedule overruns, and program scope changes, managers will take two broad categories of actions, internal actions, and external actions. The internal actions have been previously described under the capability to manage mutually reinforcing portfolios. One of the powerful external actions managers can take is the ability to influence one of the critical stakeholders that can impact program cancellations. Those stakeholders are the members of the U.S. Congress that have a vested interest in the specific program built in their state or congressional district.

Strategy scholars have long held that the choice of where a firm conducts business is an important part of a firm's strategy (Ramos & Shaver, 2009). In the defense industry, the firms have already received a benefit from choosing their specific locations by providing jobs, influence, and attention to the members of congress where the program is ultimately built (Gates, 2014). However, as the programs accrue cost overruns, schedule overruns, or program scope changes now these same programs can generate negative and unwanted publicity to the members of congress. In order to combat this negative attention, firms will donate money to the members of congress to ensure that the program does not get canceled. Members of congress have the ability to vote on both the appropriations bills and authorization bills that determine the fate of defense programs (Galvin et al., 2018). Powerful members of congress have used this power to keep programs that the U.S. Department of Defense recommended for cancellation, such as when the U.S. Air Force recommended the cancellation of the A10 aircraft (Gates, 2014).

Therefore, in the context of firms in the defense industry, I hypothesize that:

H3a: In programs that experience cost overruns, a firm's increased corporate political capability decreases the likelihood of program cancellation.

H3b: In programs that experience schedule overruns, a firm's increased corporate political capability decreases the likelihood of program cancellation.

H3c: In programs that experience program scope changes, a firm's increased corporate political capability decreases the likelihood of program cancellation.

3.0 Methods and Data

3.1 Data

The data for each program was extracted out of a DoD document called a Selected Acquisition Report (SAR). The SAR included information on the program, including the program managers, the mission and description of the item, and executive summary, threshold breaches, schedule, performance metrics, budget, funding, unit costs, and contract information. The SAR provided all of the relevant detail about a Department of Defense Acquisition program. The Defense Acquisition Management Information Retrieval (DAMIR) database maintains a SAR for every Major Defense Acquisition Program (MDAPs). MDAPs are programs that reach $525 million in research, development, test, and evaluation dollars or over $3.065 billion in procurement dollars.[6] The DAMIR database requires special access that the Office of Secretary of Defense for Acquisition, Logistics, and Technology typically grants to acquisition professionals and Department of Defense members who require access. I contacted the DAMIR help desk and requested access to the database on February 21, 2018. Since I am an active-duty Army officer affiliated with the Army War College researching Defense Programs, I was granted access to the database. This study does not include any classified or sensitive information.

The DAMIR website included information on 202 Acquisition initiatives as of March 2018 that had reached Milestone B. Once an initiative reaches Milestone B, it becomes a Program of Record and becomes the appropriate unit of analysis for DoD defense programs (Galvin et al.,

[6] See Title 10 U.S.C. 2430 (Reference (n)).

2018; McNicol & Wu, 2015). Fifty of the initiatives were duplicates or prior versions of the same program. Twenty-six of the programs were labeled For Official Use Only (FOUO) and could not be included in the study. Six of the SARs had incomplete data and could not be used for the study. That left the total number of programs in the sample as 118 with 1341 program years. The beginning of the sample period was 1982, and it ended in 2018. Of the 118 programs, 26 were canceled for a cancellation rate of 22%. The final sample included 17 different defense contractors that served as the Prime Contractor for these 118 programs. See Table 3 for a list of the defense contractors.

Table 3 Defense Contractors

	Total # of Programs	Total # of Program Years	Number of Cancelled Programs
Airbus	1	8	0
BAE	5	63	0
Bell Helicopter	1	17	0
Boeing	21	250	4
General Dynamics	9	113	4
General Electric	1	2	0
Huntington Ingalls Industries	1	7	0
ITT	1	12	0
Lockheed Martin	25	284	7
McDonnell Douglas	1	3	0
Newport News Ship Building	1	10	0
Northrop Grumman	24	279	3
Oshkosh Defense	2	24	0
Raytheon	21	234	6
Rockwell Collins Inc	1	17	0
Textron Systems Corp	2	9	1
United Defense	1	9	1
Total	118	1341	26

Firm financial data and firm program data were collected from the Capital IQ database. These 118 programs were Programs in the DAMIR database include SARs from the Army, the Air Force, the Navy, and Joint programs. Joint programs designate a lead service for the management of the program, but the equipment will go to two or more services. For example, the F35 Joint Strike Fighter is a joint program where both the Air Force and Navy received aircraft. See Table 4 for a summary of the programs.

Table 4 Program Breakdown

	Programs	Cancelled	Not-Cancelled	Joint	Not-Joint
Army	40	12	28	12	28
Air Force	37	7	30	11	26
Navy	41	7	34	5	36
Total	118	26	92	38	80

3.1.1 Dependent Variable

Program Cancellation, was operationalized as a binary variable determined by whether the program had been canceled or not after Milestone B. The dependent variable was coded as a one for the year in which the SAR listed the program as canceled. Otherwise, the variable was coded as zero for that program year. There were 26 program years (26 programs) that were coded as canceled, and the remaining 1315 program years (92 programs) were treated as right-censored (Klein & Moeschberger, 1997). Program cancellation data initially came from the DAMIR database and then was confirmed by the information in the SAR for each program.

3.1.2 Independent Variable

Cost Overruns was operationalized using three conditions proposed by previous scholars to represent cost overruns in previous research. First, if a program triggered a Nunn-McCurdy breach for the program year, it was coded as one for a cost overrun in that year (Schwartz & Connor, 2016). Second, if the program had a Program Acquisition Unit Cost (PAUC) growth during that program year, it was also coded as a one for cost overrun. PAUC growth included both Research, Development, Test, and Evaluation (RDT&E) and procurement cost, and previous scholars have used PAUC as their measure of unit cost growth in the context of program cancellations (Mcnicol, 2017). Following their lead, I measured PAUC growth (or shrinkage) by comparing the baseline value from Milestone B to the last value reported on the SAR. Third, since some programs failed to produce any items, the variable was coded as a one if the program exceeded the cost estimate of the baseline value from Milestone B during that program year to the final value reported on the SAR. Otherwise, the variable was coded as zero.

3.1.3 Independent Variable

Schedule Overruns was operationalized as the longest length of the acquisition program not meeting the terms of the contract's schedule during the program year. Schedule overruns were highlighted in the SAR as a breach of the program schedule. For example, the SAR Stryker (2011) listed three breaches to the Acquisition Program Baseline (APB) shown in figure 4 (Dopp, 2011). The first was for the Armor IFR that missed the threshold in 2004. The second was the Nuclear, Biological, Chemical Reconnaissance Vehicle (NBCRV) which achieved Full-Rate Production in

December 2011, but the threshold was in 2006. The third was the Mobile Gun System (MGS) had not met Full-Rate Production even though it was scheduled for 2006. See Figure 4.

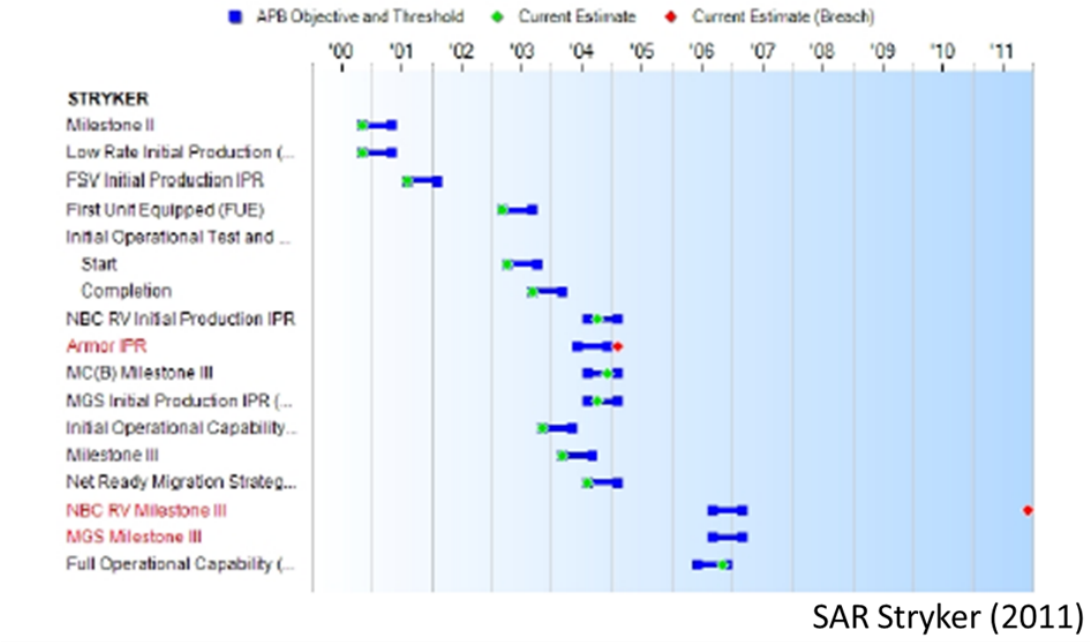

Figure 4 Schedule Overrun Example

3.1.4 Independent Variable

Program Scope Change was defined as a change in the initial contract due to an Acquisition Decision Memorandum (ADM) or an Engineering Change Proposal (ECP) authorizing a change to the current program. For instance, ADM dated April 6, 2010, Subject: Hull Survivability Enhancements for Stryker Vehicles (DVH) changed the program to modify the vehicle's hull to increase survivability for the soldiers inside the vehicle if they hit an improvised explosive device (SAR Stryker, 2011). If a program had an ADM or ECP listed in the SAR during the program year, the measure was coded the total number of ADMs and ECPs during that program year. Otherwise, it was coded as zero.

