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An Analysis of Profit Margin In Relation to the Better Buying Power Initiative

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THESIS

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Abstract

Recent Better Buying Power (BBP) initiatives have sought to better contractually align contractor profit with performance. Profit should incentivize efficiency in cost and schedule and only be awarded when earned. The current research seeks evidence that BBP has been effective in improving performance. The first part of the research examines the trends of profit margin and cost growth both before and after the implementation of the first BBP initiative. BBP recommended the use of incentive type contracts over award fee contracts, where appropriate. This research found an increased use of incentive type contracts and a reduced use of award fee contracts since BBP commenced. Incentive contracts, in particular, showed increasing profits and decreasing cost variance from 2001 to 2016 year, and a test for significance shows that contracts with reductions of cost growth corresponded to higher profit margins. Macroeconomic factors seem to have played a minimal role, suggesting the trends correspond to the changing business environment and practices which government reform initiatives have sought to institute. The research was unable to link BBP initiatives to the improving relationship between performance and profit with complete certainty, finding instead that the trend improved throughout the time period studied.

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I. Introduction

General Issue

Department of Defense (DoD) contracts have frequently experienced budget and schedule growth (Arena et al., 2006; Drezner et al., 1993; Drezner & Smith, 1990). In an effort to improve performance, the DoD has initiated numerous improvements to policy. However, many of these initiatives have resulted in little to no improvements of the acquisition process (Ritschel, 2011; Hanks et al., 2005; Lorell & Graser, 2001).

Recent acquisition initiatives in the DoD have sought to better contractually align contractor profit with performance. Profit should more strictly incentivize adherence to cost and schedule estimates (BBP, 2015). The current research looks to examine recent policy shifts within the acquisition community. Specifically, have the Better Buying Power initiatives met their intended goals of reducing cost growth by better aligning profit to performance?

Better Buying Power currently has three iterations which are referred to as BBP 1.0 (2010), BBP 2.0 (2013), and BBP 3.0 (2015). The overarching goal of all of the BBP initiatives is to "obtain greater efficiency and productivity in defense spending through leadership emphasis on cost control, streamlined processes, reduced bureaucracy, productivity, innovation, competition, the acquisition of contracted services, and workforce capabilities" (OUSD(AT&L), 2016). In particular, and the thing that motivates the current study, is that there was an emphasis placed on the utilization of fixed price incentive firm (FPIF) contracts. In addition, the BBP guidance required a

justification of contract type be included for each proposed contract before negotiations concluded. BBP 2.0 was initiated in 2013 and focused on similar areas as BBP 1.0 and added an extra emphasis on improving the tradecraft and professionalism of the acquisition workforce. BBP 2.0 also clarified language from BBP 1.0 regarding the use of FPIF contracts. The updated guidance stated that the emphasis should be on "the use of the appropriate contract vehicle for the product or services being acquired" as no one contact type fits every scenario (BBP, 2013). The third and most recent BBP initiative was in 2015. It continues to focus on the aforementioned areas as well as an additional focus on innovation, technical expertise, and quality of products (OUSD(AT&L), 2016). The current study is interested in the impact of the increased focus on incentive-based contracts.

Research Objectives

In order to examine the effectiveness of the Better Buying Power initiatives, this research observes both profit margin and cost growth over time. There have been numerous articles on each topic independently (GAO, 2017; GAO, 2009; Arnold et al., 2008; GAO, 2005; Rogerson, 1992) but very little research has tied the topics together (Frazier et al., 2001; GAO, 1987). Moreover, the results have been conflicting. For example, Frazier et al. (2001) found that the variable application of contractor share ratios is positively related to profit. Arnold et al. (2008) looked into profit policies as a method to improve contract outcomes and found that the use of policy and incentives to improve performance is not always practical. The conflicting reports suggest that there are other variables that are creating a complex environment in which profit and

performance are not easily aligned. Lastly, the Acquisition Policy Analysis Center (APAC) within OUSD AT&L examined cost growth in 2016 and found reductions attributable to BBP. The APAC study is a motivator for the current research which looks to validate the finding of reduced cost growth and link that finding back to any trends in profit margins.

The research questions for this analysis are as follows:

1. What trends of profit margin and cost growth are observed over time?
2. Does the relationship between profit margin and cost growth, relative to BBP's initiation in 2010, change in such a way that would lead one to identify an independent effect from other changes within the DoD environment?
3. To what degree can we attribute changes in profit and performance to the larger economy, program aspects, and overall policy?

Scope and Methodology

The current study looks at Major Defense Acquisition Program (MDAP) contracts that have both a final Cost Data Summary Report (CDSR) and earned value management (EVM) reporting. Contingency tables are used to test the dependency between profit and performance and examine how the relationship between these two variables may have changed since 2010. Non-parametric tests and Ordinary Least Squares (OLS) regression are employed to identify other variables that correlate with the observed trends. Particular attention is given to 2010 as a change point in the relationship between profit and performance as that was the year in which BBP originated.

The literature has claimed that many years of initiatives have had little to no improvements in the DoD acquisition community (Smirnoff & Hicks, 2008). The current study theorizes that BBP may be different, proving effective by way of the shift from subjective to objectively focused incentives. The shift away from using subjective criterion may establish a "credible commitment" both binding personnel to the desired performance-profit relationship and signaling to the contractor that the DoD is willing to take more aggressive actions if performance is not in line with expectations.

It is possible that any positive changes that the acquisition community is experiencing has nothing to do with acquisition reform. Instead, it could be due to improvements in the overall economic environment of the United States or contractors, independently, becoming more efficient. Therefore, other factors such as economic and environmental changes must also be analyzed in order to understand how such a pattern has become evident.

Summary

Chapter 2 presents economic theory and past research on acquisition reform that provide the framework for the methodology used in Chapter 3. The research data is introduced in Chapter 3 along with the statistical tests that will be used to analyze the effect of Better Buying Power in the next chapter. The statistical analysis is performed in Chapter 4 and the results are validated to determine if Better Buying Power has been successful. Lastly, the research is concluded in Chapter 5 and follow-on research is recommended.

II. Literature Review

Chapter Overview

The field of economics provides multiple theories that help us predict when a policy may and may not have an impact. The specialized field of public choice within economics cautions that outcomes may be different than what is advertised. Game theory, on the other hand, provides strategies that may overcome weaknesses of government follow through. It is the game theory perspective which suggests the potential of BBP to have had a positive impact.

Acquisition Reform

The DoD's acquisition system has consistently faced cost overruns, schedule delays, and poor contract performance. United States lawmakers have operated with a mindset that more legislation is needed in order to solve acquisition system shortfalls. As a result, there have been over 50 acquisition reforms and initiatives since 1971 (Ritschel, 2011).

There is general agreement (Ritschel, 2011; Smirnoff & Hicks, 2008) that the following four initiatives or reforms were among the "most important" to exist prior to 2008: the Nunn-McCurdy Act of 1982, the Packard Commission of 1986, the Defense Acquisition Workforce Improvement Act (DAWIA) of 1990 and the Federal Acquisition Streamlining Act (FASA) of 1994. Additionally, Ritschel contends that the Weapon System Acquisition Reform Act (WSARA) of 2009 is also among the "most important" reforms (Ritschel, 2011). Lastly and most recently, Better Buying Power (BBP) initiatives were implemented starting in 2010 by the Office of the Under Secretary of

Defense for Acquisition, Technology, and Logistics (OUSD(AT&L)). Initial reviews from AT&L itself has suggested BBP has made a difference. But the existence of extensive literature concluding that these prior initiatives were important but largely ineffective (in terms of controlling cost growth), puts into perspective the need for an independent review.

The Nunn-McCurdy Act of 1982 was originally introduced in the 1982 Defense Authorization Act and was aimed at reducing cost growth in weapon system acquisitions. The act required that programs experiencing 25% or more cost growth from the original estimate had to be reported to Congress and were subject to termination. This act was, ultimately, an increase in oversight.

Four years later in 1986, the Packard Commission was established in an effort address cost growth, schedule delays, and performance shortfalls in the weapon system procurement process. "The primary conclusion of the Packard Commission was that defense acquisition was unacceptably inefficient. Specifically, major weapons systems cost too much, take too long to field and by the time they are fielded incorporate obsolete technology" (Nordwall, 1987, p. 80). The result of the Packard Commission was a streamlined acquisition process, increased testing and prototyping, adjusting the organization culture of the acquisition community, improved planning requirements, and lastly, the adoption of the competitive firm model, when appropriate (Searle, 1997).

In 1990, the Defense Acquisition Workforce Improvement Act (DAWIA) was introduced. This act was focused on personnel who manage and implement the defense acquisition programs and how these individuals could improve their operations. A few of the changes implemented by this act were the establishment of an Acquisition Corps,

mandatory training and education requirements, the identification and designation of "critical" acquisition positions, and guidelines for choosing between civilian and military program managers. This act was largely human capital related.

The Federal Acquisition Streamlining Act (FASA) of 1994 was one result of the National Performance Review (NPR) that occurred under the Clinton campaign. The overall goal was to alleviate parts of the acquisition process that were considered to be burdensome and complex. This act helped to streamline acquisition processes through changes such as the elimination of paperwork, allowing micro purchases, and requiring less information from defense contractors (Ritschel, 2011).

The Weapon System Acquisition Reform Act (WSARA) of 2009 is one of the more recent major acquisition reform acts. This act called for both structural and organizational changes. WSARA initially required cost estimators to submit estimates at the 80% confidence level and required justification be submitted to Cost Assessment and Program Evaluation (CAPE) when lower confidence levels were utilized. The mandate for 80% confidence was later changed to require "high degree of confidence that the program can be completed without the need for significant adjustment to program budgets" (CAPE, 2017).

Berteau et al. (2010) presented seven key initiatives of WSARA that aided in structural change. Each initiative's specific focus can be categorized further as either oversight or acquisition process related.

- Oversight
    - A more stringent set of regulations on organizational conflicts of interest
    - Revised processes for reporting critical cost growth

    - Increased Congressional oversight through heightened reporting requirements

- Acquisition Processes
    - Increased competition throughout the acquisition process
    - Improved requirements formulation processes
    - Improved cost estimation processes
    - Revised Milestone A and B certification processes

To assist with the organizational changes needed, the following four positions were created:

- Director of Cost Assessment & Program Evaluation (DCAPE)
- Director, Development Test & Evaluation (DT&E)
- Director, Systems Engineering (SE)
- Director for Performance Assessments and Root Cause Analyses (PARCA)

Previous acquisition reforms have each had their own agenda but many have shared some of the same goals such as improving cost growth. One key thing that most of these previous reforms have had in common is that they did not account for human tendencies. They treated the acquisition process as a machine with everyone acting in the same manner. This is where BBP may prove to be different.

Better Buying Power began in 2010 and has goal to "obtain greater efficiency and productivity in defense spending through leadership emphasis on cost control, streamlined processes, reduced bureaucracy, productivity, innovation, competition, the acquisition of contracted services, and workforce capabilities" (OUSD(AT&L), 2016).

BBP 1.0 (2010) called for the acquisition community to do more without more and the five key focus areas are as follows:

- Target Affordability and Control Cost Growth
- Incentivize Productivity & Innovation in Industry
- Promote Real Competition
- Improve Tradecraft in Acquisition of Services
- Reduce Non-Productive Processes and Bureaucracy

BBP 2.0 was initiated in 2013 and focused on similar areas as BBP 1.0. It added an extra emphasis on improving the tradecraft and professionalism of the acquisition workforce. The third and most recent BBP initiative was in 2015. It continues to focus on the above-mentioned areas as well as an additional focus on innovation, technical expertise, and quality of products (OUSD(AT&L), 2016).

A consistent theme in the multiple acquisition reform acts is managing cost growth, schedule delays, and subpar performance. Ritschel (2011) proposed that the "solutions" presented by all the different reforms (excluding BBP) revolved around internal bureaucracy instead of focusing on the broader institutional construct made up of the executive branch, legislative branch, bureaucracy, and the defense industry. Additionally, Ritschel argues that the political-economy interactions (public choice, game theory, etc.) are not being accounted for (Ritschel, 2011).

Others have also studied cost growth relative to the effectiveness of acquisition reform. Drezner et al (1993) examined 197 contracts from 1960-1990 and found that cost growth consistently remained around 20% despite the many reforms during those years. In 1997, the Government Accountability Office (GAO) researched 33 of the 63 programs

reporting an acquisition reform cost reduction. Their study found that the total acquisition cost of these programs increased by an average of 2% which suggests that the cost savings from acquisition reform were being offset by cost increases elsewhere in the program (GAO, 1997). Other researchers such as Biery (1992), Lorell and Grasner (2001), and Hanks et al (2005) all come to the same conclusion that reforms are not resulting in significant acquisition process improvement.

Similarly, other researchers have focused their research to analyzing cost growth with respect to single acquisition reform initiatives. Ritschel (2011) performed an in depth analysis on the Nunn-McCurdy Act of 1982 as there was little research available at that time. His conclusion was that the threat of program termination was rarely enforced and the act is more of a monitoring program. He called for policy makers to enforce stricter punishments upon bureaucracy and defense industry for breaches. Searle (1997), Christensen et al. (1999), and Smirnoff and Hicks (2008) looked at cost growth and the Packard Commission. These researchers have judged the effectiveness of the Packard Commission as having mixed results. The predominant finding being that this initiative did not improve cost growth. Snider (1996), Garcia et al (1997), and Choi (2009) all concluded that DAWIA has enhanced the quality of the acquisition workforce. On the contrary, Smirnoff and Hicks (2008) found that DAWIA actually increased cost growth. Holbrook (2003), Abate (2004), and Phillips (2004) all examined the effect of FASA on cost performance. None of the researchers found improvements to cost performance after the implementation of FASA. Smirnoff and Hicks (2008) analyzed FASA and cost performance as well. Their results did find that cost growth declined for production contracts; however, R&D contracts showed no improvements. These results do not

signal that the reforms were not needed or that they were complete failures. However, the common agreement among the researchers when analyzing specific acquisition reform initiatives is that cost growth is not being affected.

