An Examination of the Patterns of Failure in Defense Acquisition Programs

by

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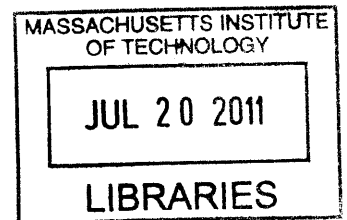Master of Aeronautical Science, Embry-Riddle Aeronautical University, 1997

Submitted to the System Design and Management Program
in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Engineering and Management

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ABSTRACT

The history of acquisition reform dates back to the Revolutionary War era, and recommendations and actions to reform the Department of Defense's acquisition system continue today. Common themes emerge from the recommendations of countless Acts, Studies, Panels, and Commissions over the past 30 years, pointing to areas that appear to have the most impact on the system. Despite these actions and recommendations, issues remain at the program execution level, resulting in increased cost and delays in fielding needed capabilities.

This work focuses on three areas. A comprehensive Literature Review of acquisition reform activities was conducted. This generated a list of common themes and focus areas that are associated with less than successful program outcomes. Following this, a series of ten patterns of behavior (acquisition archetypes) postulated for software programs developed by Carnegie Mellon University's Software Engineering Institute were examined for applicability to the larger Department of Defense acquisition system and to determine their relationship to acquisition reform actions. As part of this effort, a survey of acquisition personnel was conducted to determine the relevance of these patterns of behavior.

Based on these foundational works, the final step examined the results of the survey to answer four research questions. First, the survey results were analyzed to determine if the patterns of behavior were present with general and statistical relevance. The second question attempted to determine if the patterns of behavior led to measurable cost and/or schedule growth if they were present in the respondent's program. Third, the postulated root causes for the behaviors were compared to the common themes from acquisition reform activities to determine alignment. Finally, the survey results were analyzed to see if the patterns of behavior correlated to a particular program size, lead service, or "joint" program status.

The findings show that the patterns of behavior are present in Department of Defense acquisition programs, and some do lead to measurable cost and/or schedule growth when identified. Acquisition Reform activities have been targeted at the areas that are reported as root causes of the behaviors, and one of the ten patterns of behavior does correlate with "joint" program status.

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Dedication

This work is dedicated to the five most important people in my life. First, to my wife, Rhonda McNew, for her love and understanding of the long hours, late nights, travel, and separation that have marked these past five years of my military career, but especially the last six months of my academic journey at the Massachusetts Institute of Technology. Second, to my children, Heather and Christopher McNew, may this thesis (as well as my success at such a renown institution as MIT) remind you that there are no limits on what you can accomplish in life when you apply yourself. Finally, to my parents, Joe and Garnieta McNew, who instilled in me a strong work ethic and have always believed that I can accomplish anything.

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I could not have completed this academic journey alone, without the help, understanding, and assistance of many people.

For their advice, support, and behind the scenes actions that ultimately led to my selection for the Massachusetts Institute of Technology Lean Advancement Initiative Senior Developmental Education program, I am indebted to Col Michelle Miller-Peck and Col (Ret) Toni Arnold (USAF).

I thank Dr. Ricardo Valerdi for exposing me to the Carnegie Mellon University's Software Engineering Institute's work and for planting the seed for this thesis. I truly enjoyed your class and value our ongoing friendship.

Without the efforst of Dr. Eric Rebentisch, my thesis advisor, this work would never have come to fruition. I cannot thank him enough for his guidance and support throughout the thesis process. Your wealth of experience in the Department of Defense acquisition and product development process realms made this product significantly better than I could have alone. I would also like to thank Dr. Deborah Nightingale for her support and for teaching two great classes focused on enterprise-level activities (Integrating the Lean Enterprise and Enterprise Architecting). I also thank Mr. Tom Shields and Ms. Juliet Perdichizzi for the help and assistance managing the Lean Advancement Initiative and helping me to learn to navigate the world of the Massachusetts Institute of Technology.

There are several individuals that I must thank, without whom this research would not have taken place. First, I would like to thank Mr. Gary Hagan from the Defense Acquisition University's Main Campus at Fort Belvoir, VA, for allowing me to use the PMT-352 student population to obtain the majority of the survey respondents and ensuring a strong sampling across services and program sizes. Similarly, I need to thank several other people who helped me in obtaining survey respondents from their respective locations. These are Lt Col (Ret) Troy Snow from the Defense Acquisition University's Southern Region, CAPT Joe Beel (US Navy), COL William Cole (US Army), Ms. Michele Brazel, and Major Angela Jacobson (US Air Force).

Finally, I must thank the men and women of the Massachusetts Institute of Technology's System Design and Management Program, my family away from my family. First and foremost, I have to thank Mr. Pat Hale for making the transition from the active duty military into the System Design and Management program an easy one. In addition, I have to thank him for all his outstanding advice and support. For their help getting into and through the demanding System Design and Management program, I want to thank Ms. Chris Bates and Mr. Bill Foley for all their help and assistance. Finally, I want to thank the System Design and Management 2009, 2010, and 2011 Cohorts for their support, patience, and assistance in completing a rigorous and fascinating course of study. You've been my family away from my family and I will always cherish the times we've spent together these past 18 months.

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Executive Summary

The history of acquisition reform dates back to the Revolutionary War era, and recommendations and actions to reform the Department of Defense's acquisition system continue today. Countless Acts, Studies, Panels, and Commissions over the past 60 years have pointed to areas that appear to impact on the system at various levels. Common themes emerge from the recommendations of these panels, and they fall into three broad areas.

The first broad theme of acquisition reform recommendations was organizational change. These kinds of changes resulted in the creation of offices such as the UnderSecretary of Defense for Acquisition, Technology, and Logistics and the Director of Operational Test and Evaluation. Other commissions led to the establishment of Program Executive Officers for localized management of program execution. Some of the more recent actions have strengthened the roles of the acquisition oversight mechanisms in the Office of the Secretary of Defense.

The second broad theme of acquisition reform recommendations has been to focus on execution-related activities. Multiple commissions and panels have recommended incremental development and the use of milestones for measuring progress, dating back as early as 1970. Many other panels, including some very recent actions, have focused on increasing competition in government contracting and requiring the use of prototypes to determine early progress. Since the mid-1990s, there has been a strong focus on reducing program costs and speeding delivery of weapon systems to the field.

The third broad theme of acquisition reform recommendations was to become more "commercial". This included expanded use of commercial items and elimination of military specifications in lieu of commercial standards. These recommendations also suggested that the DoD should become more like a commercial company in its purchasing approach.

Unfortunately, many of the recommendations of the panels, commissions, and studies were never implemented for various reasons. Therefore, despite these actions and recommendations, issues remain at the program execution level, resulting in increased cost and delays in fielding needed capabilities. As part of a comprehensive Literature Review, a series of ten patterns of behavior (acquisition archetypes) postulated for software programs developed by Carnegie Mellon University's Software Engineering Institute were examined for applicability to the larger Department of Defense acquisition system and to determine their relationship to acquisition reform actions. Based on the results of this qualitative review, the ten patterns of behavior were determined to be relevant, but analytic data were needed. Therefore, a survey of acquisition personnel was conducted to determine the relevance of these patterns of behavior.