3.1.5 Moderator

The variable of managing mutually reinforcing portfolios ($Reinforcing$) was operationalized by using a course-grained proxy for the variable since there is an inherent difficulty in measuring intangible capabilities. Each firm in the defense industry produces multiple programs during each program year. Every program was assessed on several different categories such as domain (i.e., air, space, sea, land, or cyber), mission (i.e., fighter aircraft or strategic lift), powerplant (i.e., diesel engine vs. turbine), the commonality of components (i.e., same weapons system such as a 120mm cannon), and transportation mode (i.e., tracked vehicle or wheeled vehicle) by the expert opinion of the author who has over 25 years of operating and maintaining the products of the U.S. Defense Industry. Additionally, the method of coding these programs was confirmed by an Acquisition Professional with over 21 years of managing Defense Acquisition programs. For each program year, I used a Blau index of variability to calculate the overall variation of the programs in a firm. The formula for the Blau index I used was: $1 - \sum {p_i}^2$ where p is the proportion of programs in a given category, and i is the number of different categories .

3.1.6 Moderator

The moderator of Corporate Political Capabilities (CPC) operationalization consisted of the dollar amount of lobbying by the firm to the three members of congress of the location of the firm as listed on the SAR divided by the total dollar amount of money that the firm gave to members of congress for that year (Gates, 2014; Sutton et al., 2021).

Previous scholars have measured Corporate Political Activity (CPA) using all firm expenditures to legislators (Hadani et al., 2021). My measure for Corporate Political Capability

differs from CPA by focusing on specific members of Congress that the firms target in order for them to improve the outcomes of their efforts. Scholars have stated that for an activity to be considered a capability, the activity must meet be practiced routinely and must provide reliable results (Helfat & Peteraf, 2003; Kleinschmidt et al., 2007).

3.1.7 Controls

The models include the same control variables. The control variables generally fell into one of three categories, 1) related to the program, 2) related to the firm, or 3) related to congressional district.

The first control variable related to the program was labeled *Service*. This variable represents the specific department in the department of defense that the program originated from, such as the Army, Navy, or Air Force (the U.S. Marine Corps programs fell under the Department of the Navy since their funding is allocated by Congress to that Department). This variable accounts for the different cultures in the Services as differences in the services have led to different decisions on funding priorities (Builder, 1989), and the information came for the SAR. $NumberBuil$t represents the number of items built during each program year as some programs, such as Army ground combat vehicles, have thousands of vehicles, while Navy capital ships may only consist of a few ships in the program. The source for this data was the SAR. *Jointness* was a dummy variable in which multiple services (e.g., Army and Navy) provided funding to the program. Programs that had multiple services provide funding for the program were coded as a one for a joint program. Otherwise, the measure was coded as a zero. Services have different procedures for acquisition programs and different champion stakeholders and controlling for these joint programs rules out the possibility that the multiple stakeholders could impact the program's

success or failure (Galvin et al., 2018). *FMS* represented a dummy variable that indicates if the program was sold to foreign governments during that program year. Controlling for FMS as critical as FMS decisions have been shown to extend programs for export purposes. I also controlled for Technology. The *Technology Readiness Level (TRL)* is an important component of U.S. DoD programs and is a part of the decision to move the program to a program of record (post Milestone B). However, since the TRL is usually found in sensitive documents, I used the time a program stayed between Milestone A and B as a proxy for the TRL. *Contract Type* represented a dummy variable that accounts for one of seven different types of contracting mechanisms used by the Department of Defense (1-Cost Plus Incentive Fee, 2-Cost Plus Fixed Fee, 3-Firm Fixed Price, 4-Fixed Price with Economic Price Adjustment, 5-Cost Plus Award Fee, 6-Cost Sharing, and 7-Fixed Price Incentive). Prior research has shown that different contracting mechanisms can impact the success or failure of programs (Davies & Brady, 2000). The contract type was indicated on the SAR. All program data, including firm location and the prime contractor, was pulled from the program SARs.

The first control variable related to the firm was *Firm Age*. Age has been shown in prior research to impact failure in a firm (Thornhill & Amit, 2003). Additional controls included *Prior success*, which represents the number of programs each firm had successfully conducted in the past. Controlling for this was important as previous scholars have previously shown that a firm's prior success had contributed to program performance (Wheatcraft, 2011). This variable was measured by the successful number of program years each firm has conducted in the past. *Absorptive capacity* has been shown in previous research to mitigate the impacts of cost overruns and was measured by the firm's innovation effort, expressed as one plus the logarithm of the ratio of R&D expenditures to total revenue (Fernhaber & Patel, 2012; Howell, 2019). *Total Assets* from

the firm were used as previous research has shown that firm size can impact program performance (Fernhaber & Patel, 2012). Firm data was pulled from Capital IQ.

Additional data was collected to determine the U.S. Representative and U.S. Senators for each program as indicated from the contractor's location on the SAR. Congressional districts were determined from the United States House of Representatives official website[7]. Senators were determined from the United States Senate official website.[8] Additional controls included the party of the representative and senators in the district and state, the number of years in Congress, and the membership of key committees that directly impact defense acquisition programs[9]. Each of these has been cited as impacting program performance (Gates, 2014). Additionally, I controlled for the total number of members of congress that each firm donated to during each year. Data for donations from firms were provided by Opensecrets.org[10].

[7] https://www.house.gov/representatives/find-your-representative

[8] https://www.senate.gov/artandhistory/history/resources/pdf/chronlist.pdf

[9] Information on the House Armed Service Committee, House Appropriation Committee-Defense, Senate Armed Services Committee, and the Senate Appropriation Committee-Defense was obtained through information provided by the official historian of the U.S. House of Representatives: Nelson (1993) Committees in the U.S. Congress, 1947-1992, Volume 1. Nelson and Stewart (2012) Committees in the U.S. Congress, 1993-2011. Information past 2011 was pulled directly from the official U.S. House of Representatives and U.S. Senate websites.

[10] https://www.opensecrets.org

3.2 Empirical Model

For testing the main effect of cost, schedule, and scope overruns on the likelihood of program cancellations, I used a cox proportional hazards model, which gives the likelihood of experiencing an event, the program cancellation, with versus without specific factors, such as cost overruns (H1a), schedule overruns (H1b), and program scope changes (H1c). My expectation is that for programs that experience cost, schedule, and scope overruns, the likelihood of program cancellation increases. I chose a Cox proportional hazards regression model as this method is appropriate for measuring an elapsed time to an event, and it is used for the analysis of survival data (Gudmundsson & Rhoades, 2001; Motulsky, 2018). The Cox proportional hazards regression is used to compute risk ratios for each of the variables of interest. The hazard function of a program $h_p(t)$ is expressed as:

(1) $h_p(t) = h\big(t; x_p\big) = h_0(t)\exp\,(x_p'\beta)$

where $h_0(t)$ is an unspecified baseline hazard function relating the probability of failure conditional on the program having survived until time t, x_p is a vector of measured explanatory variables for the pth program, and β is the vector of regression parameters to be estimated.

The time to event variable was the program length, measured in years. The censoring value was if the program for a specific firm year was not canceled. The covariate of interest in the Cox proportional hazard model as indicated above was whether or not the program experienced a cost overrun, schedule overrun, or program scope change in the specific program year. The analysis was conducted using SAS version 9.4. Since the event of interest occurred 26 out of 1341 times, the event is classified as a rare event, and I used Firth's (1993) approach for bias reduction of

maximum likelihood estimates for rare events (Allison, 2012; King & Zeng, 2003; Williams, 2019).

3.2.1 Endogeneity

If cost overruns, schedule overruns, and program scope changes are the result of unobservable program-level factors that impact the likelihood of survival, it is possible that the empirical results are biased (Abdallah et al., 2015). In order to address this potential concern, I used a control function estimation (CFE) as an approach to control for endogeneity. The CFE approach is a more general approach than the two-stage least squares; however, it is more appropriate for non-linear models such as cox proportional hazards models (Choi & McNamara, 2018). Similar to two-stage least squares, this method first estimates the model of the explanatory variables as a function of the instrumental variables. Then, the residuals from the first step are included as variables in the main model. I used three instruments that were only correlated with the independent variables (Menaldo, 2011). I used annual funding for cost overruns which represented all of the funding for that program during the program year. Annual Funding was listed on the SAR for each program. I used overrun length for schedule overruns which included the total of all overruns measured in years from the originally scheduled date. I used the number of engineering change proposals and acquisition decision memoranda per year for program scope change. The results representing the reduced form of the residuals are included in the results tables.

4.0 Results

Table 5 provides the descriptive statistics and correlations for each variable. Table 6 presents the results of the survival analysis. Assumptions for Cox proportional analysis were met, and all models' convergence status was satisfied. Additionally, multicollinearity was not an issue since no individual variables had a maximum VIF of 3.51 (IDRE, 2021). A positive coefficient indicates an increase in the hazard rate or a decrease in the likelihood of survival. Conversely, a negative coefficient indicates a decrease in the hazard rate or an increase in the likelihood of survival (Agarwal & Audretsch, 2001).

