3-7-2003

An Analysis of the Federal Acquisition Streamlining Act and the Clinger-Cohen Act and Their Effect on Cost Overruns in Department of Defense Contracts

Andrew K. Mosier

AN ANALYSIS OF THE FEDERAL ACQUISITION STREAMLINING ACT AND THE CLINGER-COHEN ACT AND THEIR EFFECT ON COST OVERRUNS IN DEPARTMENT OF DEFENSE CONTRACTS

THESIS

Andrew Kyle Mosier, First Lieutenant, USAF

AFIT/GCA/ENV/03-06

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

AFIT/GCA/ENV/03-06

AN ANALYSIS OF THE FEDERAL ACQUISITION STREAMLINING ACT AND THE CLINGER-COHEN ACT AND THEIR EFFECT ON COST OVERRUNS IN DEPARTMENT OF DEFENSE CONTRACTS

THESIS

Presented to the Faculty

Department of Systems Engineering and Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Cost Analysis

Andrew Kyle Mosier

First Lieutenant, USAF

March 2003

AFIT/GCA/ENV/03-06

AN ANALYSIS OF THE FEDERAL ACQUISITION STREAMLINING ACT AND THE CLINGER-COHEN ACT AND THEIR EFFECT ON COST OVERRUNS IN DEPARTMENT OF DEFENSE CONTRACTS

Andrew Kyle Mosier
First Lieutenant, USAF

Approved:

//signed//	7 March 03
Michael A. Greiner, Maj, USAF (Chairman)	date
//signed//	3 March 03
David Christensen, PhD (Member)	date
//signed//	7 March 03
Daniel E. Reynolds, Professor (Member)	date

Acknowledgements

First and foremost, I thank God for giving me the strength and willpower I needed to see this research effort through to completion. Without His Son, Jesus Christ, to lean on and seek solace in, I would not have been able to finish. Without His empowering me with the Holy Spirit, I would not have had the energy to complete this thesis successfully. Many times throughout the process, I had to lean not on my understanding, but on His and His alone and for that I am eternally grateful.

I am also indebted to my family for putting up with the many times I became visibly frustrated. Not many husbands are as lucky as I am to have a wife who is as compassionate, understanding, and supportive. She picked up my slack more times than I can count. To give her any less credit than she deserves would be a tragedy. I also thank my three daughters. I thank my oldest daughter for praying for me and my schoolwork. Life would have been much more difficult without her genuine, heartfelt prayers. I thank my second daughter for her daily reminder of what it is like to have childlike innocence. It is sometimes one of the only things that gets me through the day. Last, but certainly not least, my baby girl, even though she is only six weeks old, she provided me with some much needed motivation to get me through these last few days of graduate school. She reminds me why I do what I do.

I would also like to thank Major Michael Greiner who provided me with the guidance and leadership for this research effort. I thank Professor Daniel Reynolds for his support and timely criticism of my many revisions. Finally, I thank Dr. David Christensen for paving the way for this research with his past research efforts.

1Lt Kyle Mosier

Table of Contents

Page

Page

List of Tables

Table Page

List of Figures

Figure | Page

AFIT/GCA/ENV/03-06

Abstract

This thesis examines the impact of the Federal Acquisition Streamlining Act (FASA) of 1994 and the Clinger-Cohen Act on cost overruns in Department of Defense (DoD) contracts. Many officials believe that we must change the way we do business to meet the new post-Cold War national security challenges. Changing the way we do business means reforming the acquisition process to deliver weapons systems faster and cheaper. The FASA and the Clinger-Cohen Act made more changes to the acquisition process than any other policy had in the ten years preceding.

This research effort studied 220 contracts completed between December 31, 1993 and December 31, 2001 to determine if cost overruns on contracts completed before the implementation of the FASA and the Clinger-Cohen Act were different than cost overruns on contracts completed after the implementation of the FASA and the Clinger-Cohen Act. The contracts were also subdivided to determine if the results were sensitive to acquisition lifecycle phase, branch of service, or contract type.

The results indicate that cost overruns decreased on completed contracts after the implementation of the legislation. The results were sensitive to the branch of service responsible. Air Force contracts experienced no change in cost overruns after the implementation of the FASA and the Clinger-Cohen Act, while cost overruns in Army and Navy contracts decreased. The results were not sensitive to lifecycle phase or contract type.

AN ANALYSIS OF THE FEDERAL ACQUISITION STREAMLINING ACT AND THE CLINGER-COHEN ACT AND THEIR EFFECT ON COST OVERRUNS IN DEPARTMENT OF DEFENSE CONTRACTS

I. Introduction

General Issue

September 11, 2001 is a day that will not soon be forgotten. In a single hostile act against the United States, terrorists changed the world as we know it. In 1994, Colleen Preston made a statement that the post-Cold War era introduced new political, economic, and military security challenges to the United States. In order to meet these challenges, a change in the way we do business is necessary (Preston, 1994:7). That statement has even more impact now than it did in 1994.

Since we know that change must occur, the obvious question is what must change? The 2002 budget for government spending is more than $2 trillion, of which $336 billion is allocated for defense (OMB, 2003: Table S-2). This is more than 16% of the overall budget. In order to ensure that this money is spent in the most effective manner, certain controls are in place. These controls influence the current acquisition process, which protects taxpayers from fraud, waste, and abuse. Since the acquisition process is central to how the government does business, one is led to believe that changing the way the government does business means changing the acquisition process.

General Lester Lyles, Commander of Air Force Materiel Command (AFMC) commented on change and the acquisition process.

> Organizations and people either adapt to changing environments and move forward, or they become ineffective . . . We must make the cultural changes required to be successful. We must continue to deliver tomorrow's technologies in today's weapon systems, faster, cheaper, and better (Lyles, 2002).

This research looks at how we have changed the acquisition process in order "to deliver tomorrow's technologies . . . cheaper." With the Department of Defense (DoD) activities using such a large share of the federal budget, it is easy to understand why cost performance is a major concern to those who are interested in reforming the acquisition process. Delivering weapon systems to the Warfighter in an affordable manner is no easy task, but it is something we must do in order to meet the challenges of the future.

Specific Issue

On October 13, 1994, President Clinton signed into law the Federal Acquisition Streamlining Act (FASA), which was a result of Vice President Gore's National Performance Review. Another piece of legislation, the Clinger-Cohen Act of 1996, was the result of two additional acts, the Federal Acquisition Reform Act and the Information Technology Management Reform Act (DSMC web site). These two acts are among the myriads of legislative actions aimed at improving the way the federal government does business.

A major concern in the area of cost performance is the ability to stay within budget, avoiding cost overruns. Cost overruns are defined as the difference between a contract's actual costs at completion and the budgeted costs. The effect the FASA and the Clinger-Cohen Act have had on controlling cost overruns among defense contracts is still unclear. The focus of this research is to quantify this effect and determine if the cost overrun percentage has increased, decreased, or remained the same.

Scope and Limitations of Study

The Defense Acquisition Executive Summary (DAES) database is a collection of earned value data for individual contracts on defense acquisition programs from 1970 to 2002. Since it captures all the data required to measure the fiscal health of a defense acquisition program, it will be used in this research for the purpose of analyzing cost overruns. Past research has looked at other acquisition reform initiatives and their subsequent effect on cost overruns. These research efforts will be summarized in Chapter 2. In order to center this effort on the acquisition initiatives in question, this research will be limited to those contracts that were completed between January 1, 1994 and December 31, 2001. Contracts completed before the pivotal date of December 31, 1997 will be compared to contracts completed after the pivotal date.

Additionally, this study focuses on those defense programs engaged in the System Development and Demonstration phase and the Production and Deployment phase of the acquisition life cycle (See Figure 1 below). Programs in the development phase will be compared to programs in the production phase to determine if there is a significant statistical difference in the respective cost overruns resulting from the enacted acquisition reform legislation. Programs in other phases of the acquisition life cycle will not be addressed.

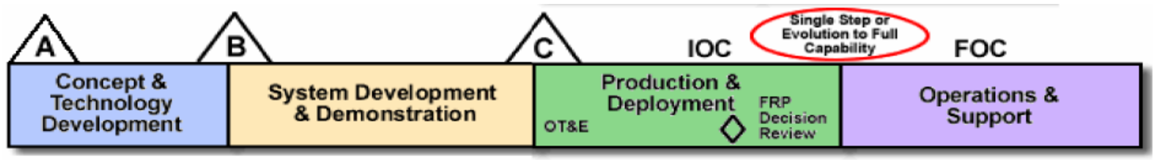

Figure 1. DoD 5000 Model (OSD Website)

Finally, this research addresses only those programs that experienced cost overruns not cost growth. Cost growth occurs when a program experiences valid changes that increase costs over the course of the procurement process. It is assumed for the purpose of this study that all changes to the baseline are valid. Thus, the final budget will be taken at face value for the purpose of analyzing cost overruns.

Research Questions and Methodology

This research benefits the DoD by providing senior leadership with analytical, quantitative insight into the cost overrun problem and how it has changed as a result of specific legislation enacted to reform the acquisition process. For the full benefit to be realized, it is important that key research questions are established. The research questions addressed by this study are as follows:

1. Is the final cost overrun percentage on contracts completed before the implementation of the FASA and Clinger-Cohen Act equal to the final cost overrun percentage on contracts completed after the implementation of the FASA and Clinger-Cohen Act?
2. Is the final cost overrun percentage sensitive to the phase of the acquisition life cycle the program is in?
3. Is the final cost overrun percentage sensitive to the branch of service responsible for the program?

4. Is the final cost overrun percentage sensitive to the type of contract?

To make a conclusion about whether or not the DoD is performing better, worse, or the same in the area of cost overruns, hypothesis testing procedures are used to determine if the differences are statistically significant. Specifically, the research hypotheses to be tested are

H_1: The mean final cost overrun percentage on contracts completed before the implementation of the FASA and Clinger-Cohen Act is not equal to the mean final cost overrun percentage on contracts completed after the implementation of the FASA and Clinger-Cohen Act.

H_2: The mean final cost overrun percentage on contracts in the development phase of the acquisition life cycle before the implementation of the FASA and Clinger-Cohen Act is not equal to the mean final cost overrun percentage on contracts in the development phase after the implementation of the FASA and Clinger-Cohen Act.

H_3: The mean final cost overrun percentage on contracts in the production phase of the acquisition life cycle before the implementation of the FASA and Clinger-Cohen Act is not equal to the mean final cost overrun percentage on contracts in the production phase after the implementation of the FASA and Clinger-Cohen Act.

H_4: The mean final cost overrun percentages on Army, Navy, and Air Force contracts completed before the implementation of the FASA and Clinger-Cohen Act are not equal to the mean final cost overrun percentages on Army, Navy, and

Air Force contracts completed after the implementation of the FASA and Clinger-Cohen Act.

H_5: The mean final overrun percentage on fixed price contracts completed before the implementation of the FASA and Clinger-Cohen Act is not equal to the mean final overrun percentage on fixed price contracts completed after the implementation of the FASA and Clinger-Cohen Act.

H_6: The mean final overrun percentage on cost reimbursable contracts completed before the implementation of the FASA and Clinger-Cohen Act is not equal to the mean final overrun percentage on cost reimbursable contracts completed after the implementation of the FASA and Clinger-Cohen Act.

Hypotheses two and three were motivated by Captain David Searle's thesis, "The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns in Major Defense Programs." In Captain Searle's thesis, he shows the impact of the Packard Commission's recommendations on cost overruns differed between the stages of the acquisition lifecycle. Specifically, he found that cost overruns on production contracts experienced no change, while cost overruns on development contracts worsened after the implementation of the Packard Commission's recommendations (Searle, 1997: 62-65).

Similarly, hypothesis four was motivated by the follow up article to Captain Searle's thesis. The sensitivity analysis performed on the branches of service showed that Air Force contracts worsened after the implementation of the Packard Commission's recommendations, while Army and Navy contracts experienced no change (Christensen, 1999: 257)

Organization of the Research

This study essentially picks up where other research has left off and provides an update to the same concerns addressed by past research. The next chapter will examine more closely the FASA and the Clinger-Cohen Act. It will also provide a more detailed look at the techniques used to calculate cost overruns. The methodology used in the research is detailed in the third chapter. It captures the data collection process and the methods used to prove or disprove the hypotheses. In chapter four, the results of the hypothesis tests are summarized and discussed along with the statistical tests necessary to show the tests are valid. The final chapter presents the conclusions of the study along with recommendations for future research.

II. Literature Review

Chapter Overview

This chapter provides the reader with an overview of the acquisition reform initiatives relevant to this research and a discussion of the tools used to monitor cost performance in the Department of Defense (DoD). It first details the Federal Acquisition Streamlining Act (FASA) and the Clinger-Cohen Act, emphasizing issues that are most pertinent to cost overruns. Next, the Earned Value Management System (EVMS) is discussed along with how the EVMS can be used to show whether or not a program has experienced cost overruns. Finally, the chapter concludes with a discussion of past research that has been accomplished with regard to acquisition reform and cost overruns.

The Federal Acquisition Streamlining Act

On October 13, 1994, President Clinton signed the FASA into law. The FASA was a result of Vice President Gore's National Performance Review (NPR). Prior to the FASA, many people believed the acquisition process was overly cumbersome and complex (DSMC web site). To alleviate those problems, the FASA introduced broader and more encompassing changes to the acquisition process than had any other acquisition reform legislation in the 10 years preceding (Tolan, 1998). The Simplified Acquisition Threshold, the Federal Acquisition Computer Network, the Truth in Negotiation Act, and military standards and specifications are the major components of the FASA that may have an effect cost performance.

The Simplified Acquisition Threshold (SAT) establishes a ceiling value below which procurement officers are not required to publicly compete commercial buying activities. The FASA raised this value from $25,000 to $100,000. In order for competition not to be circumvented, the FASA stipulates that procurements not be broken down merely to avoid requirements that apply to purchases exceeding the SAT (FAR Part 13). It also eliminated much of the paperwork that goes along with these types of purchases, making the process much more efficient (Chinworth, 2000: 166).

In accordance with the Federal Acquisition Regulation (FAR), purchases between $2,500 and $100,000 are reserved for small businesses (FAR Part 19). Related to the small business concerns, the FASA also includes preferential treatment for small disadvantaged businesses. Specifically, there is a 5% goal for procurements to originate from women-owned businesses (Tolan, 1998: 17). Purchases below $2,500 are considered "micropurchases" and are exempt from the small business requirement and the Buy American Act (DSMC web site).

The Federal Acquisition Computer Network (FACNET) was introduced with the intentions, per the FASA objectives, of reducing the amount of paperwork required within the acquisition process (DSMC web site). The FASA introduced the FACNET to the entire federal government (DSMC web site).

Raising the threshold at which requirements of the Truth in Negotiation Act (TINA) apply was the third area addressed by the FASA that may have an impact on cost. TINA requires contractors to submit cost and pricing data and to certify the data as accurate. A violation of TINA could result in defective pricing, and the contractor could be penalized (Northrop Grumman, 2002). The FASA raised the threshold to $500,000 for civilian agencies and DoD procurements (DSMC web site).

Perhaps the most significant change brought about by the FASA was the elimination of many military standards and specifications (DSMC web site). Chinworth points out that these requirements were originally designed to:

- support the development and production of complex, state-of-the-art weapons systems able to operate in demanding environments envisioned by military users;
- guarantee that long-term logistic requirements could be met for complex weapons systems;
- provide consistency in the implementation of complex programs;
- guarantee integrity in government contracting while assuring reasonable profitability for its defense contractors;
- maintain public accountability and prevent contractor abuses (Chinworth, 2000: 166).

As a result of the FASA, many procured items are now exempt from the requirement that cost and pricing data be submitted (DSMC web site). Removing the cost and pricing data submission requirement has reduced time delays, shortened the research and development process, and eliminated many design specifications and tests. This change has simplified the procurement process which leads to cost savings (DSMC web site).

The elimination of military specifications can have profound cost impact. Various studies address the idea that DoD regulations add a premium to the cost of products and services provided by government contractors. In 1994, one such study was performed by TASC, Inc. and Coopers and Lybrand. It has since become known as the "Perry Study" (Chinworth, 2000: 167). The study concluded that regulations add a significant cost premium to DoD programs. The study also asserts that corrective actions can be accomplished with the FASA, and no other statutory changes are necessary (TASC, 1994: 47).

A major improvement in reducing the number of DoD-specific requirements is the implementation of Single Process Initiatives (SPIs). These initiatives give contractors a way to find a common ground among many production programs allowing better utilization of commercial standards and practices (Chinworth, 2000: 167). Specific SPI proposals originate within the industry, which allow the contractor to develop ideas for making the processes more efficient (Chinworth, 2000: 167). SPI proposals are tracked by the Defense Contract Management Command (DCMC) via the Single Process Initiative System (SPIS) database, which is composed of reports from contractors and program managers (Chinworth, 2000: 168). The SPIS database categorizes SPI initiatives in many different areas, including business, engineering, environmental, logistics, manufacturing, quality, safety, software, and testing (Chinworth, 2000: 169). Some of the SPI initiatives do not save money directly. However, those initiatives that have reported cost savings reveal that the government is saving money through this acquisition reform effort (Chinworth, 2000: 171). Table 1 shows the top ten cost reducing processes and their associated savings.

Table 1. Top 10 cost reducing processes and savings (Chinworth, 2000: 170)

Process type	*No. of processes reporting cost data*	*Combined cost avoidance and negotiated savings*
Quality systems	45	$51M
Testing	16	$42M
Engineering-Configuration Management	43	$38M
Business - General	29	$34M
Logistics - Parts/Material Management	16	$25M
Manufacturing - Soldering/Welding	35	$24M
Quality - Multiple Processes	38	$19M
Business - Earned Value Management System	13	$16M
Quality - Nonconforming Material/MRB	13	$15M
Quality - Inspection	14	$11M

The Clinger-Cohen Act

Passed in 1996, the Clinger-Cohen Act, named for Congressman William Clinger and Senator William Cohen, resulted from two other pieces of acquisition reform legislation, the Federal Acquisition Reform Act (FARA) and the Information Technology Management Reform Act (ITMRA). The FARA and the ITMRA were passed as separate initiatives, since the impact they had on each other made them difficult to pass together (FISC website). These two acts further advanced the changes made by the FASA (DSMC website). Each is addressed separately in the following discussion.