Based on the foundational work conducted in the Literature Review discussed above, the remainder of this work examined the results of the survey to answer four research questions. First, the survey results were analyzed to determine if the patterns of behavior were present with general and statistical relevance. The second question attempted to determine if the patterns of behavior led to measurable cost and/or schedule growth if they were present in the respondent's program. Third, the postulated root causes for the behaviors were compared to the common themes from acquisition reform activities to determine alignment. Finally, the survey results

were analyzed to see if the patterns of behavior correlated to a particular program size, lead service, or "joint" program status.

The survey results show that the patterns of behavior are indeed present in the DoD acquisition system, at levels ranging from 17% to 57%. While these results do not indicate that the acquisition archetypes are present at a statistically significant level, they do point to behaviors that acquisition personnel should be aware of and attempt to avoid when possible.

When the patterns of behavior were identified by the survey respondents, several led to statistically significant reporting of measurable cost and/or schedule growth. In particular, the archetypes that affect early program decisions ("Underbidding the Contract", "Longer Begets Bigger", "Everything to Everybody", and "The Bow Wave Effect") all led to statistically significant reporting of both cost and schedule growth. These results inherently make sense, as early program decisions and actions have the longest time to manifest into cost and schedule growth. Only one other pattern of behavior, "Firefighting", was statistically linked to measurable schedule growth.

Again, when the survey respondents confirmed that a behavior pattern was present in their program, they were asked to postulate root causes for this behavior. Across all of the patterns of behavior, five areas emerged as the strongest root causes. These were requirements, execution, risk management, technology management, and funding. Interestingly, two of these (requirements and funding) are considered outside the realm of the DoD acquisition system as they are inputs, not something that program managers have direct control over.

Finally, the ten patterns of behavior were analyzed to determine if there was any correlation between identified occurrence of the archetype and program size, program lead service, or "joint" program status. With one exception, there was not identifiable correlation of any of the ten archetypes to any of these three program demographics. The exception was that the "Everything to Everybody" pattern of behavior was correlated with "joint" program status. In many ways, this makes sense as well, since the pattern of behavior is that program requirements are added to appease the needs of multiple stakeholders, driving up complexity and therefore leading to cost and/or schedule growth.

Several recommendations were made as a result of the conclusions of this research. It appears that the highest leverage area to address for acquisition reform would be to change the process used for determining program requirements, ensuring that they are technologically achievable and stable at program initiation. Other recommendations include varied levels of awareness training for the acquisition archetypes studies in this work and a renewed emphasis on risk management training for acquisition personnel.

As might be expected, the DoD acquisition system remains ripe for future study. Numerous areas of potential future research were identified. Some, such as a more in-depth study of the Services Contracting arena, have no direct link to this research but have high leverage within the DoD. Other areas were directly related to some of the findings of this research which identified areas that follow-on research could pay significant dividends.

Chapter 1 – Introduction

1.1 Research Motivation

As a career engineering and acquisition officer in the United States Air Force with over 21 years of experience, I've seen many different ideas and approaches to Acquisition Reform. These have taken many forms, from Congressionally-mandated changes to the system, revisions of the Department of Defense (DoD) Acquisition System regulations and instructions to "lightning bolts" and special emphasis on approaches such as Lean and Six Sigma. Some were implemented well, others were implemented poorly, but most were implemented at the highest levels of the system with "downhill mandates" to the front-line workforce with little instruction on how to implement the new ideas or why. Further, these initiatives were not easily tied to actual day-to-day activities for the front-line individual, increasing their frustration with an already overwhelming and complex system.

Most assessments of acquisition programs and DoD program management activities conducted by the Under-Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) and the Government Accountability Office (GAO) focus on the Acquisition Category (ACAT) I or ACAT IA programs. An ACAT I program is defined by DoD Instruction 5000.02 as requiring "an eventual total expenditure for research, development, test and evaluation (RDT&E) of more than $365 million in fiscal year (FY) 2000 constant dollars or, for procurement, of more than $2.190 billion in FY 2000 constant dollars", or is a program that has been designated by the (USD(AT&L)) as being a "special interest program".[1] A similar definition is available in the DoD Instruction for an ACAT IA (Information Technology)

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[1] DoDI 5000.02, Dec 8, 2008. Page 33.

program. However, a significant portion of the acquisition workforce does not work on these programs, and most get their early experience on smaller programs (designated as ACAT II or ACAT III, or Other (typically small projects)).

One of my first classes at the Massachusetts Institute of Technology (MIT) exposed me to some research done at the Carnegie Mellon University's (CMU) Software Engineering Institute (SEI) regarding patterns of failure in software development programs.[2] After further review of this research, I came to the conclusion that most of these patterns of failure were relevant to the entire DoD acquisition system, and not just simply software acquisition efforts. Further, many of the root causes of patterns of failure were aligned with many of the recurrent themes of acquisition reform, providing an opportunity to link these two areas.

These patterns of failure are not limited to one service or major programs, but occur in programs administered by any of the services and of any ACAT size. As such, I concluded it would be interesting to see if any one service or size program was more or less prone to any of these patterns of failure (and their associated root causes). More than that, though, was the idea that if the front-line acquisition personnel could identify these patterns of potential failure before they are completely manifest, this might improve the DoD stewardship of the taxpayers money, delivering needed systems to the warfighter on time and on cost. This has the potential to improve acquisition outcomes both today and in the future, as these front-line personnel become the senior acquisition leaders for tomorrow's major programs.

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[2] Levin and Novak (2008)

1.2 Research Framework

This research project was organized into four sections to facilitate completion as part of a 16-month (4 semester) program as part of MIT's System Design and Management 2010 Cohort. Phase 1 of this research project was a literature review of acquisition reform efforts. This includes the Defense Acquisition Performance Assessment (DAPA), numerous GAO reports, several public laws, other peer-reviewed articles, theses, and supporting material. The acquisition reform literature review is documented in Section 2.1 of this thesis.

The second phase of the research was a review and analysis of the work done by the CMU SEI on their patterns of failure in software acquisition. The primary goal of this work was to ensure that there was a reasonable basis for extending these behavior patterns to the larger DoD Acquisition System. The result of this phase of research are documented in Section 2.2 of this thesis and resulted in the development of the survey that was used to gather the data for the analysis and documentation phase.

Phase 3 of this research was the administration of an anonymous survey to acquisition professionals. The primary method of obtaining survey respondents was through the Defense Acquisition University's Program Management 352 (PMT-352) class. This ensured access to a variety of acquisition professionals (including program managers, finance personnel, contracting officers, and engineering/technical personnel) from all services. In order to ensure a large enough sample size, other survey respondents were solicited through contacts the author has made (in particular contacts in the Air Force, Army, and Navy). In all cases, no personally-identifying or program-identifying data were collected or used. The rationale behind the survey is presented in Section 3.1 of this thesis.

The final portion of this research project (Phase 4) was the analysis and documentation phase. This work included reviewing the results of the surveys and conducting a statistical analysis of the data. These data are presented in Section 3.2 and Chapter 4 of this thesis. Using these results in combination with the data gathered in the other three phases, a comprehensive analysis was conducted, conclusions were drawn (Chapter 5) and recommendations are made in Chapter 6 of this report.