Table 5 Correlatons and Descriptive Statistics

	Mean	SD	Minimum	Maximum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Cancelled	0.02	0.14	0.00	1.00	1.00																										
Service	1.97	0.79	1.00	3.00	-0.04	1.00																									
Joint	0.23	0.42	0.00	1.00	0.08	0.09	1.00																								
Total Built	0.00	1.00	-0.14	22.38	-0.01	-0.06	0.13	1.00																							
Cost Overrun	0.30	0.46	0.00	1.00	0.12	0.03	-0.05	-0.06	1.00																						
Schedule Overrun	0.11	0.31	0.00	1.00	0.23	-0.18	0.04	0.00	0.02	1.00																					
Scope	0.23	0.42	0.00	1.00	0.02	-0.17	-0.05	0.02	0.04	0.05	1.00																				
Prior Success	0.00	1.00	-1.33	2.70	0.06	0.32	0.06	-0.01	0.01	0.08	0.14	1.00																			
Absorptive Capacity	0.00	1.00	-13.15	2.97	0.00	0.15	0.15	0.01	-0.10	0.01	-0.13	-0.02	1.00																		
Contract Type	4.54	2.14	1.00	8.00	-0.12	0.14	-0.10	0.06	0.11	-0.23	-0.02	0.05	-0.08	1.00																	
TRL	0.00	1.00	-1.03	3.76	0.02	0.22	0.13	0.00	-0.03	0.01	-0.11	0.07	0.01	-0.13	1.00																
FMS	0.26	0.44	0.00	1.00	-0.05	0.00	0.28	0.07	0.03	-0.10	0.06	0.19	0.07	0.11	-0.11	1.00															
Total Assets ($M)	0.00	1.00	-1.31	13	0.04	0.23	0.05	0.01	-0.01	-0.02	0.14	0.58	0.17	0.02	-0.01	0.15	1.00														
Firm Age	0.00	1.00	-3.51	2.97	0.07	0.11	0.09	0.04	0.06	0.08	-0.06	0.35	0.16	0.03	0.05	0.10	0.35	1.00													
Party rep	0.51	0.50	0.00	1.00	-0.04	0.00	0.03	-0.05	0.08	0.01	-0.04	-0.12	-0.16	0.10	0.02	0.15	-0.19	-0.16	1.00												
Years in Congress	0.00	1.00	-1.23	4.03	0.00	-0.06	0.02	0.03	-0.10	-0.06	-0.05	-0.04	-0.08	0.01	-0.07	0.12	-0.02	-0.03	0.07	1.00											
Party Sen1	0.43	0.50	0.00	2.00	0.00	-0.13	0.06	0.04	0.02	-0.09	0.03	-0.10	0.00	0.14	-0.03	0.10	-0.03	-0.03	0.10	0.05	1.00										
Years in Sen1	0.00	1.00	-1.13	3.68	-0.02	-0.01	0.05	-0.03	-0.03	0.19	-0.01	0.02	0.18	-0.08	-0.05	-0.09	-0.13	0.00	-0.10	-0.07	-0.22	1.00									
Party Sen2	0.51	0.50	0.00	1.00	0.02	-0.19	0.14	0.10	-0.03	-0.05	0.09	-0.02	0.03	0.07	-0.11	0.20	0.02	-0.12	0.16	0.09	0.61	-0.22	1.00								
Years in Sen2	0.00	1.00	-1.63	3.08	0.04	-0.15	0.00	-0.05	-0.04	0.10	0.09	0.13	-0.05	0.09	-0.14	-0.03	0.08	0.11	-0.08	-0.01	0.16	0.12	0.06	1.00							
HASC	0.23	0.42	0.00	1.00	-0.03	0.19	-0.08	-0.04	0.10	-0.11	0.02	0.12	-0.04	0.10	0.03	0.03	0.08	-0.04	0.16	0.00	0.08	-0.05	-0.04	-0.09	1.00						
SASC	0.52	0.53	0.00	2.00	0.04	-0.22	0.07	-0.03	-0.04	0.11	0.00	0.05	0.18	-0.01	-0.16	0.05	0.07	0.22	0.06	-0.02	0.12	-0.03	0.22	0.21	-0.06	1.00					
HACD	0.08	0.27	0.00	1.00	0.02	-0.01	0.04	0.03	0.00	0.10	-0.03	0.05	-0.04	-0.01	0.09	0.04	0.06	-0.04	0.08	0.12	0.03	-0.06	0.07	-0.15	-0.10	-0.07	1.00				
SACD	0.45	0.51	0.00	2.00	-0.03	0.31	-0.05	0.03	-0.04	-0.07	-0.08	0.08	0.02	0.01	0.10	0.07	0.01	-0.03	-0.17	0.05	-0.15	0.12	-0.03	-0.06	0.00	-0.53	0.11	1.00			
Number of Congressmen	0.00	1.00	-2.53	1.98	0.04	0.36	0.01	-0.05	0.09	0.01	0.05	0.78	0.01	0.03	0.14	0.11	0.54	0.27	-0.10	-0.07	-0.02	-0.11	0.05	-0.02	0.14	0.04	0.11	0.08	1.00		
Reinforcing	0.00	1.00	-0.66	5.06	-0.02	-0.03	-0.10	-0.01	0.08	-0.08	0.00	-0.23	-0.34	0.16	0.00	-0.02	-0.16	0.14	0.01	0.07	0.04	-0.12	-0.01	0.02	0.01	-0.16	-0.04	0.13	-0.28	1.00	
CPC	0.00	1.00	-0.92	7.96	-0.01	-0.16	-0.01	0.05	-0.01	0.05	0.02	-0.15	-0.03	0.05	-0.13	0.06	-0.12	-0.01	0.00	0.05	0.03	0.22	0.00	0.04	-0.05	0.08	0.00	-0.01	-0.24	0.13	1.00

Note: All correlation values (positive and negative) greater than 0.2 are significant at $p<0.05$.

Table 6 Modeling Results-Cox Proportional Hazards with Firth's Bias Correction

Variable	Model 1 - Controls Parameter Estimate	Model 1 Standard Error	Model 1 p value	Model 2 Parameter Estimate	Model 2 Standard Error	Model 2 p value	Model 3 Parameter Estimate	Model 3 Standard Error	Model 3 p value
Joint	1.146	0.572	0.045	8.328	2.809	0.003	10.638	2.861	0.000
Total Planned	-0.007	0.109	0.945	1.255	0.437	0.004	0.616	0.257	0.017
Prior Success	0.181	0.585	0.757	-2.699	2.091	0.197	0.222	1.341	0.869
Absorptive Capacity	-0.220	0.201	0.273	5.429	1.700	0.001	3.432	1.013	0.001
Contract Type 1	-2.348	0.989	0.018	1.357	1.871	0.468	-1.866	1.866	0.317
Contract Type 2	0.358	0.900	0.691	6.671	2.517	0.008	1.724	1.432	0.229
Contract Type 3	2.581	2.377	0.278	18.765	6.893	0.007	36.250	9.595	0.000
Contract Type 4	-3.205	0.885	0.000	-7.602	2.389	0.002	-5.342	1.637	0.001
Contract Type 5	0.226	2.230	0.919	16.797	5.982	0.005	7.932	3.822	0.038
Contract Type 6	0.184	2.260	0.935	26.558	8.830	0.003	7.338	4.835	0.129
Contract Type 7	-3.514	1.314	0.008	2.053	2.644	0.438	5.083	2.366	0.032
FMS	-1.059	0.868	0.223	-5.804	3.034	0.056	-18.207	4.892	0.000
TRL	-0.448	0.311	0.150	-0.666	0.570	0.243	-1.454	0.549	0.008
Total Assets	-0.359	0.428	0.402	-6.304	2.167	0.004	-5.759	1.768	0.001
Firm Age	0.737	0.328	0.025	-0.109	0.875	0.901	1.594	0.831	0.055
Party rep	-0.136	0.583	0.816	-0.108	1.144	0.925	1.584	1.341	0.237
Years in Congress	0.237	0.252	0.346	-1.954	0.982	0.047	-0.264	0.623	0.672
Years in Sen1	-0.147	0.280	0.598	-2.347	0.785	0.003	-3.453	0.958	0.000
Party Sen2	1.353	0.602	0.025	0.189	1.751	0.914	4.611	1.883	0.014
Years in Sen2	-0.002	0.238	0.993	2.943	1.205	0.015	-0.852	0.605	0.159
HASC	0.079	0.652	0.904	4.837	1.974	0.014	2.603	1.452	0.073
SASC - One Senator	-0.012	0.683	0.986	-3.391	1.809	0.061	2.773	1.474	0.060
SASC - Twp Senator	2.992	1.154	0.010	9.448	3.520	0.007	11.298	3.348	0.001
HACD	0.209	1.082	0.847	2.594	1.958	0.185	2.658	1.609	0.099
SACD -One Senator	-1.021	0.680	0.133	-5.046	2.109	0.017	-1.065	1.322	0.421
SACD -Two Senator	6.606	2.581	0.011	20.354	6.239	0.001	22.015	6.504	0.001
Number of Congressmen	-0.213	0.432	0.622	3.864	1.711	0.024	0.246	0.869	0.777
Cost Overrun				0.276	0.113	0.015	3.385	1.249	0.007
Schedule Overrun							3.451	1.442	0.017
Program Scope Changes									
Reinforcing									
CPC									
Reinforcing*Cost									
CPC*Cost									
Reinforcing*Schedule									
CPC*Schedule									
Reinforcing*Scope									
CPC*Scope									
Waldχ2 (df)	40.9 (29)			27.9 (31)			37.8 (33)		