The FARA made specific changes to the Simplified Acquisition Procedures (SAP). The FARA requires that SAP be used for commercial item purchases between $100,000 and $5 million (Pendolino and Causey, 1996: 7). The FARA also removed the link between SAP and the FACNET. As mentioned earlier, the FASA had raised the simplified acquisition threshold from $25,000 to $100,000. It also required, however, that agencies adhere to a $50,000 threshold until they had implemented FACNET. The FARA repealed this requirement, but stipulated that the agency must have full FACNET capability by the end of 1999 or its threshold would be reduced to $50,000 (Pendolino and Causey, 1996: 7).

Also addressed in the FARA, commercial items are exempt from the TINA. That is, vendors are not required to submit cost or pricing data for contracts below the SAT of $500,000 (Pendolino and Causey, 1996: 8). The FARA also released commercial items from the requirements of the Cost Accounting Standards (CAS). Commercial items now have their own guidance consistent with commercial practices, FAR cost principles, and CAS. This guidance is intended to ensure contractors do not overcharge the government (Pendolino and Causey, 1996: 8).

The second piece of legislation comprising the Clinger-Cohen Act is the Information Technology Management Reform Act (ITMRA), passed because of long delays and multi-million dollar cost overruns on information technology (IT) projects. Two prime examples were the Internal Revenue Service (IRS) tax systems modernization and the Federal Aviation Administration (FAA) advanced automation system (Beachboard, 1997). The ITMRA states that the FAR council will ensure that,

> to the maximum extent practicable, the process for acquisition of information technology is a simplified, clear, and understandable process that specifically addresses the management of risk, incremental acquisitions, and the need to incorporate commercial information technology in a timely manner (ITMRA Sec. 5201).

One of the biggest changes brought about by the ITMRA is the repeal of Section 111 of the Federal Property and Administrative services Act of 1949 known as the Brooks Act. The Brooks Act gave the General Services Administration exclusive authority to procure information technology resources for all of the federal government

(Pendolino and Causey, 1996: 12). The ITMRA effectively gives control of IT resources back to the individual agencies.

Oversight for the acquisition of IT resources rests with the Director of the Office of Management and Budget (OMB). The director is required to encourage agencies to procure IT resources in a cost-effective manner (Pendolino and Causey, 1996:12). Along with the responsibility of procuring IT resources for their agency, each executive director must issue guidance concerning cost/benefits, risks, and other evaluation criteria for IT acquisitions (Pendolino and Causey, 1996: 13).

The ITMRA introduced a concept known as modular contracting for IT resources. Under this concept, agencies acquire an IT system in successive increments, which allows them to manage large acquisitions more efficiently. The ITMRA requires the FAR to contain guidance on the use of modular contracting (Pendolino and Causey, 1996: 13). The ITMRA also encourages agencies to use pilot programs that test new and innovative ways of acquiring IT resources. Upon discovering a way that saves money, the agency and contractor are allowed to share the savings (Pendolino and Causey, 1996: 13).

The Earned Value Management System

This section discusses the building blocks of the earned value management system (EVMS) and how it is used to calculate cost overruns. The EVMS has its roots in industry, but is primarily used by the DoD to analyze defense contracts and determine if they are on track with respect to their proposed budget and schedule (Christensen, 1998: 374). The government first mandated the use of earned value in 1967 as part of the

Cost/Schedule Control Systems Criteria (C/SCSC) (Fleming and Koppelman, 2000: 59). In 1996, the DoD changed the name from C/SCSC to the Earned Value Management Control Systems Criteria (DoD, 1996).

For the EVMS to be effective, projects must have certain elements. A budget and a schedule are two of the most important elements. These elements provide a clear, demonstrable method for managing a defense contract of any size (Christensen, 1998: 375). Projects are typically subdivided into smaller, more manageable elements or work packages. These work packages were originally called Cost Account Plans, but were more aptly renamed in 1996 as Control Account Plans (CAP), since more than costs alone are controlled at this level (Fleming and Koppelman, 2000: 59). Each CAP comprises a detailed work plan, a time to start and finish each task, and an authorization for resources (i.e. budget). The sum of all the CAPs makes up a project's scope, schedule, and budget (Fleming and Koppelman, 2000: 111).

There are three fundamental building blocks of the EVMS from which most earned value calculations can be accomplished. These three building blocks include the Budgeted Cost of Work Scheduled (BCWS), the Budgeted Cost of Work Performed (BCWP), and the Actual Cost of Work Performed (ACWP) (DSMC website). The glossary of earned value terms from the website of the Office of the Under Secretary of Defense for Acquisition Technology and Logistics gives the following definitions for each of these terms:

1. BCWS – the sum of budgets for all work packages and the amount of effort scheduled to be completed by a certain time. It is used primarily for calculations related to schedule and will not be used for the purpose of this research.

2. BCWP – the sum of budgets for completed work packages and completed portions of work packages. This is the "earned value" part.

3. ACWP – the costs that were actually incurred and recorded in accomplishing the work in a given time period.

The Budget at Completion (BAC) and the Estimate at Completion (EAC) are two other EVMS tools necessary in calculating cost overruns. The BAC is the sum of all budgets established for the contract (DAU, 2001). As Figure 2 shows below, it is the BCWS line extended to the end of the time period for any given contract. The EAC is more difficult to calculate, since there are a multitude of EAC formulas. For this reason, contractors usually submit a range of EACs (Christensen, 1993: 17). One of the most popular EAC computations uses the cumulative Cost Performance Index (CPI) as the basis for determining the EAC (Christensen, 1996: 37). The cumulative CPI (CPI_{cum}) is the BCWP to date divided by the ACWP to date. A CPI_{cum} less than one is undesirable and indicates the contract is overrunning costs (Christensen, 2001). Figure 2 shows the EAC as the ACWP line extrapolated out to the end of the time period for any given contract.

The cumulative Cost Variance (CV) is calculated by subtracting the ACWP from the BCWP (DSMC website). A negative number is the cost overrun to date; a positive number indicates the contract is under running costs. The Variance at Completion (VAC) is calculated by subtracting the EAC from the BAC (DSMC website). Similar to the CV, a negative VAC indicates a final cost overrun while a positive number indicates no cost overrun. See Figure 2 for a graphical representation of these calculations.

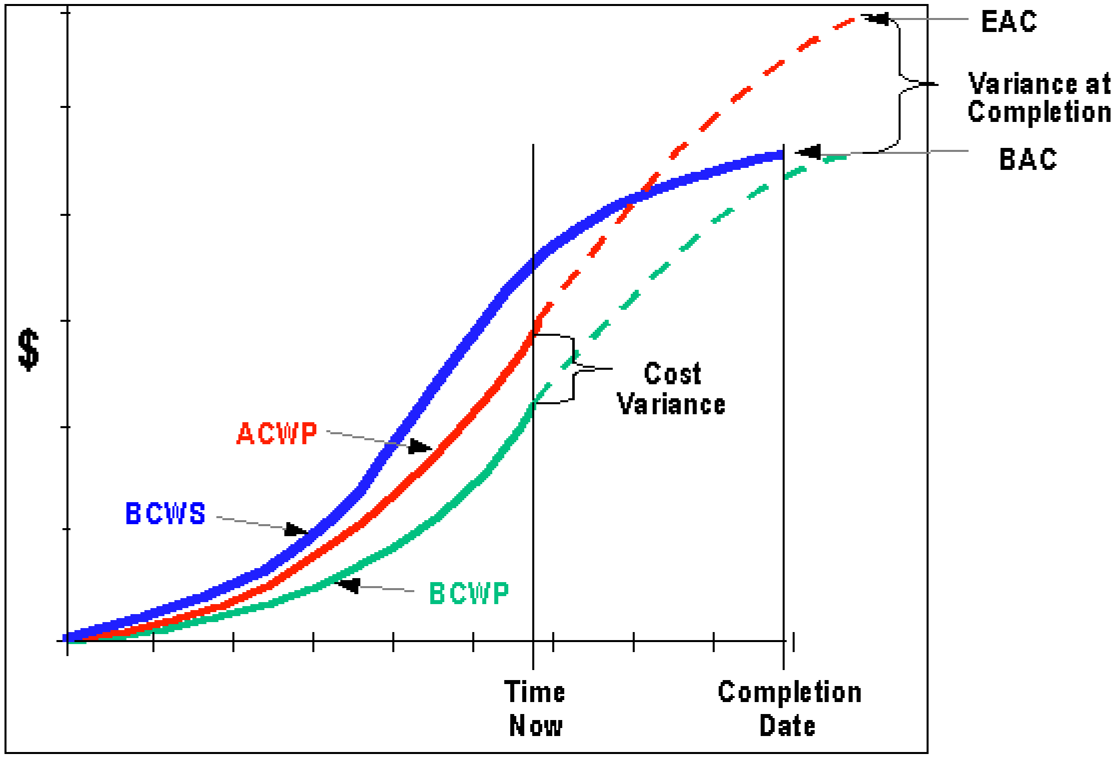

Figure 2. EVMS Graph

Past Research Regarding Acquisition Reform and Cost Overruns

This section discusses past research related to acquisition reform and cost overruns. The discussion is organized to illustrate how this research complements these past efforts. It explains the focus, methodology, and conclusions of the following studies: "The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns on Defense Acquisition Contracts" (Christensen, Searle, and Vickery,1999), "Cost Overrun Optimism: Fact or Fiction?" (Christensen,1994), "Is the CPI-Based EAC a Lower Bound to the Final Cost of Post A-12 Contracts?" (Christensen and Rees,2001), and "Does a Rubber Baseline Guarantee Cost Overruns on Defense Acquisition Contracts" (Christensen and Gordon,1998).

The Packard Commission was formed by President Ronald Reagan in 1986 to review the defense acquisition process and recommend improvements to the procurement process that would minimize cost growth and reduce schedule delays (Christensen et al., 1999: 251). In their study of the Packard Commission, Christensen, Searle, and Vickery analyzed the effect of the recommendations by the Packard Commission on cost overruns among defense contracts (Christensen et al., 1999: 251).

Prior to data analysis, Christensen, Searle, and Vickery hypothesized that cost performance among defense contracts would improve (i.e., cost overruns would decrease) after implementation of the Packard Commission's recommendations (Christensen et al., 1999: 254). They tested this hypothesis by comparing the average cost overrun percentage on contracts completed before implementation to the average cost overrun percentage on contracts completed after implementation using a non-parametric test (Christensen et al., 1999: 254). They used a non-parametric test because a parametric test failed the assumptions of normality and constant variance (Christensen, 1999: 262). They also tested whether cost performance was sensitive to contract phase or branch of service (Christensen et al., 1999: 256). Using 269 contracts from the DAES database, their study yielded the results shown in Table 2.

Table 2. The Effect of Packard Commission Recommendations on Defense Cost Performance (Christensen et al., 1999: 257)

		Contract Phase		Managing Service		
	All Contracts	Development Contracts	Production Contracts	Air Force	Navy	Army
Number of Contracts	269	8	188	113	134	22
Final overrun before implementation (%)	5.6	4.1	6.2	2.8	7.6	8.1
Final overrun after implementation (%)	9.5	15.3	7.2	12.7	6.1	17
Difference (%)	3.9	11.2	1.0	9.9	-1.5	8.9
Statistical Significance (p)	0.055	0.014	0.294	0.003	0.206	0.110

At an alpha of 0.10, they found that cost performance worsened overall after implementation of the Packard Commission's recommendations (Christensen et al., 1999: 256). As Table 2 shows, they also discovered that the change in cost performance was sensitive to contract phase and branch of service. The effect of implementing the Packard Commission's recommendations varied between phases and branches of service. Perhaps the most startling finding from their study was that cost overruns on Air Force contracts more than tripled after implementation (Christensen et al., 1999: 257).

The method used to calculate Estimates at Completion (EAC) is pertinent to this research. Seeing how EACs are computed helps the reader see why there is a systematic problem with government contracts overrunning costs. "Cost Overrun Optimism: Fact or Fiction?" (Christensen) is one study that shows how EACs are computed. In this study, Christensen demonstrates the existence of a cultural problem by proving that cost overruns projected by the contractor and government are too optimistic over the life of the contract (Christensen, 1994: 25).

Christensen's 1994 study was partially motivated by the A-12 Administrative Inquiry completed by Chester Beach, which found "abiding cultural problems" not unique to the Navy (Christensen 1996: 36). In this inquiry, Beach speculates that pessimistic EACs (i.e., estimates that make the program look bad) are held back to protect the program and program managers' careers (Christensen, 1994: 25). Using 64 completed contracts, Christensen tested this assertion by comparing overruns at various completion points with projected final costs to determine if government and contractor estimates are consistently optimistic (Christensen, 1994: 25). For the purpose of his study, Christensen defined an overly optimistic estimate as one in which the projected final overrun is less than the current overrun. As justification for this definition, Christensen cites multiple studies supporting the conclusion that a contract's cost performance will not improve after the 15% completion point (Christensen, 1994: 29). He found that the government's estimated overrun and the contractor's estimated overrun were consistently optimistic throughout the life of contract.

Another study, "Is the CPI-Based EAC a Lower Bound to the Final Cost of Post A-12 Contracts?" (Christensen and Rees, 2001) further enhances the understanding of how an EAC is calculated. In this study, Christensen and Rees prove the validity of using the government's rule for using the EAC based on the cumulative CPI (EAC_{cpi}) as a floor to the final cost of a contract (Christensen and Rees, 2001). In other words, using the EAC_{cpi} assumes the cost performance of a contract will not improve and will either stay the same or worsen throughout the life of the contract. To test the rule, Christensen and Rees formed the following null hypothesis:

H_o: CPI-based EAC $\geq$ Final Cost

If the null hypothesis is not rejected, the EAC_{cpi} is not a floor to the final cost. Rejection of the null validates the rule of using the EAC_{cpi}. For the purpose of this study, the cumulative CPI was calculated at three different completion points: the 20% point, the 50% point, and the 70% point (Christensen and Rees, 2001).

Since the Defense Acquisition Executive Summary database has contracts of all sizes, Christensen and Rees adjusted for these differences by normalizing the data as the deviation from final cost (DAC) using the following formula: $DAC = \frac{EAC - FinalCost}{FinalCost}$ (Christensen and Rees, 2001). Using 52 post A-12 contracts (i.e., contracts starting after 31 December 1991), they subdivided the database into contracts in development versus contracts in production, cost reimbursable contracts versus fixed price contracts, and Army contracts versus Navy contracts versus Air Force contracts. The results are shown Table 3.

Table 3. EAC Deviation From Final Cost (Christensen and Rees, 2001)

Contract		Early Stage		Middle Stage		Late Stage	
Category	n	mean	p	mean	p	mean	p
All	52	-0.107	0.001	-0.047	0.014	0.003	0.559
Development	24	-0.146	0.003	-0.069	0.029	0.001	0.509
Production	26	-0.073	0.041	-0.018	0.23	0.018	0.834
Cost Reimbursable	34	-0.144	0.001	-0.063	0.018	0.002	0.527
Fixed Price	15	-0.025	0.255	-0.019	0.26	0.008	0.718
Army	14	-0.112	0.04	-0.076	0.077	0.014	0.615
Air Force	12	-0.185	0.011	-0.052	0.121	0.003	0.532
Navy	26	-0.069	0.057	-0.028	0.135	-0.004	0.575

As Table 3 shows, at an alpha of 0.05, the EAC_{cpi} is a reasonable floor to the final cost of contracts in the early and middle stages for all but Fixed Price and Navy contracts.

When a contract undergoes frequent changes, many people assume the contract is more vulnerable to a cost overrun. Christensen and Gordon's study, "Does a Rubber Baseline Guarantee Cost Overruns on Defense Acquisition Contracts," addresses this notion. When changes are large and occur frequently, the contract has what is known as a "rubber baseline" and is thought by some people to be the root of cost overruns (Christensen and Gordon, 1998: 43).

Christensen and Gordon tested the relationship between cost overruns and baseline stability using two statistical models. The first-test was a two factor analysis of variance (ANOVA) test using the schedule cost index (SCI) as the measure of cost overruns. The primary factor was the number of changes to the contract using the contract budget base (CBB) as the measure of baseline stability. The CBB includes the Budget at Completion (BAC) and the Management Reserve (MR). A significant change is defined as one that changes the CBB by more than 10%. The secondary factor used in the ANOVA test was the contract's completion point. To test the relationship between the two factors and the SCI, they used an alpha level of 0.05 (Christensen and Gordon, 1998: 45).

The second analysis accomplished was a linear regression test using the last reported CPI (CPI_L) as the measure of cost overruns and the coefficient of variation of the Performance Measurement Baseline (CV_{PMB}) as the measure for baseline stability. Statistical significance was determined using the regression coefficient of the CV_{PMB}. If the coefficient of the CV_{PMB} was significantly different from zero, they concluded that there is a relationship between the CPI and the PMB (Christensen and Gordon, 1998: 46).

Christensen and Gordon's study using the DAES database included 669 contracts from 165 programs for the ANOVA test and 401 contracts encompassing 131 programs for the linear regression test. Based on the results from both tests, they found that there was no statistical relationship between baseline stability and cost overruns. Also, this finding was not sensitive to the branch of service in question (Christensen and Gordon, 1998: 47). A summary of their findings from each test is shown in Tables 4 and 5 below.