Chapter 2 – Literature Review

This section reviews the previous research and work done in the arena of acquisition reform and acquisition patterns of failure. The Literature Review begins with a review of the history of acquisition reform initiatives for the DoD, dating from the early days of the Republic through the 2006 Defense Acquisition Performance Assessment (DAPA) and subsequently enacted Public Laws and Government Accountability Office (GAO) and Office of the Secretary of Defense (OSD) reviews and reports. Following the discussion of acquisition reform, there is a significant focus on the Carnegie Mellon University (CMU) Software Engineering Institute (SEI)'s work in Acquisition Archetypes[3], as these are integral to this research. The section concludes with a summary of key findings and introduces the research questions and hypotheses for this work.

2.1 Acquisition Reform Literature

The concept that there are newer or better ways to acquire products and services for the Department of Defense is not a new one. In fact, the history of concern with providing weaponry to the American military dates back to the Revolutionary War era, when General George Washington initiated the development of a government-owned cannon foundry because private firms were too risk averse.[4] In the intervening years, countless panels and "Blue Ribbon Commissions" have been chartered and more than 4000 statutes have been passed in an attempt to improve the system of proving goods and services to the men and women of the United States

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[3] CMU SEI (2009I)
[4] Graham, H.D. (1975)

Armed Forces.[5] The following subsections will review some of the more relevant and most recent activity in the area of DoD Acquisition Reform.

2.1.1 Significant Previous Acquisition Reform Efforts (Pre-2006)

A search of literature referring to DoD Acquisition Reform will generate a plethora of articles, research papers, white papers, magazine articles, opinion pieces, and other material. In summing up the challenge of acquisition reform and the primary actions that preceded the most recent major panel (the 2006 DAPA), six articles were especially useful. A list of these articles is provided in Table 1, and summaries are provided below.

Author	Year Published	Title
Cancian, M.	1995	Acquisition Reform: It's Not as Easy as it Seems
Reeves, S.V.	1996	The Ghosts of Acquisition Reform: Past, Present, and Future
Foelber, R.	1982	Cutting the High Cost of Weapons
Christensen, Searle, and Vickery	1999	The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns on Defense Acquisition Contracts
Grasso, V.B.	2002	Defense Acquisition Reform: Status and Current Issues
Rogers and Birmingham	2004	A Ten-Year Review of the Vision for Transforming the Defense Acquisition System

Table 1: Summary of Pre-2006 Acquisition Reform

Cancian, in a 1995 *Acquisition Review Quarterly* opinion piece, effectively described why acquisition reform is so difficult: the system involves multiple players with different priorities and often competing goals.[6] The players and their motivations are summarized in Table 2 below. While some are focused on cost and schedule, others are focused on performance or other socio-economic aspects. These differing values make each actor behave differently.

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[5] Reeves, S.V., (1996).
[6] Cancian, M. (1995).

In his discussion, Cancian noted three areas that involve trade-offs in the traditional acquisition system. In his first example, special access programs (so-called "black programs") typically sacrifice in-process visibility (and sometimes cost) for technology and/or performance

Player	Priorities and Goals
Congress	- Fiscal responsibility to ensure taxpayer funds spent appropriately - Further socio-economic goals (e.g., small &/or disadvantaged business)
OSD	- Affordability of overall DoD Budget - Programs deliver cost/schedule/performance per the agreed-to plan
Military Services (Users)	- Obtaining products/services that will provide warfighter advantage - High-performance systems delivered rapidly when needed
Program Managers	- Field and deliver hardware to the user - Meet cost/schedule/performance parameters per acquisition plans
Defense Industry	- Deliver quality products/services that meet requirements - Make a profit and remain in business

Table 2: Cancian's Summary of Players and Motivations[7]

increases. His second example is commercial-off-the-shelf (COTS) technology, where lower costs and faster availability (schedule) are prioritized, but sometimes at the expense of the performance requirements and operating capabilities required by military forces. His final trade-off example is in the area of contract oversight, where lower oversight of contractor performance can increase the risk of the contractor having problems that remain hidden much longer than they could or should, thus increasing cost and schedule risk.[8]

Cancian also described the DoD's history with different types of contracting approaches. In particular, he noted that the 1950s were a period where "Cost-plus" contracts (those that covered all the contractor's costs of providing the product in addition to some type of fee/profit) were the norm. In the 1960s, the use of "Cost-plus" contracts was replaced with a preference for "Fixed-price" contracts, where the contractor was paid a fixed price (including some type of

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[7] Cancian, M. (1995).
[8] Cancian, M. (1995).

fee/profit) and delivery of the product was required regardless of the ultimate cost to the contractor. This cycle then repeated, with "Cost-plus" contractors coming back into favor in the 1970s, replaced with a preference for "Fixed-price" contracts in the 1980s, and then swinging back to "Cost-plus" contracts in the 1990s. Cancian asked when the pendulum will swing back to a preference for "Fixed-price" contracts.[9] As we will later see from the USD(AT&L) memo dated, 14 Sep 2010, that time may be now.[10]

Reeves (1996) provided a thorough review of the entire history of acquisition reform from the early days of the Republic through the Federal Acquisition Streamlining Act of 1994.[11] In reviewing the period before World War II (what he would term as the "pre-modern" era of acquisition reform), he covered in impact of several panels and laws, and traced some of the key acquisition statutes from today's environment to this era. Nonetheless, his most beneficial contribution was a review of 11 primary panels, boards, and laws that emerged between 1945 and 1995. These are summarized in Table 3 below.

Like Cancian's finding about the cyclic preference for "Cost-plus" or "Fixed-price" contracts, Reeves work highlighted the oscillation of focus on acquisition reform initiatives. Some of these initiatives advocated a centralized acquisition workforce under the Secretary of Defense, while others advocated decentralized control with more OSD oversight. Ultimately, the most influential of these commissions, the Packard Commission, left a lasting legacy of centralized control with decentralized execution. This approach is still in place today in the form of the UnderSecretary of Defense for Acquisition (now USD(AT&L)), the Service Acquisition

[9] Cancian, M. (1995).
[10] USD(AT&L) (2010).
[11] Reeves, S.V. (1996).

Commission/ Study/ Act	Year	Key Impacts
Hoover 1	1949	- Centralized control of Service acquisition through the Office of the Secretary of Defense
Rockefeller Committee	1953	- Created 6 Assistant Secretaries of Defense - Eliminated Service-unique boards and agencies
Hoover 2	1953	- Reduced direct Government business operations - Focused on business efficiency in acquisition
McNamara Initiative	1961	- Established Planning, Programming and Budgeting System largely still in use today
Fitzhugh Commission	1970	- Recommended flexible acquisition strategies - Proposed incremental development and milestones - Advocated for professional acquisition personnel
Commission on Gov't Procurement	1972	- Formed Office of Federal Procurement Policy - Competitive contracting in acquisition - Established independent operational test and evaluation activity (now DOT&E)
Grace Commission	1983	- Proposed single acquisition agency under OSD - Cited Congress as a contributor to acquisition woes
Packard Commission	1985	- Created UnderSecretary of Defense for Acquisition, Service Acquisition Executives, and Program Executive Officers - Consolidated Federal Acquisition Regulations - Increase the use of competition and prototyping - Recommended expanded use of "commercial" items
Section 800 Panel Report	1993	- Initiated review of all acquisition laws for relevance - Simplified acquisition procedures (under $100K) - Allowed DoD to act like a commercial purchaser
National Performance Review	1993	- Simplified acquisition procedures - Eliminated military specifications - "Pilot programs" to test new acquisition approaches
FASA	1994	- Unified, simplified procurement code - Implemented many "languishing" acquisition reform recommendations from prior panels/commissions

Table 3: Major Commissions, Studies, or Acts from World War II through 1995[12]

Executives (one each in the Air Force, Army, and Navy (with the Navy supporting the Marine

Corps)), and lower-level Program Executive Officers.[13] Unfortunately, this structure brings with

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[12] Reeves, S.V., (1996).
[13] Reeves, S.V., (1996).

it a series of overlapping spans of control creating multiple, sometimes redundant reporting requirements.