The Better Buying Power initiatives (2010, 2013, 2015) have made efforts to improve efficiency and productivity while controlling costs in the DOD acquisition system. BBP has called for the DOD to align *profitability* more tightly with Department goals. The defense industry is motivated by profit. Higher profits should be reserved for better performance while lower profits for poorer performance (OUSD AT&L, 2014). Another important emphasis of BBP was the use of incentive type contracts. The 2014 annual report on the defense acquisition system found that Cost Plus Incentive Fee (CPIF) and Fixed Price Incentive Fee (FPIF) contracts were "highly correlated" with better cost and schedule performance. Incentive based contracts share the impact of overruns and underruns between the government and the contractor. This report did not mandate the use of incentive contracts but it "reinforced our (the DoD) preference for these types of contracts when they are appropriate" (BBP 3.0, 2015).

How has this latest policy reform faired? In terms of cost growth, the Acquisition Policy Analysis Center (APAC) analyzed the annual growth of contract costs in 2016 for MDAPs in the development and early production stages. Part of this study was in response to BBP 3.0's instruction for the APAC to "track and analyze the use of various contract types and incentives to determine if additional measures can be taken to further improve cost and schedule performance. APAC will report the results of its analysis annually to the USD(AT&L)" (BBP 3.0, 2015).

The APAC research found three factors affecting contract growth. First, contract growth tends to follow the defense budget: higher budget years corresponds to higher cost growth. Second, the APAC tied two different reform eras to reductions in cost growth. The first was the Goldwater-Nichols Act and the second was the BBP era. The study used "standard statistical modeling techniques to identify statistically significant factors that are likely causes of growth". APAC's results attributed a 1% cost growth reduction to Goldwater-Nichols and a 2% cost growth reduction to BBP. The researchers did note that it is "difficult to trace changes to individual policy changes". Lastly, the APAC study found a constant base growth of approximately 5% in their model from 1981-2015 (all other things equal) which indicates there were "remaining uncertainties, risks, and investments" that had not been accounted for (Davis & Anton, 2016).

In terms of profit, there have been several research articles but certainly less attention throughout the era of policy reforms. The GAO analyzed the DOD's use of monetary incentives (profit or fee) on multiple occasions (2005, 2009, 2017). Rogerson (1992) and Arnold et al. (2008) have both looked into profit policies as a method to improve contract outcomes and both had different conclusions as to the theoretical value of such policies. A clear picture cannot be drawn from these studies, thus necessitating the current study.

The Rogerson (1992) research was primarily theoretical in nature but was able to show that incentives are important to innovation. In other words, profit is a driving force in a contractor's performance. However, he also states that performance is difficult to judge. The current research looks to expound on Rogerson's study and link performance, in the form of cost growth, back to the profit received by the contractor. Profit may be an

incentive that improves performance but profit policy and performance must be effectively aligned as to not reward poor performance. This is what the current research looks to do that the prior research was not able to do.

Other studies have given reasons to doubt that contract policy can affect change. The IDA analysis by Arnold et al. (2008) analysis examined whether or not profit policy and contract incentives were able to improve defense contract outcomes. This research was started after the USD AT&L issued cost guidance in 2007 that stated "contract finance and profit policies drive desired results". IDA's analysis found "that there is not a realistic prospect of using the incentive tools permitted by DFARS to greatly improve the average performance, schedule, and cost outcomes the Defense Department obtains" (Arnold et al., 2008). Two of the key findings that resulted in this outcome were related to the contract type and associated risk as well as the phase of the contract. First, IDA's research affirmed the findings of past research (Cross, 1966; Fischer, 1968; Frazier et al., 2001) where contracts with an award or incentive fee construct have less cost growth than those not containing them. While this seems promising, IDA does direct increased usage of these contract types. They recognize that contract types are based on risk and that contractors cannot be forced to take on more or less risk. If this were the case then contractors would simply offset the added risk with a higher target cost during negotiations. Ultimately, the researchers believe that if mandatory use of these contract types were implemented then "the net result could be a contract that experiences less cost growth but with a cost to the Defense Department that is the same or even greater" (Arnold et al., 2008). Second, firms expect to receive large profits during the production phase. Federal Acquisition Regulation (FAR) does impose a limit on profit; however, the

limit is for cost-plus-fixed-fee (CPFF) contracts. In order to obtain these larger profits, firms must first be chosen to develop a system. This chance at higher profit during production is seen as an incentive during the development stages. Bids are often submitted with a strategy across multiple phases in a process often referred to as "buying in" (Christiansen and Gordon, 1998). Such interdependencies between contracts suggest that policy changes may be effective in controlling costs for one phase but have the opposite effect on another phase. Consequently, the use of policy and incentives to improve defense contract outcomes is not always possible (Arnold et al., 2008).

Public Choice

The theory of public choice is valuable for understanding the form and application of law and policy. This theory may be able to explain some of the decision making that occurs within the acquisition community. The public choice theory can be linked back to economists such as Kenneth Arrow, Duncan Black, James Buchanan, Gordon Tullock, Anthony Downs, William Niskanen, Mancur Olson, and William Riker. However, the theory began to receive much more attention when James Buchanan won the Nobel Prize in Economics in 1986 (Shaw, n.d.). Public choice utilizes economic theories and methods in analyzing political behavior (Shughart II, n.d.). Buchanan claims that public choice is meant to be an "application and extension of economic theory to the realm of political or governmental choices" (Buchanan, 1978, p. 39).

Public choice must be distinguished from public interest. Public interest thinking presumes good faith, responsibility, and technical expertise of agents. The military weapon system acquisition process is assumed to be both technically and economically

efficient while providing goods at the least cost to society. Political leaders and their agents act selflessly and efficiently for the best interest of society (Tullock et al., 2002).

But there is both popular and academic writing revealing a certain skepticism of such idealized government performance. Recent popular views of government accountability identify a litany of causes for cost growth. Research into the causes of cost growth are a ubiquitous tale of bad management (Chaplain et al., 2006; Paltrow, 2013).

Public choice assumes that people act according to their own self-interest. Alternatively, public interest assumes public servants are carrying out the best interest of the population in which they serve and that all self-interest is ignored. Buchanan describes it as comparing "saints" to "sinners" (Buchanan, 1979, p. 49). As a matter of principle, public choice treats the individual as the primary unit of analysis (Shughart II, n.d.). Public choice demands we consider government to be agents of real flesh and blood, fallible, and self-serving to some degree.

Ritschel (2011) provided evidence for the superiority of public choice to public interest for understanding the DoD. "The process of military weapon systems acquisitions is dominated by political and not by economic considerations." He finds in his survey that the acquisition framework prior to 2011 "delivers a non-optimal allocation of resources where military weapon systems have an inefficiently high average cost and exacerbated cost variance due primarily to political influence." Ritschel's analysis concluded that the acquisition community needs to adapt in order "to incorporate a broader political-economic construct" as decisions cannot be made efficiently in a "political vacuum" (Ritschel, 2011).

If public choice has accurately described the nature of the political and public agents, to the complexity of the military acquisition system and the amount of bureaucracy involved, it is nearly impossible for officials to act without any self-interest. The public interest way of thinking is not the best model or set of assumptions for military acquisitions. Political factors can have a negative influence on contract performance, and policy may filter poorly through the system resulting in negligible improvements.

Game Theory

Numerous game theory models have reach similar conclusions. Some lessons of game theory, nonetheless, suggest ways policy change may have an impact. A review will serve to produce a hypothesis. The concept of game theory has been around since before 1850; however, formal game theory was fielded in 1944 with the publishing of *Theory of Games and Economic Behavior* by John von Neumann and Oskar Morgenstern and more recently by Thomas Schelling and Herbert Gintis in social-evolutionary modeling. Today everything from parenting to soccer has been analyzed through game theory and was popularized in the movie, *A Beautiful Mind,* about John Nash who won Nobel Prize for his work.

Game theory is the study of conflict and cooperation and is applied when multiple agents have interdependent decisions to make. Each decision has an associated payoff. One would assume that each agent is going to act in such a way to receive the highest payoff. Turocy and von Stengel (2001) describe the goal of game theory as a method to

"provide a language to formulate, structure, analyze, and understand strategic scenarios" (Turocy & von Stengel, 2001).

There have been multiple studies involving game theory and acquisition processes such as Flyvbjerg et al. (2003), Gardener & Moffat (2008), and Ritschel (2011). Flyvbjerg et al. (2003) analyzed cost overruns and delays of infrastructure projects in the public sector using what he called a "megaprojects paradox". The paradox is that there is a growing number of large projects being undertaken while a large majority of the projects are experiencing poor performance. Why are these projects still being started when past performance shows a high likelihood that the promised performance will not be delivered? For example, the Channel tunnel linked U.K. and France. It promised economic growth in the planning stage but it ultimately faced 80% cost overruns, financing costs 140% higher than projected, and revenues that were less than 50% of the projected amount. The poor performance resulted in a decline of the French and United Kingdom economies rather than the growth that was promised in planning. One of the reasons that Flyvbjerg gives for poor performance is "project promoters often avoid and violate established practices of good governance, transparency and participation in political and administrative decision making, either out of ignorance or because they see such practices as counterproductive to getting projects started" (Flyvbjerg et al., 2003). The issue then becomes one of determining if the poor contract performance is the fault of the contractor or the fault of project managers promising unrealistic outcomes in order to get their projects started. If the project managers are making unrealistic claims then that also supports the public choice theory as they are acting in self-interest instead of public interest.

Gardener and Moffat (2008) present game theory as a theoretical structure to understand the United Kingdom's defense market. As with most highly technical, innovative projects, risk and uncertainty are prevalent. The researchers identified a "Conspiracy of Optimism" as the source of poor performance in acquisition programs. As in the typical example of game theory's Prisoner's Dilemma, multiple parties are exploiting the acquisition situation for short-term gain. The game theory in this analysis was between the Ministry of Defense (MOD) and Industry with a choice to go with a realistic strategy or an optimistic strategy for a project's estimate of performance, time, and cost. There were three main factors that influenced each player's decision for the cost estimate. First, the desire of MOD in having the project approved to move forward in the acquisition process was a factor. The second factor was the desire by the Industry (individual companies) to out compete their rivals and be selected as contractor. Lastly, both the MOD and Industry desired a high enough priority on the program so that there was no concern for the program being cancelled post-bidding (Gardener & Moffat, 2008).

Table 1 reflects how the factors discussed previously explain the perceived pay-offs to the two players. The results shown in the table reflect that it is in both player's best interest to choose an optimistic stategy as the other alternatives have potential unfavorable outcomes. For example, if the Ministry of Defense chose a realistic budgeting strategy then they face a reduced chance of getting the project funded and the perception of value-for-money (VFM) is also reduced. For Industry, if the winning bid is based off a realistic budget and MOD has budgeted optimistically, then the project is now under-funded and now has immediate concerns for the project's future (Gardener & Moffat, 2008). In the system that Moffat and Gardener have presented, the key factor is

uncertainty. The acquisition system is full of uncertainties and is vulnerable to the "Invasion of Optimism". In order to ensure realistic strategies, human characteristics and tendencies must be controlled for (Gardener & Moffat, 2008).

Table 1 - Perceived Pay-Offs to MOD and Industry

	MOD budgets optimistically	MOD budgets realistically
Industry bids optimistically	MOD **Easy entry into equipment plan (EP) (+)** **Favorable value-for-money (VFM) (+)** Industry **Easy entry into EP (+)** **Stay in EP (+)**	MOD **Difficult entry into EP (-)** **Bad VFM pre-bid (-)** **Good VFM post-bid (+)** Industry **Difficult entry into EP (-)** **Stay in EP (+)**
Industry bids realistically	MOD **Easy entry into EP (+)** **Project faces cancellation (-)** Industry **Easy entry into EP (+)** **Stay in EP (+)** **Project faces cancellation (-)**	MOD **Difficult entry into EP (-)** **Bad VFM (-)** Industry **Difficult entry into EP (-)** **Stay in EP (+)** **Low risk of cancellation (+)**

Source: Modified from (Gardener & Moffat, 2008)

Ritschel (2011) investigated whether game theory could be used to explain cost variance in military weapon system contracts. The measure of cost variance used in his analyses was based off the Defense Acquisition University's (DAU) earned value management gold card. Cost variance (CV) consists of subtracting the actual cost of work performed (ACWP) from the budgeted cost of work performed (BCWP).

The program's cost estimate is affected by the players who make up an Integrated Product Team (IPT). The individual in charge is the Program Manager (PM) and has the overarching goal of providing the requested capability to the requestor. Other members of the IPT have different top priorities. The engineer may prioritize the best technical solution, the logistics personnel may care about maintainability, budget personnel may be

focused only on the funding aspect, and the cost estimators may wish to constrain the total program cost. The cost estimator formulates an estimate based off the inputs provided by the IPT.