Table 4. Summary of ANOVA Test

Sources of Variation	Sums of Squares	Degrees of Freedom	Mean Square	F	F Critical (α=0.05)
Factor A: Quarters	0.1099	3	0.0366	1.251	2.618
Factor B: Changes	0.0890	4	0.0223	0.760	2.385
Interaction	0.5914	12	0.0493	1.683	1.767
Error	19.561	668	0.0293		

Table 5. Summary of Regression Analysis

Sample		CPI_L		CV_{PMB}		Slope		
Category	n	Mean	Std Dev	Mean	Std Dev	β_1	Std Error	t
AF	151	0.96	0.11	0.36	0.58	0.004	0.015	0.271
Navy	142	0.94	0.11	0.32	0.42	-0.009	0.219	-0.407
Army	108	0.92	0.12	0.62	0.72	-0.006	0.016	-0.364

The results of Christensen and Gordon's study showed that cost overruns were not caused by the stability of the baseline. They conclude their study by stating that more research was needed in determining what caused a contract to have a cost overrun. While this thesis does not directly address the cause of cost overruns, it does provide further insight into the issues addressed by the FASA and the Clinger-Cohen Act as they relate to cost overruns. This insight can be used to stimulate further research into the issues addressed by the two pieces of legislation.

III. Methodology

Chapter Overview

This chapter provides an overview of the process and tools used to conduct the research and data analysis for this effort. It begins with a discussion of the Defense Acquisition Executive Summary (DAES) database, followed by how its data is aggregated into the sample that is used for testing the hypotheses. It then re-introduces the hypotheses stated in Chapter 1 coupled with a more thorough discussion of each hypothesis and how each pertains to the research. The hypotheses section is followed by a presentation of the tests that will be used to prove or disprove the hypotheses. This section will define the hypothesis tests and their corresponding assumptions and also describe the tests associated with each assumption. The chapter concludes by detailing the significance levels and possible errors that could occur.

DAES Database

The DAES database is a part of the Consolidated Acquisition Reporting System (CARS), which is a "personal computer-based data entry and reporting system" (CARS website). CARS is comprised of the DAES, the Selected Acquisition Report (SAR), and the Acquisition Program Baseline (APB). Its main purpose is to achieve the following objectives:

1. Reduce the workload in preparing the APB, DAES, and SAR
2. Standardize and automate project status information for program managers and other acquisition executives

3. Provide timely and accurate tools to the Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics) (OUSD(AT&L)) and the military services for the purpose of analysis

4. Improve acquisition data management and interchange capabilities

5. Establish software, data, and documentation standards for acquisition (CARS website).

The use of CARS is mandatory for all Major Defense Acquisition Programs (ACAT I) and Major Automated Information Systems (ACAT IA). An ACAT I program is defined as a program estimated by the Under Secretary of Defense-Acquisition Technology and Logistics (USD-AT&L) to require eventual expenditure for research, development, test, and evaluation of more than $365 million in Fiscal Year (FY) 2000 constant dollars. A program is considered an ACAT IA if it is 1) designated by the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD-C3I), or 2) estimated to require more than $32 million in program costs for any given year, more than $126 million in total program costs, or more than $378 million in total lifecycle costs. All costs are FY 2000 constant dollars (DAU Glossary, 2001). The CARS software specifies the format of the DAES with the exception of the memo and comment fields (DOD 5000.2-R, 2002).

The DAES serves as an early warning report to the OUSD-AT&L by describing any actual and potential program problems. It also describes any mitigating actions taken (DOD 5000.2-R, 2002). The DAES presents total projected costs and quantities for all years through the end of the current phase of the acquisition life cycle (DOD 5000.2-R, 2002). All ACAT I and ACAT IA programs are required to report program status information to the DAES database on a quarterly basis (DOD 5000.2-R, 2002). There are two times when this quarterly cycle is not adhered to. It is not adhered to when a Nunn-McCurdy breach has occurred or is suspected to occur. A Nunn-McCurdy breach is when "the program acquisition unit cost (PAUC) or the average procurement unit cost (APUC) (in base-year dollars) increases by 15% or more over the PAUC objective or APUC objective of the currently approved APB (in base year dollars)" (DOD 5000.2-R, 2002). The DAES quarterly reporting cycle is also not adhered to when a Program Objective Memorandum (POM) or Budget Estimate Submission (BES) causes a program to deviate from the approved APB threshold. Both of these situations require an out of cycle submission to the DAES database (DOD 5000.2-R, 2002).

The following columns from the DAES database are pertinent to this research:

1. *Contract Identification (CID)* – The CID is a number assigned to each contract. It is used in this research to ensure that no contracts are repeated and to identify the branch of service responsible for the contract.

2. *Contract Number (CNO)* – The CNO is a number assigned to each contract for further identification. It is also used in this research to determine that no contracts are repeated.

3. *Submit Date (SUBMITDATE)* – This is the date the data was submitted to the DAES database. It is used in this research to represent the contract completion date.

4. *Program Phase (PPHASE)* – PPHASE is the phase of the acquisition lifecycle the contract was in at the time the data was submitted. It is used in this research to divide the data into phases.

5. *Actual Cost of Work Performed (ACWP)* – An element of the EVMS, it is the cumulative cost of the work completed to date. It is used in this research to calculate cost overruns.

6. *Budgeted Cost of Work Performed (BCWP)* – The BCWP is the cumulative budgeted cost of the work performed to date. It is also used in this research to calculate cost overruns.

7. *Cumulative Budget Base (CBBASE)* – The CBBASE is the total budget for the contract. It is used in conjunction with the Management Reserve to calculate the completion percentage of a contract.

8. *Management Reserve (MR)* – The MR is money set aside that is used at the discretion of top management.

9. *Contract Type (CTYPE)* – The CTYPE is the type of contract for the corresponding line item. It is used to subdivide the database into Fixed Price contracts and Cost Reimbursable contracts.

Since the DAES database contains contracts dated back to 1970, it had to be scaled back to include only those contracts relevant to the research questions. First, all contracts completed before December 31, 1993 and after December 31, 2001 were removed. This time period was selected based on Searle's Packard Commission study (Searle, 1997: 39). The time period was also based on expert opinion after discussions with Dr. David Christensen, an expert in the earned value field and Ms. Sandra Meckley, a representative of the acquisition office for the Secretary of the Air Force. This timeframe is appropriate since it encompasses the enacting of the FASA and the Clinger-Cohen Act. Contracts within this timeframe are further separated into groups on either side of December 31, 1997.

The second step in organizing the DAES database used the following equation to determine the percentage completion of each contract:

$$\frac{BCWP}{CBBASE - MR}$$

Contracts that were not more than 75% complete were removed from the database. Most costs are incurred between the 15 and 75 percent completion points. This is shown in Figure 2 by the cost curve flattening out as the contract nears completion. Studies have shown costs to be relatively stable beyond the 75% completion point. Thus, a contract that is at least 75% complete is considered complete in terms of costs incurred (Searle, 1997: 41).

The third step used the CID and the CNO to determine if there were multiple instances of the same contract. If any duplicate contracts were found, the latest submission was retained and the rest were discarded. The following table shows the number of contracts in each sample that were used for hypotheses testing.

Table 6. Treatment Matrix of DOD Contracts

Category	Pre-1997	Post-1997
H_1 - Total Contracts	107	113
H_2 - Development	41	64
H_3 - Production	66	49
H_4 - Army	19	28
H_4 - Navy	47	58
H_4 - Air Force	41	27
H_5 - Fixed Price	39	54
H_6 - Cost Reimbursable	67	59

Research Questions and Hypotheses

This section reintroduces the research questions posed in Chapter 1. Each research question will be followed by a corresponding hypothesis and a brief discussion of its relevance to the research. Keep in mind that the overall goal of this research is to determine if the FASA and the Clinger-Cohen Act had any effect on cost overruns among DoD contracts.

<u>Research Question #1</u>

Compared to contracts completed before the FASA and Clinger-Cohen Act, did cost overruns on contracts completed after the FASA and Clinger-Cohen Act significantly worsen, stay the same, or improve?

Research Hypothesis #1

H_A: The mean final cost overrun percentage on contracts completed before December 31, 1997 is not equal to the mean final cost overrun percentage on contracts completed after December 31, 1997.

The answer to this question will help determine whether the FASA and the Clinger-Cohen Act had an effect on cost overruns. The final cost overrun percentage is used instead of the actual overrun to make the contracts comparable. The DAES includes contracts of all sizes, and to compare a $1 million contract to a $100 million contract could be misleading. To illustrate, a $1 million cost overrun on the former contract would yield an overrun percentage of 100%, whereas the same cost overrun on the latter contract would be a 1% overrun. Thus, the overruns are normalized to prevent this problem. Equation 1 presented below is used to calculate the final cost overrun. Equation 2 is used to convert the final overrun from a dollar amount to a percentage. The Budget at Completion (BAC) is calculated by subtracting the Management Reserve (MR) from the Contract Budget Base (CBBASE).

$$FinalOverrun = BAC - ACWP \qquad (1)$$

$$FinalOverrun\% = \frac{BAC - ACWP}{BAC} \qquad (2)$$

Research question #2 is addressed by two hypotheses. They are presented together with the discussion following.

Research Question #2

Is the effect of the FASA and Clinger-Cohen Act on cost overruns sensitive to the phase of the acquisition life cycle the contract is in?

Research Hypothesis #2

H_A: With respect to contracts in the development phase of the acquisition lifecycle, the final overrun percentage on contracts completed before December 31, 1997 is not equal to the final overrun percentage on contracts completed after December 31, 1997.

Research Hypothesis #3

H_A: With respect to contracts in the production phase of the acquisition lifecycle, the final overrun percentage on contracts completed before December 31, 1997 is not equal to the final overrun percentage on contracts completed after December 31, 1997.

After considering the overall effect the FASA and Clinger-Cohen Act have had on cost overruns, the sensitivity to phases of the acquisition lifecycle is addressed by the two research questions stated above. Research hypothesis #2 looks at development contracts, while research hypothesis #3 deals with only those contracts in the production phase of the acquisition lifecycle. Even if this research determines the FASA and Clinger-Cohen Act have had no effect on cost overruns, the answer to these questions will provide senior leadership with additional insight as to where efforts should be focused on reducing cost overruns. It will also help determine if tactics need to be adjusted for contracts in different phases of the acquisition lifecycle.

Research Question #3

Is the effect of the FASA and the Clinger-Cohen Act on cost overruns sensitive to the branch of service responsible for the contract?

Research Hypothesis #4

H_A: The mean final cost overrun percentages for Army, Navy and Air Force contracts completed before December 31, 1997 are not equal to the mean final cost overrun percentages on Army, Navy and Air Force contracts completed after December 31, 1997.

This research question was motivated by Christensen, Searle and Vickery's research. Since they found that cost overruns were drastically worse for the Air Force after implementation of the Packard Commission's findings, it was a natural curiosity to see how the respective branches of service have been performing since then. This comparison will be accomplished by using the Contract ID number (CID) to identify which branch of service is responsible and dividing the contracts into respective samples. This research question does not address Marine contracts individually. An initial inspection of the database revealed that there were an insufficient number of Marine contracts to comprise their own sample. Since the Marines are part of the Department of the Navy (DoN), these contracts were rolled into the Navy sample and treated as Navy contracts. For testing purposes, this hypothesis will be divided into three sub-hypotheses to test each service individually.

<u>Research Question #4</u>

Is the effect of the FASA and Clinger-Cohen Act on cost overruns sensitive to the type of contract?

<u>Research Hypothesis #5</u>

The mean final overrun percentage on fixed price contracts completed before the implementation of the FASA and Clinger-Cohen Act is not equal to the mean final overrun percentage on fixed price contracts completed after the implementation of the FASA and Clinger-Cohen Act.

<u>Research Hypothesis #6</u>

The mean final overrun percentage on cost reimbursable contracts completed before the implementation of the FASA and Clinger-Cohen Act is not equal to the mean final overrun percentage on cost reimbursable contracts completed after the implementation of the FASA and Clinger-Cohen Act.

Hypothesis #5 and Hypothesis #6 will determine if there is a difference in the effect the FASA and Clinger-Cohen Act had on cost overruns. This research question was motivated by the fundamental difference in contract types. In a fixed price contract, the contractor bears the financial burden of a cost overrun. Since the price is fixed, a cost overrun must be absorbed by the contractor's profit. Conversely, in a cost reimbursable contract, the contractor is generally reimbursed the total cost of the contract plus a fixed fee. Therefore, a cost overrun on a cost reimbursable contract is absorbed by the government. This basic difference of how cost overruns are handled between the two types of contracts creates a natural curiosity that this research can satisfy.

Hypothesis Tests

This section discusses the hypothesis tests used to compare the samples. It details how the tests will be conducted, presents the necessary formulas, and also provides a discussion of any key assumptions that are pertinent to draw inferences from the results of the tests. A flowchart, which graphically depicts the logical steps taken to test the hypotheses, is presented at the end of this section.

The two sample t-test is used to test the hypotheses stated above. It uses the sample means of the final overrun percentage and tests that the difference between the sample means is zero. If the test does show that the difference between the sample means is zero, then the difference between the population means can be inferred to be zero as well. The t-test uses a standardized variable (t) that follows a *t* distribution with ν degrees of freedom. The t-test statistic and degrees of freedom are calculated using equations 3 and 4:

$$t = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{s_1^2}{m} + \frac{s_2^2}{n}}} \qquad (3)$$

$$\nu = \frac{\left[\frac{(s_1)^2}{m} + \frac{(s_2)^2}{n}\right]^2}{\frac{\left(\frac{(s_1)^2}{m}\right)}{m-1} + \frac{\left(\frac{(s_2)^2}{n}\right)}{n-1}} \qquad (4)$$

, where

$\bar{x}$ = sample mean from the first sample,
$\bar{y}$ =sample mean from the second sample,
s_1= sample variance from the first sample,
s_2= sample variance from the second sample,
m = sample size of the first sample,
n = sample size of the second sample.
(Devore, 2000: 366)

Since the research questions are focused on determining if the final overrun percentages are equal and are concerned with which sample is greater, a two tailed test is appropriate. The null hypotheses will be rejected under the following conditions:

$$t \geq t_{\alpha/2,v} \text{ or } t \leq -t_{\alpha/2,v}$$

The two sample t-test has two key assumptions that should be satisfied to validate its inferences. The first assumption is that the observations are normally distributed. The normality assumption is assessed visually and quantitatively. The visual assessment is accomplished by constructing a normal probability plot and checking its linearity. If the observations come from a normal distribution, the line should fall close to a straight line (Devore, 2000: 190). The quantitative assessment for normality is accomplished using the Shapiro-Wilk test. The calculations for the Shapiro-Wilk test are performed using the

JMP software package, version 5.0. The Shapiro-Wilk test yields a p-value between 0 and 1. Normality can be assumed when the p-value is greater than 0.05.

Fortunately, since this research involves using averages of the final cost overruns, it is not absolutely necessary to have normally distributed data. The central limit theorem states "if [the sample size] is sufficiently large, the [mean] has approximately a normal distribution" (Devore, 2000: 235). This theorem allows the two sample t-test to be used in the absence of normality and still have confidence in the resulting inferences. The theorem is somewhat ambiguous stating that the sample size must be "sufficiently large." It is not specific because the number of required observations varies from sample to sample. Having a sample size greater than 30 is generally accepted as a sufficiently large number for any distribution (Devore, 2000: 236). For this research, three groups of contracts have sample sizes less than 30: the pre-1997 Army contracts, the post-1997 Army contracts, and the post-1997 Air Force contracts. As shown in Table 6, their respective sample sizes are 19, 28, and 27. For tests involving these samples, it will be important for the results of the t-test to be corroborated by the results of a non-parametric test. The non-parametric used for corroboration is the Wilcoxon Signed Rank test, which does not require the assumption of normality.

The second assumption for the two sample t-test is that the observations have constant variance. Constant variance will be tested using the modified Levene test. It is a robust test that can be used in the absence of normality and when sample sizes are not equal (Neter et al, 1996: 766). These calculations are also accomplished using JMP, version 5.0. The details of these calculations can be found in the 4th edition of Applied Linear Statistical Models by Neter, Kutner, Nachtsheim, and Wasserman. The Levene test yields a p-value which needs to be greater than 0.05 to assume constant variance. Conversely, if a p-value of less than 0.05 is obtained, it cannot be assumed that the data has constant variance. For the samples without constant variance, it is important that the two sample t-test be corroborated by a test that does not require homogenous variances. The test used to support the conclusions drawn with the two sample t-test is the Welch ANOVA test. The Welch ANOVA test is commonly used in the absence of non-homogenous variances to test whether the means of the two samples are equal. In this test, the means are weighted by the reciprocal of the sample variances of the group means (JMP, 2002). The flowchart in Figure 3 shows the logic involved in the selection of the appropriate hypothesis tests.

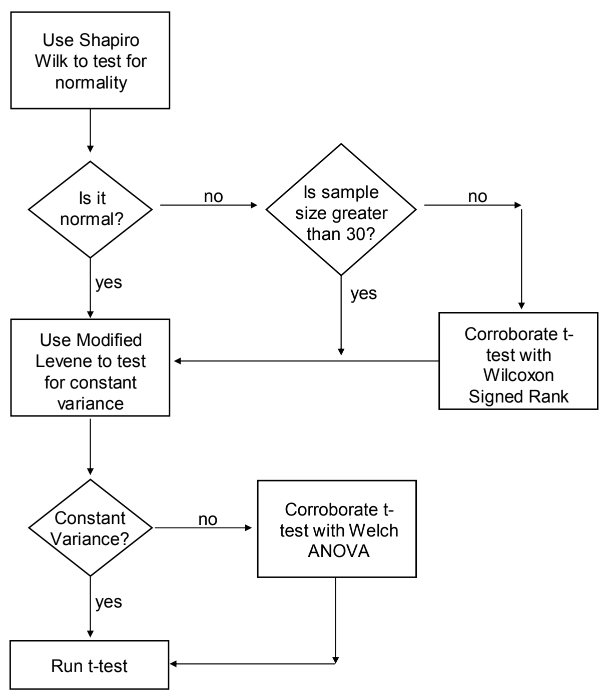

Figure 3. Flowchart for Hypothesis Test Selection

Significance Level and Errors

The level of significance for this research is set at an alpha level of 0.05. In other words, this is the smallest p-value at which the null hypotheses are not rejected. This level alpha is used for the hypothesis tests and for the assumptions of normality and constant variance tests. For the hypothesis tests, using an alpha level of 0.05 allows us to be confident that the corresponding means fall somewhere between the upper 2.5% and lower 2.5% tails of the t distribution. A higher p-value means we are even more confident that the mean is located in the desired area. So the user is able to use judgment in the interpretation of this research, the associated p-values are reported.