There were several things that most of the commissions and panels agreed upon. One of these was the need to streamline the DoD acquisition system by reducing and streamlining the procurement policies and regulations. This ultimately led to the consolidated Federal Acquisition Regulations. Another area of agreement that emerged more recently was that the DoD should increase its pursuit and use of commercially-available items and COTS technologies. Finally, there was also consensus that the DoD needs a well-trained, professional staff of acquisition personnel.

Because it was not a "commission", one acquisition reform area that was not discussed by Reeves was the Carlucci Initiatives of 1981. A Deputy Secretary of Defense in the Reagan Administration, Frank Carlucci attempted to address the high cost of DoD weapons acquisition programs with a set of 32 initiatives, since termed the "Carlucci Initiatives".[14] These initiatives were released in April 1981 and attempted to shorten development timelines, reduce cost, and improve readiness of the weapons acquired. Foelber summarized the key recommendations, which included increased use of multi-year procurements, production at efficient rates, full funding to enhance program stability, better program cost estimates, more advantageous use of competition, and reduction in the number of DoD Directives.[15] Many of these themes had been discussed during years prior to Carlucci's Initiatives and many of these remain areas being discussed as acquisition reform recommendations today.

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[14] Foelber R. (1982).
[15] Foelber R. (1982).

Christensen, Searle, and Vickery conducted a review of the cost performance on 269

contracts to gauge the effectiveness of the implementation of the 1985 Packard Commission's

recommendations.[16] As noted above, the principle recommendations of the Packard Commission

involved organizational changes, process streamlining, smaller acquisition staffs, reduced

oversight, and increased use of testing and prototyping.[17,18] Their research examined programs

completed four years prior to the effective implementation date of the Packard Commission

recommendations and the four years after the effective implementation date. Unfortunately, the

results were not as expected, with the average cost overrun increasing (getting worse) by a

statistically significant 3.9%. This analysis confirmed Thomas McNaugher's 1990 prediction

that impact of the Packard Commission's recommendations may do more harm than good to the

acquisition system.[19,20] Further, their research showed that the likelihood of an increased cost

overrun was sensitive to both contract phase (more likely in development contracts rather than

production contracts) and service (Air Force contracts were most likely to overrun, whereas

Army and Navy contracts did not change significantly).[21]

The data from Christensen, Searle, and Vickery are particularly important, as the next

major round of Acquisition Reform initiatives following the Packard Commission were the

Federal Acquisition Streamlining Act (FASA) of 1994 and the Federal Acquisition Improvement

Act (FAIA) of 1995. Both of these acquisition reform approaches focused on reinforcing

recommendations from the Packard Commission, such as streamlining regulations and

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[16] Christensen, D.S., Searle, D.A., and Vickery, C. (1999).
[17] Reeves, S.V., (1996).
[18] Christensen, D.S., Searle, D.A., and Vickery, C. (1999).
[19] Rogers, E.W., and Birmingham, R.P. (2004).
[20] McNaugher, T.L. (1990).
[21] Christensen, D.S., Searle, D.A., and Vickery, C. (1999).

implementing organizational and cultural change. Christensen, Searle, and Vickery's conclusion was that the Carlucci Initiatives and the recommendations of the Packard Commission were ineffective for controlling program cost overruns, and therefore it is unlikely that the FASA of 1994 or the FAIA of 1995 would yield different results.[22]

As part of her work for the Congressional Research Service, Grasso (2002) examined the impacts of several public laws on the acquisition reform landscape.[23] Like many of the commissions discussed by Reeves, Grasso identified the challenges of acquisition reform in the late 1990s as having three key areas. The first challenge was the dwindling defense budgets, reducing every year from 1987 through 1997. The second challenge was to incorporate more commercial technology into defense products and to take advantage of the faster cycle time for the development of these commercial technologies. Finally, the third challenge was to overcome the bureaucracy (regulations and culture of DoD acquisitions) to effectively reduce the cost of acquiring weapons for the DoD.[24]

Grasso then examined the impact of several acquisition reform laws, starting with the FASA of 1994. She also dissected the Federal Acquisition Reform Act (FARA) of 1996 and some of the other changes mandated by the Fiscal Year 1996 Defense Authorization Act. Regarding the FASA of 1994, Grasso reached the same conclusions on the key impacts of this law as Reeves. Turning to the FARA of 1996, Grasso saw the key provisions as simplifying the regulations governing the acquisition of commercial products and services and consolidating all contract protest adjudication actions with the Government Accountability Office (GAO). One

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[22] Christensen, D.S., Searle, D.A., and Vickery, C. (1999).
[23] Grasso, V.B. (2002).
[24] Grasso, V.B. (2002).

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other provision that is also mentioned is a reduction of 15,000 acquisition workforce personnel

and the requirement to develop a plan to eliminate as many as 25% of the remaining workforce

in following years. In another major change, the Fiscal Year 1996 Defense Authorization Act

required each of the services to be responsible for their acquisition of information technology

and appointing a Chief Information Officer to oversee these expenditures. [25]

Grasso also recounted several DoD initiatives undertaken in the late 1990s to increase the

success of acquisition outcomes. The first was aimed at decreasing cost and increasing access to

commercial products, and was termed the Single Process Initiative. This initiative required

contractors to eliminate different procedures within plants and across divisions, establishing one

process (nominally the best, most cost effective process) for use on all military and commercial

products. A second DoD initiative was codifying the use of the Integrated Product Team

approach, linking the contractor, the acquisition office, and the USD(AT&L) staff increasing

information flow and integrating the acquisition approval process. This was an attempt to reduce

some of the communications problems added by the multiple layers resulting from the Packard

Commission recommendations. Third, DoD began the use of a concept called cost as an

independent variable (CAIV). This approach was designed to make cost a key factor in the

program decision process, to the point that performance capabilities might have to be "traded

away" to ensure an acceptable cost outcome. Finally, in a controversial approach, DoD began

the use of "best value" in determining the winners of competitive contracts. No longer would the

low bidder be the winner of such contracts, now a complete package assessing the proposed

technical performance, past record of the bidder, and cost would be evaluated to choose the

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[25] Grasso, V.B. (2002).

winner. This would sometimes result in the award of the contract to other than the low bidder, as happened on a Navy contract for amphibious assault ships.[26]

Rogers and Birmingham (2004) pick up their review of acquisition reform activities where Reeves left off in his work. They provided a summary of the major acquisition reform actions from 1993 through 2003.[27] Following a comprehensive review of documents from the era, they selected seven seminal documents as the key actions during this period. These are listed in summarized in Table 4 below.