The Weapon System Acquisition Reform Act (WSARA) of 2009 initially required cost estimates to be submitted with a confidence level of 80% with mandatory reporting when a lesser confidence level was used (Public Law 111-23, 2009). This 80% requirement was later changed (Public Law 114-328, 2016) as few projects were being submitted at the required 80% level. Estimates were submitted closer to the 50% confidence level as reported by the Cost Assessment and Program Evaluation (CAPE) office. The lower confidence reporting was the result of the PM facing the difficult task of determining an appropriate cost estimate that minimizes the chance of cost-overruns but also still makes the program competitive for funding in the Planning, Programming, Budgeting, and Execution (PPBE) (Ritschel, 2011).

Ritschel's analysis presented Table 2 to show three different scenarios of game theory where the DOD has to choose whether to submit a high or low confidence budget estimate and Congress has to decide whether they are going to fund the project. Each scenario used Mixed Strategy Nash Equilibrium (MSNE) where the equilibria was determined by probabilities assigned to each payoff in the matrix using a specified system of equations. The MSNE results are reflected in Table 3. The results of the analyses of the three scenarios is that scenario 3 is the optimal choice. This scenario calls for the DOD to submit a low confidence estimate 80% of the time as it has the highest payoff to the DOD and for Congress to fund the project 80% of time as not funding resulted in a negative payoff. Other research by Arena et al. (2008), GAO (2009), and

Defense Acquisition Performance Assessment Project (DAPA, 2005) supports the claim that low confidence estimates are routinely utilized.

Table 2 - Game Theory

		Scenario 1		Scenario 2		Scenario 3	
		DoD		DoD		DoD	
		High Confidence Level	Low Confidence Level	High Confidence Level	Low Confidence Level	High Confidence Level	Low Confidence Level
Congress	Fund	3,2	-1,3	2,2	0,3	3,3	-1,4
	Don't Fund	-1,1	0,0	0,1	2,0	-1,1	0,-3

Source: Ritschel, 2011

Table 3 - MSNE

	MSNE		
	Scenario 1	Scenario 2	Scenario 3
DoD	(0.2, 0.8)	(0.5, 0.5)	(0.2, 0.8)
Congress	(0.5, 0.5)	(0.5, 0.5)	(0.8, 0.2)

Source: Ritschel, 2011

The Flyvbjerg (2003), Gardener & Moffat (2008), and Ritschel (2011) analyses provide support that game theory may factor into cost variance in the DOD acquisition system. Flyvbjerg claims that the PMs are submitting unrealistic estimates in order to get projects funded. This claim is supported by the consistently high cost variance present in the 3 projects he analyzed through case studies. Moffat & Gardener presented similar analyses using the UK's Ministry of Defense budgeting decision and the industries bidding decision. In their scenario, there is a dominant strategy that results in the best outcome for both parties; however, this outcome is not necessarily the outcome with the lowest cost. Ritschel presents a scenario where there is no dominant strategy in which the DoD has to decide whether or not to use low or high confidence level in their cost estimate and Congress has to decide to fund or not fund. The acquisition system is

complex, there are many players, and players are known to make decisions based off of political factors.

Disconnects between policy intentions, good practices, and actual follow-through would suggest that the DoD is going submit a cost estimate that falls around the 50% confidence level as the goal is to get the project funded. Such a practice means there is a high likelihood of overruns. In such an environment, it may be incumbent to take policy action which can more strictly reduce the potential of cost growth, or contractually preclude the growth we leave ourselves open to. Better Buying Power seems to have taken such actions.

One method of controlling costs when there is uncertainty in the program's estimate is better aligning a contractor's incentive to their performance which is the goal of the Better Buying Power initiatives. In order for this happen, the DoD must ensure that they establish a "credible commitment" to this behavior so that the new policies are taken seriously.

The problem that a series of failed policy initiatives creates is a mutual lack of faith or follow through. The signals of seriousness and competency are lost. In Ritschell's outcome, there is no dominant strategy. The game becomes a coordination or brinkmanship game between the DoD and Congress in which each party is speculating how the other might act and responds respectively. There is great uncertainty. A coordination game is one in which multiple Nash equilibria exist. Schecter and Gintis (2016) present examples of a coordination game. Table 4 reflects a dilemma where a man wants to attend a wrestling event while a woman wants to attend a concert. However, each prefers the company of the other versus attending their preferred event

alone as reflected by the two Nash equilibria. In this example, it is in each player best interest to coordinate their decisions as to ensure they both receive some positive utility (Schecter & Gintis, 2016). But the outcome is entirely unpredictable.

A second example is presented as a game of chicken (Table 5). It provides insight into how to resolve a coordination game. Two teens are driving toward each other and a head-on collision is imminent. Each teen wants to bolster their reputation by driving straight. However, if they both drive straight then they are both injured. Therefore, the only way to "win" would be to drive straight while your opponent swerves. There's no way to guarantee that your opponent is going to swerve so some may attempt to develop a reputation for being "crazy" and state they are going straight no matter what and that they don't care if they are injured (Schecter & Gintis, 2016). Credible commitment can more confidently resolve such uncertain speculation by signaling a certain path of action by one player. In this case it would be the "crazy" teenager signaling that they are going straight no matter what. Credible commitment states that when faced with a threat in a conflict situation, the threat has to be credible in order to be effective (Schelling, 1980).

Table 4 - Battle of the Sexes

		Man	
		Concert	Wrestling
Woman	Concert	(2, 1)	(0, 0)
	Wrestling	(0, 0)	(1, 2)

Source: Modified from Schecter & Gintis, 2016

Table 5 – Chicken

		Teen 2	
		Straight	Swerve
Teen 1	Straight	(-2, -2)	(1, -1)
	Swerve	(-1, 1)	(0, 0)

Source: Modified from Schecter & Gintis, 2016

Suppose that the DOD is willing to give a contractor reasonable profit in exchange for contract performance that meets an established criterion. Both parties have full knowledge of the outcome as long as they both fulfill their contractual obligations. However, if the contractor believes that the government is going to pay them reasonable profit regardless of their performance level based off of historical information then there is no credible commitment and the contractor has no real incentive to perform their best. Historically, this has been the case in the DoD as reported by the Government Accountability Office's (GAO) research in 2005, 2009, and 2017. Their 2005 research found that the DoD paid billions in award and incentive fees regardless of acquisition outcomes; the 2009 research found initiatives to cure the findings from 2005 were having mixed results as they were not being consistently applied. History undermines each new effort as weakness is presumed. The 2017 report found that the DoD did appear to be better allocating award and incentives based on established criteria; however, the GAO recommended better record keeping on incentive outcomes in order to maximize effectiveness in the establishment of incentive arrangements in future contracts. The current research provides for a different theoretical foundation from prior research. Credible commitment promises a solution from self-serving influences. The encouragement to use and enforce incentive contracts, if responded to, creates an automatic mechanism for awarding profit without subjective evaluation. Incentive contracts are a credible commitment relative to award contracts that have been budgeted as if the award is inevitable.

Summary

Is it possible that the BBP initiatives are different than past initiatives? Will the focus of aligning contractor profitability with contractor performance improve the defense acquisition system? The next chapter, methodology, discusses how the researchers plan to answer these questions.

III. Methodology

Chapter Overview

The paper provides a series of statistical tests placing profit margin as the dependent variable. Ordinary Least Squares (OLS) regression as well as non-parametric tests are employed to permit a time-series portrayal of the relationship of various independent variables to profit. This is done first as a simple bivariate analysis and then as a multivariate analysis to include Stepwise regression. Due to the nature of the variables, the key relationship between cost variance and profit must be conducted using contingency tables.

Data

Data was obtained from the Cost Assessment Data Enterprise (CADE). CADE's data is compiled from multiple authoritative databases such as Defense Automated Cost Information Management System (DACIMS) and Defense Acquisition Management Information Retrieval (DAMIR). The data available in CADE consists of reports such as Contractor Cost Data Reports (CCDRs), Integrated Program Management Reports (IPMRs), and Cost Analysis Requirements Descriptions (CARDs).

The profit data, specifically, for each contract was obtained in the form of Cost Data Summary Reports (CDSRs) which are also often referred to as 1921s. There are also several other types of 1921s such as the Function Cost-Hour Report (1921-1), Progress Curve Report (1921-2), and Contractor Business Data Report (1921-3); however, this report only focuses on the 1921.

The 1921 contains descriptive data such as program name, contract number, contract type, contract price and ceiling, period of performance, report cycle (initial, interim, or final), and cost data broken down by work breakdown structure (WBS) for both "to date" and "at completion". In addition to WBS elements, other costs such as subtotal, general and administrative (G&A), undistributed budget (UB), and management reserve (MR) are also reported. A blank 1921 is provided in Appendix A for reference.

CDSR reporting is required on ACAT I and ACAT IA programs when the estimated contract value at completion is greater than $50 million (DoDI 5000.02). These reports may be generated at the contract level or for a specific task or delivery order. There are a few exceptions per DoDI 5000.02 to this reporting requirement (Appendix B). The original database contained 2,032 final CDSRs. A CDSR is considered final when at least 95% of the contract cost have been incurred and the government has received its end item. The current study only views completed contracts.

The original database was analyzed for accuracy. There were 5 groups of exclusions that were identified (Table 6). First, there were 917 subcontractor reports that were removed as this analysis was strictly utilizing prime contractor reports. Subcontractors have requirements that are often less stringent than primes for both profit and earned value reporting. Next, Equation 1 was used to verify that each sample was at least 95% complete. There were 62 data points that did not meet this threshold and were excluded. This report focused on development and production contracts; therefore, 54 data points that were labeled as operations and sustainment (O&S) or some other life cycle phase were excluded. Exclusion #4 was due to missing data on the 1921. The missing data was primarily samples that did not have an accurate period of performance

listed or the sample was missing 1 or more of the values that would be required to calculate profit margin. The majority of the contracts that were missing values were Firm Fixed Price (FFP) contracts, but there did not appear to be any consistent themes or trends as to which commodity or contractor had missing values on the 1921. Lastly, the dataset contained 26 duplicate entries that were excluded. These were most commonly the result of reports being submitted using two different version of the 1921 (2007 vs 2011). Duplicates were identified by filtering the data by contract number and contract amount. If these two fields were identical then they were further researched before removal from the database. The final profit database consisted of 913 samples.

Table 6 – Data Exclusions

	1921s
Final Reports	2032
Exclusion 1: Subcontractors	917
Exclusion 2: < 95% Complete	62
Exclusion 3: Non-Production/Development Phase	54
Exclusion 4: Missing Values	60
Exclusion 5: Duplicates	26
Final Dataset	**913**

$$\%\ Complete = \frac{\text{Subtotal Cost + G\&A (to date)}}{\text{Subtotal Costs + G\&A + UB (at Completion)}} \qquad \textbf{Equation 1}$$

Where

- Subtotal costs: Total cost provided by the highest level WBS Reporting Element

- General & Administrative (G&A): Indirect expenses related to overall management and administration of the contractor's business unit

- Undistributed Budget (UB): Portion of the budget applicable to program effort that has not yet been allocated to control account budgets.

The contract cost performance data was obtained from the Earned Value Management Central Repository (EVM-CR) also located within CADE. EVM-CR provides a central location for reporting, collecting, and distributing EVM data on ACAT 1 programs. This authoritative database is utilized by OSD, all branches of the armed forces, and other DOD components. As of November 2018, EVM-CR contained reports on approximately 80 ACAT 1A, 1C, and 1D programs and 210 contracts and tasks reporting data (CADE, n.d.). EVM reporting is primarily required for award and incentive contracts. Reporting requirements are typically based off of the contract values starting at $20 million. Detailed EVM reporting requirements can be found in Appendix C.

Monthly EVM reports are submitted by the contractor and reviewed by the Program Management Offices (PMOs). The primary data from these reports that is used in this analysis is the Budgeted Cost of Work Performed (BCWP) and Actual Cost of Work Performed (ACWP). The definitions of each term are found in Table 8 and can be used to calculate cost variance using Equations 3 and 4.

The statistical tests in the current report required that a contract or contract line item number (CLIN) have both EVM and profit data. No available reports had both of these measures and no contract had a unique identifier that allows linking of reports. Therefore, the database containing both profit and performance data had to be constructed manually. The EVM-CR database within CADE was used to search each of the 913 samples from the profit database. The contract number from the CDSR database

was searched in EVM-CR system. Next, CLINs, work orders, or task orders were matched from the CDSR *report name* or *contract task name* descriptions to the EVM-CR reports. In the event that the description from *report name* or *contract task name* was not sufficient in matching to a specific EVM report, the subtotal cost from the CDSR and the ACWP from the EVM were compared. If those amounts were within 5% of each other than they were treated as possible matching reports. The periods of performance from the two different reports were then compared for those possible matches. If they were for the same period then they were treated as matching reports. There were 85 samples from the profit database that had EVM reports available but they were not able to be linked with complete certainty. The samples had the same task order but neither the amounts nor periods of performance were similar; therefore, they had to be excluded. The final result was a database consisting of 130 samples across unique 97 contracts that matched to 130 samples from the CDSR database and EVM databases.