Variable	Model 4 Parameter Estimate	Model 4 Standard Error	Model 4 p value	Model 5 Parameter Estimate	Model 5 Standard Error	Model 5 p value	Model 6 Parameter Estimate	Model 6 Standard Error	Model 6 p value
Joint	5.620	1.943	0.004	6.110	1.741	0.000	1.353	1.231	0.272
Total Planned	-0.318	0.202	0.115	-0.263	0.191	0.169	-0.171	0.225	0.448
Prior Success	2.887	1.755	0.100	-3.035	1.553	0.051	2.225	1.331	0.095
Absorptive Capacity	-0.962	0.447	0.031	-0.451	0.290	0.119	-0.289	0.299	0.333
Contract Type 1	-9.209	3.468	0.008	-9.585	2.848	0.001	3.051	1.974	0.122
Contract Type 2	-3.047	1.771	0.085	1.457	1.388	0.294	2.897	1.638	0.077
Contract Type 3	22.658	6.970	0.001	21.435	5.744	0.000	38.774	9.989	0.000
Contract Type 4	-13.817	3.925	0.000	-13.485	3.478	0.000	-2.253	1.837	0.220
Contract Type 5	-0.761	3.325	0.819	5.273	3.015	0.080	14.766	5.236	0.005
Contract Type 6	9.728	4.518	0.031	6.878	3.785	0.069	27.192	7.721	0.000
Contract Type 7	-7.794	2.849	0.006	-2.625	2.149	0.222	8.608	3.143	0.006
FMS	-12.150	4.111	0.003	-2.848	1.841	0.122	-10.740	3.105	0.001
TRL	-2.167	0.911	0.017	-0.062	0.489	0.898	-2.137	0.718	0.003
Total Assets	-3.285	1.270	0.010	-3.134	1.106	0.005	0.578	0.916	0.528
Firm Age	3.192	1.008	0.002	1.702	0.596	0.004	-0.575	0.654	0.379
Party rep	-0.725	1.503	0.630	2.587	1.106	0.019	3.130	1.465	0.033
Years in Congress	2.733	0.844	0.001	2.576	0.709	0.000	2.294	0.763	0.003
Years in Sen1	-0.754	0.595	0.206	-2.148	0.702	0.002	-1.962	0.721	0.007
Party Sen2	10.100	2.918	0.001	2.559	1.183	0.031	1.366	1.577	0.386
Years in Sen2	-1.394	0.844	0.099	1.027	0.466	0.028	-2.257	0.725	0.002
HASC	4.711	1.764	0.008	6.468	2.020	0.001	1.123	1.088	0.302
SASC - One Senator	-2.094	1.715	0.222	0.033	1.346	0.981	2.659	1.434	0.064
SASC - Twp Senator	6.318	2.977	0.034	9.931	2.986	0.001	7.014	2.772	0.011
HACD	-2.459	2.522	0.330	-4.884	2.059	0.018	-4.612	2.243	0.040
SACD -One Senator	-1.995	1.456	0.171	-3.122	1.278	0.015	-1.279	1.182	0.279
SACD -Two Senator	33.516	9.274	0.000	40.843	10.153	<.0001	40.089	10.421	0.000
Number of Congressmen	-3.129	1.518	0.039	-0.168	0.994	0.866	-6.375	1.826	0.001
Cost Overrun	**2.877**	1.217	0.018	-2.450	1.014	0.016	-1.576	1.203	0.190
Schedule Overrun	**1.143**	0.620	0.066	-2.634	1.617	0.103	6.242	1.939	0.001
Program Scope Changes	**2.104**	0.518	<.0001	-1.874	0.962	0.052	2.146	1.015	0.035
Reinforcing				-0.066	0.439	0.880	1.724	0.618	0.005
CPC							0.723	0.425	0.089
Reinforcing*Cost				-4.088	1.208	0.001	-5.312	1.491	0.000
CPC*Cost							0.371	0.918	0.686
Reinforcing*Schedule									
CPC*Schedule									
Reinforcing*Scope									
CPC*Scope									
Waldχ2 (df)	29.3 (35)			43.4 (38)			41.7 (41)		

Variable	Model 7 Parameter Estimate	Model 7 Standard Error	Model 7 p value	Model 8 Parameter Estimate	Model 8 Standard Error	Model 8 p value	Model 9 Parameter Estimate	Model 9 Standard Error	Model 9 p value	Model 10 Parameter Estimate	Model 10 Standard Error	Model 10 p value
Joint	2.555	1.288	0.047	1.626	1.270	0.201	6.124	1.873	0.001	3.421	1.312	0.009
Total Planned	-0.923	0.319	0.004	-0.025	0.175	0.886	-0.865	0.320	0.007	-0.338	0.235	0.150
Prior Success	1.299	1.479	0.380	2.083	1.374	0.130	-1.912	1.387	0.168	-3.234	1.394	0.020
Absorptive Capacity	0.149	0.305	0.624	-0.241	0.288	0.403	0.297	0.330	0.368	-0.121	0.329	0.713
Contract Type 1	3.554	2.353	0.131	5.977	2.631	0.023	2.571	2.469	0.298	-2.320	2.234	0.299
Contract Type 2	4.800	2.258	0.034	5.960	2.180	0.006	6.090	2.521	0.016	3.342	1.812	0.065
Contract Type 3	36.858	9.567	0.000	42.287	11.209	0.000	14.398	5.883	0.014	9.742	5.800	0.093
Contract Type 4	-2.475	1.843	0.179	-1.838	1.735	0.290	-5.667	2.418	0.019	-8.268	2.892	0.004
Contract Type 5	12.094	5.156	0.019	20.070	6.245	0.001	6.766	4.712	0.151	0.834	4.021	0.836
Contract Type 6	27.492	8.316	0.001	36.758	10.184	0.000	7.794	6.119	0.203	3.305	4.394	0.452
Contract Type 7	0.570	3.130	0.856	12.122	3.953	0.002	-10.771	4.419	0.015	-10.821	4.219	0.010
FMS	-6.688	2.485	0.007	-9.772	2.876	0.001	-0.121	1.703	0.943	2.185	1.923	0.256
TRL	-2.031	0.766	0.008	-1.936	0.698	0.006	-0.275	0.562	0.625	-0.773	0.584	0.186
Total Assets	0.400	0.995	0.688	1.057	0.851	0.214	-2.198	1.040	0.035	-1.851	1.079	0.086
Firm Age	0.473	0.559	0.398	-1.959	0.766	0.011	0.643	0.526	0.222	0.916	0.572	0.110
Party rep	1.541	1.098	0.161	4.975	1.554	0.001	-4.457	1.499	0.003	-3.683	1.536	0.017
Years in Congress	2.687	0.828	0.001	2.580	0.764	0.001	-0.052	0.533	0.923	-0.016	0.571	0.977
Years in Sen1	-3.446	0.959	0.000	-1.434	0.650	0.028	-3.074	1.004	0.002	-1.155	0.680	0.089
Party Sen2	-0.691	1.655	0.677	-1.637	1.465	0.264	0.105	1.643	0.949	2.273	1.198	0.058
Years in Sen2	-0.628	0.538	0.243	-2.402	0.777	0.002	1.456	0.641	0.023	0.754	0.659	0.253
HASC	1.407	1.173	0.230	1.691	1.174	0.150	3.165	1.274	0.013	3.188	1.306	0.015
SASC - One Senator	0.676	1.425	0.635	3.757	1.660	0.024	-0.589	1.476	0.690	0.452	1.439	0.754
SASC - Twp Senator	6.698	2.655	0.012	11.271	3.304	0.001	7.140	2.540	0.005	5.916	2.189	0.007
HACD	-4.026	2.057	0.050	-2.959	2.153	0.169	5.655	2.713	0.037	4.902	2.679	0.067
SACD -One Senator	-4.435	1.493	0.003	-0.671	1.046	0.522	-7.044	2.075	0.001	-7.239	2.199	0.001
SACD -Two Senator	40.936	10.691	0.000	46.243	12.050	0.000	21.391	6.629	0.001	13.895	4.358	0.001
Number of Congressmen	-6.870	1.962	0.001	-7.298	2.145	0.001	-1.715	1.149	0.136	-0.289	0.938	0.758
Cost Overrun	-0.760	1.010	0.452	3.473	1.608	0.031	0.766	1.247	0.539	1.613	1.213	0.183
Schedule Overrun	4.827	1.774	0.007	5.102	1.634	0.002	1.645	1.733	0.343	-2.930	1.191	0.014
Program Scope Changes	1.006	0.914	0.271	3.094	1.115	0.006	-1.351	1.034	0.191	-0.011	1.529	0.994
Reinforcing	0.756	0.608	0.213	2.800	0.879	0.001	1.706	0.638	0.008	1.859	0.629	0.003
CPC	0.812	0.445	0.068	1.032	0.493	0.036	2.397	0.699	0.001	-0.535	0.801	0.504
Reinforcing*Cost	1.801	0.745	0.016	-1.170	0.656	0.075	0.814	0.535	0.128	**-1.481**	0.829	0.074
CPC*Cost	0.845	0.522	0.106	0.965	0.548	0.078	-0.271	0.524	0.606	**0.059**	0.623	0.924
Reinforcing*Schedule	-7.103	1.982	0.000	-7.252	2.202	0.001	-6.405	1.787	0.000	**-3.747**	1.277	0.003
CPC*Schedule				-2.653	1.120	0.018	-1.227	1.320	0.353	**-0.050**	0.866	0.954
Reinforcing*Scope							0.509	0.468	0.277	**1.213**	0.632	0.055
CPC*Scope										**2.980**	1.070	0.005
Waldχ2 (df)	34.6 (43)			34.7 (45)			36.4 (47)			46.2 (49)		

Table 7 Modeling Results (Continued)

Variable	Model 2 Parameter Estimate	Model 2 Standard Error	Model 2 p value	Model 3 Parameter Estimate	Model 3 Standard Error	Model 3 p value	Model 4 Parameter Estimate	Model 4 Standard Error	Model 4 p value	Model 5 Parameter Estimate	Model 5 Standard Error	Model 5 p value
Endogeneity Residual for Cost Overruns	8.489	2.146	<.0001	8.439	1.949	<.0001	7.381	1.589	<.0001	8.054	1.847	<.0001
Endogeneity Residual for Schedule Overruns				3.886	2.515	0.122	-3.151	2.206	0.153	-1.466	2.321	0.528
Endogeneity Residual for Program Scope Changes							9.769	3.323	0.003	-2.884	1.705	0.091
Endogeneity Residual for Reinforcing * Cost										0.685	1.957	0.726
Endogeneity Residual for Reinforcing * Schedule												
Endogeneity Residual for Reinforcing * Scope												
Endogeneity Residual for CPC * Cost												
Endogeneity Residual for CPC * Schedule												
Endogeneity Residual for CPC * Scope												