Document	Date	Key Tenets
National Performance Review	1993	- Simplify procurement - Eliminate regulatory burden - More reliance on commercial marketplace
SecDef Perry Memo	1994	- Change culture of Acquisition System - Increase acquisition outcome effectiveness - Eliminate bureaucracy
Re-engineer the Acquisition System	1995	- Increase system responsiveness - Reduce program costs - Seek to leverage commercial industry base
Defense Reform Initiative	1997	- Reduce cycle time - Speed delivery of products to field - Reduce costs
The Road Ahead	2000	- Reduce cycle time - Reduce total ownership cost - Reduce DoD overhead costs
Rumsfeld Reform Vision	2001	- Reduce cycle time - Improve acquisition workforce - Strengthen industrial base - Increase commercial technology use
Cancellation of DoD 5000 Series	2002	- Increase Program Manager flexibility - Enable innovation in acquisition programs - Reduce cycle time

Table 4: Seven Key Acquisition Reform Iniatives from 1993 - 2003[28]

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[26] Grasso, V.B. (2002).
[27] Rogers, E.W., and Birmingham, R.P. (2004).
[28] Rogers, E.W., and Birmingham, R.P. (2004).

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There were two key themes that emerged from these documents, largely driven by the end of the Cold War and the increase in commercial technology development rates. The first was the need to increase the speed of the system to rapidly deliver new technology to the warfighter. The second was the need to reduce the cost of the system (both program costs and overhead costs).

Diving deeper, the DoD needed to increase the speed of the system to take advantage of the rapidly changing state of commercial technology. Following World War II and through the end of the Cold War, the U.S. military was a technology development leader, typically pushing the edges of technology beyond the needs of the commercial marketplace. However, some urgency was lost with the end of the Cold War, and this coincided with an explosion in the personal technology arena. Together, these combined to put the DoD Acquisition System in a lagging position, often forced to change baseline technologies because the DoD acquisition cycle time exceeded the production life of its underlying commercial technology.[29]

The second thrust, reducing costs, was also an outgrowth of the end of the Cold War, driven by declining defense budgets. As the focus shifted to other domestic priorities and the search for a "peace dividend"[30], the DoD was faced with hard choices on how to support its multitude of modernization programs with less money available than originally planned. The initial focus was on reducing the cost of the systems being acquired (to fit within the reduced overall budget). As time passed in this era, the focus turned to the idea of eliminating bureaucracy, reducing regulatory burden, and increasing program manager flexibility to reduce

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[29] Rogers, E.W., and Birmingham, R.P. (2004).
[30] Reeves, S.V., (1996).

the "overhead" costs of the DoD Acquisition System, thereby freeing funds for development or procurement of new warfighter resources.

2.1.2 Defense Acquisition Performance Assessment (DAPA)

In mid-2005, the Acting Deputy Secretary of Defense chartered a wide-ranging assessment of the DoD Acquisition System which eventually became known as the Defense Acquisition Performance Assessment (DAPA). There were two major differences between this assessment and many of the commissions and panels of the previous decades referenced by Reeves and Rogers and Birmingham. First, the DAPA was focused on the entire acquisition process, encompassing all aspects of the system (people, processes, and organizations). Second, the DAPA was led by a respected former member of the acquisition community (Retired USAF Lieutenant General Ronald Kadish) and other key players included current and former acquisition personnel from all services and industry.[31]

After reviewing hundreds of documents, conducting numerous interviews, and reviewing the comments provided through a public-accessible website, the DAPA team concluded that not much had changed, and that the system was still facing some of the problems that were evident and discussed during the Packard Commission despite all of the actions, panels, commissions, and recommendations of the intervening years. In attempting to discover the root of this dilemma, the team proposed that there are really three inter-related processes that make up the larger DoD Acquisition System: budgeting, requirements generation, and acquisition. They refer to all of these three processes as "Big A". (See Figure 1.) The smaller process of acquisition, termed "Little a", focuses on the mechanics of acquisition (contracting, engineering,

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[31] Kadish, R.T., et. al. (2006).

program financial management, and testing). This is where most of the previous recommendations have been focused. The DAPA contention is that without addressing changes in these three larger processes and the people and organizations that support them as an integrated approach, any attempts to reform the system will ultimately be unsuccessful (as demonstrated by Christensen, Searle, and Vickery's examination of the impact of the Packard Commission's recommendations).[32,33]

After breaking down these three processes and examining the organizations and personnel involved, the DAPA generated eight major findings, which for the purposes of brevity
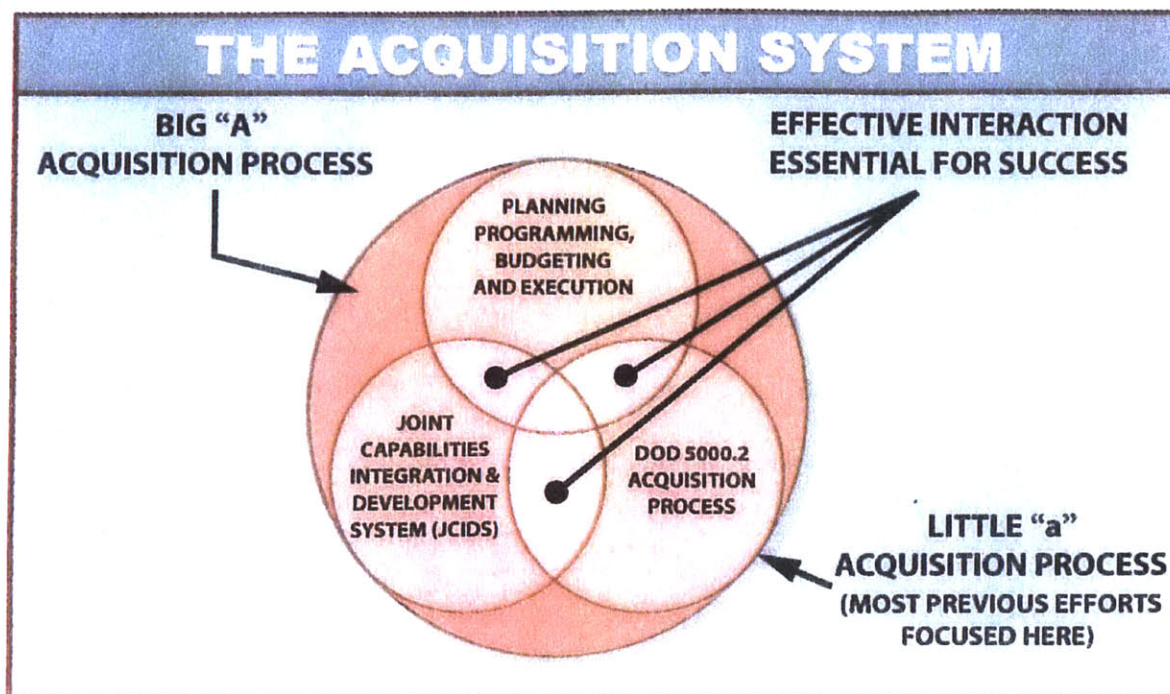
Figure 1: DAPA Representation of the DoD Acquisition System[34]

here can be summarized into four major themes: technology, instability, oversight, and complexity. First, technology is the root of the advantage possessed by the U.S. military.