When drawing conclusions from the results of any research using hypothesis testing procedures, it is inevitable that errors may occur. It is possible for the null hypothesis to be rejected when it should not be rejected. In this situation, a type I error is said to have occurred. It is also possible to fail to reject the null hypothesis when it should have been rejected. This error is known as a Type II error. The only way to have a hypothesis test where no errors can occur is to be able to examine the entire population (Devore, 2000: 314). Since many of the contracts in the DAES database were excluded from the study for various reasons (e.g. incomplete data) and many smaller contracts are not included in the database, the entire population of DoD contracts is not available. This research uses a representative sample; however, inferences based on the results of this study should be interpreted with the knowledge that these two errors may be present.

IV. Results

Chapter Overview

This chapter presents the results of the hypothesis tests along with the results of the tests for the assumptions of normality and constant variance. Each hypothesis is presented individually with the results of the normality and constant variance tests shown first followed by the associated hypothesis tests. The redundancy in this chapter is intended to allow the results of each hypothesis to stand alone. This method of organization gives the reader some flexibility in how the chapter is read. The results and associated statistics for each hypothesis are summarized at the end of the chapter.

Hypothesis #1

Normality for the samples corresponding to Hypothesis #1 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. A perfectly normal distribution is depicted in a normal probability plot by a straight line. Therefore, an approximate straight line can be assumed to approach a normal distribution. Figures 4 and 5 in Appendix A show the normal probability plots associated with Hypothesis #1. Figure 4 is constructed using the Pre-1997 contracts, and Figure 5 is constructed using the Post-1997 contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistic of 0.806 and 0.944 respectively and p-values of less than 0.0002. Since this is less than the alpha of 0.05, this confirms that these two samples do not come from populations with a normal distribution. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 26.9445 and a p-value of less than 0.0001. Since the p-value is less than the 0.05 level of significance, it can be assumed that these samples do not have constant variance. See Table 7 for a summary of the tests for constant variance.

Even though the assumption of normality is violated, the Central Limit Theorem stated in Chapter 3 allows for the two sample t-test to be used in the absence of normality. Since the samples do not have constant variance, the Welch ANOVA test is also performed to validate the results of the t-test. Using the t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 4.345 and a p-value of less than 0.0001. The Welch ANOVA test supports these results with a test statistic of 18.2374 and a p-value of less than 0.0001. Therefore, the null hypothesis is rejected and one can assume that the mean final overrun percentage of the pre-1997 contracts is not equal to the mean final overrun percentage of the post-1997 contracts. Since the mean final overrun percentage of the post-1997 contracts is better than the mean final overrun percentage of the pre-1997 contracts, one can assume that cost overruns improved after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Hypothesis #2

Normality for the samples corresponding to Hypothesis #2 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. Figures 6 and 7 in Appendix A show the normal probability plots associated with Hypothesis #2. Figure 6 is constructed using the Pre-1997 development contracts, and

Figure 7 is constructed using the Post-1997 development contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistics of 0.823 and 0.925 respectively and p-values of less than 0.0007. Since the p-value is less than the alpha of 0.05, this confirms that these two samples to not come from populations with a normal distribution. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 17.1864 and a p-value of less than 0.0001. Since the p-value is less than the 0.05 level of significance, it can be assumed that these samples do not have constant variance. See Table 7 for a summary of the tests for constant variance.

Even though the assumption of normality is violated, the Central Limit Theorem stated in Chapter 3 allows for the two sample t-test to be used in the absence of normality. Since the samples do not have constant variance, the Welch ANOVA test is also performed to validate the results of the t-test. Using the two sample t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 4.098 and a p-value of less than 0.0001. The Welch ANOVA test supports these results with a test statistic of 12.3937 and a p-value of 0.0009. Therefore, the null hypothesis is rejected and one can assume that the mean final overrun percentage of the pre-1997 development contracts is not equal to the mean final overrun percentage of the post-1997 development contracts. Since the mean final overrun percentage of the post-1997 development contracts is better than the mean final overrun percentage of the pre-1997 development contracts, one can assume that cost overruns for contracts in the development phase of the acquisition lifecycle improved after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Hypothesis #3

Normality for the samples corresponding to Hypothesis #3 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. Figures 8 and 9 in Appendix A show the normal probability plots associated with Hypothesis #3. Figure 8 is constructed using the pre-1997 production contracts, and Figure 9 is constructed using the post-1997 production contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistics of 0.790 and 0.962 and p-values of less than 0.0001 and 0.1941, respectively. Since the p-value for the pre-1997 production contracts is less than the alpha of 0.05, this confirms that this sample does not come from a population with a normal distribution. However, based on the p-value associated with the post-1997 production contracts, this sample appears to be normally distributed. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 9.4562 and a p-value of 0.0026. Since the p-value is less than the 0.05 level of significance, it can be assumed that these samples do not have constant variance. See Table 7 for a summary of the tests for constant variance.

Even though the assumption of normality is violated with one of these samples, the Central Limit Theorem allows for the two sample t-test to be used to test this hypothesis. The Central Limit Theorem stated in Chapter 3 allows for the two sample t-test to be used in the absence of normality. Since the samples do not have constant variance, the Welch ANOVA test is also performed to validate the results of the t-test. Using the two sample t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 2.588 and a p-value of 0.0109. The Welch ANOVA test supports these results with a test statistic of 8.0131 and a p-value of 0.0056. Therefore, the null hypothesis is rejected and one can assume that the mean final overrun percentage of the pre-1997 production contracts is not equal to the mean final overrun percentage of the post-1997 production contracts. Since the mean final overrun percentage of the post-1997 production contracts is better than the mean final overrun percentage of the pre-1997 production contracts, one can assume that cost overruns for contracts in the production phase of the acquisition lifecycle improved after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Hypothesis #4

The final hypothesis is divided in three sub-hypotheses dealing with Army, Navy, and Air Force contracts separately. Each sub-hypothesis has its own tests for normality and constant variance along with an associated two sample t-test to assess each sub-hypothesis.

Army Contracts

Normality for the samples corresponding to sub-hypothesis #1 of Hypothesis #4 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. Figures 10 and 11 in Appendix A show the normal probability plots associated with sub-hypothesis #1 of Hypothesis #4. Figure 10 is constructed using the pre-1997 Army contracts, and Figure 11 is constructed using the post-1997 Army contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistics of 0.707 and 0.908 and p-values of less than 0.0001 and 0.0189, respectively. Since the p-values for these two samples are less than the alpha of 0.05, this confirms that these samples do not come from a population with a normal distribution. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 3.6796 and a p-value of 0.0614. Since the p-value is greater than the 0.05 level of significance, it can be assumed that these samples do have constant variance. See Table 7 for a summary of the tests for constant variance.

Since the assumption of normality is violated with these two samples and the sample sizes are too small to invoke the Central Limit Theorem, the two sample t-test must be corroborated by the Wilcoxon Signed Rank test. Using the two sample t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 2.591 and a p-value of 0.0128. The Wilcoxon Signed Rank test supports these results with a test statistic of -2.265 and a p-value of 0.0235. Therefore, the null hypothesis is rejected and one can assume that the mean final overrun percentage of the pre-1997 Army contracts is not equal to the mean final overrun percentage of the post-1997 Army contracts. Since the mean final overrun percentage of the post-1997 Army contracts is better than the mean final overrun percentage of the pre-1997 Army contracts, one can assume that cost overruns on Army contracts improved after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Navy Contracts

Normality for the samples corresponding to sub-hypothesis #2 of Hypothesis #4 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. Figures 12 and 13 in Appendix A show the normal probability plots associated with sub-hypothesis #2 of Hypothesis #4. Figure 12 is constructed using the pre-1997 Navy contracts, and Figure 13 is constructed using the post-1997 Navy contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistics of 0.857 and 0.951 and p-values of less than 0.0001 and 0.0384, respectively. Since the p-values for these two samples are less than the alpha of 0.05, this confirms that these samples do not come from a population with a normal distribution. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 21.997 and a p-value of less than 0.0001. Since the p-value is less than the 0.05 level of significance, it can be assumed that these samples do not have constant variance. See Table 7 for a summary of the tests for constant variance.

Even though the assumption of normality is violated with these two samples, the Central Limit Theorem stated in Chapter Three allows for the two sample t-test to be used to test this hypothesis. Since the samples do not have constant variance, the Welch ANOVA test is also performed to validate the results of the t-test. Using the two sample t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 3.578 and a p-value of 0.0005. The Welch ANOVA test supports these results with a test statistic of 11.0182 and a p-value of 0.0016. Therefore, the null hypothesis is rejected and one can assume that the mean final overrun percentage of the pre-1997 Navy contracts is not equal to the mean final overrun percentage of the post-1997 Navy contracts. Since the mean final overrun percentage of the post-1997 Navy contracts is better than the mean final overrun percentage of the pre-1997 Navy contracts, one can assume that cost overruns on Navy contracts improved after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Air Force Contracts

Normality for the samples corresponding to sub-hypothesis #3 of Hypothesis #4 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. Figures 14 and 15 in Appendix A show the normal probability plots associated with sub-hypothesis #3 of Hypothesis #4. Figure 14 is constructed using the pre-1997 Air Force contracts, and Figure 15 is constructed using the post-1997 Air Force contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistics of 0.750 and 0.936 and p-values of less than

0.0001 and 0.1043, respectively. Since the p-value for the pre-1997 Air Force contracts is less than the alpha of 0.05, this confirms that this sample does not come from a population with a normal distribution. Based on the p-value associated with the post-1997 Air Force contracts, this sample appears to be normally distributed. Like the post-1997 production contracts, this sample also shows why a visual check is not completely adequate when testing for normality. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 4.4692 and a p-value of less than 0.0383. Since the p-value is less than the 0.05 level of significance, it can be assumed that these samples do not have constant variance. See Table 7 for a summary of the tests for constant variance.

Even though the assumption of normality is violated with one of these samples, the Central Limit Theorem stated in Chapter Three allows for the two sample t-test to be used to test this hypothesis. Since the samples do not have constant variance, the Welch ANOVA test is also performed to validate the results of the t-test. Using the two sample t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 1.580 and a p-value of 0.1188. The Welch ANOVA test supports these results with a test statistic of 3.2134 and a p-value of 0.0779. Therefore, the null hypothesis is not rejected and one can assume that the mean final overrun percentage of the pre-1997 Air Force contracts is equal to the mean final overrun percentage of the post-1997 Air Force contracts. Since the mean final overrun percentage of the post-1997 Air Force contracts is statistically the same as the mean final overrun percentage of the pre-1997 Air Force contracts, one can assume that cost overruns on Air Force contracts experienced no change after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Hypothesis #5

Normality for the samples corresponding to Hypothesis #5 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. Figures 16 and 17 in Appendix A show the normal probability plots associated with Hypothesis #5. Figure 16 is constructed using the pre-1997 fixed price contracts, and Figure 17 is constructed using the post-1997 fixed price contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistics of 0.913 and 0.934 and p-values of 0.0060 and 0.0074, respectively. Since the p-values for these two samples are less than the alpha of 0.05, this confirms that these samples do not come from normally distributed populations. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 15.872 and a p-value of 0.0001. Since the p-value is less than the 0.05 level of significance, it can be assumed that these samples do not have constant variance. See Table 7 for a summary of the tests for constant variance.

Even though the assumption of normality is violated with these two samples, the Central Limit Theorem allows for the two sample t-test to be used to test this hypothesis. Since the samples do not have constant variance, the Welch ANOVA test is also performed to validate the results of the t-test. Using the two sample t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 2.364 and a p-value of 0.0202. The Welch ANOVA test supports these results with a test statistic of 4.8804 and a p-value of 0.031. Therefore, the null hypothesis is rejected and one can assume that the mean final overrun percentage of the pre-1997 fixed price contracts is not equal to the mean final overrun percentage of the post-1997 fixed price contracts. Since the mean final overrun percentage of the post-1997 fixed price contracts is better than the mean final overrun percentage of the pre-1997 fixed price contracts, one can assume that cost overruns for fixed price contracts improved after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Hypothesis #6

Normality for the samples corresponding to Hypothesis #6 is tested both visually and quantitatively. The visual test is accomplished by using a normal probability plot. Figures 18 and 19 in Appendix A show the normal probability plots associated with Hypothesis #6. Figure 18 is constructed using the pre-1997 cost reimbursable contracts, and Figure 19 is constructed using the post-1997 cost reimbursable contracts. As one can see, the plots do not yield straight lines, so it is likely that these two samples are not normally distributed. The quantitative test for normality, the Shapiro-Wilk test, yields test statistics of 0.756 and 0.941 and p-values of less than 0.0001 and 0.0105, respectively. Since the p-values for these two samples are less than the alpha of 0.05, this confirms that these samples do not come from normally distributed populations. See Table 7 for a summary of the tests for normality.

The modified Levene test, which is the test for equal variances, yields a test statistic of 15.5955 and a p-value of 0.0001. Since the p-value is less than the 0.05 level of significance, it can be assumed that these samples do not have constant variance. See Table 7 for a summary of the tests for constant variance.

Even though the assumption of normality is violated with these two samples, the Central Limit Theorem allows for the two sample t-test to be used to test this hypothesis. Since the samples do not have constant variance, the Welch ANOVA test is also performed to validate the results of the t-test. Using the two sample t-test to test that the mean of the first sample is equal to the mean of the second sample yields a test statistic of 3.582 and a p-value of 0.0005. The Welch ANOVA test supports these results with a test statistic of 14.016 and a p-value of 0.0003. Therefore, the null hypothesis is rejected and one can assume that the mean final overrun percentage of the pre-1997 cost reimbursable contracts is not equal to the mean final overrun percentage of the post-1997 cost reimbursable contracts. Since the mean final overrun percentage of the post-1997 cost reimbursable contracts is better than the mean final overrun percentage of the pre-1997 cost reimbursable contracts, one can assume that cost overruns for cost reimbursable contracts improved after the treatment date of December 31, 1997. See Table 7 for a complete summary of the results for this hypothesis.

Table 7. Statistical Analysis Summary

Hypothesis 1 Total Population of Contracts

Sample 1:	Total Pre-1997 Contracts: 107 values ranging from -134.82 to 22.04				
Sample 2:	Total Post-1997 Contracts: 113 values ranging from -48.87 to 25.96				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.806	0.944		
	p-value	0	0.0002		
	Mean FO%	-11.79	0.85		
	Standard Deviation	27.83	13.17		
	Modified Levene	26.945			
	p-value	0.0001			
		Test Statistic	p-value		
	Two Sample t-test	4.345	0.0001		
	Welch ANOVA	4.271	0.0001		
	Wilcoxon Signed Rank	-3.393	0.0007		

Hypothesis 2 Development Contracts

Sample 1:	Pre-1997 Development Contracts: 41 values ranging from -134.82 to 22.04				
Sample 2:	Post-1997 Development Contracts: 64 values ranging from -48.87 to 22.68				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.823	0.925		
	p-value	0.0001	0.0007		
	Mean FO%	-18.86	-0.29		
	Standard Deviation	31.89	13.89		
	Modified Levene	17.186			
	p-value	0.0001			
		Test Statistic	p-value		
	Two Sample t-test	4.098	0.0001		
	Welch ANOVA	3.52	0.0009		
	Wilcoxon Signed Rank	-3.445	0.0006		

Hypothesis 3 Production Contracts

Sample 1:	Pre-1997 Production Contracts: 66 values ranging from -96.88 to 20.81				
Sample 2:	Post-1997 Production Contracts: 49 values ranging from -32.71 to 25.96				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.79	0.962		
	p-value	0.0001	0.1941		
	Mean FO%	-7.39	2.36		
	Standard Deviation	24.21	12.13		
	Modified Levene	9.4562			
	p-value	0.0026			
		Test Statistic	p-value		
	Two Sample t-test	2.588	0.0109		
	Welch ANOVA	2.831	0.0056		
	Wilcoxon Signed Rank	1.971	0.0487		

Hypothesis 4.1 Army Contracts

Sample 1:	Pre-1997 Army Contracts: 19 values ranging from -134.82 to 7.76				
Sample 2:	Post-1997 Army Contracts: 28 values ranging from -48.87 to 23.29				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.707	0.908		
	p-value	0.0001	0.0189		
	Mean FO%	-18.42	0.86		
	Standard Deviation	33.47	17.25		
	Modified Levene	3.679			
	p-value	0.0614			
		Test Statistic	p-value		
	Two Sample t-test	2.591	0.0128		
	Welch ANOVA	2.311	0.0295		
	Wilcoxon Signed Rank	-2.265	0.0235		

Hypothesis 4.2 Navy Contracts

Sample 1:	Pre-1997 Navy Contracts: 47 values ranging from -94.84 to 20.63				
Sample 2:	Post-1997 Navy Contracts: 58 values ranging from -32.71 to 25.96				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.857	0.951		
	p-value	0.0001	0.0384		
	Mean FO%	-13.33	0.52		
	Standard Deviation	26.82	11.07		
	Modified Levene	21.997			
	p-value	0.0001			
		Test Statistic	p-value		
	Two Sample t-test	3.578	0.0005		
	Welch ANOVA	3.319	0.0016		
	Wilcoxon Signed Rank	-2.678	0.0074		

Hypothesis 4.3 Air Force Contracts

Sample 1:	Pre-1997 Air Force Contracts: 41 values ranging from -97.36 to 22.04				
Sample 2:	Post-1997 Air Force Contracts: 27 values ranging from -31.91 to 24.52				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.75	0.936		
	p-value	0.0001	0.1043		
	Mean FO%	-6.95	1.58		
	Standard Deviation	25.96	12.97		
	Modified Levene	4.469			
	p-value	0.0383			
		Test Statistic	p-value		
	Two Sample t-test	1.58	0.1188		
	Welch ANOVA	1.793	0.0779		
	Wilcoxon Signed Rank	1.128	0.2593		

Hypothesis 5 Fixed Price Contracts

Sample 1:	Pre-1997 Fixed Price Contracts: 39 values ranging from -46.99 to 22.04				
Sample 2:	Post-1997 Fixed Price Contracts: 54 values ranging from -37.17 to 22.68				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.914	0.934		
	p-value	0.0060	0.0074		
	Mean FO%	-7.85	0.30		
	Standard Deviation	20.23	13.00		
	Modified Levene	15.872			
	p-value	0.0001			
		Test Statistic	p-value		
	Two Sample t-test	2.364	0.0202		
	Welch ANOVA	2.209	0.0310		
	Wilcoxon Signed Rank	-1.491	0.1360		

Hypothesis 6 Cost Reimbursable Contracts

Sample 1:	Pre-1997 Cost Reimbursable Contracts: 67 values ranging from -134.82 to 20.63				
Sample 2:	Post-1997 Cost Reimbursable Contracts: 59 values ranging from -48.87 to 25.96				
		Sample 1	Sample 2		
	Shapiro-Wilk	0.756	0.941		
	p-value	0.0001	0.0105		
	Mean FO%	-14.40	1.37		
	Standard Deviation	31.39	13.41		
	Modified Levene	15.596			
	p-value	0.0001			
		Test Statistic	p-value		
	Two Sample t-test	3.582	0.0005		
	Welch ANOVA	3.744	0.0003		
	Wilcoxon Signed Rank	3.036	0.0024		

V. Conclusions

Chapter Overview

This chapter discusses the findings of this research along with the potential impact of those findings to the DoD. It begins with a restatement of the research questions followed by a discussion relating the results of the hypothesis tests to the research questions. Then, some limitations of the research are presented with a discussion of how the limitations affect the interpretation of the results. The chapter concludes with some suggestions for future research that would complement this study.