Due to limitations of the data in the current report, the relationship between cost growth and profit margin is not easily examined. In the logical OLS format, the actual cost of work performed (ACWP) would be on one side of the relationship and contract subtotal cost would be on the other side. However, these amounts are fundamentally the same thing and would be acting on both sides of the relationship. Profit margin contains subtotal cost in the denominator of its formula as seen in Equation 2 and the variables are defined in Table 7. Subtotal cost is defined as "total cost provided by the highest level WBS Reporting Element." Cost growth is measured using cost variance which is the difference in the budgeted cost of work performed (BCWP) and the actual cost of work performed (ACWP). Variance is analyzed as a percentage of BCWP. The formulas for

cost variance are shown in Equation 3 and 4 and defined in Table 8. Due to these similarities, statistical analysis using regression between cost growth and profit margin is not permitted as the slope would be indeterminate.

$$\textbf{\textit{Profit Margin}}\ (\%) = \frac{\textbf{\textit{Profit}}}{\textbf{\textit{Subtotal cost+G\&A+UB+MR}}} \qquad \textbf{Equation 2}$$

Table 7 - Profit Margin Definitions

Term	Definition
Profit/Loss or Fee	Profit is the excess of revenues over expenses in fixed-price contracts. Loss is the excess of expenses over revenue in contracts that contain limited Government liability such as fixed-price contracts and cost plus contracts with cost ceilings. In special cost-reimbursement pricing arrangements, fee is a form of profit representing an agreed-to amount beyond the initial estimate of costs that reflects a variety of factors, including risk, and is subject to statutory limitations. Fee may be fixed at the outset of performance, as in a cost-plus-fixed-fee arrangement, or may vary (within a contractually specified minimum maximum range) during performance, as in a cost-plus-incentive-fee arrangement.
Subtotal Cost	Total cost provided by the highest level WBS Reporting Element
General and Administrative (G&A)	Indirect expenses related to the overall management and administration of the contractor's business unit, including the following: a company's general and executive offices; the cost of staff services such as legal, accounting, public relations, financial, and similar expenses; and other general expenses. G&A is also a generic term used to describe expenses with a beneficial or causal relationship to cost objectives that cannot be more accurately assigned to overhead areas for Engineering, Manufacturing Operations, Material, and so on.
Undistributed Budget (UB)	The portion of the budget applicable to program effort that has not yet been allocated to control account budgets or to Management Reserve.
Management Reserve (MR)	The amount of the total allocated budget that is held back for management control and risk purposes at the total contract level rather than designated for the accomplishment of specific tasks.

Source: Data item description "Cost Data Summary Report", 2011

$$\text{Cost Variance (CV)} = \text{BCWP} - \text{ACWP} \qquad \textbf{(Equation 3)}$$
$$\text{CV\%} = (\text{CV} / \text{BCWP}) * 100 \qquad \textbf{(Equation 4)}$$

Table 8 - Cost Variance Definitions

Term	Definition
Budgeted Cost for Work Performed (BCWP)	The sum of the budgets for completed work packages and completed portions of open work packages, plus the applicable portion of the budgets for level of effort and apportioned effort. May be expressed as a value for a specific period or cumulative to date.
Actual Cost of Work Performed (ACWP)	The costs actually incurred and recorded in the Earned Value Management System for accomplishing the work performed within a given accounting period. ACWP reflects the applied costs that may be expressed as a value for a specific period or cumulative to date.

Due to the previously mentioned limitations in comparing profit margin and cost variance, other variables are analyzed in order to determine their significance in predicting profit margin. In a few instances, variables are also tested against a dependent variable for cost growth in order to provide a more holistic view of the analysis. These variables fall into 1 of 3 categories: technical, economical, or environmental.

Technical variables are primarily categorical variables that are obtained from the contractor's Cost Data Summary Report (CDSR). They are as follows:

- Commodity
- Branch of Service
- Contractor
- Life Cycle Phase
- Contract Type
- Incentive Structure
- Period of Performance Start Year

This paper does not analyze in detail each of these variables as most are not significant predictors; however, a detailed listing for each variable is provided in Appendix D through I that contains the sample size, mean cost variance, and mean profit margin for the variable with regard to all years, the years before 2011, and the years after 2010.

Most of the variables are self-explanatory and will be discussed as needed throughout the analysis. However, the two variables for profit structure and contract type require further clarification. Contract type originally contained 16 unique inputs when pulled from the CDSRs. These inputs were condensed into contract types of Cost, Fixed,

and Mixed. Mixed samples are those containing multiple CLINs or work orders with both a cost and fixed type of contract. The same listing was also used to create variables for profit structure. Variables of "IF" for incentive fee or "AF" for award fee established. There were 8 samples that contained both incentive and award fee structures and 28 samples where the 1921 did not indicate either type.

Two of the primary technical variables that are analyzed are the period of performance start year and incentive structure. The period of performance start year is important for the time-series part of the analysis. In order to determine if Better Buying Power has been effective, a binary variable was created that would result in '1' if the period of performance start year was greater than 2010 and would result in '0' if not. The second key variable was profit structure. The profit structure could either be incentive fee (IF), award fee (AF), both incentive and award, or neither incentive or award. Separate binary variables were created for both IF and AF where the result would be a '1' if the sample was strictly IF or AF and a '0' if not. The time and profit structure variables can be directly linked to specific aspects of Better Buying Power and may provide the most measurable insight in analyzing whether Better Buying Power has been implemented effectively.

Economic variables were also included to test whether it's a changing economy that is resulting in increasing profit margins or if the changes may be the result of some other factor such as the implementation of Better Buying Power. Economic variables for the gross domestic product rate change from prior year, federal funds rate, unemployment rate, and the service's budget during the year of contract performance start. The rates for each variable are associated with the period of performance start year. The data for each

variable was obtained from authoritative sources such as the Bureau of Economic Analyses, Federal Reserve website, and the President's Budget.

Environmental variables were analyzed to account for signals that contractors may have received from prior knowledge of DoD acquisitions. They are all exploratory in nature. They are proxies designed to capture the influence of observable signals to the contractor that the government is serious. These variables are included as an extension of game theory; whereas, a coordination game is resolve through one agent picking up a signal of credible commitment. As such, variables for the median profit from prior years are introduced into the model. One variable captures the prior year median profit margin for the EVM only contracts (130 samples) while another variable captures the median profit margin from the larger, non-EVM dataset (913 samples). The variables derived from the larger dataset excluded the 130 samples used in the smaller dataset. The theory is that contactors are aware of the overall DoD climate of profit and it may influence their behavior.

Statistical Analysis

The intent of a profit incentive is to adequately reward a contractor for their performance. Performance is normally measured in terms of technicality, cost, and schedule. This analysis is only focused on cost performance in the form of cost variance/growth. The hypothesis would be that cost growth declines (increases) as profit margin increases (decreases). This thesis has 3 research questions which are as follows:

1. What trends of profit margin and cost growth are observed over time?

2. Does the relationship between profit margin and cost growth, relative to BBP's initiation in 2010, change in such a way that would lead one to identify an independent effect from other changes within the DoD environment?
3. To what degree can we attribute changes in profit and performance to the larger economy, program aspects, and overall policy?

In order to assess trends over time for the first research question, OLS regression is used to fit a regression line using profit margin as a dependent variable and the start year of the period of performance (POP) as an independent variable. The same process is done using cost variance as a dependent variable and time as the independent variable. Additionally, these same trends are examined for both incentive only contracts and non-incentive contracts. All statistical tests in this analysis use an alpha of 0.05.

The second research question looks to examine the relationship of profit margin and cost growth relative to the year 2010 when BBP was initiated. If BBP has been affective then we would expect to see cost growth declining post-2010 and profit margin increasing post-2010. In addition, BBP encouraged the use of incentive structured contracts vs award structures. We'd expect to see an increase in the incentive type contract post-2010 and a reduction in award type contracts. For this part of the research, bivariate, non-parametric analysis is used with profit margin as a dependent variable and also with cost variance as a dependent variable. The independent variables used were all binary, dummy variables. The first dummy variable used was based off of the POP start year. The second variable was based on the profit structure. The Wilcoxon Test is used to test whether the differences in the medians is significant using an alpha of 0.05.

The analysis for research question #3 has 3 parts. First, a one-way analysis of variance (ANOVA) is used to test the significance of the economic variables. The environmental variables were also explored using a one-way ANOVA. If the p-value from the ANOVAs is less than 0.05 than the tested variable is considered to be a significant predictor of profit martin or cost variance.

The second part of the analysis utilized Stepwise Regression to determine the best-fitting model using all technical, economic, and environmental variables. The intent of the model is not to predict future profit margin. Instead, it is used to determine how much of the variance can be explained. Since cost variance cannot be used as an independent variable with profit margin, we would expect the model to have a large amount of unexplained variance (low r-squared). The theory is that performance as an independent variable would be able to explain more of the observed variance. This regression model is tested for normality using a Shapiro Wilk Goodness-of-Fit Test and constant variance using Breusch-Pagan Test. In addition, studentized residuals are used to explore potential outliers and Cook's Distance is used to explore any overly influential data points.

Due to the limitations mentioned previously with using regression to relate profit margin and cost variance, contingency tables were used. A contingency table is a statistical tool that allows for the analysis of the relationship between at least two nominal variables using rows and columns. The table provides for probability-related calculations in order to confirm whether two variables are truly independent. The current research used the median profit margin before 2011 (9.79%) and the mean cost variance % prior to 2011 (1.14%) in order to establish binary, categorical variables. If the median profit

margin or median cost variance was greater than the median of the data prior to 2011 then it received a '1' while everything less than the median during the same period would be labeled a '0'.

Pearson's Chi-Squared Test and the Odds-Ratio Test for significance are more commonly used tests for independence. However, these tests require larger sample sizes to support the p-value approximation that is provides. The current research utilizes Fisher's Exact Test as it is preferred when dealing with smaller sample sizes. One benefit to the Fisher's Exact Test is that it provides an exact calculation of a p-value given the data presented (Agresti, 1992).

Fisher's Exact can be used for both 1 and 2-tailed hypothesis tests. However, the current research uses only a 1-tailed test to test the relationship between cost growth (x) and profit margin (y). The hypothesis for a left-tailed test is as follows:

H_o: The median CV% and profit % are independent of each other

H_a: The probability (sample profit margin > than the median profit margin prior to 2011) is greater when the observed CV% is less than the median CV% prior to 2011

For the current research, the p-value for the left-tailed test is expected to be less than 0.05. This would signal that cost growth and profit margin are not independent. If this hypothesis is true then that would further support the claim that Better Buying Power has been effective in improving the DoD acquisition community by bettering aligning profitability and performance.

Lastly, sensitivity analysis was performed in order to determine if the observed trends post-2010 are due to Better Buying Power or if it's possible that the acquisition

environment was already improving. The dummy variable for the Period of Performance Start Year was adjusted to use 2008 as a reference point. Anything after 2008 would be coded a '1' and anything prior to 2009 would be labeled a '0'. The same non-parametric and regression tests that were utilized previously were used with this new time variable. If the acquisition environment was already improving in 2008 then we cannot say with complete certainty that the observed changes after 2010 are the direct result of BBP.

Summary

Chapter 3 has discussed the sources of the data used in the current research. In addition, the methods of combining the profit and performance databases were described. Next, statistical analysis using non-parametrics, OLS regression, and contingency tables is discussed. The results of these tests are discussed in Chapter 4.

IV. Analysis and Results

Overview

The Office of the Under Secretary of Defense (OUSD) for Acquisition, Technology, and Logistics (AT&L) has recently reported reduced cost variance on earned value contracts (Davis & Anton, 2016). The positive trends that are presented in this chapter may be capturing what the acquisition community has aimed for with the implementation of Better Buying Power. These results reflect that the DoD may be willing to pay a higher profit in exchange for better performance on contracts. This chapter looks to examine what trends, if any, are reflected in the data, how has profit margin and the use of incentive contracts changed since the implementation of Better Buying Power in 2010, and to what degree can we relate the observed changes to Better Buying Power? The current research aims to link profit and performance into one analysis and determine whether the reduced cost variance occurs with contracts that receive higher profit margins over the 2001-2016 timeframe, or whether it is an artifact of some other driver.

This chapter discusses the analysis and results starting with descriptive statistics. Next, the results of the non-parametric and ordinary least squares (OLS) regression are discussed and significant correlations of profit margin are identified. The correlations fall into 3 categories: technical, economical, and environmental. Economic and environmental variables are introduced into the regression in order to test the effect that each one may have on profit margin as it could potentially be factors outside of the DoD that are responsible for the acquisition improvements. Contingency tables are introduced

along with their results in order to examine the relationship between profit margin and cost variance together. Finally, the sensitivity analysis is discussed.

Descriptive Statistics

The database consisted of the following 6 categorical variables: commodity, branch of service, contract type, incentive structure, contractor, and contract phase. The distributions of each of these variables in shown in Table 9 and the mean profit margins and cost variances for each can be found in Appendix D through Appendix I. Some variables were not used in the analysis but their distributions are provided in the Appendix to allow for a more complete picture of the database.

Descriptive statistics in the data set are broken down into 3 groups: all years, pre-2011, and post-2010. The dataset of 130 samples had a median cost variance of 0.99% and a median profit margin 13.21% when all years are included (Table 9). The cost variance reported is not as high as others have reported e.g. Drezner et al. (1993). Drezner examined program SARs from 1960-1990 in his analysis and found the mean cost growth to be around 20%. The difference between the current research and Drezner's research is likely due to the current research focusing on specific CLINs and work orders while Drezner looked at program level data from the Selected Acquisition Reports (SARs).