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[32] Kadish, R.T., et. al. (2006).
[33] Christensen, D.S., Searle, D.A., and Vickery, C. (1999).
[34] Kadish, R.T., et. al. (2006).

Second, the security and economic environments are changing which drives instability into the DoD Acquisition System ("Big A"). Third, oversight is the preferred approach for assessing program performance, but personnel in oversight positions have little accountability for the end products. Further, this oversight increases the burden on the personnel actually performing the acquisition work ("Little a") in the form of duplicative reviews, and multiple levels of approval. Finally, both the acquisition system ("Little a") and the products they are acquiring are very complex; therefore the execution, management, and oversight of the work is difficult and prone to cost and schedule increases.[35]

In presenting their findings, the DAPA identified six focus areas within the "Big A" system. These are the three processes (acquisition ("Little a"), requirements, and budgeting) and the people and organizations involved (system organization, the workforce, and industry). The relationship of these is depicted in Figure 2.

The findings of the DAPA are summarized in Table 5. The DAPA team recognized that their complete set of recommendations was a radical departure from those of previous panels and commissions. However, their belief was that without addressing all of the areas with major influences on the DoD Acquisition System ("Big A"), continuing to implement changes to the acquisition process ("Little a") would not produce the change required to break out of the patterns that have been present for over 30 years.

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[35] Kadish, R.T., et. al. (2006).
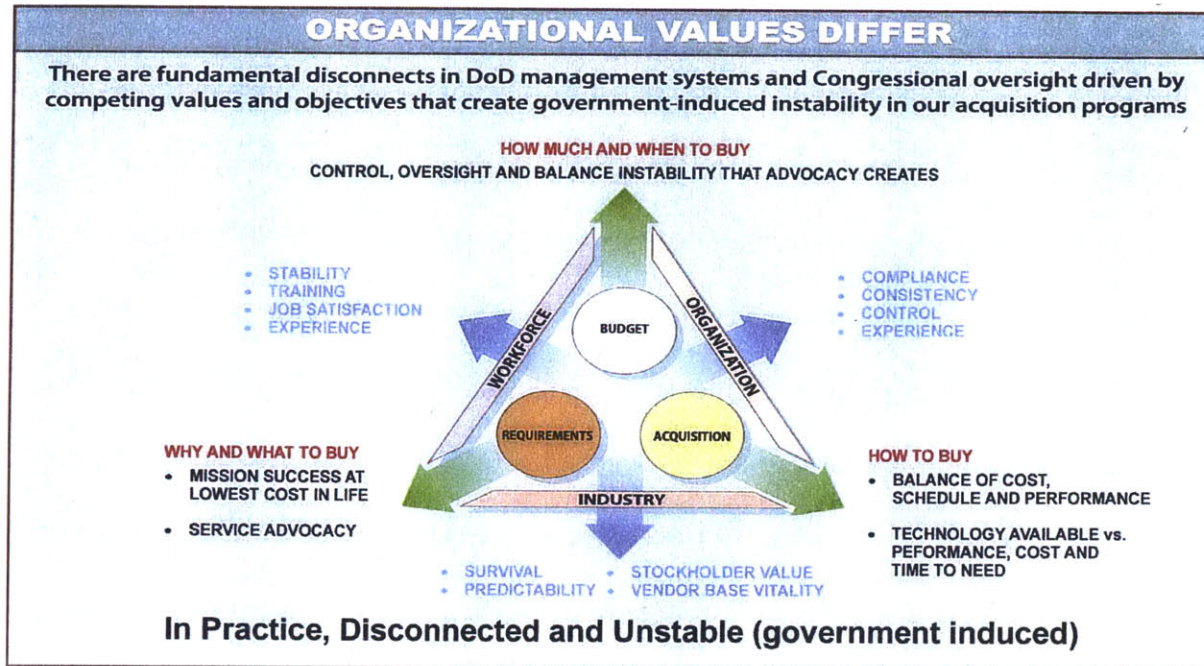
Figure 2: DAPA Focus Areas and Their Relationships[36]

Focus Area	Findings
Organization	- Establish 4-Star led Acquisition System Commands in each Service - Assign accountability to Services / Program Managers at Milestone B - Re-organize USD(AT&L) focusing on joint programs, not oversight
Workforce	- Establish Service Acquisition Executives with 5-year terms - Allow retention of high-performing military acquisition personnel - Increase number of federal civilians in acquisition activities
Budget	- Establish 'Stable Program Funding Account' to shield programs from shortfalls in other areas of the DoD budget - Reduce program funding transfers and changes to procurement quantities - Fund programs to cost estimates of 80% likelihood of success
Requirements	- Combatant Commanders provide 15-year forecasts of gaps and excesses - Create 'operationally acceptable' category for testing results - Allow program managers to defer non-key requirements to later increments to ensure time-certain development goals
Acquisition	- Establish time-certain development as preferred acquisition strategy - Streamline procurement, increase subcontractor competition - Assign program managers for programs from Milestone B through Low-Rate Production
Industry	- Eliminate barriers to entry for non-traditional suppliers - Government insight into make/buy decisions of Lead System Integrators

Table 5: DAPA Recommendations[37]

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[36] Kadish, R.T., et. al. (2006).

Many of their recommendations run counter to the current political and military climate. In the area of "Organization", creating the 4-Star-led Acquisition Systems Commands runs counter to the general will of the Services who typically see the acquisition community as disconnected from the warfighter. Further, their proposed re-organization of the USD(AT&L) staff would eliminate several entrenched civilian employees and disrupt power bases built on organizational oversight roles that have little or no accountability. Another example of their out-of-the-box thinking is the proposal for Service Acquisition Executives (SAE) to have five-year terms. Typically, the SAE is a political appointee who would serve for one administration (could change every four years). Their proposed change would bring stability to the process by having the SAEs be guaranteed to cross administrations. Another example is the assignment of program managers to their positions from Milestone B through the end of Low-Rate Initial Production (LRIP). This also runs counter to the typical Service approach where program managers are only assigned for 2-3 years.

Like many of the commissions and panels before them, though, many of the recommendations of the DAPA remain just recommendations. Only a few have truly been implemented since the report's publication in 2006. One of those recommendations that has been implemented is an increase in the number of federal civilian employees in the fields of program management, systems engineering, contracting, and financial management. This was done as part of a five-year plan to increase the size of the federal procurement force while reducing the reliance on contractor support personnel.[38] In many respects, this is an "undoing" of the reduction of the acquisition workforce that resulted from the Federal Acquisition Reform Act of

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[37] Kadish, R.T., et. al. (2006).
[38] GAO (2009a) GAO-09-616T.

1996.[39] A second recommendation that has been partially implemented affected the assignment of program managers to large programs. USD(AT&L) levied a requirement in 2007 that program managers sign a tenure agreement that extends the next major program milestone closest to four years.[40] This eliminates some of the instability caused by the sometimes rapid turnover of government program managers on major defense acquisition programs.[41] A third recommendation, partially implemented by the Weapon System Acquisition Reform Act of 2009, was the requirement to conduct cost estimates using an 80% confidence level for all major defense acquisition programs.[42]

2.1.3   Weapon System Acquisition Reform Act (WSARA) of 2009

One of the early priorities of the Obama Administration was to implement reforms for the Department of Defense acquisition system.[43] This came to fruition in the Weapon System Acquisition Reform Act of 2009, signed into law by the President on May 22, 2009.[44] This law contains three major divisions (Titles), each with several paragraphs and sections.