Research Questions

Recall that the purpose of this study was to determine what effect the Federal Acquisition Streamlining Act (FASA) and the Clinger-Cohen Act had on cost overruns in DoD contracts. Specifically, did cost overruns improve, worsen or stay the same after the implementation of the FASA and the Clinger-Cohen Act? To make this determination, the following research questions were posed:

1. Is the final cost overrun percentage on contracts completed after the implementation of the FASA and Clinger-Cohen Act equal to the final cost overrun percentage on contracts completed before the implementation of the FASA and Clinger-Cohen Act?
2. Is the final cost overrun percentage sensitive to the phase of the acquisition life cycle the program is in?
3. Is the final cost overrun percentage sensitive to the branch of service responsible for the program?

4. Is the final overrun percentage sensitive to the type of contract?

The results of the hypothesis tests suggest that the FASA and Clinger-Cohen Act have had a positive impact on cost overruns within DoD programs. So, to answer the first research question, the final cost overrun percentage has improved for DoD contracts after the implementation of the FASA and the Clinger-Cohen Act. This suggests that Congress and DoD leadership have made some effective strides with current acquisition reform initiatives.

The second research question is aimed at determining if the improvements in cost overruns are sensitive to the phase of the acquisition lifecycle. The results indicate that cost overruns have improved in both development and production contracts since the implementation of the FASA and the Clinger-Cohen Act. Thus, the improvements are not sensitive to the phase of the acquisition lifecycle. This effect of the FASA and the Clinger-Cohen Act is contrary to how the Packard Commission's recommendations affected cost overruns. The Packard Commission recommendations contributed to an increase in cost overruns for development contracts while cost overruns in production contracts experienced no change (Searle, 1997: 72).

The third research question addressed whether the improvements in cost overruns are sensitive to the branch of service responsible for the contract. The results show that cost overruns improved in both Army and Navy contracts. Air Force contracts, however, did not change enough to conclude with confidence that the populations are statistically different. Therefore, the FASA and the Clinger-Cohen Act affected no change on Air Force contracts.

The fourth research question asks whether or not the improvement in cost overruns is sensitive to the type of contract. The results show that cost overruns for fixed price and cost reimbursable contracts improved after the implementation of the FASA and Clinger-Cohen Act. Therefore, the improvement in cost overruns is not sensitive to the type of contract, which implies that policy changes specific to contract type is not necessary.

Limitations

Before the conclusions are used for any decision making, there are four important limitations that must be considered. First, the treatment date of December 31, 1997 may not reflect the full implementation of the FASA and the Clinger-Cohen Act. This date was selected based on past research and the expert opinion of acquisition professionals. Since the selection process was not scientific, a date other than the one selected could better represent the implementation of the two acts. Further analysis would determine if the results are sensitive to slight changes in the treatment date.

The second limitation involves the contracts contained in the DAES database. There are times when contracts are cancelled for various reasons, poor cost performance not withstanding. Using contracts that are 75% complete excludes those contracts that were cancelled before the 75% completion point. Including those contracts could yield different results. More information is necessary to establish which contracts were cancelled and to ascertain whether this limitation had a pivotal effect on the results.

Linking the acquisition reform initiatives to the cost performance of DoD contracts is the third limitation of this study. The decrease in cost overruns noted in the results of this study may in fact be coincidental. The assumption is that the FASA and Clinger-Cohen Act caused the decrease in cost overruns. However, without a more rigorous statistical analysis, this cause and effect can only be assumed.

The final limitation of this study is the inability of it to capture cost savings in DoD acquisitions. Reducing the cost at which the government is able to procure items is considered a positive impact of acquisition reform initiatives. Since many of these cost savings occur prior to the awarding of the contract, the savings are not immediately discernible. To quantify this impact, one would have to look at contracts on similar items before and after the treatment date to see if the cost per item decreased. This limitation is very important in how the results are interpreted. For example, if the Air Force had plentiful cost savings that were not captured in the final overrun percentages, then it is possible that the FASA and the Clinger-Cohen Act led to those cost savings. Therefore, the impact of the FASA and Clinger-Cohen Act may be much greater than the change in the final overrun percentage indicates.

Recommended Future Research

Since this research indicates that the FASA and the Clinger-Cohen Act contributed to the reduction of cost overruns on DoD acquisitions, any future research that strengthens those assertions would greatly benefit this study. This section outlines three areas of recommended research that could increase the confidence in the results of this analysis.

First, there is an indication that a different methodology yields different results. Similar research was accomplished using an alternate definition of cost variance. Using the same treatment date, Captain Mark Holbrook used the following equation to calculate the final cost overrun percentage:

$$\frac{ACWP - BCWP}{BCWP}$$

His conclusion was that current acquisition reform had no effect on the final cost overrun percentage of DoD contracts. Since this conclusion is contrary to the results shown in this research, further analysis would benefit both Capt Holbrook's research and this research. A comparison of both methods used to calculate cost overruns would determine which method is more appropriate. The results of a comparative analysis would profoundly impact how these two efforts are interpreted.

The second area of recommended research is to subject some of the constraints of this research to a sensitivity analysis to determine if slight shifts in the methodology yield different results. Two constraints that are suited for a sensitivity analysis are the dates used to capture the impact of the FASA and the Clinger-Cohen Act and the percentage completion of the contracts. A combination of dates with varying pivot dates should be analyzed and compared to see how sensitive the results are to the selected dates. Graphing the changes in the final cost overrun percentages would give further insight into how long acquisition reform legislation takes to impact the DoD procurement process. The results of this analysis hinge on the 75% completion point being accurate. As stated previously, this completion point was used because past research has shown that the majority of costs are incurred at this point and the contract can be considered complete in terms of cost (Searle, 1997: 41). Testing contract completion percentages greater than 75% would show whether cost overruns worsen, improve or stay the same after the 75%

completion point. Drastic changes in the cost overrun percentage after the 75% completion point could contradict the results of this effort.

The third area of recommended research would give deeper insight into the Clinger-Cohen Act. Sandra Meckley believes that much of the impact of the Clinger-Cohen Act is just now being felt (Meckley, 2002). This could be due to the increased emphasis on Information Technology (IT) resources in recent years. To determine the validity of Ms. Meckley's assumption, one would need to isolate the contracts dealing with IT resources and perform a hypothesis test with only those contracts using a more recent treatment date.

Appendix A

Normal Probability Plots

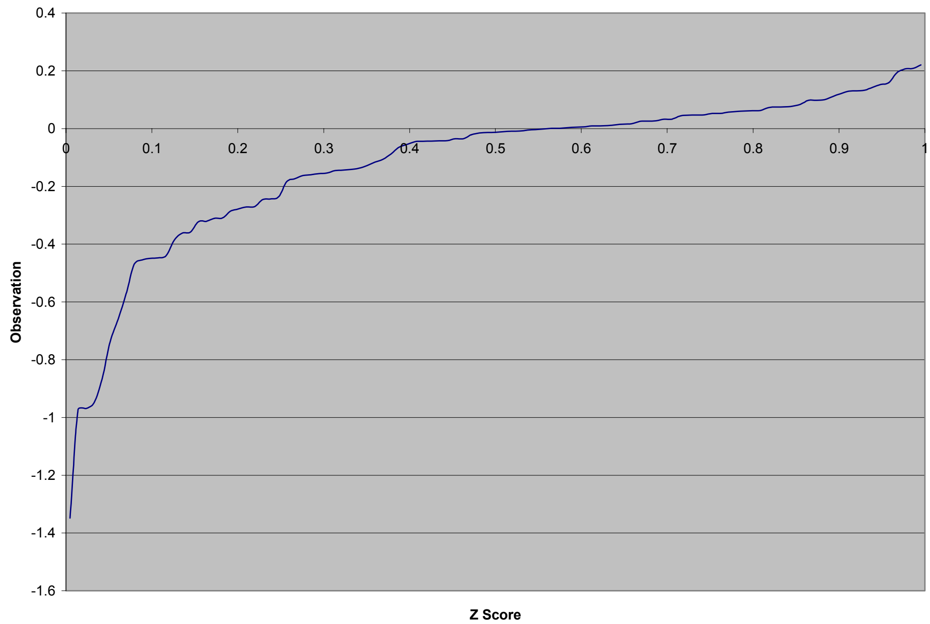

Figure 4. Normal Probability Plot (Pre-1997 Contracts)

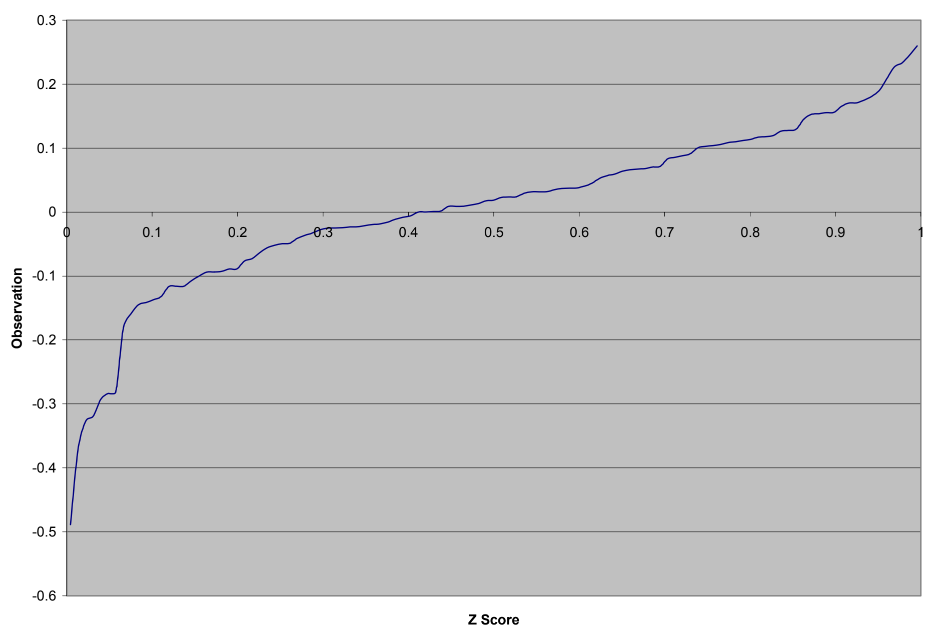

Figure 5. Normal Probability Plot (Post-1997 Contracts)

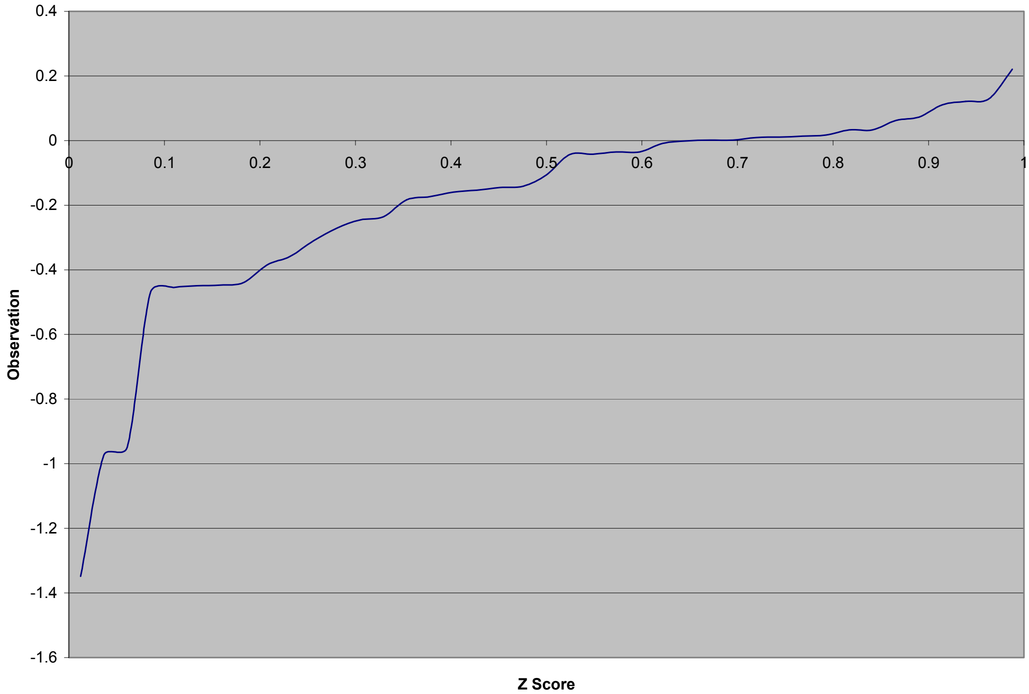

Figure 6. Normal Probability Plot (Pre-1997 Development Contracts)

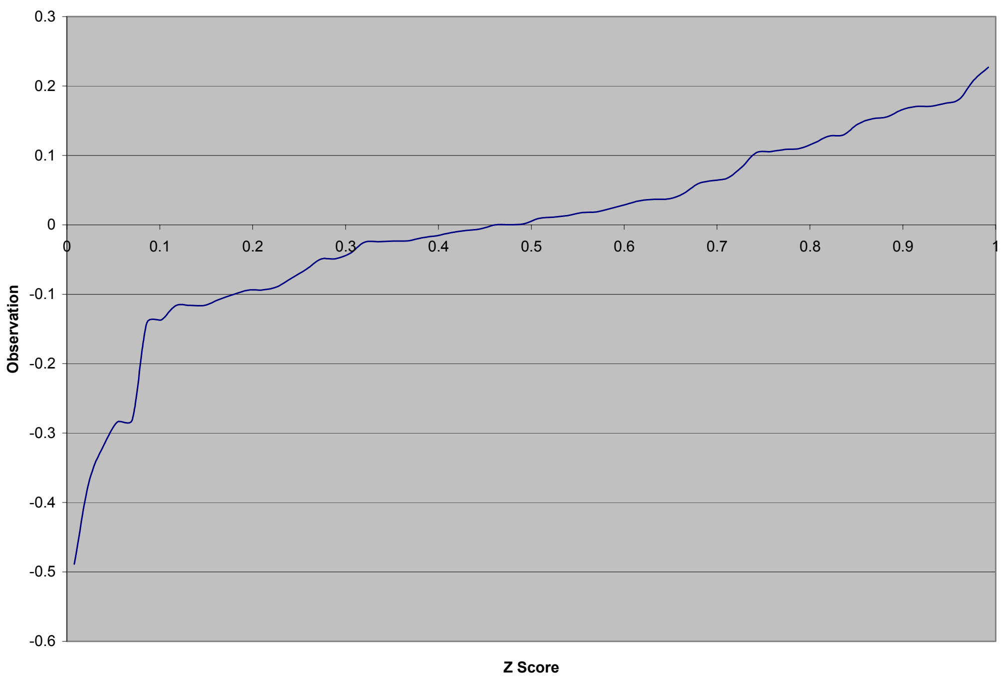

Figure 7. Normal Probability Plot (Post-1997 Development Contracts)