Variable	Model 6 Parameter Estimate	Model 6 Standard Error	Model 6 p value	Model 7 Parameter Estimate	Model 7 Standard Error	Model 7 p value	Model 8 Parameter Estimate	Model 8 Standard Error	Model 8 p value	Model 9 Parameter Estimate	Model 9 Standard Error	Model 9 p value	Model 10 Parameter Estimate	Model 10 Standard Error	Model 10 p value
Endogeneity Residual for Cost Overruns	7.019	1.676	<.0001	7.927	1.846	<.0001	7.975	1.909	<.0001	7.172	1.628	<.0001	6.477	1.432	<.0001
Endogeneity Residual for Schedule Overruns	-12.271	3.901	0.002	-14.285	4.154	0.001	-10.809	3.542	0.002	-11.120	4.009	0.006	-7.657	3.317	0.021
Endogeneity Residual for Program Scope Changes	8.723	2.972	0.003	1.372	2.104	0.514	8.749	2.839	0.002	-3.031	2.068	0.143	-3.267	2.132	0.125
Endogeneity Residual for Reinforcing * Cost	7.107	2.474	0.004	6.538	2.519	0.009	7.465	2.661	0.005	0.518	2.638	0.844	1.454	2.834	0.608
Endogeneity Residual for Reinforcing * Schedule	4.737	2.145	0.027	-0.357	2.135	0.867	2.955	2.438	0.226	-9.492	3.092	0.002	-8.295	3.250	0.011
Endogeneity Residual for Reinforcing * Scope				2.891	2.602	0.267	0.225	2.839	0.937	-11.305	3.805	0.003	-13.049	4.806	0.007
Endogeneity Residual for CPC * Cost							2.432	3.572	0.496	8.147	3.658	0.026	8.181	4.074	0.045
Endogeneity Residual for CPC * Schedule										6.633	2.414	0.006	9.359	4.096	0.022
Endogeneity Residual for CPC * Scope													-2.029	4.192	0.628

The controls in model 1 of table 6 reveal several interesting insights. Joint programs (programs funded by two or more services) and the technology readiness level had a negative and significant result on the likelihood of program survival. For joint programs, the increased likelihood of cancellation is most likely due to the different performance objectives required by the multiple services, which can add additional requirements to the program and a need for additional coordination among stakeholders. Several contract types (1-Cost plus incentive fee, 4-Fixed price with economic price adjustment and 7-Cost sharing contracts), firm age, the party of the Senators, and when both Senators from the firm's state were on both the Senate Armed Services Committee and the Senate Appropriations Committee had a negative and significant result on the likelihood of program survival.

Hypothesis 1a proposing that cost overruns would increase the likelihood of program cancellation was supported (β=2.877, p=0.018, model 4). The main effect of cost overruns on program cancellation was positive and significant. This indicates that programs without cost overruns are 82.3% (Hazard Ratio = exp(2.877)=17.76) more likely to survive compared to programs that had a cost overrun.

Hypothesis 1b proposing that schedule overruns would increase the likelihood of program cancellation was marginally supported at $p<0.1$ (β=1.143, p=0.066, model 4). The main effect of schedule overruns on program cancellation was positive and significant. This indicates that programs without schedule overruns are 96.8% (Hazard Ratio = exp(1.143)=3.14) more likely to survive compared to programs that had a schedule overrun.

Hypothesis 1c proposing that program scope changes would increase the likelihood of program cancellation was supported (β=2.104, $p<0.001$, model 4). The main effect of program scope changes on program cancellation was positive and significant. This indicates that programs

without program scope changes are 91.8% (Hazard Ratio=exp(2.104)=8.199) more likely to survive compared to programs that had a program scope change.

Hypothesis 2a proposing that the relationship of programs with cost overruns to program cancellation is attenuated by the capability of managing mutually reinforcing portfolios was marginally supported at $p<0.1$ (β=-1.48, p=0.074, model 10). The interaction of cost overruns and the capability of managing mutually reinforcing portfolios was negative and significant, indicating a decrease in the likelihood of program cancellation. Figure 5 shows the graphical representation of the interaction hypotheses.

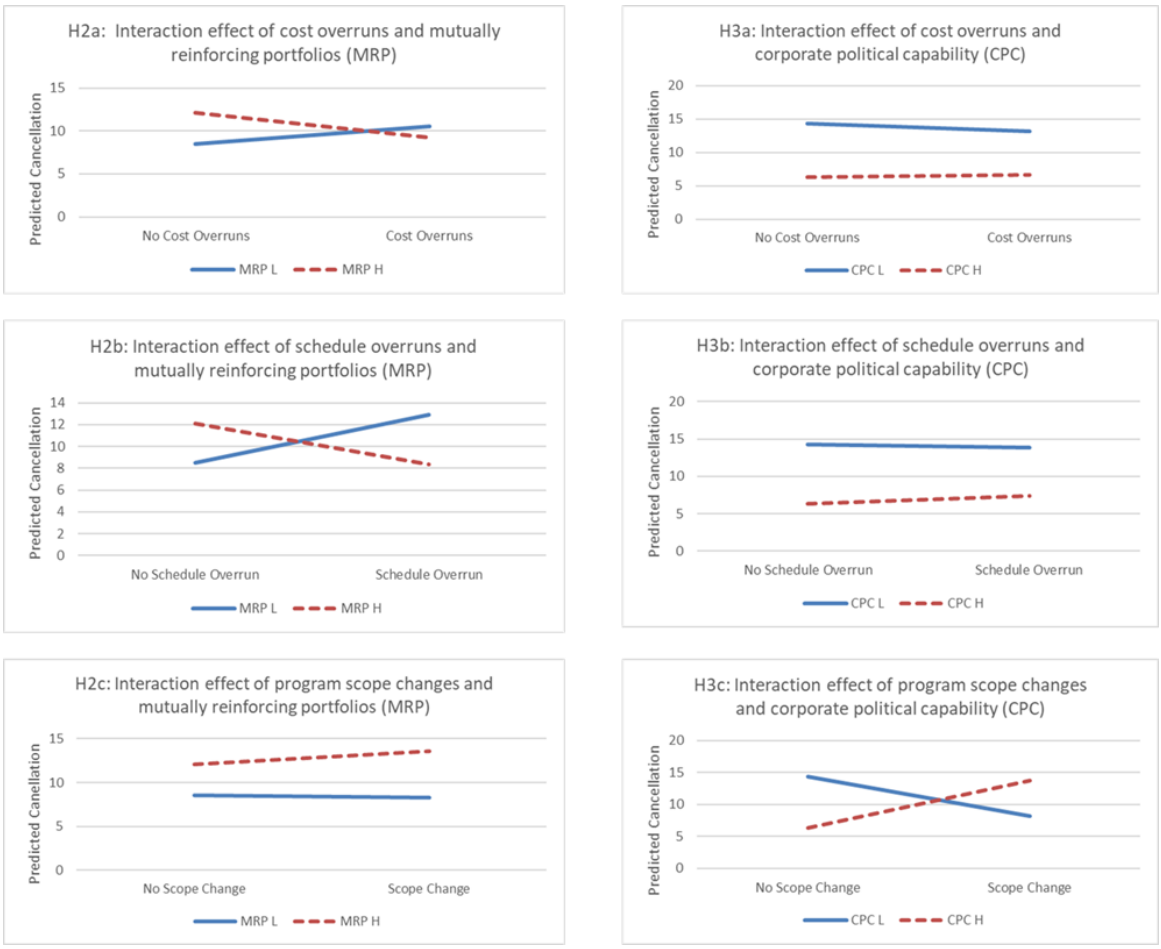

Figure 5 Graphical Representation of the Interaction Hypotheses[11]

Hypothesis 2b proposing that the relationship of programs with schedule overruns to program cancellation is attenuated by the capability of managing mutually reinforcing portfolios was supported (β=-3.747, $p<0.003$, model 10). The interaction of schedule overruns and the capability of managing mutually reinforcing portfolios was negative and significant, indicating a decrease in the likelihood of program cancellation.

[11] To plot the interaction effects, the moderating variables were plotted as having either a high or low level determined by one standard deviation either above or below the mean (Nadkarni et al., 2019).

Hypothesis 2c proposing that the relationship of programs with program scope changes to program cancellation is attenuated by the capability of managing mutually reinforcing portfolios was not supported (β=1.213, p=0.055, model 10). The interaction of program scope changes and the capability of managing mutually reinforcing portfolios was positive and significant, indicating an increase in the likelihood of program cancellation.

Hypothesis 3a proposing that the relationship of programs with cost overruns to program cancellation is attenuated by corporate political capability was not supported (β=0.059, p=0.924, model 10). The interaction of cost overruns and corporate political capability was positive, indicating an increase in the likelihood of program cancellation; however, the results were not significant.

Hypothesis 3b proposing that the relationship of programs with schedule overruns to program cancellation is attenuated by corporate political capability was not supported (β=-0.050, p=0.954, model 10). The interaction of schedule overruns and corporate political capability was negative, indicating a decrease in the likelihood of program cancellation; however, the results were not significant.

Hypothesis 3c proposing that the relationship of programs with program scope changes to program cancellation is attenuated by corporate political capability was not supported (β=2.98, p=0.005, model 10). The interaction of program scope changes and corporate political capability was positive and significant, indicating an increase in the likelihood of program cancellation.

4.1 Robustness Checks

Three tests for model fit were conducted (-2 LOG L, Akaike Information Criterion (AIC), and Schwarz Bayesian Information Criterion (SBC) to check model fit statistics of a model with no predictors versus the model with additional controls. All three provided consistent results. Additionally, three separate tests were conducted to determine if at least one of the regression coefficients is significantly different from zero. These tests were the Likelihood Ratio, the Score Statistic, and the Wald Statistic (Klein & Moeschberger, 1997). All three provided consistent results.

Additional robustness tests were conducted on the baseline hypotheses. First, for cost overruns, I used the program acquisition unit cost (PAUC) increase as PAUC has been used in previous research as a measure of cost overruns in DoD acquisition programs (McNicol & Wu, 2015). The results were supported (β=0.275, p=0.0149), indicating consistency in the model regardless of the measure for cost overruns.

Second, for schedule overruns, I used an alternate measure of the acquisition program not meeting the terms of the contract's schedule. If the program had a schedule breach during the program year, the variable was coded as a one; otherwise, it was coded as a zero. The results were marginally supported (β=2.783, p=0.146), indicating consistency in the model regardless of the measure for schedule overruns.

Third, for program scope changes, I used an alternate measure of program scope changes. Program scope changes were defined as a change in the initial contract due to an Acquisition Decision Memorandum (ADM) or an Engineering Change Proposal (ECP) authorizing a change to the current program. If the program had a program scope change during the program year, the variable was coded as a one; otherwise, it was coded as zero. The results were positive indicating

an increase in program cancellation; however, they were not significant (β=0.876, p=0.460). The use of the alternative measure indicated that the number of program scope changes per program year is a more robust measure of program cancellation than just indicating if the program had a program scope change for the year.