2.1.3.1 WSARA of 2009 Title I

The first major division of the law addresses the "Acquisition Organization" of the Department of Defense.[45] The major impacts of Title I are the creation and strengthening of several OSD- and USD(AT&L)-level organizations, some of which have direct reporting requirements to the Congressional defense committees. The new positions are the Director of Cost Assessment and Program Evaluation (reporting directly to the Secretary of Defense), the

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[39] Grasso, V.B. (2002).
[40] USD(AT&L). (2007).
[41] GAO (2007) GAO-08-62R.
[42] Public Law 111.23 (2009). Title I, Paragraph 101, Section 2334(d)(1)
[43] Doyle, J. M. (2009).
[44] Kruzel, J. J. (2009).
[45] Public Law 111-23 (2009). Title I

Director of Developmental Test and Evaluation (reporting to the USD(AT&L), and the requirement to designate an official responsible for performance assessment and root cause analysis of major defense acquisition programs (reporting to the Secretary of Defense). Title I also elevates the position of the Director of System Engineering within the USD(AT&L) structure and strengthens the role of the Director of Defense Research and Engineering. Finally, Title I directs the Joint Requirement Oversight Council (JROC) (the body responsible for approving requirements for acquisition programs) to seek the advice and input of the Combatant Commanders.[46]

Under Title I of the WSARA of 2009, there appear to be some very positive steps. The first is the partial codification of the DAPA recommendation that the Director of Cost Analysis and Performance Evaluation ensure that cost estimates for major defense acquisition programs at the 80% confidence level. Another positive step would be the requirement for the Director of Developmental Test and Evaluation to ensure that the developmental test programs for major defense acquisition programs are integrated with the operational test programs to ensure proper alignment of resources and avoid duplication of test events where possible. The elevated role of the Director of System Engineering ensures a stronger, up-front focus on life-cycle issues such as reliability, availability, maintainability, and sustainability. The strengthened role of the Director of Defense Research and Engineering was intended to address the concerns over the maturity level of critical technologies in many acquisition programs. Finally, the requirement for the JROC to seek and consider the inputs of the Combatant Commanders is another partial

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[46] Public Law 111-23 (2009). Title I, Paragraphs 101-105.

implementation of a DAPA recommendation aimed at ensuring acquisition programs will ultimately support the warfighter in anticipated battle theaters.[47,48]

Unfortunately, there may also some negative implications for the DoD Acquisition System in Title I of the WSARA of 2009. The creation of new offices and elevations of other positions reinforces and extends the bureaucracy of the OSD. As noted, some of these new offices have direct reporting requirements to the Congressional defense committees. Contrary to the recommendations of the DAPA, these organizations increase the reporting requirements on program managers and create news layers of management and oversight that have no accountability for program execution. This is particularly true of the new Director of Cost Analysis and Program Evaluation, the Director of Developmental Test and Evaluation, and the increased role of the Director of System Engineering. All of these offices now have key approval roles for major defense acquisition programs with no program execution accountability.

2.1.3.2 WSARA of 2009 Title II

The second major division of the Weapon System Acquisition Reform Act of 2009 addresses "Acquisition Policy"[49], and it will have the most impact on the DoD Acquisition System. The key elements of Title II are the mandate to conduct cost, schedule, and performance trade-offs as part of the requirements generation process, the requirement for major defense acquisition programs to include competition (or the option for competition) at the prime contractor and sub-contractor levels throughout the life-cycle of the system, the requirement for prototyping as part of the development process, several changes to the way major defense

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[47] Public Law 111-23 (2009). Title I, Paragraphs 101-105.
[48] Kadish, R.T., et. al. (2006).
[49] Public Law 111-23 (2009). Title II.

acquisition programs are handled following critical cost growth breaches (to include the presumption of termination for programs experiencing critical cost growth), and new regulations governing issues with organizational conflicts of interest between prime contractors and business units that might be providing advisory assistance to the DoD with respect that that program.[50]

There are several significant impacts of Title II. First, Paragraph 201 (that addresses trade-offs among cost, schedule, and performance) will force the requirements community to prioritize its performance needs and allow the acquisition community to insert cost and schedule information associated with each of the performance requirements. Ultimately, this paragraph requires the JROC to organize requirements in such a way as to support acquisition in increments that provide militarily useful capability while considering the cost and schedule impacts of delaying performance increases to later increments of the weapon system. Further, the law requires that the JROC provide a time frame in which the first militarily useful increment is required, a step in the direction of DAPA's proposal for time-certain development.[51,52]

The second major impact of Title II is in the area of competition. Paragraph 202 requires that programs plan for competition at the prime contractor and subcontractor levels throughout the life-cycle of the system.[53] While this is intended to "improve contractor performance", there are likely to be significant cost and schedule implications associated with this requirement. Competitive prototypes during early acquisition phases will increase the up-front development cost of weapons systems. Acquiring complete technical data packages to allow "build-to-print" capability from competing contractors may also drive up the initial acquisition cost as many

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[50] Public Law 111-23 (2009).Title II, Paragraphs 201-207.
[51] Kadish, R.T., et. al. (2006).
[52] Public Law 111-23 (2009). Title II, Paragraphs 201.
[53] Public Law 111-23 (2009). Title II, Paragraphs 202.
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contractors accept lower profit levels during development with the understanding that higher profit levels will be available during the "captive" production period. Similar arguments could also be made regarding the impact of competition at sub-contractor levels, as prime contractors may not be able to rely on "preferred suppliers" throughout the product life cycle and will have to acquire technical data packages that allow "build-to-print" competition during future production. This may further drive up the price of development programs.

Paragraphs 204-206 are focused on programs that run afoul of the "Nunn-McCurdy" provisions of the Department of Defense Authorization Act of 1982,[54] but they also have implications for all major defense acquisition programs. The most influential provision of these sections is the new presumption that programs that experience critical cost growth as defined by the provisions of Nunn-McCurdy will be terminated and require special action on the part of the DoD to ensure their continuance. In the past, programs were terminated by exception, so this is a significant change. Further, these paragraphs direct that every major defense acquisition program that has not completed Milestone C (Full-Rate Production Decision point) will have to undergo the certification process to ensure they support valid requirements and have sufficient structure to deliver their performance requirements.[55] These provisions seem to make sense at face value, but like the codification of bureaucratic structures in Title I, they provide OSD offices with the ability to influence and change programs while having no accountability for program execution outcomes contrary to the recommendations of the DAPA.[56]

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[54] Public Law 97-86, (1981). Section 917 of Title 10, United States Code.
[55] Public Law 111-23 (2009). Title II, Paragraphs 204-206.
[56] Kadish, R.T., et. al. (2006).

2.1.3.3 WSARA of 2009 Title III

The third major division of the law covers "Additional Acquisition Provisions".[57] This

section of the Act covers a wide range of topics that don't align neatly with the previous sections.

Among these provisions are new DoD-level individual and team awards (to include the ability to

provide cash awards to the winners) and an increased focus on oversight mechanisms for Earned

Value Management systems used by contractors. This section also includes language requiring

new considerations relative to the defense technology and industrial base and new financial

reports on the operations, maintenance, and support costs of DoD weapons systems. In general,

the recommendations of this Title should not be considered particularly controversial.