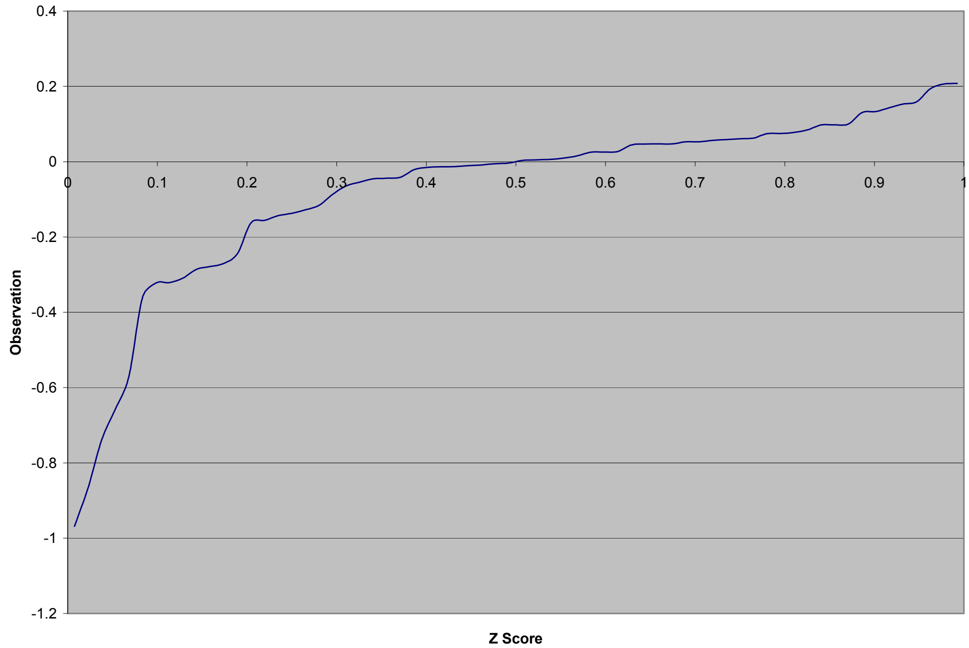

Figure 8. Normal Probability Plot (Pre-1997 Production Contracts)

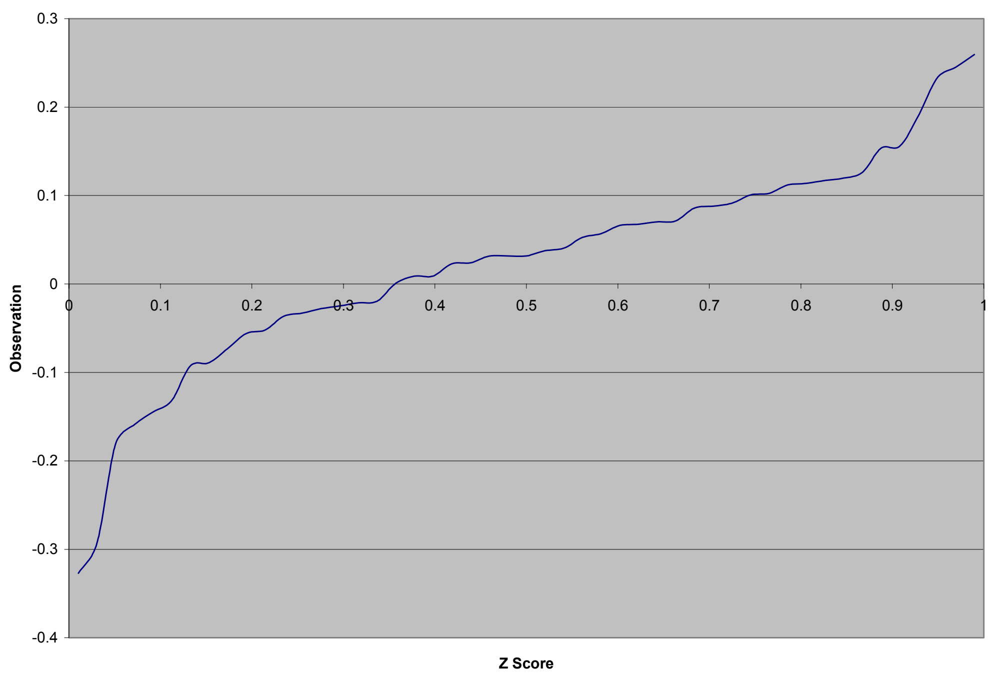

Figure 9. Normal Probability Plot (Post-1997 Production Contracts)

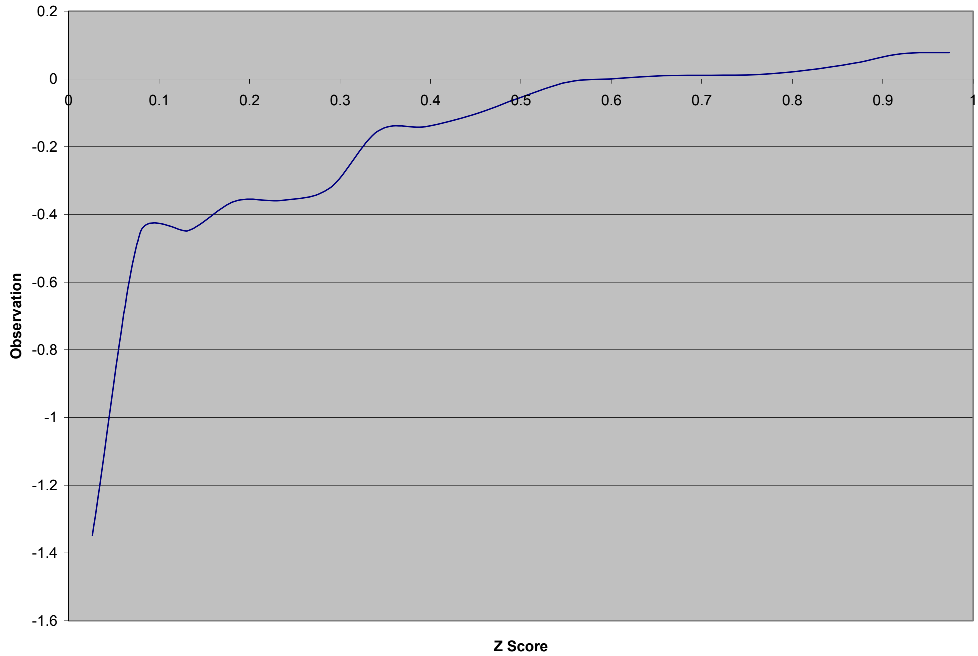

Figure 10. Normal Probability Plot (Pre-1997 Army Contracts)

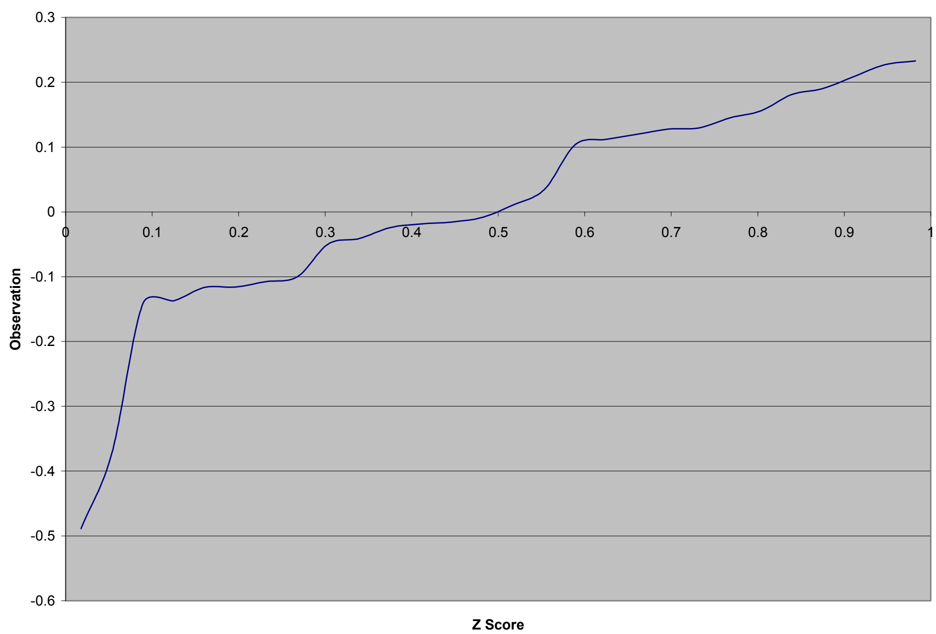

Figure 11. Normal Probability Plot (Post-1997 Army Contracts)

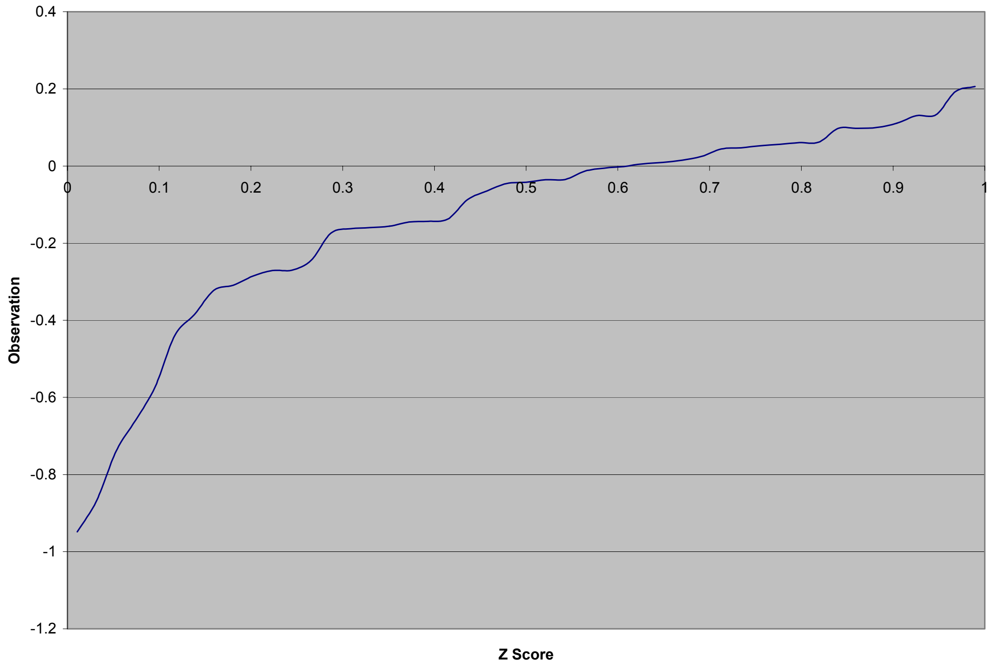

Figure 12. Normal Probability Plot (Pre-1997 Navy Contracts)

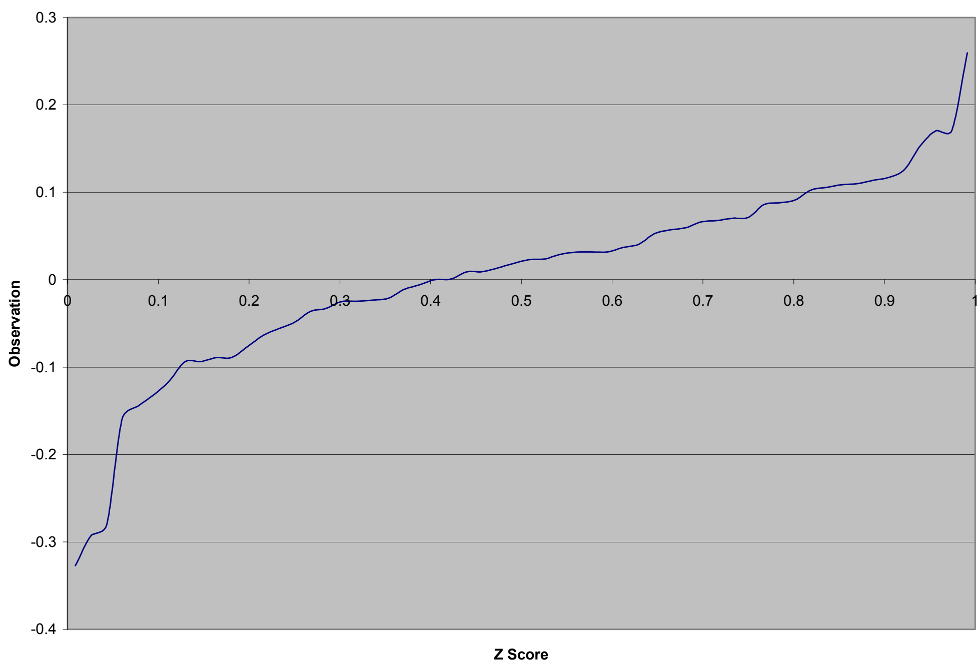

Figure 13. Normal Probability Plot (Post-1997 Navy Contracts)

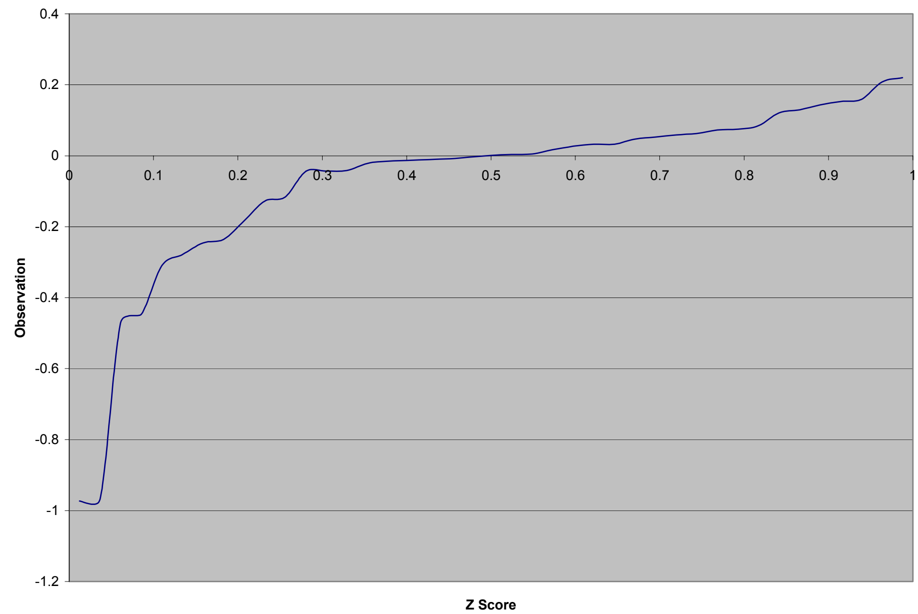

Figure 14. Normal Probability Plot (Pre-1997 Air Force Contracts)

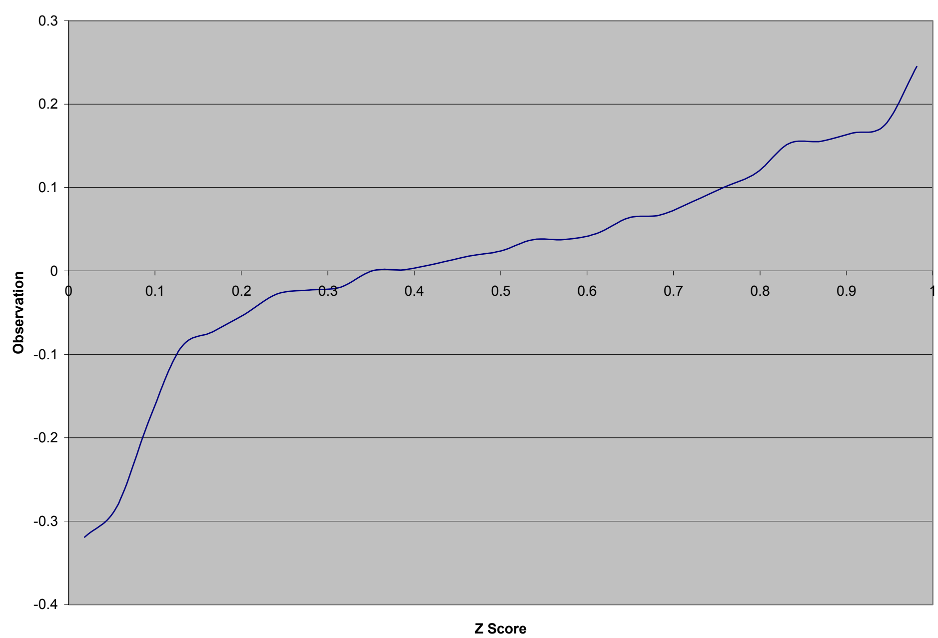

Figure 15. Normal Probability Plot (Post-1997 Air Force Contracts)

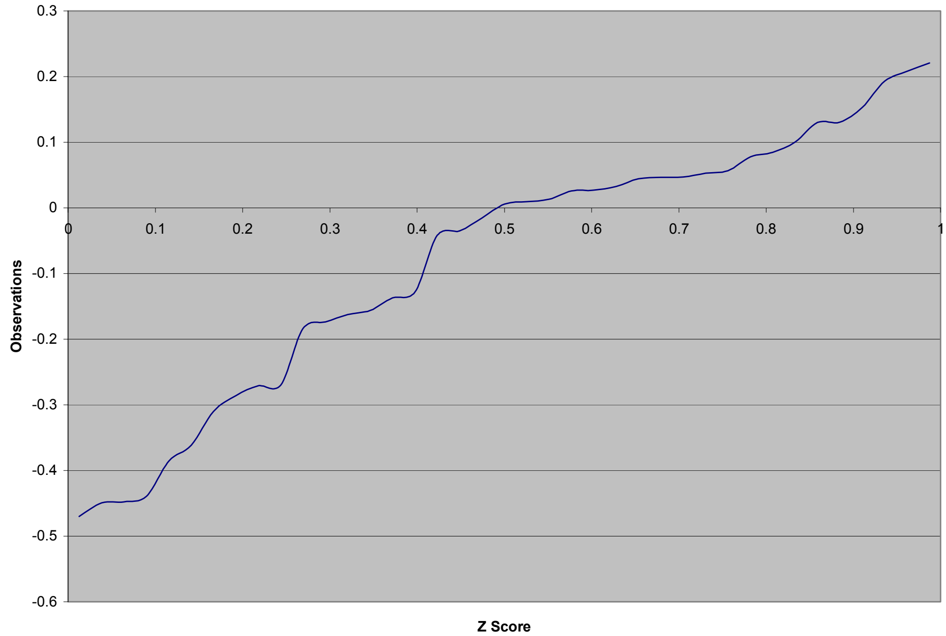

Figure 16. Normal Probability Plot (Pre-1997 Fixed Price Contracts)