Table 9- Variable Distributions

Total Samples	**130**		
Commodity	#	**Profit Structure**	#
Aircraft	44	Incentive	72
Ship	24	Neither	28
UAV	22	Award Fee	22
Electronic/Automated Software	19	Both	8
Missiles	12	**Contract Type**	#
Space	5	Cost	72
Ordinance	2	Fixed	51
Surface Vehicle	2	Mixed	7
Service	#	**Phase**	#
Navy	74	Production	73
Air Force	30	Development	57
Army	21	**Contractor**	#
DoD (Joint)	5	Contractor A	20
POP Start Year	#	Contractor B	19
2001	3	Contractor C	14
2003	4	Contractor D	13
2004	3	Contractor E	12
2005	3	Contractor F	10
2006	12	Contractor G	9
2007	13	Contractor H	6
2008	11	Contractor I	5
2009	12	Contractor J	5
2010	17	Contractor K	3
2011	12	Contractor L	3
2012	15	Contractor M	2
2013	12	Contractor N	2
2014	8	Contractor O	2
2015	4	Contractor P	2
2016	1	Contractor Q	1
<2011	78	Contractor R	1
>2010	52	Contractor S	1

Technical Variables

Using the descriptive statistics presented in Table 10, we can analyze the trends over time by plotting the profit margin and cost variance with the Period of Performance Start Year. Figure 1 shows the plot of profit margin by the POP start year. The POP start year has been normalized to the year 2000 so '0' on the figure would be representative of the year 2000, '10' would represent the year 2010, etc. The red trend line shows that profit margin is positively correlated with the POP start year. The POP start date is a significant predictor of profit margin as the t-statistic produced a p-value less .0001 as seen in Table 11. The regression result can be interpreted as each year starting with 2000 adding an additional 0.7% to profit margin.

Table 10 - Descriptive Statistics

	All Samples		Year < 2011		Year > 2010	
	Cost Variance %	Profit Margin %	Cost Variance %	Profit Margin %	Cost Variance %	Profit Margin %
Mean	2.86	10.49	4.74	8.90	0.03	12.87
Median	0.99	13.21	1.14	9.79	0.33	10.91
Std Dev	10	6.7	10.25	6.36	8.98	6.53
Upper 95% Mean	4.59	11.65	7.05	10.33	2.53	14.69
Lower 95% Mean	1.12	9.33	2.43	7.46	-2.47	11.05
N	130	130	78	78	52	52

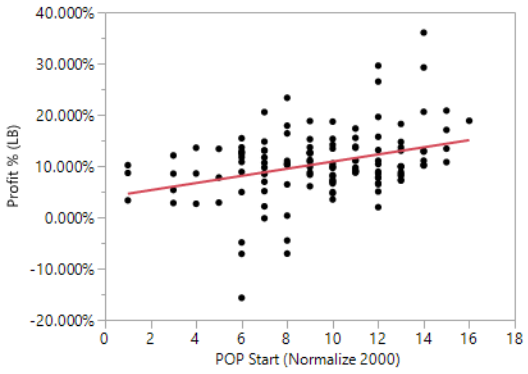


Figure 1 - Profit % by POP Start (Normalized)

Table 11 - Parameter Estimate Profit % by POP Start

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0391	0.0169	2.31	0.0224*
POP Start (Normalize 2000)	0.0070	0.0017	4.11	<.0001*
RSquare	0.1165			

Figure 2 reflects cost variance % by the normalized POP start date. CV% is negatively correlated with the POP start year as visualized by the red trend line and via the negative estimate shown in Table 12. POP start is a significant predictor of CV% with a p-value of 0.0049. The regression output can be interpreted as each years' cost variance declines by 0.75% starting in year 2000.

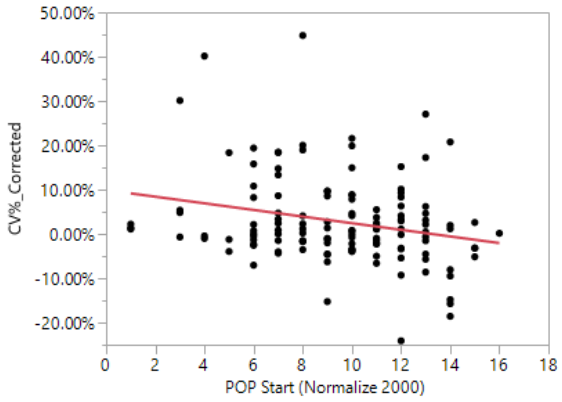


Figure 2 - Cost Variance % by POP Start (Normalized)

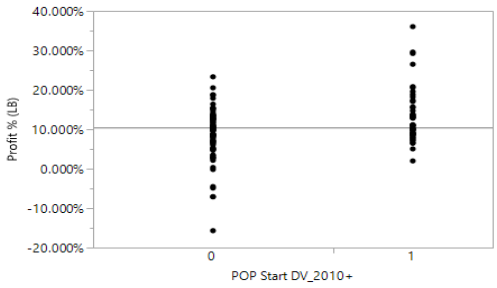
Table 12 - Parameter Estimate CV % by POP Start

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0991	0.0261	3.80	0.0002*
POP Start (Normalize 2000)	-0.0075	0.0026	-2.86	0.0049*
RSquare	0.0602			

The research has shown trends that we would expect to see if BBP has been successful in better aligning profit to performance. Next, the periods pre-2011 and post-2010 are analyzed for changes. There were 78 samples pre-2011 and 52 samples post-

2010. The summary statistics in Table 10 reflect that cost variance has declined and profit margin has increased from the time pre-2011 to post-2010. Median profit margin increased from 9.79% to 10.91% while median cost variance declined from 1.14% to 0.33%. Both of these results may be indicative of the Better Buying Power initiative improving the acquisition environment as intended through the better alignment of profitability to performance.

The non-parametric Wilcoxon Test was utilized to test the significance in the changing medians. The benefit of non-parametric analysis is that outliers are ignored. The null hypothesis with this test would be that the medians are the same and the alternate would be that the medians are statistically different. Figure 3 shows the results of the test using profit margin as a dependent variable and the dummy variable for pre-2011/post-2010 as the independent variable. The p-value is less than 0.05 so the null hypothesis is rejected and the medians are considered to be statistically different.



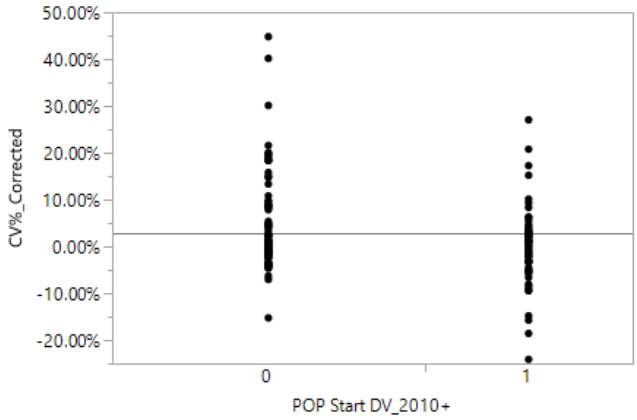
1-Way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
6.9566	1	0.0084*

Figure 3- Profit Margin Pre-Post Wilcoxon

A similar non-parametric test was completed using cost variance as the dependent variable. The results are reflected in Figure 4. The difference in median cost variance

pre-2011 and post-2010 is statistically significant with a p-value of .0351. Both of these results support the claim that BBP has been effective. Next, the use of incentive contracts is examined.



1-Way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
4.4422	1	0.0351*

Figure 4- Cost Variance % Pre-Post Wilcoxon

Better Buying Power encouraged the use of incentive-based contracts over award fee. Table 13 shows the data breakdown based on if the contract type contained an incentive (IF) or award (AF) profit structure. There were 28 samples where the contract type did not contain IF or AF. In addition, there were 8 contracts that contained both IF and AF. This is due to a sample reporting multiple CLINs that had different contract types and/or profit structures. Over 61% of the data contained some sort of incentive structure. For the data post-2010, samples with AF only and those containing both IF and AF reported small sample sizes. As such, the reliance on the measures of central tendency in these categories must be discounted.

Table 13 - Incentive Structure

	All Samples			Year < 2011			Year > 2010		
Profit Structure	Number	Median CV%	Median Profit %	Number	Median CV%	Median Profit %	Number	Median CV%	Median Profit %
IF	72	1.27	10.84	35	8.77	6.62	37	-0.65	11.10
AF	22	1.11	8.89	20	0.35	8.77	2	5.61	10.00
Neither	28	-0.02	10.29	17	0.02	10.33	11	-0.14	10.25
Both	8	3.28	10.86	6	3.28	10.86	2	5.74	9.35

Table 14 reflects the number of samples by period of performance start year. Additionally, the table depicts the number of IF only and AF only samples along with each ones respective percentage of the total database. Figure 5 provide a visual representation that the number of IF contracts as a percentage of total contracts in the database has increased during the Better Buying Power era while the number of AF contracts has declined. The decline in IF contracts in years 2014-2016 is not concerning as this is likely due to the lack of samples available in those years. The lack of samples in those years is due to this analysis only using completed projects and the majority of projects that started after 2013 may still be in progress.

Better Buying Power was first introduced in 2010 which is why the data is shown for all samples, pre-2011, and post-2010. At first glance, it appears that the biggest change is for IF contracts. They account for a higher percentage of the whole set, and they show a dramatic decrease in cost variance and an increase in profit margin. The others suggest business as usual. The non-parametric Wilcoxon Test was used to test the significance in the changing medians. If the p-values from the test were less than 0.05 then the difference in the medians is considered significant.

Table 14 - IF/AF Distribution by POP Year

Year	Total Samples	# Incentive Only	% of Total	# Award Only	% of Total
2001	3	0	0.0%	3	100.0%
2003	4	2	50.0%	1	25.0%
2004	3	1	33.3%	2	66.7%
2005	3	1	33.3%	1	33.3%
2006	12	4	33.3%	5	41.7%
2007	13	5	38.5%	3	23.1%
2008	11	6	54.5%	2	18.2%
2009	12	7	58.3%	1	8.3%
2010	17	9	52.9%	2	11.8%
2011	12	8	66.7%	1	8.3%
2012	15	11	73.3%	1	6.7%
2013	12	9	75.0%	0	0.0%
2014	8	6	75.0%	0	0.0%
2015	4	3	75.0%	0	0.0%
2016	1	0	0.0%	0	0.0%
<2011	78	35	44.9%	20	25.6%
>2010	52	37	71.2%	2	3.8%

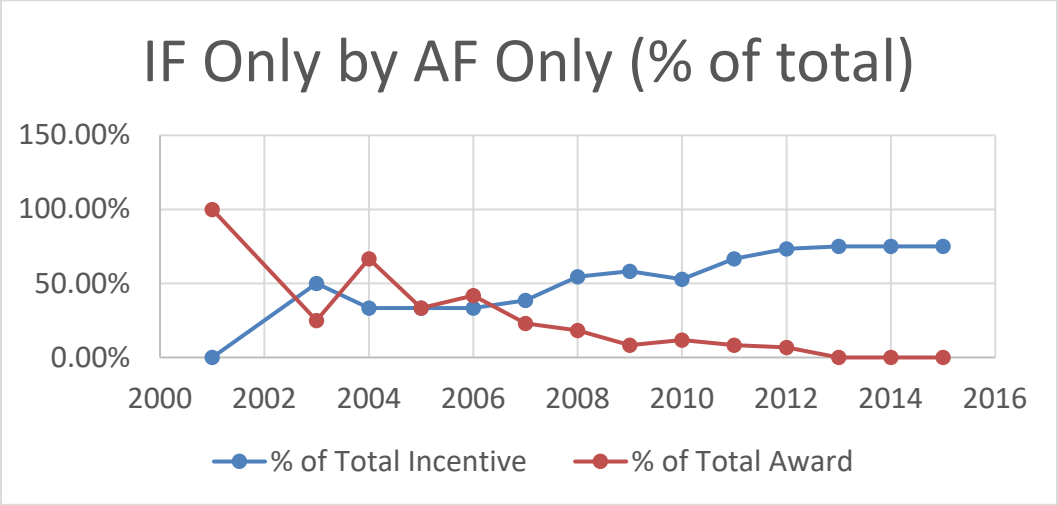


Figure 5- Incentive Only by Award Fee Only Distribution

Table 15 and 16 provides the results of the non-parametric test for differences in medians. For contracts containing only an incentive structure, the median profit margin increased from 6.62% to 11.10%. The Wilcoxon Test validates that the difference in means is significant with a p-value of 0.0041. The difference in medians for the non-incentive contracts before and after 2010 was not significant. As such we cannot reject the null. This suggests nothing has changed in the non-IF acquisition process.

For the period before 2011, non-incentive contracts received a higher profit margin at 10.03% compared to the 6.62% received by those with an incentive structure. The Wilcoxon Test results show that the difference in those means is not significant. For the period post-2010, IF contracts received a higher profit margin of 11.10% when compared to the 10.25% received by the non-incentive contracts. The Wilcoxon Test resulted in a p-value of 0.2710 which indicates that the difference in medians in not significant.

Table 15 - Profit Margin Wilcoxon Test on Incentive and Pre-2011 / Post-2010

Profit	Pre-2011	Post-2010	Pvalues
IF	6.62%	11.10%	0.0041
Non-IF	10.03%	10.25%	0.5881
	0.1411	0.271	

Similarly, cost variance was examined with the same time and incentive variables (Table 16). The difference in median cost variance for contracts containing only an incentive structure was significant with a p-value of 0.0031. Likewise, the difference in median cost variance for IF and non-IF contracts for the pre-2011 period was also significant. The post-2010 period comparing IF and non-IF did not result in a significant

difference in medians. This is likely due to the lack of non-IF samples post-2010. Post-2010 non-IF samples reported median values that were not statistically significant.