Fourth, I ran the interaction models with the alternate operationalizations used above with the moderators. The results were consistent with the primary measures used in the analysis in direction and significance except for the interaction with corporate political capability and the alternate measure for schedule overruns. The alternate operationalization for schedule overruns resulted in a positive but not significant interaction (β=0.726, p=0.252), indicating an increase in the likelihood of program cancellation. This result differed from the primary operationalization in which the interaction of schedule overruns and corporate political capability was negative, indicating a decrease in the likelihood of program cancellation; however, the results were not significant (β=-0.05, p=0.954, model 10).

5.0 Discussion

The purpose of this study is to examine program outcomes through a capabilities-based lens. Accordingly, I seek to expand the capabilities literature by empirically testing the impacts of managing mutually reinforcing portfolios and corporate political capabilities on program cancellation. In addition, I contribute to the research on defense acquisition by empirically testing deeply embedded assumptions about why major defense programs fail. Studying the firm capabilities deepens the understanding of both practitioners and scholars and assists the defense industry and the DoD in developing complex products for the use of the defense of the United States.

Strategy scholars need to pay attention to firms in the CoPS industries for two reasons. First, as well established in the strategy literature, the choices of markets that a firm competes in clearly represent the strategy that a firm follows (Chen & Miller, 2012; Wiersema & Beck, 2017). Second, by definition, CoPS are difficult, capital, and resource-intensive undertakings (Davies & Brady, 2000). As some scholars have suggested, 40% of firms in the fortune 500 are not likely to survive over the next ten years (Diamandis & Kotler, 2020). These scholars suggest that the speed of innovation and firms' inability to adapt will be the primary drivers of a firm's demise. Since the firms that produce CoPS are susceptible to both of these trends, understanding the capabilities of successful firms is paramount for strategy scholars and practitioners.

5.1 Theoretical Contributions

The first contribution is to research on firms that produce CoPS and program cancellation as I demonstrate that the certain characteristics of complex programs have implications for program outcomes. As previously mentioned, the research streams on program cancellation have long held that cost overruns, schedule overruns, and program scope changes are positively associated with program cancellation. This research contributes to the defense acquisition literature by empirically demonstrating these assumptions.

The second contribution is to the capability literature. In conceptualizing and operationalizing the capabilities of managing mutually reinforcing portfolios and corporate political capability, this work provides a deeper understanding of outcomes of the strategies firms use to impact program cancellation.

The capability of managing mutually reinforcing portfolios was successful in moderating the impacts on program cancellation of cost overruns, schedule overruns but not successful in moderating the impact of program scope changes (Table 6, Model 10). Scholars state that the capability for effective portfolio management improves firms' performance when the firm builds a portfolio that is a balance of the programs that align with the firm's goals (Cooper & Edgett, 2008; Fernhaber & Patel, 2012), and the programs have a high degree of interaction across the organization (Floricel & Ibanescu, 2008; Killen & Hunt, 2013). The results of this study indicate that the capability does not provide a benefit to firms for those programs that experience program scope changes. It is possible that when the characteristics of the program are changed significantly enough, the capability to manage mutually reinforcing portfolios no longer serves any benefits and can serve to have a detrimental impact on a program's success. As the programs experience increased changes, it is likely that the firm needs to build new processes, find new suppliers, and

re-train managers and employees on the skills required for the new requirement (Hensel, 2010). The new requirements that occur as a result of a change to the program's scope may alter the program enough so that the program no longer aligns with the firm's goals or has a high degree of interaction across the organization.

Additionally, the shrinkage of the number of firms in the defense industry capable of managing a major defense acquisition program may result in a direct competitor possessing the skills, parts, or competencies required by a significant shift in a program's scope (Hensel, 2010). This could cause the DoD to question whether or not the program is still viable or if the prime contractor is still the best choice to continue with the program.

The corporate political capability variable did not moderate the impact of program cancellation as predicted. This is potentially due to the context of the capability. In the period of the sample of programs from this study (1982-2018), members of Congress are well aware of public perception (Cayton, 2017), and voting against military-related matters might be against their self-interests as during this timeframe, the military profession was seen as one of the most trustworthy professions and members of congress were seen as the least trustworthy.[12]

In the case of program scope changes, an increased level of corporate political capability tended to increase the likelihood of program cancellation (Table 6, Model 10). This is potentially due to the knowledge asymmetry between the firms, the DoD, and the members of congress. The U.S. DoD has a statutory requirement under the Nunn-McCurdy Act to report Major Defense Acquisition Programs that experience cost and schedule overruns. It is likely that the DoD and members of congress pay more attention and seek information out on cost and schedule

[12] https://www.pewresearch.org/

performance since the U.S. Congress passed a law requiring certain levels of cost and schedule overruns to be reported. However, program scope changes are not required to be briefed to congress under the Nunn-McCurdy Act, and members of congress might be surprised by the program scope changes and less likely to support those changes, especially if the result of the change results in loss of prestige, lost jobs in their state/districts, or public embarrassment (Savage, 2009).

While the decision for firms to develop their corporate political capability makes sense from a strategic decision-making perspective (Hillman et al., 1999; Hillman & Hitt, 1999), there is also a potential downside to firms developing this capability. Powerful stakeholders, such as Congress members, could use their influence to steer programs to firms where the member of Congress stands to benefit personally. For example, Senator Perdue, the chairman of the Senate Armed Service Subcommittee on Seapower, began accumulating shares of a company that manufactures submarine parts right before he took control of the subcommittee in 2019 (Brodey, 2020). In his role, he would have had an influence on the National Defense Authorization Act, in which a $4.7 billion program for submarines was awarded. The Senator later sold his shares in the company that manufactured parts for the submarine at a significant profit. While the goal of these programs is to provide items to defend the United States and its interests, stakeholders could potentially steer programs to firms that either provide a benefit to their congressional district or state (Gates, 2014) or provide a financial benefit to them personally (Karpoff et al., 1999; Rendon & Rendon, 2016) regardless of their impact to national security.

5.2 Managerial Implications

This study lies at the intersection of corporate strategy and National Security. As previously stated, the majority of the literature focuses on the Defense Acquisition side of a symbiotic relationship. Since the DoD does not have the ability to develop CoPS without the defense industry, it is critical to look at the capabilities that make the firms in the defense industry successful. Failure to understand the capabilities impacting program cancelation can have detrimental effects on the U.S. Defense Industrial Base. The Defense Industrial Base accounts for $147B of the annual U.S. Budget. While the U.S. Department of Defense does have its own organic industrial base (e.g., Redstone Arsenal[13]), the organic industrial base (OIB) is incapable on its own of developing and producing the complex products and systems required in defense of the United States. The R&D, intellectual capital, economies of scale of the firms in the defense industrial base provide a vital component of the United States' competitive advantage on the global scale (Galvin, 2018). A reduction in the number of firms competing in the defense industry would be a strategic threat to the United States' defense as the ability to build weapon systems would be significantly degraded. Firms have a choice of what CoPS they will produce as well as in what industry they will compete. Just like Kodak, the firm that first developed the digital camera,

[13] Redstone Arsenal is located in Alabama and is one of many depots, arsenals, and ammunition plants that make up the Organic Industrial Base (OIB). Redstone Arsenal falls under the command of the Army Material Command and conducts repairs, provides equipment, and serves as a source of intellectual capital for the DoD. Some tenant organizations include the NASA Marshall Space Flight Center, U.S. Army Combat Capabilities, Development Command Aviation & Missile Center, the Missile Defense Agency, DIA and the Missile and Space Intelligence Center.

decided that they would enter the U.S. pharmaceutical industry in response to the U.S. Government's request for additional help in response to a national crisis (Levy, 2020), firms in the defense industry could choose to leave the defense industry and develop CoPS for customers with the potential of higher profit margins (Depeyre & Dumez, 2009) and fewer influential stakeholders.

Additionally, there is a high financial cost to developing a corporate political capability. On average, firms in the defense industry spent $1.3 million to 266 members of Congress every year. If the capability does not significantly improve program outcomes, the firm might invest its limited resource of money to more relevant capabilities. However, if the firms recognize that even though corporate political capability does not improve program outcomes for troubled programs, it may still engage in corporate political capability if the firm believes that the capability could generate support among stakeholders for future consideration of major defense acquisition programs.

5.3 Post Hoc Analysis

A post hoc analysis was conducted on the capability of managing mutually reinforcing portfolios. In order to conduct this analysis, I used an alternate measure for the capability. I used the total number of programs that a firm manages divided by the number of similar programs. The new measure may serve as a better measure of the resources that a firm has to moderate the impacts of cost overruns, schedule overruns, and program scope changes on program cancellations. The results indicated that the relationship of cost overruns to program cancellation was moderated by the new measure of managing mutually reinforcing portfolios was not supported (β=3.939,

p=0.012). See Model 11, Table 8. The interaction of cost overruns and the new measure of managing mutual reinforcing portfolios was positive and significant, indicating an increase in the likelihood of program cancellation. The results indicated that the relationship of schedule overruns to program cancellation was moderated by the new measure of managing mutually reinforcing portfolios was not supported (β=1.724, p=0.243). The interaction of schedule overruns and the new measure was positive, indicating an increase in the likelihood of program cancellation; however, the results were not significant.