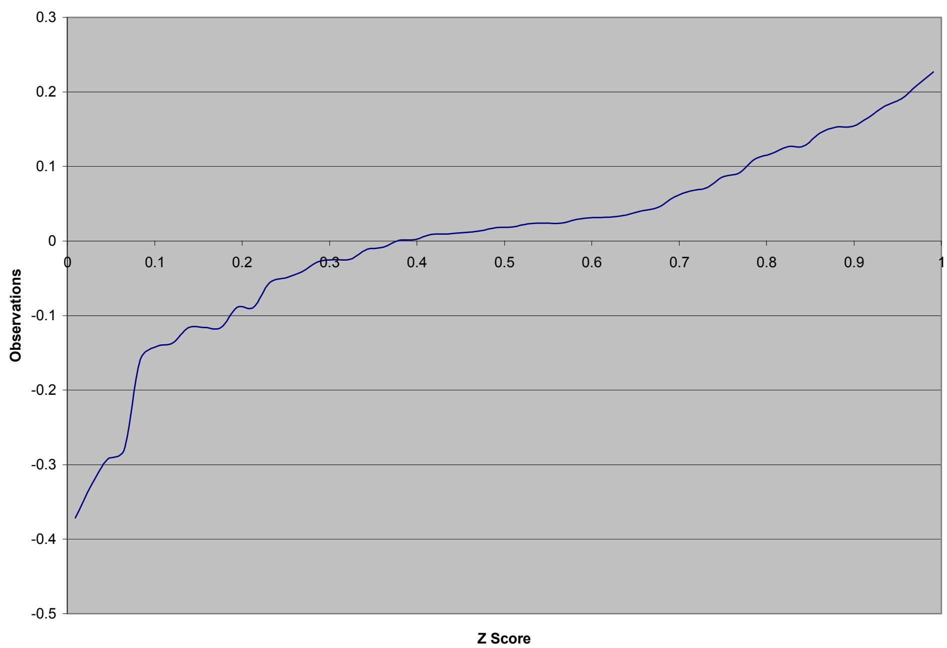

Figure 17. Normal Probability Plot (Post-1997 Fixed Price Contracts)

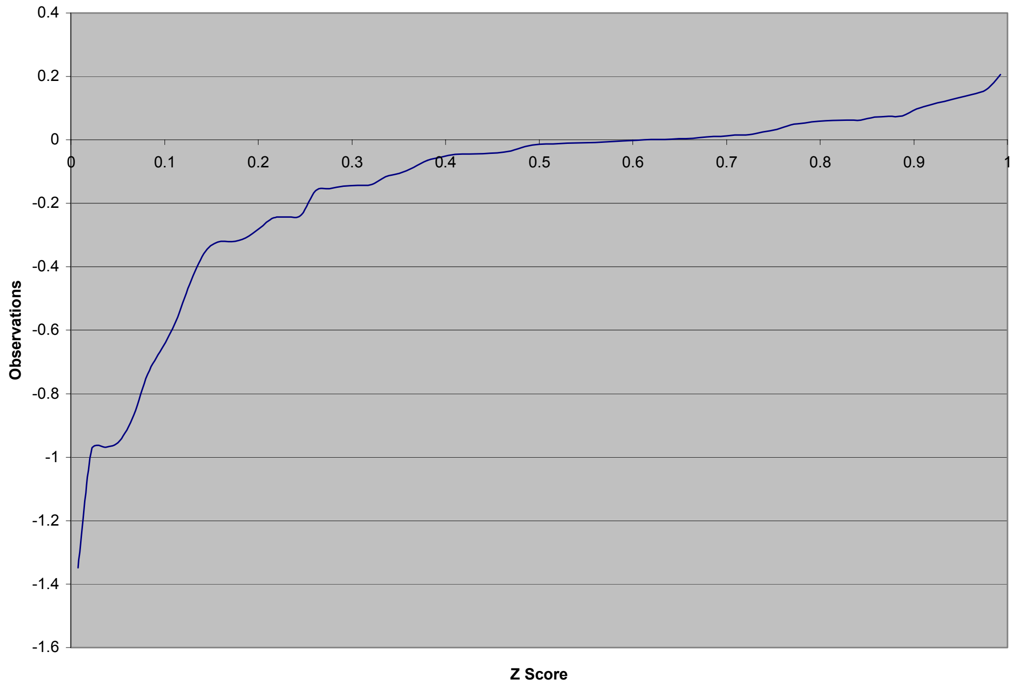

Figure 18. Normal Probability Plot (Pre-1997 Cost Reimbursable Contracts)

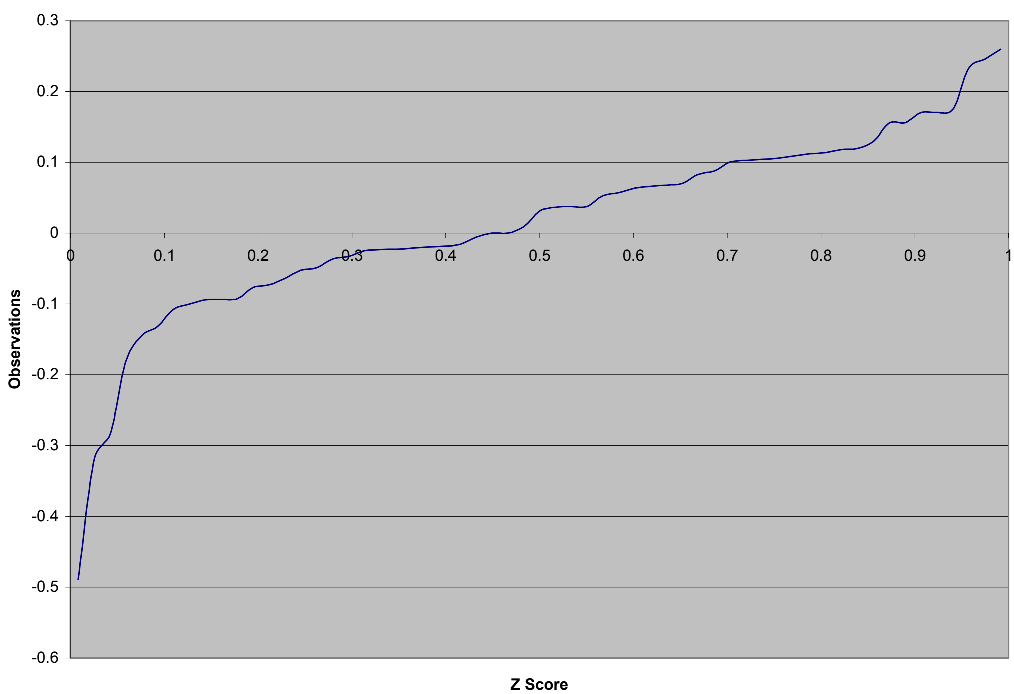

Figure 19. Normal Probability Plot (Post-1997 Cost Reimbursable Contracts)

Appendix B

Data Table For Contracts Used In This Study

SUBMITDATE	SERVICE	PPHASE	CTYPE	BAC	ACWP	FO	FO%	%COMP
1/25/1994	Navy	Production	CR	108.8	109.4	-0.6	-0.55147	99.26471
1/25/1994	Navy	R&D	CR	40.7	79.3	-38.6	-94.8403	199.7543
3/25/1994	Navy	Production	CR	83.8	139	-55.2	-65.8711	99.40334
4/25/1994	Navy	Production	CR	1019.4	1004	15.4	1.510693	98.22445
5/25/1994	Army	R&D	FP	14.7	21.3	-6.6	-44.898	125.1701
5/25/1994	Air Force	R&D	CR	873.9	1088.5	-214.6	-24.5566	124.4536
7/25/1994	Navy	Production	CR	1158.4	1440.6	-282.2	-24.3612	97.6692
7/25/1994	Navy	Production	CR	998.8	900.9	97.9	9.801762	79.72567
7/25/1994	Navy	Production	FP	787	635.1	151.9	19.30114	77.19187
7/25/1994	Army	R&D	CR	76.5	84.6	-8.1	-10.5882	94.24837
8/25/1994	Air Force	Production	CR	309.3	289.9	19.4	6.272228	97.51051
8/25/1994	Navy	Production	CR	551.3	721.6	-170.3	-30.8906	117.0143
8/25/1994	Navy	Production	FP	163.8	142.4	21.4	13.06471	95.116
8/25/1994	Navy	Production	CR	49	77	-28	-57.1429	132.8571
9/25/1994	Air Force	Production	CR	134	114.8	19.2	14.32836	90.89552
10/25/1994	Air Force	Production	CR	897.3	1147	-249.7	-27.8279	106.7982
10/25/1994	Air Force	Production	CR	945.3	984.5	-39.2	-4.14683	95.10208
10/25/1994	Navy	Production	CR	248.9	329.1	-80.2	-32.2218	117.5573
11/25/1994	Navy	Production	FP	491	441.7	49.3	10.04073	95.21385
12/25/1994	Air Force	Production	CR	238.8	239.6	-0.8	-0.33501	97.52931
12/25/1994	Air Force	Production	CR	756.1	764	-7.9	-1.04484	96.21743
12/25/1994	Air Force	Production	CR	611.6	638.5	-26.9	-4.3983	89.99346
12/25/1994	Air Force	Production	FP	180.8	165.5	15.3	8.462389	82.68805
12/25/1994	Air Force	Production	CR	1447.7	1478.5	-30.8	-2.12751	94.77792
12/25/1994	Air Force	Production	FP	881	993.6	-112.6	-12.7809	98.29739
12/25/1994	Air Force	R&D	CR	215.1	224.4	-9.3	-4.32357	104.7885
1/25/1995	Navy	Production	CR	1095.3	1067.7	27.6	2.519858	97.00539
2/25/1995	Navy	Production	FP	853.8	816	37.8	4.427266	90.68869
2/25/1995	Air Force	R&D	CR	86.1	75.7	10.4	12.07898	90.82462
3/25/1995	Navy	Production	CR	287.8	500.4	-212.6	-73.8707	155.9764
3/25/1995	Navy	Production	CR	117.3	93.1	24.2	20.63086	78.34612
3/25/1995	Army	R&D	CR	44.6	50.9	-6.3	-14.1256	110.3139
4/25/1995	Air Force	Production	CR	165.7	167.1	-1.4	-0.8449	97.40495
4/25/1995	Air Force	Production	CR	19.5	16.4	3.1	15.89744	100
4/25/1995	Navy	Production	FP	228	293.1	-65.1	-28.5526	118.7719
5/25/1995	Army	R&D	FP	285.2	282.5	2.7	0.946704	98.10659
6/25/1995	Army	R&D	CR	72.8	98.9	-26.1	-35.8516	98.48901
6/25/1995	Navy	R&D	FP	485.5	672.7	-187.2	-38.5582	98.4758
7/25/1995	Air Force	Production	CR	102.7	102.2	0.5	0.486855	99.22103
7/25/1995	Air Force	Production	CR	1406.1	1400.9	5.2	0.369817	97.47529
8/25/1995	Navy	Production	CR	65.8	122.8	-57	-86.6261	168.693
8/25/1995	Navy	Production	CR	66.6	70.9	-4.3	-6.45646	89.33934
8/25/1995	Army	R&D	CR	93.8	93.7	0.1	0.10661	97.8678

SUBMITDATE	SERVICE	PPHASE	CTYPE	BAC	ACWP	FO	FO%	%COMP
8/25/1995	Navy	R&D	FP	127.7	183.8	-56.1	-43.9311	130.0705
9/25/1995	Army	Production	CR	373.1	345.4	27.7	7.424283	90.37791
9/25/1995	Navy	Production	CR	264.6	250.6	14	5.291005	93.68859
9/25/1995	Army	R&D	CR	34.3	49.9	-15.6	-45.481	140.2332
9/25/1995	Army	R&D	CR	29	28.7	0.3	1.034483	99.31034
10/25/1995	Army	Production	CR	236.4	312.3	-75.9	-32.1066	119.797
10/25/1995	Air Force	R&D	FP	89.3	77.7	11.6	12.98992	95.85666
10/25/1995	Navy	R&D	CR	24.2	22.7	1.5	6.198347	90.90909
10/25/1995	Navy	R&D	FP	386.3	490.9	-104.6	-27.0774	97.54077
11/25/1995	Air Force	Production	CR	116.1	110.6	5.5	4.737295	99.05254
11/25/1995	Navy	Production		526.8	475.2	51.6	9.794989	97.03872
12/25/1995	Air Force	R&D	FP	157.8	228.4	-70.6	-44.7402	98.73257
1/25/1996	Air Force	R&D	FP	5547.9	8154.7	-2606.8	-46.9871	93.41012
2/25/1996	Air Force	R&D	CR	89	110	-21	-23.5955	94.26966
3/25/1996	Navy	Production	FP	57.6	65.5	-7.9	-13.7153	100.6944
4/25/1996	Air Force	Production	CR	632	640.1	-8.1	-1.28165	93.03797
4/25/1996	Navy	Production	FP	659.5	628.5	31	4.700531	97.04321
4/25/1996	Air Force	R&D	FP	95.8	125.5	-29.7	-31.0021	96.55532
4/25/1996	Navy	R&D	FP	118.9	123.9	-5	-4.20521	94.0286
5/25/1996	Navy	Production	CR	1099.8	1089.4	10.4	0.945626	106.6285
5/25/1996	Navy	Production	CR	965.9	1009.6	-43.7	-4.52428	100.1242
5/25/1996	Army	R&D	FP	424.1	418.5	5.6	1.320443	98.5145
6/25/1996	Army	Production	FP	58.3	56.8	1.5	2.572899	98.11321
6/25/1996	Army	Production	FP	43.8	40.4	3.4	7.762557	94.97717
6/25/1996	Navy	Production	FP	563	531.1	31.9	5.666075	95.13321
6/25/1996	Navy	R&D	FP	953	1118.6	-165.6	-17.3767	113.6516
7/25/1996	Air Force	Production	FP	1421.2	1382.7	38.5	2.708978	97.55137
7/25/1996	Air Force	R&D	CR	10514.3	9751.9	762.4	7.251077	88.23507
7/25/1996	Navy	R&D	FP	17.1	17.7	-0.6	-3.50877	95.90643
8/25/1996	Army	R&D	CR	199.6	468.7	-269.1	-134.82	224.7495
8/25/1996	Air Force	R&D	CR	735.3	722.8	12.5	1.699986	96.40963
9/25/1996	Navy	R&D	CR	68.5	60.9	7.6	11.09489	88.90511
10/25/1996	Air Force	R&D	CR	76.2	73.7	2.5	3.28084	97.50656
10/25/1996	Air Force	R&D	CR	77.2	77.1	0.1	0.129534	99.6114
10/25/1996	Navy	R&D	CR	97.6	97.7	-0.1	-0.10246	94.97951
11/25/1996	Air Force	Production	CR	92	102.7	-10.7	-11.6304	100.2174
11/25/1996	Navy	Production	CR	1911	1936.4	-25.4	-1.32915	104.652
12/25/1996	Air Force	Production	CR	11779.5	10895.7	883.8	7.502865	93.06592
12/25/1996	Air Force	R&D	CR	10014.8	19765.1	-9750.3	-97.3589	196.7997
12/25/1996	Navy	R&D	CR	21.9	25.4	-3.5	-15.9817	100
12/25/1996	Navy	R&D	CR	24.1	27.6	-3.5	-14.5228	100.4149
1/25/1997	Navy	R&D	CR	127.8	132.3	-4.5	-3.52113	94.2097
2/25/1997	Air Force	Production	CR	80.2	157.9	-77.7	-96.8828	110.0998
2/25/1997	Navy	Production	CR	104.6	119.6	-15	-14.3403	106.5966
2/25/1997	Army	R&D	CR	149.6	172.6	-23	-15.3743	97.59358
4/25/1997	Navy	Production	CR	520.6	488.9	31.7	6.089128	94.98655
5/25/1997	Army	Production	CR	189.3	199.6	-10.3	-5.4411	97.14739
5/25/1997	Navy	Production	CR	512.7	444.4	68.3	13.32163	92.90033