Table 16 - Cost Variance Wilcoxon Test on Incentive and Pre-2011 / Post-2010

Cost	Pre-2011	Post-2010	Pvalues
IF	8.77%	-0.65%	0.0031
Non-IF	0.22%	1.09%	0.9504
	0.0048	0.5649	

So far the analysis has shown that there is a statistically significant difference in median profit margin and median cost variance during the period's pre-2011 and post-2010. The median profit margin increased from one period to the next while cost variance declined. The statistics presented in Tables 15 and 16 show that profit margin increased on IF contracts from pre-2011 to post-2010, cost variance declined on IF samples during the same period, and Table 13 reflects the increased use of incentive structured contracts as opposed to award fee.

When buying a home, some buyers may choose to pay an upfront fee in exchange for a lower interest rate on the mortgage. This is known as "buying down the rate". Similarly, using the results in this analysis, we may infer that the DoD has chosen to buy-down rate of cost variance by agreeing to pay a higher profit margin. Better Buying Power called for better alignment of a contractor's profitability with their performance. The DoD's willingness to pay a higher profit in exchange for better performance sends a signal to the contractor that their performance matters.

In a 2013 testimony to the House of Representatives, Pierre Chao stated that "Culturally, we have evolved to a point where we would rather pay $1 billion and 5% profit for a defense good, than $500 million and a 20% profit" (*Twenty-five Years*, 2013)

Increased profit margins are not to be seen as a negative for the DoD. Former Under Secretary of Defense for AT&L, Frank Kendall, argued that capitalism results in industries striving to maximize profit. The DoD has the responsibility of both protecting taxpayer's interests but also ensuring fair treatment of industry partners. Without reasonable profit, the industries have no incentive to work with the DoD. Kendall also contends "we (DoD) will benefit if profit incentives provide effective motivation to industry and are tied to the goals we value" (Kendall, 2015).

Economic Variables

As discussed in Chapter 2, acquisition reforms have not always been successful or shown results as originally intended. For the current research, it is possible that a changing economy or other factor outside of the DoD's control have been the reason for profit margin's increasing while cost variance has decreased. In order to account for these economic conditions, the following variables were tested:

- Gross Domestic Product % Change Year Prior to POP Start
- Federal Fund Rate of the POP Start Year
- Unemployment Rate of the POP Start Year
- Service's Budget of the POP Start Year

When analyzing these economic variables with profit margin, the only significant variable was the Federal Fund rate with a p-value of 0.0097 and an R-square of 0.0511 (Table 17). There was negative correlation between the Fed Fund rate and profit margin so as the rate increases, profit margins declined. This variable by itself does not explain

much, but it may prove to be more useful in the multivariate analysis. The other three variables tested did not result in significant findings.

Table 17 - Parameter Estimates Profit % by Economic Variables

Parameter Estimates- Profit % to GDP % Change Prior Yr				
Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept	0.1075	0.0086	12.53	<.0001
GDP % Change Prior Year	-0.1536	0.3726	-0.41	0.6809
RSquare	0.0013			
Parameter Estimates- Profit % to Fed Rate POP Start				
Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept	0.1158	0.0071	16.31	<.0001
FedRatePopStart	-0.8302	0.3163	-2.62	0.0097
RSquare	0.0511			
Parameter Estimates- Profit % to Unemployment POP Start				
Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept	0.0896	0.0234	3.82	0.0002
Unemployment PopStart	0.2163	0.3220	0.67	0.5030
RSquare	0.0035			
Parameter Estimates- Profit % to Service Budget POP Start				
Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept	0.0986	0.0136	7.25	<.0001
Service Budget by Year	0.0000	0.0001	0.51	0.6079
RSquare	0.0021			

Multivariate Regression

Bivariate analysis provided some insight into the variables that correlate with profit margin. However, multivariate regression can be utilized to further explore which combination of factors may correlate with profit margin and to what extent. Using stepwise regression, the variables discussed throughout Chapter 4 were explored in order to find the combination of variables that best fits the data. The stepwise regression used a p-value threshold of 0.05 when determining the best fit. Stepwise regression does not test the assumptions of normality, constant variance, or multi-collinearity when determining the best fit. Therefore, the test of those assumptions are provided as well.

The results of the regression are shown in Table 18. The model had 6 variables that were all significant as indicated by the p-values (Prob<|t|) less than 0.05. All variables are binary variables of '1' or '0'. The model's R-square was 0.3736 which may be considered relatively low. However, the model, for reasons previously explained, cannot include cost variance as an independent variable with profit margin as the dependent variable. The economic variables were not significant enough to be included in the model. The absence of these variables may signal that the changes being observed are internal to the Department of Defense.

Table 18 - Multivariate Results

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta	VIF
Intercept	0.0588	0.0093	6.33	<.0001*	0	.
DV_Aircraft	0.0421	0.0106	3.97	0.0001*	0.2988	1.1100
DV_AF	0.0287	0.0116	2.47	0.0148*	0.1813	1.0566
Contractor E	0.0505	0.0176	2.88	0.0048*	0.2191	1.1403
Contractor H	-0.1049	0.0250	-4.20	<.0001*	-0.3298	1.2103
DV_Fixed	0.0339	0.0105	3.24	0.0015*	0.2478	1.1486
POP Start DV_2010+	0.0303	0.0101	3.00	0.0033*	0.2225	1.0822
RSquare	0.3736					

The 6 variables that did show significance in the model were as follows: Commodity-Aircraft, Service-Air Force, Contractor E, Contractor H, Contract Type-Fixed, and Period of Performance Start Year >2010. All variables were binary. The database had 44 samples that were aircraft. This variable had the second highest effect as determined by taking the absolute value of the standard beta shown in Table 18. There were 30 Air Force samples in the database and this variable had the least effect of the 6 variables. Contractor E had 12 samples in the database with 8 being Navy contracts and 4 Army. The variable with the highest effect using standard beta was Contractor H. This

contractor experienced poor performance on 6 samples. However, 5 of the 6 samples were all for the same Navy program. Each report was for performance on different periods of the project. Next, the variable for fixed contract type was significant in the model. There were 51 fixed samples which were 68% Navy. These 51 samples were mostly commodities of aircraft or ships. Fixed type contracts would be expected to earn more profit than cost contracts as fixed contracts contain more risk for the contractor. Lastly, the variable distinguishing between pre-2011 and post-2010 was significant. There were 52 samples post-2010 in which 31% of these were aircraft and 52% were Navy. The results were then tested for normality, constant variance, multi-collinearity, outliers, and any other overly influential data points.

The test for normality was completed using a Shapiro-Wilk Test on the residuals from the Table 18 model. This test used the following hypothesis:

- Ho: Residuals are Normally Distributed
- Ha: NOT normal

The goodness-of-fit test for normality resulted in a p-value of 0.0253 which leads to the null hypothesis being rejected. However, the shape of the plotted distribution of the residuals must also be considered before rejecting (Figure 6). The shape of the distribution could be considered to be “approximately normal”; therefore, the test for normality would be a “soft-fail” and the analysis could continue.

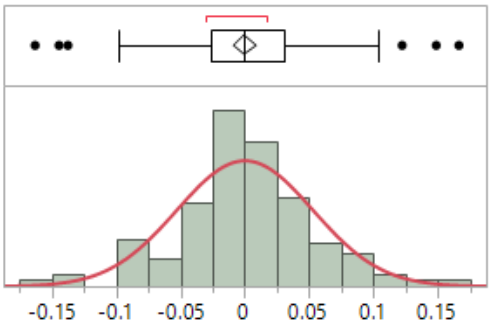


Figure 6 - Residuals Plotted for Test of Normality

A Breusch-Pagan (BP) test for constant variance was also performed. The hypothesis for this test was as follows:

- Ho: Residuals have Constant Variance
- Ha: Residuals do NOT have constant Variance

The BP test resulted in a p-value of <0.0001 so the null hypothesis would be rejected. Since this test failed, the lognormal value of the dependent variable (profit margin %) was used to re-run the test. The p-value of the BP test when using the lognormal value was also <0.0001 which would result in the test failing for constant variance. As a result, similar to the test for normality, the plotted distribution of the residuals from the model in Table 18 can be observed for a possible "soft-fail". As seen in Figure 7, there is no apparent pattern or other distinguishing shape to the plotted data that would indicate a violation of constant variance. The result is determined to be a "soft-fail".

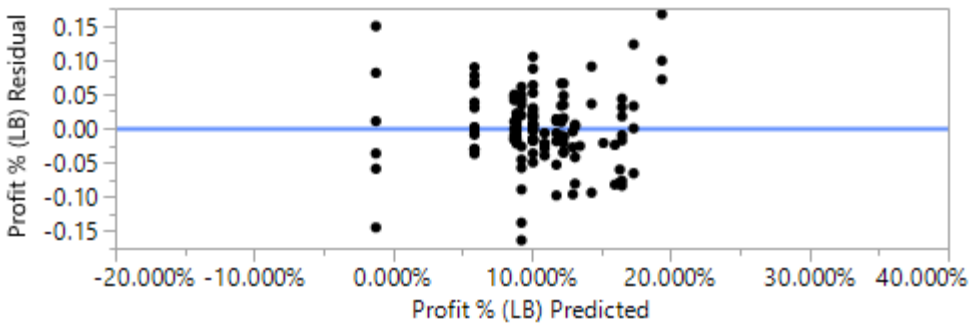


Figure 7 - Residuals by Predicted Plot for Constant Variance

The test for multi-collinearity was accomplished using variance inflation factors (VIF). VIF is the relation of the variance in a multivariate model divided by the variance of a bivariate model. Table 18 shows the VIF scores for each variable. Generally, any VIF score greater than 5.0 would require further analysis as multi-collinearity may be an issue. None of the variables in the current research have concerns for multi-collinearity.

Next, the impact of any potential outliers was examined by plotting the model's studentized residuals. There were two data points that exceeded 3 standard deviations. These samples were excluded and the model was re-analyzed without them. This resulted in the dummy variable for Air Force no longer being significant. The two data points were added back into the model and the variable for Air Force was removed. The updated model is reflect in Table 19.

Table 19- Updated Multi-regression Model

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	0.19823079	0.039646	12.9203
Error	124	0.38049673	0.003069	**Prob > F**
C. Total	129	0.57872752		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta	VIF
Intercept	0.067331	0.008788	7.66	<.0001*	0	.
DV_Aircraft	0.04019	0.010787	3.73	0.0003*	0.285026	1.1038701
General Dynamics	0.042135	0.017587	2.40	0.0181*	0.182796	1.0979195
Huntington Ingalls	-0.1131	0.025246	-4.48	<.0001*	-0.35566	1.1887
DV_Fixed	0.0335404	0.010663	3.15	0.0021*	0.245447	1.1484716
POP Start DV_2010+	0.0303088	0.010317	2.94	0.0039*	0.222541	1.0822298
RSqaure	0.3425					

Using the new model, the previously tested assumptions were re-accomplished. The test for normality also failed the Shapiro Wilk Test. However, the residuals reflect (Figure 8) what most would consider to be a normal distribution with the data grouped around 0 and no large groupings in the tails of the distribution. We consider this to be a soft-fail.

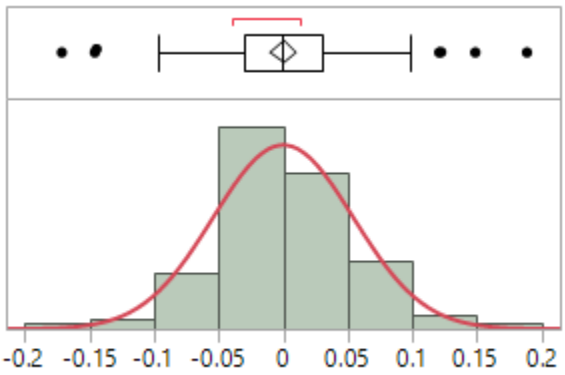


Figure 8- Model 2 Residuals Plotted for Test of Normality

The test for constant variance failed when using the BP Test as it did in the first model. The test also failed when using the lognormal of the dependent variable Profit Margin %. The residuals by predicted plot in Figure 9 reflect no apparent pattern or other distinguishing shape to the plotted data that would indicate a violation of constant variance. We consider this to be a soft-fail of the test for constant variance.

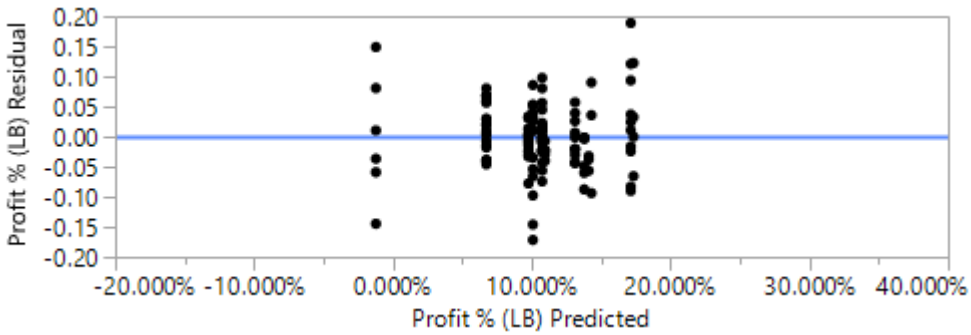


Figure 9- Model 2 Residuals by Predicted Plot for Constant Variance

The test for multi-collinearity reflected no issues as indicated by the VIF scores in Table 19. As before, the test for outliers using studentized residuals had two data points exceeded 3 standard deviations. However, if those points are excluded, the model's results do not change as they did when the variable for Air Force was included. Therefore, the 2 samples remain in the model as they do not change the overall results.