Table 8 Modeling Results Inverse MRP

	Model 11 -Inverse MRP		
Variable	Parameter Estimate	Standard Error	p value
Joint	1.385	1.546	0.371
Total Planned	0.451	0.259	0.082
Prior Success	-5.641	1.588	0.000
Absorptive Capacity	-0.584	0.310	0.060
Contract Type 1	-11.054	3.126	0.000
Contract Type 2	0.553	1.700	0.745
Contract Type 3	9.503	3.650	0.009
Contract Type 4	-10.585	2.596	<.0001
Contract Type 5	7.017	3.603	0.051
Contract Type 6	3.336	3.603	0.355
Contract Type 7	-7.896	2.526	0.002
FMS	1.342	1.442	0.352
TRL	-1.274	0.680	0.061
Total Assets	1.724	0.464	0.000
Firm Age	1.069	0.494	0.030
Party rep	5.093	1.678	0.002
Years in Congress	0.484	0.529	0.360
Years in Sen1	1.009	0.662	0.128
Party Sen2	0.605	0.908	0.506
Years in Sen2	-0.476	0.526	0.365
HASC	-1.670	1.382	0.227
SASC - One Senator	-0.246	1.645	0.881
SASC - Twp Senator	7.610	2.801	0.007
HACD	-0.592	1.874	0.752
SACD - One Senator	-3.393	1.622	0.037
SACD - Two Senator	23.931	7.154	0.001
Number of Congressmen	3.690	1.179	0.002
Cost Overrun	2.997	1.214	0.014
Schedule Overrun	-2.464	1.199	0.040
Program Scope Changes	0.685	0.879	0.436
Inverse MRP	-1.519	1.283	0.237
CPC	-1.624	0.962	0.091
Inverse MRP*Cost	**3.939**	1.570	0.012
CPC*Cost	**0.749**	0.588	0.203
Inverse MRP*Schedule	**1.724**	1.477	0.243
CPC*Schedule	**-1.327**	0.863	0.124
Inverse MRP*Scope	**2.203**	1.170	0.060
CPC*Scope	**3.732**	1.243	0.003
Wald χ2 (df)		44.6 (49)	

The results indicated that the relationship of program scope changes to program cancellation was moderated by the new measure of mutually reinforcing portfolios was not supported (β=2.203, p=0.06). The interaction of program scope changes and the new measure of managing mutually reinforcing portfolios was positive and significant, indicating an increase in the likelihood of program cancellation. In addition, using the new measure of managing mutual

reinforcing portfolios in the model resulted in the interaction of cost and corporate political capability as not supported (β=0.749, p=0.203), the interaction of corporate political capability and schedule overruns was marginally supported at p<.15 (β=-1.327, p=0.124), and the interaction of corporate political capability and program scope changes was not supported (β=3.73, p=0.003).

An additional post hoc analysis was conducted disaggregating cost overruns into the three components that originally constituted a cost overrun. Cost overruns for the program year as a result of a Nunn-McCurdy breach as indicated from the SAR were coded as one. Cost overruns for the program year as a result of a Program Acquisition Unit Cost (PAUC) growth were coded as two. Cost overruns for the program year that failed to produce any items were coded as three if the program exceeded the cost estimate of the baseline value from Milestone B during that program. The results provide some interesting insights. Two of the three categories of program cost overruns resulted in positive and significant results for the baseline hypothesis, Nunn-McCurdy breaches (β=5.302, p=0.045, n=8) and PAUC growth cost overruns (β=5.66, p=0.011, n=0), indicating an increased likelihood of program cancelation. See Model 12 in Table 9.

Table 9 Modeling Results Cost Disaggregation

	Model 12 Cost Dis			Model 13		
Variable	Parameter Estimate	Standard Error	p value	Parameter Estimate	Standard Error	p value
Joint	1.535	1.197	0.200	4.835	1.479	0.001
Total Planned	-0.364	0.214	0.089	-0.416	0.218	0.056
Prior Success	-0.543	1.272	0.669	-1.937	1.190	0.104
Absorptive Capacity	-0.715	0.353	0.043	2.427	0.871	0.005
Contract Type 1	-8.525	2.547	0.001	3.401	1.813	0.061
Contract Type 2	-5.150	1.831	0.005	5.039	1.947	0.010
Contract Type 3	18.655	5.185	0.000	16.103	5.586	0.004
Contract Type 4	-19.107	4.868	<.0001	0.373	1.648	0.821
Contract Type 5	-4.602	3.771	0.222	18.182	4.956	0.000
Contract Type 6	9.606	4.388	0.029	23.202	5.774	<.0001
Contract Type 7	-12.780	3.623	0.000	0.877	2.138	0.682
FMS	-6.210	2.505	0.013	-0.176	1.723	0.919
TRL	-3.387	0.928	0.000	-0.016	0.461	0.972
Total Assets	0.624	0.860	0.468	-1.067	0.891	0.231
Firm Age	1.110	0.645	0.085	-0.549	0.492	0.265
Party rep	-0.902	0.979	0.357	-1.767	1.099	0.108
Years in Congress	3.158	0.804	<.0001	-0.049	0.528	0.925
Years in Sen1	-0.575	0.486	0.237	-2.934	0.783	0.000
Party Sen2	5.623	1.699	0.001	-3.137	1.289	0.015
Years in Sen2	-0.827	0.461	0.072	-0.475	0.492	0.335
HASC	-2.361	1.388	0.089	-1.360	1.189	0.253
SASC - One Senator	-2.080	1.268	0.101	2.471	1.423	0.083
SASC - Twp Senator	1.900	2.019	0.347	12.229	3.176	0.000
HACD	-0.448	1.293	0.729	0.993	1.819	0.585
SACD - One Senator	-1.600	1.170	0.172	-0.088	1.145	0.939
SACD - Two Senator	28.080	6.788	<.0001	19.938	5.451	0.000
Number of Congressmen	-1.199	1.020	0.240	0.324	0.837	0.698
Cost Overrun -Nunn	**5.302**	2.642	0.045	8.129	3.057	0.008
Cost Overrun-PAUC	**5.661**	2.222	0.011	0.568	1.140	0.618
Cost Overrun-No items	**-4.289**	1.398	0.002	-3.260	1.424	0.022
Schedule Overrun	-0.993	1.102	0.368	4.093	1.257	0.001
Program Scope Changes	-0.125	0.872	0.886	5.080	1.520	0.001
Reinforcing				2.476	0.729	0.001
CPC				2.778	0.787	0.000
Reinforcing*Cost-Nunn				**-3.147**	2.309	0.173
Reinforcing*Cost-PAUC				**0.118**	0.542	0.827
Reinforcing*Cost-No Items				**-2.398**	0.994	0.016
CPC*Cost-Nunn				**17.773**	6.392	0.005
CPC*Cost-PAUC				**-0.651**	0.546	0.233
CPC*Cost-No Items				**-0.601**	1.315	0.648
Reinforcing*Schedule				-2.374	0.994	0.017
CPC*Schedule				-1.120	0.660	0.090
Reinforcing*Scope				-0.378	0.483	0.434
CPC*Scope				-0.352	0.572	0.539
Wald $\chi 2$ (df)		35.9 (37)			48.1 (55)	

However, programs that failed to produce any items but exceeded the baseline estimate had a negative and significant result indicating a decrease in the likelihood of program cancellation (β=-4.29, p=0.002, n=8).[14] However, this disaggregated measure of cost overruns resulted in non-significant results for programs that experienced schedule overruns and programs that experienced

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[14] The remaining 10 program years that were cancelled did not have any cost overruns during that program year. In contrast, there were 599 program years that did not produce an item, did not experience a cost overrun of any type, and were not cancelled. For example, the CVN-68 Nimitz class nuclear aircraft carrier was a program of record for 12 years before the first item was produced (Simei, 2009).

program scope changes (β=-0.99, p=0.37 and β=-0.125, p=0.89). This post hoc analysis considers all of the information made publicly available through the SARs; however, additional information as to the reasons for the cost overruns is sometimes included in the classified annexes to the SARs.[15] Again, this classified information was not included in this analysis of the cost overruns, and no classified material was used in this report.

For the interactions using the disaggregated measure of programs experiencing cost overruns, I expected similar results across all three areas; however, this was not the case. The main model testing Hypothesis 2a proposing that the relationship of programs with cost overruns to program cancellation is attenuated by the capability of managing mutually reinforcing portfolios was supported at p<.1 (β=-1.481, p=0.074, model 10, table 6). The disaggregated measure of cost breakdowns saw similar results for the interaction of the capability of managing mutually reinforcing portfolios and cost overruns triggered by a Nunn-McCurdy breach (β=-3.147, p=0.173, model 13, table 9) and the interaction of managing mutually reinforcing portfolios and cost overruns that exceed the baseline cost threshold but did not have any items built (β=-2.39, p=0.016, model 13, table 9). However, the results were not significant for the interaction of mutually reinforcing portfolios and cost overruns triggered by a PAUC increase (β=0.118, p=0.827, model 13).

The main model testing Hypothesis 3a proposing that the relationship of programs with cost overruns to program cancellation is attenuated by corporate political capability was not supported (β=-0.050, p=0.954, model 10). The disaggregated measure of cost breakdowns and the

[15] Heimann (2014) RQ-4A/B Global Hawk SAR states that additional breakdowns of the cost thresholds are included in the classified annex.

interaction with corporate political capability saw similar non-significant results for the interaction of corporate political capability and cost overruns triggered by a PAUC increase (β=-0.651, p=0.233, model 13, table 9) as well as the interaction of corporate political capability and cost overruns triggered that exceed the baseline cost threshold but did not have any items built (β=-0.601, p=0.648, model 13, table 9). However, the results were positive and significant for cost overruns triggered by a Nunn-McCurdy breach (β=17.78, p=0.005, model 10, table 6), indicating an increase in the likelihood of program cancellation. This result is most likely due to the firm realizing that problems exist within the program, and they are trying to save their program with donations to powerful stakeholders that have shown that they are willing to overrule the DoD on program cancellation decisions if they feel that it is in their best self-interest (Gates, 2014). However, since the U.S. DoD has a statutory requirement under the Nunn-McCurdy Act to report Major Defense Acquisition Programs that experience cost and schedule overruns and it is likely a Nunn-McCurdy Act Breach on a major defense acquisition program would be a newsworthy event (Eckstein, 2021). Therefore, members of Congress might not be willing to support a program that appears to the public that is a waste of U.S. taxpayers' dollars.