SUBMITDATE	SERVICE	PPHASE	CTYPE	BAC	ACWP	FO	FO%	%COMP
5/25/1997	Navy	Production	CR	706.2	767.8	-61.6	-8.72274	108.5811
6/25/1997	Army	R&D	CR	122.5	123.6	-1.1	-0.89796	90.44898
7/25/1997	Navy	Production	FP	561	648.6	-87.6	-15.615	100
7/25/1997	Navy	Production	FP	329.1	327.1	2	0.607718	91.46156
8/25/1997	Air Force	Production	CR	94.8	89.2	5.6	5.907173	98.10127
8/25/1997	Air Force	Production	FP	70	66.3	3.7	5.285714	99.14286
8/25/1997	Air Force	Production	FP	39.3	39.9	-0.6	-1.52672	99.49109
8/25/1997	Air Force	R&D	FP	109.8	85.6	24.2	22.04007	95.81056
9/25/1997	Navy	Production	FP	1060.4	1346.6	-286.2	-26.9898	105.7243
10/25/1997	Air Force	Production	FP	500.6	424	76.6	15.30164	96.1646
10/25/1997	Air Force	Production	FP	228.3	180.8	47.5	20.80596	77.48576
11/25/1997	Army	Production	FP	26.3	35.8	-9.5	-36.1217	86.69202
11/25/1997	Army	Production	FP	157	149.7	7.3	4.649682	93.63057
11/25/1997	Air Force	R&D	FP	255.6	302.5	-46.9	-18.349	98.90454
11/25/1997	Air Force	R&D	FP	85.9	83.1	2.8	3.259604	95.57625
12/25/1997	Navy	Production	FP	676.5	786.4	-109.9	-16.2454	114.8263
1/25/1998	Navy	Production	FP	632.9	818.2	-185.3	-29.2779	100.632
3/25/1998	Army	R&D	FP	120.2	137.2	-17	-14.1431	97.33777
3/25/1998	Navy	R&D	FP	60.9	78	-17.1	-28.0788	98.02956
4/25/1998	Army	Production	FP	219.2	177.5	41.7	19.02372	77.82847
4/25/1998	Navy	Production	FP	382.2	323.5	58.7	15.35845	89.76975
5/25/1998	Army	R&D	FP	46.5	48.8	-2.3	-4.94624	99.78495
5/25/1998	Navy	R&D	FP	233.9	208.2	25.7	10.9876	84.95083
7/25/1998	Army	R&D	FP	55.5	63.1	-7.6	-13.6937	98.91892
7/25/1998	Army	R&D	FP	442.8	446.5	-3.7	-0.83559	95.16712
8/25/1998	Army	Production	CR	10.9	9.2	1.7	15.59633	86.23853
8/25/1998	Navy	Production	FP	552.4	534.9	17.5	3.167994	97.4294
9/25/1998	Navy	Production	FP	843.9	919	-75.1	-8.89916	95.94739
9/25/1998	Army	R&D	FP	113.7	99.2	14.5	12.75286	86.45558
10/25/1998	Navy	Production	FP	3188.5	3267.6	-79.1	-2.48079	98.96817
11/25/1998	Army	Production	CR	243	215.8	27.2	11.19342	91.15226
11/25/1998	Air Force	Production	CR	246.8	264.8	-18	-7.29335	98.2577
11/25/1998	Air Force	Production	CR	129.4	131.9	-2.5	-1.93199	101.4683
11/25/1998	Air Force	Production	CR	421.9	498.1	-76.2	-18.0612	117.0894
11/25/1998	Navy	Production	CR	131.5	136.3	-4.8	-3.65019	94.60076
11/25/1998	Navy	Production	FP	283.7	250.5	33.2	11.7025	90.51815
2/25/1999	Navy	Production	CR	683.1	781.9	-98.8	-14.4635	116.1323
2/25/1999	Navy	R&D	CR	386.9	411.6	-24.7	-6.38408	98.13905
3/25/1999	Army	R&D	CR	75.8	77.2	-1.4	-1.84697	94.19525
5/25/1999	Army	R&D	FP	536	598.2	-62.2	-11.6045	99.16045
5/25/1999	Navy	R&D	FP	300.8	335.7	-34.9	-11.6024	105.0532
6/25/1999	Army	R&D	CR	249.5	276.3	-26.8	-10.7415	110.7415
7/25/1999	Air Force	R&D	CR	388.3	388.2	0.1	0.025753	98.50631
8/25/1999	Air Force	R&D	CR	106.7	102.7	4	3.748828	96.15745
11/25/1999	Army	R&D	FP	118.4	114.3	4.1	3.462838	96.28378
12/25/1999	Navy	R&D	CR	244.7	267.7	-23	-9.39926	99.95913
2/25/2000	Air Force	R&D	CR	130.6	110.3	20.3	15.54364	84.76263
3/25/2000	Air Force	R&D	CR	289.9	265.8	24.1	8.313211	89.92756

SUBMITDATE	SERVICE	PPHASE	CTYPE	BAC	ACWP	FO	FO%	%COMP
4/25/2000	Navy	Production	CR	214.3	199.8	14.5	6.766216	96.82688
5/25/2000	Navy	R&D	FP	26.7	27	-0.3	-1.1236	98.12734
5/25/2000	Navy	R&D	CR	407.5	438.7	-31.2	-7.65644	91.0184
6/25/2000	Army	R&D	CR	1420	2114	-694	-48.8732	144.5141
6/25/2000	Navy	R&D	CR	25.8	26.4	-0.6	-2.32558	93.02326
7/25/2000	Army	Production	CR	3413.3	2618.2	795.1	23.29417	76.76149
7/25/2000	Army	R&D	CR	254.5	280	-25.5	-10.0196	98.54617
7/25/2000	Air Force	R&D	CR	77.1	101.7	-24.6	-31.9066	95.33074
8/25/2000	Air Force	Production	CR	668.9	730.9	-62	-9.26895	112.528
8/25/2000	Navy	Production	CR	72.1	68.3	3.8	5.270458	99.58391
8/25/2000	Air Force	R&D	CR	76.9	98.7	-21.8	-28.3485	120.2861
9/25/2000	Navy	Production	CR	689.5	618.8	70.7	10.25381	95.27194
9/25/2000	Air Force	Production	CR	58.3	56.1	2.2	3.773585	95.02573
9/25/2000	Navy	R&D	FP	25.8	28.1	-2.3	-8.91473	98.83721
11/25/2000	Navy	Production	FP	879.5	1019.4	-139.9	-15.9068	97.55543
11/25/2000	Navy	Production	FP	314.6	285.9	28.7	9.122695	94.56453
11/25/2000	Navy	R&D	CR	40.8	40.8	0	0	100
1/25/2001	Navy	Production	CR	1567.4	1518.1	49.3	3.145336	97.37782
1/25/2001	Navy	Production	CR	225.3	223.3	2	0.887705	98.57967
1/25/2001	Navy	R&D	CR	3420.8	3441.1	-20.3	-0.59343	99.58197
1/25/2001	Navy	R&D	CR	674.8	738.1	-63.3	-9.38056	100.0741
2/25/2001	Navy	Production	FP	924.1	975.9	-51.8	-5.60545	92.20864
2/25/2001	Navy	Production	CR	44.7	50.6	-5.9	-13.1991	90.82774
2/25/2001	Air Force	Production	CR	464.1	488.3	-24.2	-5.21439	106.2487
4/25/2001	Navy	Production	FP	160.5	213	-52.5	-32.7103	123.8629
5/25/2001	Air Force	R&D	FP	85.3	71.2	14.1	16.52989	83.47011
5/25/2001	Navy	R&D	FP	166.6	163.5	3.1	1.860744	94.41777
7/25/2001	Navy	Production	FP	17.3	16.6	0.7	4.046243	78.03468
7/25/2001	Navy	Production	FP	616.7	597.1	19.6	3.178207	95.83266
8/25/2001	Army	R&D	FP	169.5	176.5	-7	-4.12979	97.40413
8/25/2001	Army	R&D	FP	73.9	82.5	-8.6	-11.6373	97.29364
9/25/2001	Air Force	R&D	FP	3524.2	3287.4	236.8	6.719255	95.30106
10/25/2001	Air Force	Production	FP	395.7	392.2	3.5	0.884508	95.42583
10/25/2001	Navy	Production	CR	42.3	39.5	2.8	6.619385	94.56265
10/25/2001	Navy	Production	CR	481.7	454.3	27.4	5.688188	96.49159
10/25/2001	Navy	Production	CR	520.6	474.8	45.8	8.797541	92.1821
10/25/2001	Navy	Production	CR	460.9	428.5	32.4	7.029724	88.17531
10/25/2001	Navy	Production	CR	1321.9	1350	-28.1	-2.12573	97.99531
10/25/2001	Navy	Production	CR	1660.6	1715.3	-54.7	-3.29399	96.24834
10/25/2001	Navy	Production	CR	1382.8	1225.5	157.3	11.37547	79.98988
10/25/2001	Navy	Production	FP	2331.9	2037.4	294.5	12.62919	80.63811
10/25/2001	Air Force	Production	FP	75.6	77.7	-2.1	-2.77778	96.42857
10/25/2001	Air Force	Production	FP	263.3	257	6.3	2.392708	93.96126
10/25/2001	Navy	Production	FP	1602.6	1465.1	137.5	8.579808	95.51354
10/25/2001	Army	R&D	FP	616.7	488.1	128.6	20.85293	79.63353
10/25/2001	Army	R&D	FP	171.8	169.9	1.9	1.105937	98.83586
10/25/2001	Army	R&D	FP	69.4	71.1	-1.7	-2.44957	86.02305
10/25/2001	Air Force	R&D	CR	82.9	84.8	-1.9	-2.29192	100.7238

SUBMITDATE	SERVICE	PPHASE	CTYPE	BAC	ACWP	FO	FO%	%COMP
10/25/2001	Air Force	R&D	CR	539	444.7	94.3	17.49536	81.05751
10/25/2001	Air Force	R&D	FP	101.8	100	1.8	1.768173	98.91945
10/25/2001	Navy	R&D	FP	3150.3	3121.3	29	0.920547	97.52405
10/25/2001	Navy	R&D	FP	525.3	512.8	12.5	2.379593	96.24976
11/25/2001	Army	Production	CR	124.4	109.5	14.9	11.97749	80.54662
11/25/2001	Air Force	Production	CR	220.7	198.5	22.2	10.0589	92.75034
11/25/2001	Air Force	Production	CR	351.9	265.6	86.3	24.52401	83.74538
11/25/2001	Navy	Production	FP	919.8	854.2	65.6	7.131985	86.93194
11/25/2001	Navy	Production	FP	1011.8	988.7	23.1	2.28306	89.97826
11/25/2001	Navy	Production	FP	139.7	139.6	0.1	0.071582	97.56621
11/25/2001	Army	R&D	FP	672.8	922.9	-250.1	-37.173	129.3847
11/25/2001	Army	R&D	FP	166.9	142.7	24.2	14.4997	86.51887
11/25/2001	Army	R&D	FP	41	31.7	9.3	22.68293	77.80488
11/25/2001	Army	R&D	FP	135.4	110.9	24.5	18.09453	81.0192
11/25/2001	Air Force	R&D	CR	182	170.4	11.6	6.373626	93.46154
11/25/2001	Air Force	R&D	FP	331.5	280.9	50.6	15.26395	80.84465
11/25/2001	Navy	R&D	FP	148.7	146.7	2	1.34499	99.05851
11/25/2001	Navy	R&D	FP	196.9	185.2	11.7	5.942103	91.77247
11/25/2001	Navy	R&D	CR	106.7	88.5	18.2	17.05717	84.44236
11/25/2001	Navy	R&D	CR	307.1	322.1	-15	-4.8844	92.21752
11/25/2001	Navy	R&D	CR	514.3	527.2	-12.9	-2.50826	85.08653
11/25/2001	Navy	R&D	CR	16.1	14.4	1.7	10.55901	87.57764
11/25/2001	Navy	R&D	CR	66.2	59	7.2	10.87613	85.04532
11/25/2001	Navy	R&D	CR	126.1	104.6	21.5	17.04996	81.99841
11/25/2001	Navy	R&D	CR	138.8	133.7	5.1	3.674352	85.44669
12/25/2001	Navy	Production	CR	1161.7	860.1	301.6	25.96195	75.30343
12/25/2001	Army	R&D	CR	78.8	68.6	10.2	12.94416	90.22843
12/25/2001	Army	R&D	CR	210.6	188.7	21.9	10.39886	92.40266
12/25/2001	Army	R&D	CR	82.7	84	-1.3	-1.57195	96.85611
12/25/2001	Air Force	R&D	FP	13447	12842.8	604.2	4.493196	92.06143
12/25/2001	Air Force	R&D	FP	2198.6	2195.1	3.5	0.159192	98.20795
12/25/2001	Air Force	R&D	CR	396.1	349.4	46.7	11.78995	87.83136
12/25/2001	Navy	R&D	FP	285	276.7	8.3	2.912281	94.98246

Bibliography

Beachboard, John. (1997) "Assessing the Information Technology Management Reform Act," *Government Information Quarterly,* 14, 291. Retrieved 30 July 2002 from EBSCOhost database.

Chinworth, Michael. "Acquisition Reform in the United States: Assessing Change," *Defense Analysis,* 16: 165-183.

Christensen, David, and David Rees. "Is the CPI-Based EAC a Lower Bound to the Final Cost of Post A-12 Contracts?" Submitted to the *Journal of Cost Analysis and Management* on 21 September 2001. n. pg. Revised 17 December 2001.

Christensen, David, David Searle, and Caisse Vickery. "The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns," *Acquisition Review Quarterly*, 251-262 (Summer 1999).

Christensen, David, and James Gordon. "Does a Rubber Baseline Guarantee Cost Overruns on Defense Acquisition Contracts?" *Project Management Journal*, 29: 43-51 (September 1998).

Christensen, David. "The Costs and Benefits of the Earned Value Management Process," *Acquisition Review Quarterly,* 373-386 (Fall 1998).

Christensen, David. "Project Advocacy and the Estimate at Completion Problem." *The Journal of Cost Analysis and Management,* 35-60 (Spring 1996).

Christensen, David. "Determining an Accurate Estimate at Completion," *National Contract Management Journal*, 25: 17-25 (1993).

Consolidated Acquisition Reporting System. "The CARS Automated System Overview," CARS website. http://cars.grci.com/index.htm. 18 October 2002.

Defense Acquisition University. *Glossary: Defense Acquisition Acronyms and Terms,* 10: January 2001

Defense Systems Management College. "Clinger-Cohen Act of 1996," DSMC website. n. pag. http://www.dau.mil/jdam/contents/clinger-cohen.htm. 23 May 2002.

Defense Systems Management College. "Federal Acquisition Streamlining Act," DSMC website. n. pag. http://www.dau.mil/jdam/contents/fasa.htm. 11 April 2002.

Department of Defense. *Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs. DoD Regulation 5000.2-R.* Washington: GPO, 1996.

Department of Defense. *Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs. DoD Regulation 5000.2-R.* Washington: GPO, 2002.

Devore, Jay. *Probability and Statistics for Engineering and the Sciences*. California: Duxbury, 2000.

Fleet and Industrial Supply Center. "Acquisition Reform," FISC website. n. pag. http://www.nor.fisc.navy.mil. 11 April 2002.

Fleming, Quentin and Joel Koppelman. *Earned Value Project Management.* New York: Project Management Institute, 1996.

JMP. Version 5.0, IBM. Computer software. SAS Institute Incorporated, Cary NC, 2002.

Lyles, Lester. "AFMC Meeting Transformation Challenges," AFMC Public Affairs website. n. pag. https://www.afmc-mil.wpafb/HQ-AFMC/PA/. 6 May 2002.

Meckley, Sandra. Acquisition Management Policy Division for the Secretary of the Air Force, Washington, D.C. Personal Correspondence. 8 August 2002.

Neter, John, Michael Kutner, Christopher Nachtsheim, and William Wasserman. *Applied Linear Statistical Models*. Boston: McGraw-Hill, 1996.

Northrop Grumman. "Truth in Negotiations Act: TINA," Northrop Grumman website. n. pag. http://sensor.northgrum.com/ethics/Documents. 6 August 2002

Office of Federal Procurement Policy. Federal Acquisition Regulation. Washington: OFPP, 29 July 02.

Office of Management and Budget. *Budget of the United States Government, Fiscal Year 2003*. Washington: Government Printing Office, 2002.

Office of the Secretary of Defense. "The 5000 Model," Figure in Deskbook on website. n. pag. http://web2.deskbook.osd.mil/5000Model.asp. 5 August 2002.

Pendolino, Timothy and Nathanael Causey. (1996) "The Fiscal Year 1996 Department of Defense Authorization Act: Real Acquisition Reform in Hiding?," *Army Lawyer,* April 1996, 6-25. Retrieved 8 August 2002 from Military Library FullTEXT database.

Preston, Colleen. "Acquisition Reform: Making it a Reality," *Acquisition Review Quarterly,* 6-11 (Winter 1994).

Searle, David. "The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns in Major Defense Acquisition Programs," AFIT/GCM/LAS/97S-12, MS Thesis, School of Logistics and Acquisition Management, Air Force Institute of Technology (AU), Wright Patterson AFB, OH, September 1997.

TASC, Inc and Coopers and Lybrand. *The DoD Regulatory Cost Premium: A Quantitative Assessment,* December 1994.

Tolan, Jr., Patrick. (1998) "Government Contracting with Small Businesses in the Wake of the Federal Acquisition Streamlining Act, The Federal Acquisition Reform Act, and Adarand: Small Business as Usual?," *Air Force Law Review,* 44, n. pg. Retrieved 6 August 2002 from Military Library FullTEXT database.

United States Congress. *Information Management Technology Reform Act of 1996*. Public Law No. 104-106, 104th Congress. Washington: GPO, 1996.

REPORT DOCUMENTATION PAGE						*Form Approved* *OMB No. 074-0188*

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From – To)*
03-25-2002	**Master's Thesis**	Aug 2001 – Mar 2003

4. TITLE AND SUBTITLE

AN ANALYSIS OF THE FEDERAL ACQUISITION STREAMLINING ACT AND THE CLINGER-COHEN ACT AND THEIR EFFECT ON COST OVERRUNS IN DEPARTMENT OF DEFENSE CONTRACTS

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Mosier, Andrew Kyle, 1Lt, USAF

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)

Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 P Street, Building 640
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GCA/ENV/03-06

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Mr. Bob Leach
OUSD(AT&L)ARA/AM
3020 Defense Pentagon
Room 3D161
Washington, DC 20301-3020 phone: 703-614-0200

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This thesis examines the impact of the Federal Acquisition Streamlining Act (FASA) of 1994 and the Clinger-Cohen Act on cost overruns in Department of Defense (DoD) contracts. Many officials believe that we must reform the acquisition process to meet the new post-Cold War national security challenges. The FASA and the Clinger-Cohen Act made more changes to the acquisition process than any other policy had in the ten years preceding.

This research effort studied 220 contracts completed between December 31, 1993 and December 31, 2001 to determine if cost overruns on contracts completed before the implementation of the FASA and the Clinger-Cohen Act were different than cost overruns on contracts completed after the implementation of the FASA and the Clinger-Cohen Act. The contracts were also subdivided to determine if the results were sensitive to acquisition lifecycle phase, branch of service, or contract type.

The results indicate that cost overruns decreased on completed contracts after the implementation of the legislation. The results were sensitive to the branch of service responsible. Air Force contracts experienced no change in cost overruns after the implementation of the FASA and the Clinger-Cohen Act, while cost overruns in Army and Navy contracts decreased. The results were not sensitive to lifecycle phase or contract type.

15. SUBJECT TERMS

Acquisition, Acquisition Reform, Cost Performance, Cost Overruns, FASA, Clinger-Cohen Act

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			Michael Greiner, Maj, USAF (ENV)
					19b. TELEPHONE NUMBER *(Include area code)*
U	U	U	UU	85	(937) 255-3636, ext 4588; e-mail: Michael.Greiner@afit.edu