Cook's Distance Test is used to determine if there are any overly influential samples in the dataset. Any sample with a Cook's D point higher than 0.5 would need to be investigated further as it could be overly affecting the model's results. This model had no data points exceeding the 0.5 threshold.

Environmental Variables

In order to account for the overall acquisition environment, variables were created that represented the median profit margin in the prior years. One variable used the EVM data only along with the median profit margin in the year prior to the POP start year. The other variable used the median profit margin from the larger dataset of 913 samples. The 130 samples that were used in the primary analysis were excluded and the median profit margin of the remaining 783 samples were used to calculate a median profit margin for each period of performance start year. The reasoning for these variables is that it is possible that contractors may act on knowledge of profit potential and performance from prior periods. For instance, in a 2007 contract negotiation, a contractor may know that the median profit margin was high in the previous year and suspect that the current environment suggests even higher potential profits now. This information could then be used during contract negotiations in 2008.

The result of using median profit from the year prior as a predictor of profit margin is shown in Table 20 for both variables tested. In the bivariate analysis, median profit from the prior year is not a significant predictor of current profit margin. These results simply state that the variables we tested are not significant. However, it is possible that contractors are still using environmental signals that were not tested in this analysis when negotiation profit.

Table 20 - Parameter Estimate Profit % by Mean Profit Yr Prior (EVM Only)

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0338494	0.038349	0.88	0.3791
Median Profit Prior Year (EVM)	0.7175908	0.382913	1.87	0.0632

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.1416248	0.046858	3.02	0.0030*
Median Profit Prior Year (All)	-0.277315	0.350884	-0.79	0.4308

Contingency Tables

Previously discussed limitations with OLS regression did not allow for the use of cost variance as a predictor of profit margin. However, contingency tables can be used to explore the relationship between the two variables by converting each variable to a nominal variable.

Figure 10 is a contingency table that uses nominal variables for profit margin and cost variance. These two variables are setup as binary where a '1' is assigned if the profit margin or cost variance is greater than the median of the pre-2011 data. The median profit margin prior to 2011 was 9.79%. The y-axis would be a '1' (red) if a samples profit margin were greater than 9.79%. The same is true for CV% on the x-axis. If CV% is greater than the mean of 1.14% prior to 2011 than a '1' was assigned (blue).

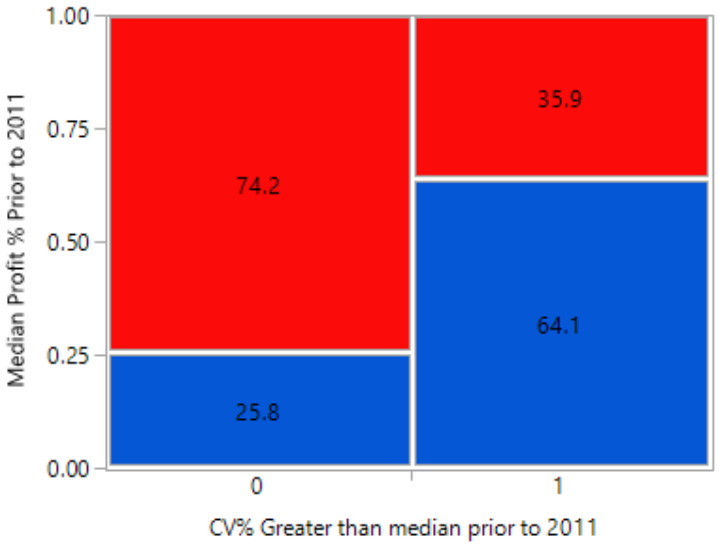


Figure 10 - Contingency Table Profit Margin by Cost Variance %

The figure can be interpreted as the profit margin was greater than the median 74.2% of the time when cost variance was less than the median. Likewise, cost variance was greater than the median 64.1% of the time when profit margin was less than the median. There was a 35.9% chance that both profit margin and cost variance were greater than the medians and a 25.8% chance that both were less than the median. From this figure, it can be concluded that profit margin and performance are inversely related, and as the profit margin increases over the median from prior-2011, there's a higher probability for cost growth to remain under the median that existed prior to 2011.

The following hypothesis was used to test the contingency table for independence:

H_o: The median CV% and profit % are independent of each other

H_a: The probability (sample profit margin > than the median profit margin prior to 2011) is greater when the observed CV% is less than the median CV% prior to 2011

The Fisher's Exact Test resulted in a p-value of <0.0001 for the left-tailed test. Since this value was less than 0.05, the null hypothesis is rejected. This signals that the two variables are dependent of each other and that the likelihood of profit margin exceeding 9.79% is more probable when the cost variance is less than 1.14%.

Sensitivity Analysis

It may be contested that the chosen year of 2010 captures an effect that would be found by choosing another year. That is a concern for the study, and a sensitivity analysis was conducted using the year 2008 as a dividing year. This sensitivity analysis will assist in answering the final research question which revolves around the degree in which we can relate profit and performance to overall policy and program aspects.

First, the sensitivity analysis used the non-parametric Wilcoxon Test to test for significant difference in medians for both profit margin and cost variance during the pre-2009 period and post-2008 period. When using profit margin as the dependent variable, the p-value was 0.0224 indicating the medians were significantly different. When using cost variance as the dependent variable, the medians were also significantly different with a p-value of 0.0261.

Next, similar to what was accomplished earlier in chapter 4, the difference in IF and Non-IF contracts during the pre-2009 and post-2008 period was analyzed for both profit and cost variance. These results are shown in Table 21. For easier reference, the

previous results using 2010 as a cutoff are provided under the sensitivity results. For profit margin, the difference in medians between IF and Non-IF contracts is statistically significant during the pre-2009 period. The post-2008 is not statistically significant at an alpha of 0.05; however, the p-value is fairly close when using a one-tailed test (0.0517) so it's worth mentioning. The difference in medians for IF contracts pre-2009 and post-2008 is statistically significant. For cost variance (right-side of Table 21), we see the same results that we saw when using the 2010 as a reference year.

Table 21-Wilcoxon Results for Sensitivity Analysis

Profit	Pre-2009	Post-2008	Pvalues
IF	2.81%	11.17%	0.0008
Non-IF	10.45%	9.72%	0.4936
	0.0097	0.1034	

Cost	Pre-2009	Post-2008	Pvalues
IF	15.80%	-0.65%	0.0002
Non-IF	0.13%	0.96%	0.7088
	0.0003	0.5513	

Profit	Pre-2011	Post-2010	Pvalues
IF	6.62%	11.10%	0.0041
Non-IF	10.03%	10.25%	0.5881
	0.1411	0.271	

Cost	Pre-2011	Post-2010	Pvalues
IF	8.77%	-0.65%	0.0031
Non-IF	0.22%	1.09%	0.9504
	0.0048	0.5649	

The results of the sensitivity analysis reflect that the DoD acquisition environment was improving before 2010. Therefore, we are unable to link the observed changes directly to the Better Buying Power initiative. This, however, doesn't mean that BBP has been completely ineffective.

Overall Analysis

The regression models in this analysis were not designed to predict future profit margin. They were designed to explore significant drivers of historical profit margin. It becomes harder to find significant variables in a model as more variables are added. One of the key findings in this model is that the post-2010 samples were significant drivers of a profit margin. These samples were positively correlated with profit margin which show

that something happened in the year's post-2010 where profit margins increased. None of the economic or environmental variables that were discussed proved to be significant in the multi-regression model. The absence of these control variables may indicate that the acquisition changes were internal to the DOD and not the general public.

Using the presented data, there may be evidence to support the Better Buying Power reform and its impact on improving the acquisition community. Cost growth has declined between the pre-2011 and post-2010 period and profit margins have increased over the same periods. However, the sensitivity analysis findings reflect changes occurring prior to the BBP implementation. This finding makes it difficult to determine exactly to what degree the observed changes are attributable to BBP.

V. Conclusions and Recommendations

Chapter Overview

The research questions presented in Chapter 1 are reviewed, and interpreted answers are provided using the results from Chapter 4. Next, limitations in the data and research methods are discussed. Finally, recommendations for future research are presented.

Conclusion of Research

The first research question in this analysis examined what trends of profit margin and cost growth are observed over time. Cost variance and profit margin were plotted as dependent variables with the period of performance start year as the independent variable. This resulted in profit margin reflecting a positive correlation with time, such as, as the years progressed, profit margin increased. Cost variance reflected a negative correlation. These trends set the framework for the remaining analysis as they are what we would expect to see if Better Buying Power has been effective.

The research then examined specific trends relative to when BBP was initiated in 2010. First, the research found a statistically significant difference in medians for both profit margin and cost variance from before 2011 and after 2010. The median profit margin prior to 2011 was 9.79% and the mean cost variance was 1.14%. For the period post-2010, the median profit margin increased to 10.91% and the mean cost variance declined to 0.33%.

In addition, BBP recommended using incentive structured (IF) over award fee (AF) structured contracts. This report showed that there was an increased usage of

incentive structures and a reduced use of the award structure. For the incentive structured samples, profit margin increased from 6.62% before 2011 to 11.10% after 2010. Likewise, the cost growth for the IF samples declined from 8.77% to -0.65%. The non-parametric Wilcoxon Test confirmed that these differences were statistically significant. These results may signal that the DoD has embraced the mentality of Chao (2013) who implied we ought not shy away from profits, but treat them as a rightful reward for performance. Perhaps the DoD is now willing to pay higher profit in exchange for better contract performance. In addition, the results may indicate that acquisition professionals are adhering to recommendations and guidance that Better Buying Power has introduced.

Lastly, the third research question looked to determine the degree in which observed changes are attributable to the larger economy, program aspects, and overall policy. Multivariate regression was one tool used to assist in answering this question by finding a model that best represented the profit data. There were no variables that were highly predictive of profit margin. The multivariate model was only able to explain 34% of the variance in the mean profit margin. While the results are naturally tempered by the inability to include performance into the OLS regression, this result signals that there is still a large amount of variance to be explained which is logical as there is only so much that can be controlled through incentives. Importantly, the research found that economic factors such as unemployment rate, federal funds rate, gross domestic product (GDP), and the branch of service's budget were not significant predictors of profit margin. This suggests that the underlying reason for the observed trends may be internal to the DoD through technical differences in programs or management of programs. In addition, there was little evidence to support that the changes being observed were due to the overall

acquisition environment. The environmental variables were exploratory and found no significant results. This does not convey that the environment has not had an impact but simply means additional exploration may be necessary.

Cost growth is believed to be a major predictor of profit margin. However, performance, in the form of cost growth, was one variable that was not able to be tested as an independent variable with profit margin as a dependent variable. Therefore, contingency tables were used to show a dependent relationship between profit margin and cost variance where profit margin increases as cost variance declines and vice versa.

A central question of the research was to determine how (if at all) Better Buying Power had impacted the DoD acquisition community. It is more difficult to determine, however, if the changes observed may be traced specifically to the implementation of BBP. This study found the trends to have begun before 2010 as seen through the sensitivity analysis which produced statistically significant differences when using other years.

The study has, nonetheless, identified a pattern which should give some faith that the environment set by a series of acquisition reforms has improved its management of cost. There has been a marked reduction in cost overruns in recent years. This study's preliminary analysis of economic variables found no dramatic changes attributable to the economy which seems to indicate changes are due to contractor performance.

Limitations

The current research had a few significant limitations. First, the dataset used in this analysis was a combination of two different data sources. Profit data was pulled

from Cost Data Summary Reports (CDSR) and performance data from Earned Value Management (EVM) reports. Not all projects require EVM reporting. Therefore, there were significantly more CDSR reports available than there were EVM reports. Each of these reports have their owned intended purposes and are not designed to be easily compared with each other. As such, linking CDSR samples to EVM samples was a complicated process. Second, one of the unique aspects of this research was analyzing profit and performance. However, as discussed in Chapter 3, these two variables were not able to be analyzed using regression. Consequently, other predictors of profit margin were explored using statistical analysis. Lastly, the current research was focused on the changes that occurred before and after Better Buying Power was initiated. Most projects in the database have periods of performance that are several years in length. Therefore, the sample size of the analysis was limited as many projects starting after 2014 are still in progress.

Recommendations for Future Research

There is ample opportunity for future research on topics similar to those presented in the current research. The current study has shown a marked uptick in the use of incentive contracts, but such growth cannot continue indefinitely. It will be interesting to see how cost performance changes with an expanded time frame, and once an equilibrium or new norm is established. While this study finds the new trends encouraging, it is possible that the momentum toward incentive contracts goes too far, pushing into contract areas where it is ill-suited. In many ways, the current study was an early look at a dynamic that yet to full play out. First, as time progresses, there should be more data

available to compare pre-2011 and post-2010. In addition, the effect of the other Better Buying Power initiatives in 2012 and 2015 could also be examined. This analysis could introduce contractor performance ratings from the Contractor Performance Assessment Reporting System (CPARS) to create a more robust analysis. Second, further research could also be done on profit margin in the form examining specific contract profits and contractual profit share ratios. Lastly, the environment of the DoD acquisition community has much to explore. Training initiatives and certification requirements have changed drastically in the past decade. Research on the effect of this training and certification requirement could be accomplished to determine if positive changes in recent years are attributable to the workforce becoming better at their jobs.