Additionally, the model using the disaggregation of cost overruns provided consistent results for Hypothesis 2b proposing that the relationship of programs with schedule overruns to program cancellation is moderated by the capability of managing mutually reinforcing portfolios. Both were supported (β=-3.747, p=0.003, model 10 and β=-2.374, p<0.017, model 13, table 9). The interaction of schedule overruns and the capability of managing mutually reinforcing portfolios was negative and significant, indicating a decrease in the likelihood of program cancellation.

The model using the disaggregation of cost overruns provided consistent results for Hypothesis 2c, proposing that the relationship of programs with program scope changes to program cancellation is moderated by the capability of managing mutually reinforcing portfolios. Both were not supported (β=1.213, p=0.005, model 10 and β=-0.378, p=0.434, model 13). However, the interaction of program scope changes and the capability of managing mutually reinforcing portfolios was negative but not significant instead of positive and significant as the results are in model 10.

The model using the disaggregation of cost overruns for Hypothesis 3b proposing that the relationship of programs with schedule overruns to program cancellation is moderated by corporate political capability was supported at $p<0.1$ (β=-1.12, p=0.090, model 13, table 9). This result differed from the results of the initial measure for cost overruns (β=-0.050, p=0.954, model 10, table 6). The interaction of schedule overruns and corporate political capability was negative, indicating a decrease in the likelihood of program cancellation. This is most likely due to the separating out the impact of the Nunn-McCurdy Act breaches, which provide increased scrutiny by both the U.S. public and the U.S. Congress (Schwartz & Connor, 2016). A firm's corporate political capability can influence the stakeholders' decisions on the programs that experience schedule overruns as long as the DoD and defense contractor believe that the program will deliver the appropriate capability required by the DoD and these programs do not cause the members of congress any undue attention from their constituents. Both the military and the defense industry are vested in the success of the programs, and both parties will work to mitigate the impacts of schedule overruns.

Additionally, MDAPs can take years for the fielding of items to the department of defense. It is possible that the corporate political capability may be able to convince the stakeholders that

the item in the program will still produce the desired results even though the timeline for the program completion has grown. For example, the DoD might be counting on the items from an MDAP to counter the growing influence of China in the South China sea. Firms may use their corporate political capability to either convince the stakeholders that China's influence in the South China sea with only continue to grow and the items are still necessary even though they might be delayed, or that canceling the program and starting a new MDAP will only take longer than accepting the new delivery date of the current program.

The model using the disaggregation of cost overruns provided consistent results for Hypothesis 3c. The model was not supported (β=-0.352, p=0.539, model 13, table 9). However, even though both predictions were not supported, the interaction of program scope changes and corporate political capability was negative but not significant in the post hoc analysis instead of positive and significant as in the original model (β=2.980, p=0.0005, model 10).

An additional post hoc analysis was conducted looking at the interactions among the baseline measures. Model 14, table 10 lists the results of the model. The results indicated that the interactions between cost overruns and schedule overruns (β=1.769, p=0.536) and cost overruns and program scope changes were not significant (β=-0.014, p=0.996). However, the interaction between schedule overruns and program scope changes was positive and significant (β=6.803, p=0.033). In addition, the three-way interaction between cost overruns, schedule overruns, and program scope changes was negative and significant (β=-16.052, p=0.005). This indicates that the interaction of program scope changes and schedule overruns differs across the levels of cost overruns.[16]

[16] https://stats.idre.ucla.edu/other/mult-pkg/faq/general/faqhow-can-i-understand-a-three-way-interaction-in-anova/

Table 10 Modeling Results Three Way Interaction

	Model 14 - Three Way Interaction		
Variable	Parameter Estimate	Standard Error	p value
Joint	1.198	1.317	0.363
Total Planned	-0.487	0.259	0.060
Prior Success	1.460	0.636	0.022
Absorptive Capacity	1.523	1.293	0.239
Contract Type 1	-1.017	0.502	0.043
Contract Type 2	-8.780	2.522	0.001
Contract Type 3	-1.525	1.340	0.255
Contract Type 4	26.096	7.752	0.001
Contract Type 5	-15.733	4.141	0.000
Contract Type 6	2.895	3.448	0.401
Contract Type 7	15.269	5.315	0.004
FMS	-4.012	1.729	0.020
TRL	-13.994	4.270	0.001
Total Assets	-0.253	0.920	0.783
Firm Age	4.070	1.165	0.001
Party rep	0.773	1.066	0.468
Years in Congress	4.882	1.318	0.000
Years in Sen1	-0.794	0.557	0.154
Party Sen2	9.380	2.803	0.001
Years in Sen2	-0.258	0.461	0.576
HASC	-1.678	1.473	0.255
SASC - One Senator	-7.374	2.324	0.002
SASC - Twp Senator	0.120	2.045	0.953
HACD	-3.444	1.753	0.050
SACD - One Senator	-5.106	1.734	0.003
SACD - Two Senator	47.600	12.178	<.0001
Number of Congressmen	-2.341	1.097	0.033
Cost Overrun	9.577	3.397	0.005
Schedule Overrun	-1.548	2.333	0.507
Program Scope Changes	-0.345	1.669	0.836
Schedule*Cost	1.769	2.860	0.536
Scope*Cost	-0.014	2.641	0.996
Scope*Schedule	6.803	3.185	0.033
Cost*Schedule*Scope	-16.052	5.722	0.005
Wald χ2 (df)	34.2 (40)		

5.4 Limitations and Future Research

First, while 22% (26 out of 118) major defense acquisition programs in the sample were eventually canceled, a limitation of the study is the exclusion of the 26 programs labeled For Official Use Only (FOUO). Since the event of interest, program cancellation, is a rare event, if even a small number of the 26 programs were canceled, it could have significant impacts on the results of the study.

Second, scholars conducting further research of these capabilities might consider including a more in-depth measure of a program's complexity as a control. For example, providing a count of specific sub-systems (e.g., radios, radars, engines) that share commonality across the firm's programs divided by the total number of sub-systems in the program of record as well as including

the total number of sub-contractors used might provide interesting insights. Previous research has shown that as the number of sub-contractors increases so does the management oversight of the prime contractor, which increases the likelihood of problems in the execution of the program (Davies & Hobday, 2005; Hobday, 2000; Mirza et al., 2013).

Future scholars could also explore patent data for each of the U.S. DoD's major acquisition programs as an additional component of complexity. Patent data could provide insights into the complexity of the program, as well as possibly giving insights into the ability of the firm to transfer knowledge (Mealey et al., 2017). Additionally, another measure of the program's complexity that future scholars might want to include is the length of time from a milestone B decision to the point where the program reaches its initial operating capability (IOC).

Third, while corporate political capability did not consistently moderate the impact of program cancellation, an opportunity exists for scholars to conduct qualitative research into why these firms continue to contribute to members of congress. A thorough investigation of a small number of cases might provide additional insights for scholars conducting research into CPC and DoD Program cancellations. It is possible that even though firms know that that the likelihood of trouble programs is high, these firms still give to members of Congress as a measure of future goodwill toward the consideration of future major defense acquisition programs.

Fourth, this study used the program year as the time frame for analysis. Future researchers should consider if the timeframe should be expanded to see if multi-year time frames are a better unit of analysis. While the DoD's budget is designed, built, adjudicated, and approved every year on specific dates, program acquisition problems, decisions, DoD strategy changes, and emerging world events are event-driven and don't necessarily overlap with the fiscal year decisions required in funding the major defense acquisition programs (Galvin et al., 2018). Looking at the programs

as a whole might provide additional insights masked by only looking at the program through each year. For example, if a program is in trouble early in its life cycle, then the firm might put additional resources into its corporate political capability to try to save the program. In this case, firms may employ an increased amount of corporate political capability for several years before the program is eventually canceled. Additionally, future scholars might glean additional insights by lagging the program cancellation variable by one year. Lagging the variable might capture some of the event-driven events listed above that don't necessarily occur in the fiscal year but impact the program cancellation decision.

Fifth, while I did use several measures to control for a firm's history, such as the age of the firm and past major defense acquisition program success, there are other measures that might provide valuable insights. For example, future researchers might look at the number of consolidations that each firm in the defense industry has undergone to determine if this has an impact on program cancellation. It is possible that some firms are better able to integrate the knowledge, skills, and resources of absorbed firms better than others. In addition, while this study looked at the past success of major defense acquisition programs, another measure of firm history that might prove insightful is the past success of all DoD acquisition programs. Since the majority of DoD acquisition programs are under the MDAPs dollar thresholds of $525 million in research, development, test, and evaluation dollars or over $3.065 billion in procurement dollars, it is possible that the firms gain additional attributes from successfully completing smaller DoD programs that assist in the success of the larger acquisition programs.[17]

[17] For the FY2021 request, only $88.9B out of $243.4B (36.4%) finances major defense acquistion programs. The remaining 63.6% are under the MDAP threshold (Comptroller/CFO, 2020a).

Sixth, future scholars might want to consider some structural markers of corporate capability. For example, some of the firms might have corporate shared services units or other elements that might provide an advantage in managing CoPS. Since there might not be enough variability in data for the number of firms in the sample for quantitative analysis, it might make sense to conduct a qualitative analysis of a few firms to determine how each of the firms incorporates these structural markers into managing major defense acquisition programs.

Finally, due to the complex nature of the study, future scholars might consider exploring a small subset of canceled and non-canceled programs using a qualitative analysis. This analysis might provide interesting insights that would deepen our understanding of program cancellations and firms' capabilities in the defense industry and lead to additional constructs for consideration. Scholars might choose a canceled and not canceled defense acquisition program in the same firm, such as Boeing's Future Combat System and YAL-1A Airborne Laser, or they may choose two canceled programs from different firms to determine commonalities across the programs.

6.0 Conclusion

In conclusion, since DoD acquisition programs are inherently complex and each program is designed to push the technology past the limits of the previous generation of programs, developing a deeper understanding of the strategic capabilities required by the dwindling number of firms in the U.S. defense industry is critical for both scholars and practitioners. As defense programs in the future will grow both in complexity and costs, managers and professionals on both sides must work to ensure that these programs survive the cut.

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