Appendix

Appendix A – Blank CDSR

SECURITY CLASSIFICATION

Unclassified

COST DATA SUMMARY REPORT

Form Approved
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 8 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Executive Services Directorate (0704-0188). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE ABOVE ORGANIZATION.

a. MDAP:
b. PHASE:

2. PRIME MISSION PRODUCT

3. CONTRACTOR TYPE (X one)
- PRIME / ASSOCIATE
- DIRECT-REPORTING SUBCONTRACTOR

4. NAME/ADDRESS (Include ZIP Code)

5. APPROVED PLAN NUMBER

6. CUSTOMER (DIRECT-REPORTING SUBCONTRACTOR USE ONLY)

7. CONTRACT TYPE

8. CONTRACT PRICE

9. CONTRACT

10. TYPE ACTION
a. CONTRACT NO.:
b. LATEST MODIFICATION:
c. SOLICITATION NO.:
d. NAME:

11. PERIOD OF PERFORMANCE
a. START DATE *(YYYYMMDD)*:
b. END DATE *(YYYYMMDD)*:

12. APPROPRIATION
- RDT&E
- PROCURE
- O&M

13. REPORT CYCLE
- INITIAL
- INTERIM
- FINAL

14. SUBMISSION NUMBER

15. RESUBMISSION NUMBER

16. REPORT AS OF *(YYYYMMDD)*

17. NAME (Last, First, Middle Initial)

18. DEPARTMENT

19. TELEPHONE NUMBER (Include Area Code)

20. EMAIL ADDRESS

21. DATE PREPARED *(YYYYMMDD)*

WBS ELEMENT CODE	WBS REPORTING ELEMENTS	NUMBER OF UNITS TO DATE	COSTS INCURRED TO DATE			NUMBER OF UNITS AT COMPLETION	COSTS INCURRED AT COMPLETION		
			NONRECURRING	RECURRING	TOTAL		NONRECURRING	RECURRING	TOTAL
A	B	C	D	E	F	G	H	I	J

22. REMARKS

DD FORM 1921, 20070416 PREVIOUS EDITION IS OBSOLETE. SECURITY CLASSIFICATION Unclassified

Appendix B - Cost and Software Data Reporting (CSDR) Requirements

REQUIRED REPORT	WHEN REQUIRED	SOURCE
Contractor Cost Data Report (CCDR)	• All major contracts[1] and subcontracts, regardless of contract type, for ACAT I and IA programs and pre-MDAP and pre-MAIS programs subsequent to Milestone A approval, valued at more than $50 million[2] (then-year dollars). Reporting is continued even if a program has been downgraded from an ACAT I or IA, unless waived by DCAPE. • Not required for contracts priced below $20 million (then-year dollars). • The CCDR requirement on high-risk or high-technical-interest contracts priced between $20 million and $50 million is left to the discretion of the DoD Program Manager and/or the Deputy Director, Cost Assessment (DDCA). • Required for major components (i.e., government furnished equipment) of an ACAT I program that are managed by the Services as ACAT II or ACAT III, and if the contract value exceeds $50 million or if determined to be a high-risk or high-technical-interest contract priced between $20 million and $50 million by the Program Manager and/or the DDCA. • Not required under the following conditions, provided the DoD Program Manager requests and obtains approval for a reporting waiver from the DDCA: procurement of commercial systems or procurement of non-commercial systems bought under competitively-awarded firm fixed-price contracts, as long as competitive conditions continue to exist.	DoD 5000.04-M-1 (Reference (at)) This instruction
Software Resources Data Report (SRDR)	• All major contracts[1] and subcontracts, regardless of contract type, for contractors developing or producing software elements within ACAT I and IA programs and pre-MDAP and pre-MAIS programs subsequent to Milestone A approval for any software development element with a projected software effort greater than $20 million (then-year dollars). • The SRDR requirement on high-risk or high-technical-interest contracts priced below $20 million is left to the discretion of the DoD Program Manager and/or the DDCA.	DoD 5000.04-M-1 This instruction
Contractor Business Data Report	• Required for all contractor business entities (e.g., plant, site, or business unit) responsible for contracts with CSDR requirements.	DoD 5000.04-M-1
Contractor Sustainment Report	• All major contracts[1] and subcontracts, regardless of contract type, valued at more than $50 million[2] (then-year dollars).	SEC. 832 of P.L. 112-81 (Reference (v)) DoD 5000.04-M-1

Notes:

1. For CSDR purposes, the term "contract" (or "subcontract") may refer to the entire standalone contract, to a specific task or delivery order, to a series of tasks or delivery orders, to a contract line item number, or to a series of line item numbers within a contract. The intent is to capture data on contractual efforts necessary for cost estimating purposes irrespective of the particular contract vehicle used. All contracts for the procurement of end items, software, or services to support the acquisition of MDAP and MAIS programs (or ACAT II and III programs which meet the above thresholds) must include the Data Item Descriptions (DIDs) and Contract Data Requirements Lists necessary for the reporting of CSDR data.
2. For CSDR purposes, contract value will represent the estimated price at contract completion (i.e., initial contract award plus all expected authorized contract changes) and be based on the assumption that all contract options will be exercised.
3. CSDR is further discussed in section 4 of Enclosure 10.

Source: DoDI 5000.02

Appendix C - EVM Requirements

REQUIREMENTS	WHEN REQUIRED[1]	SOURCE
For Cost/Incentive Contracts[2] ≥ $50 Million[3]		
– Compliance with EVM system guidelines in ANSI/EIA-748[4]	At contract award and throughout contract performance	Part 7 of Office of Management and Budget (OMB) Circular A-11 (Reference (c)) This instruction
– EVM system formally validated and accepted by cognizant contracting officer	At contract award and throughout contract performance	
– Integrated Program Management Report (IPMR) (DI-MGMT-81861[5])	Monthly	
– Integrated Baseline Reviews	Within 180 calendar days after contract award, exercise of options, and major modifications	
For Cost/Incentive Contracts[2] ≥ $20 Million[3] but < $50 Million[3]		
– Compliance with EVM system guidelines in ANSI/EIA-748[4] (no formal EVM system validation)	At contract award and throughout contract performance	Part 7 of OMB Circular A-11 This instruction
– IPMR (DI-MGMT-81861[5]) (tailoring of formats recommended)	Monthly	
– Integrated Baseline Reviews	Within 180 calendar days after contract award, exercise of options, and major modifications	
For Cost/Incentive Contracts[2] < $20 Million[3]	At the discretion of the Program Manager based on cost-benefit analysis	Part 7 of OMB Circular A-11 This instruction
– IPMR, Format 6 (DI-MGMT-81861[5])	At the discretion of the Program Manager based on Government requirements	
For Firm Fixed-Price Contracts[2] regardless of dollar value	Limited Use–will be approved by the MDA based on a business case analysis	Part 7 of OMB Circular A-11 This instruction
– IPMR, Format 6 (DI-MGMT-81861[5])	At the discretion of the Program Manager based on Government requirements	

Notes:
1. EVM is required, as outlined in the table, unless the EVM requirement has been waived by the CAE per paragraph 6c in Enclosure 2.
2. The term, "Contracts," includes contracts, subcontracts, intra-government work agreements, and other agreements. For Indefinite Delivery/Indefinite Quantity contracts, EVM will be applied to the individual task orders or group of related task orders in accordance with the requirements in this table. "Incentive" contracts include fixed-price incentive. EVM is required for Fixed-Price Incentive Fee development and integration contracts with measurable and discrete work scope. In cases where the work scope is not measurable and discrete, program offices should follow the process to obtain a DFARS deviation.
3. Application thresholds are in then-year dollars.
4. ANSI/EIA-748 = American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) Standard 748, Earned Value Management Systems (Reference (au)).
5. DI-MGMT-81861 = DID: Integrated Program Management Report (Reference (av))
   a. If EVM is not required or a deviation is obtained, the IPMR should be used and tailored to obtain cost and/or schedule reporting when desired by the Government. For example, for full rate production contracts where EVM is not applicable, a tailored IPMR including a cost report showing actuals and a top-level schedule providing delivery dates of end products would be sufficient for Government management and oversight.
   b. Flow-down of the IPMR DID to the subcontractors is at the discretion of the program office.

Source: DoDI 5000.02

Appendix D – Commodity Distribution

	All Samples			Year < 2011			Year > 2010		
Commodity	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %
Aircraft	44	-0.77	12.85	28	0.96	10.90	16	-3.81	16.25
Ship	24	7.29	9.29	16	11.26	5.42	8	-0.64	17.03
UAV	22	0.03	11.10	11	-1.01	12.05	11	1.07	10.14
Electronic/Automated Software	19	6.46	7.88	9	9.75	5.38	10	3.50	10.14
Missiles	12	8.14	7.61	8	9.87	6.58	4	4.69	9.66
Space	5	0.51	11.52	3	1.53	12.66	2	-1.04	9.79
Ordinance	2	0.91	7.18	1	-2.33	12.38	1	4.15	1.99
Surface Vehicle	2	2.47	9.13	2	2.47	9.13	0	0.00	0.00

Appendix E – Branch of Service Distribution

	All Samples			Year < 2011			Year > 2010		
Service	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %
Navy	74	4.89	10.00	47	7.07	7.99	27	1.10	13.49
Air Force	30	-1.71	12.59	17	0.94	10.78	13	-5.17	14.96
Army	21	1.34	9.31	11	0.03	9.42	10	2.77	9.19
DoD (Joint)	5	6.56	10.05	3	7.12	10.52	2	5.74	9.35

Appendix F – Contractor Distribution

	All Samples			Pre-2011			Post-2010		
Contractor	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %
Contractor A	20	1.06	10.62	14	1.75	10.61	6	-0.55	10.63
Contractor B	19	-2.77	13.99	10	-0.05	11.72	9	-5.80	16.51
Contractor C	14	3.31	8.68	9	5.92	7.79	5	-1.38	10.27
Contractor D	13	1.51	10.31	9	0.08	10.33	4	4.73	10.27
Contractor E	12	0.22	13.91	8	3.17	11.09	4	-5.69	19.57
Contractor F	10	-0.56	11.13	3	-7.48	14.02	7	2.40	9.88
Contractor G	9	0.89	12.96	7	1.69	11.09	2	-1.93	19.53
Contractor H	6	13.82	-1.22	6	13.82	-1.22	0	0.00	0.00
Contractor I	5	15.56	8.60	2	33.19	-1.79	3	3.80	15.52
Contractor J	5	6.56	10.05	3	7.12	10.52	2	5.74	9.35
Contractor K	3	15.19	9.64	1	18.35	2.89	2	13.61	13.01
Contractor L	3	14.33	6.80	1	40.16	2.66	2	1.41	8.87
Contractor M	2	24.54	1.57	2	24.54	1.57	0	0.00	0.00
Contractor N	2	9.62	9.97	0	0.00	0.00	2	9.62	9.97
Contractor O	2	-7.00	17.15	0	0.00	0.00	2	-7.00	17.15
Contractor P	2	-0.52	7.35	2	-0.52	7.35	0	0.00	0.00
Contractor Q	1	-4.52	8.45	0	0.00	0.00	1	-4.52	8.45
Contractor R	1	0.03	12.84	1	0.03	12.84	0	0.00	0.00
Contractor S	1	1.12	6.46	0	0.00	0.00	1	1.12	6.46

Appendix G – Profit Structure Distribution

	All Samples			Year < 2011			Year > 2010		
Profit Structure	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %
IF	72	4.21	10.57	35	9.30	7.19	37	-0.60	13.77
AF	22	1.37	9.73	20	0.95	9.71	2	5.61	10.00
Neither	28	0.18	10.83	17	0.24	10.70	11	0.09	11.03
Both	8	4.12	10.65	6	3.58	11.08	2	5.74	9.35

Appendix H – Contract Type Distribution

	All Samples			Year < 2011			Year > 2010		
Contract Type	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %
Cost	72	3.03	9.53	49	3.14	9.82	23	2.78	8.92
Fixed	51	3.30	11.79	27	7.68	7.29	24	-1.63	16.84
MC	7	-2.14	10.90	2	4.23	8.04	5	-4.68	12.04

Appendix I – Life Cycle Phase Distribution

	All Samples			Year < 2011			Year > 2010		
Phase	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %	Number	Mean CV%	Mean Profit %
Prod	73	2.37	10.87	42	3.55	9.80	31	0.77	12.30
Dev	57	3.48	10.01	36	6.13	7.84	21	-1.06	13.72

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14. ABSTRACT

Recent Better Buying Power (BBP) initiatives have sought to better contractually align contractor profit with performance. Profit should incentivize efficiency in cost and schedule and only be awarded when earned. The current research seeks evidence that BBP has been effective in improving performance. The first part of the research examines the trends of profit margin and cost growth both before and after the implementation of the first BBP initiative. BBP recommended the use of incentive type contracts over award fee contracts, where appropriate. This research found an increased use of incentive type contracts and a reduced use of award fee contracts since BBP commenced. Incentive contracts, in particular, showed increasing profits and decreasing cost variance from 2001 to 2016 year, and a test for significance shows that contracts with reductions of cost growth corresponded to higher profit margins. Macroeconomic factors seem to have played a minimal role, suggesting the trends correspond to the changing business environment and practices which government reform initiatives have sought to institute. The research was unable to link BBP initiatives to the improving relationship between performance and profit with complete certainty, finding instead that the trend improved throughout the time period studied.

15. SUBJECT TERMS
Profit Margin; Cost Variance; Better Buying Power; Acquisition Reform

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