2.1.4 Government Accountability Office (GAO) Reports

The GAO is a non-partisan agency whose mission is to support the Congress of the

United States "by providing reliable information and informed analysis" and recommending

improvements for the benefit of the American people.[58] Each year it performs studies and

analysis at the direction of Congress in many different areas, one of which is the arena of

Department of Defense acquisition. Each fiscal year's study plan includes a review of major

defense programs along with numerous other, Congressionally-directed studies. For this

research, the GAO reports reviewed were primarily completed after the publication of the DAPA

report (after 2006) in order to eliminate any potential duplication of material or findings that

were already included in prior studies.

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[57] Public Law 111-23 (2009). Title III.
[58] GAO (2009c). GAO-08-507SP.

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In November 2007, the GAO issued a report on DoD Program Manager Empowerment and Accountability.[59] This report supported the National Defense Authorization Act of 2007 by following up on information previously reported about the same subject in a 2005 GAO report. This report reiterated the finding that DoD has more programs in its portfolio than it can afford, and it confirmed a 2006 report's conclusions that weapon system programs need a foundation of mature technologies, robust, fully-defined requirements, and realistic initial cost and schedule estimates in order to provide the best opportunity for a successful acquisition execution outcome.[60] These last items are themes that are repeated in many of the GAO reports and briefings from 2006-2010.

This 2007 GAO report does, however, indicate that the DoD is making strides toward improving the conditions for successful acquisition outcomes. It reported that the DoD has instituted Program Management Agreements that require the program manager, milestone decision authority, the requirements community, and the budgeting community to document the agreed-to scope and resources of the program. This documents the funding profile and helps avoid "requirements creep" by clearly stating performance and schedule expectations. Another step being taken by the DoD was the institution of program manager tenure agreements for ACAT I and ACAT II programs. While there were some similar rules in place, these were not rigidly adhered to, and the new agreements are intended to provide programs with much more stability during the developmental phase. Finally, the GAO recounted that DoD is now focusing on "time-defined acquisitions" which are intended to deliver the first increment with militarily-

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[59] GAO (2007). GAO-08-62R.
[60] GAO (2007). GAO-08-62R.

useful capability in 5-6 years.[61] These two developments look like more attempts by the DoD to implement DAPA findings regarding program manager tenure and time-certain development.[62]

In a 2008 review assessing the impacts of recent programmatic decisions on the Joint Strike Fighter program, the GAO found that the program had been able to maintain its developmental cost estimate only by deferring requirements and reducing test resources.[63] While the GAO also devoted considerable time to the potential benefits of an alternative engine program in this report, it had several relevant conclusions.

The GAO reported that the original program development schedule was planned to be 10.5 years, and by 2008 it had already grown by an additional 18 months. Exacerbating this, the program had already spent 66% of its development funding, but admitted to being complete with only 50% of the work. In another significant finding, the GAO reported that the program currently had "billions of dollars in unfunded requirements".[64] If all these requirements are indeed valid and must be addressed, there is definitely a problem looming for this program. Finally, the GAO reported that the program had decided to reduce test assets and planned flight tests, combined with revisions to the planned testing. It predicted that this "increases the risks of not finding and fixing design and performance problems until late into production, when it is more expensive and disruptive to do so."[65]

In a separate 2008 report[66] recommending changes to the acquisition environment, the GAO cited that the DoD Acquisition System's three fundamental processes (identifying

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[61] GAO (2007). GAO-08-62R.
[62] Kadish, R.T., et. al. (2006).
[63] GAO (2008a). GAO-08-569T
[64] GAO (2008a). GAO-08-569T (page 8).
[65] GAO (2008a). GAO-08-569T (page 2).
[66] GAO (2008b). GAO-08-782T (page 6).

warfighter needs (requirements), allocating resources (budgeting), and developing and procuring

weapon systems (DAPA's "Little a")) are "fragmented and broken".[67] In making this case that is

similar to DAPA's assessment of the "Big A" acquisition system, the GAO cited examples from

the requirements and budgeting processes that ultimately affect the program outcomes of the

"Little a" system.

In this 2008 report, the GAO stated that the current requirements process cannot adjust to

rapidly changing warfighter needs, does not assign any priority ratings to one program over

another, and often takes more than one year to result in an approved requirements document.[68]

The fundamental baseline of any acquisition program is its requirements. If these are not

properly determined, the entire program will be on shaky ground from the start. With respect to

funding issues, the GAO concluded that the lack of priority assigned to the requirements for new

programs, combined with the limited budget available for new programs, led to unrealistically

low program cost estimates.[69] When these cost estimates were translated into funding allocations

in the budget, they became the maximum funding available for programs to use in requests for

proposals released to the contractor community. If the contractors determined that the work

required to meet the requirements exceeds the funding available, they had to revise their bids

(effectively underbidding what they expect the work to require) so that they could have a

proposal that responsively answered to the proposal request announcement. Further, the GAO

acknowledged, as the DAPA did, that both the DoD and Congress shift funds between programs,

"undermining well-performing programs to pay for poorly performing ones".[70]

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[67] GAO (2008b). GAO-08-782T (page 2).
[68] GAO (2008b). GAO-08-782T (page 6).
[69] GAO (2008b). GAO-08-782T.
[70] GAO (2008b). GAO-08-782T (page 6).

Three years after the DAPA report was published, the GAO issued a 2009 report on the acquisition workforce, and in particular contractor support personnel.[71] This report echoed some of the same conclusions of both the DAPA and the WSARA of 2009. The GAO concluded that allowing contractor support personnel to perform or highly influence inherently governmental activities risked "the loss of government control over and accountability for mission-related policy and program decisions"[72] and could lead to the organizational conflicts of interest noted in Title III of the WSARA of 2009.[73] In conducting its research, the GAO found that contractors were 29% of the overall DoD acquisition workforce, and that in many program offices surveyed, that percentage was even higher. The report did note, however, that the DoD is in the process of converting a significant number of contractor positions to government employees and increasing its hiring of new government acquisition personnel.[74] In many respects, this was an implementation of one of the workforce initiatives of the DAPA.[75]

While it is not particularly relevant to the research of this thesis, there was one other important conclusion from this 2009 GAO report, and in some ways it expands on the concepts presented in the DAPA. The GAO concluded that the DoD did not have a complete understanding of its personnel needs in the area of acquisition. The GAO indicated that the DoD did not have a comprehensive assessment of the acquisition skill-set and skill-mix required to perform its mission, nor did it have an accurate understanding of the acquisition skill-set and skill-mix it currently had in its military, civilian, and contractor personnel. This is contrary to best practices in industry, where companies typically compare the competencies of their

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[71] GAO (2009a). GAO-09-616T
[72] Public Law 111-23 (2009). Title III.
[73] GAO (2009a). GAO-09-616T (page 3)
[74] GAO (2009a). GAO-09-616T
[75] Kadish, R.T., et. al. (2006).

workforce to the competencies they need for business success and adjust their personnel accordingly. While the limitations of hiring and releasing government employees complicate this matter, the lack of understanding of the comprehensive skill-set required to perform the mission is an area that DoD needs to and is addressing.[76]

Another 2009 GAO report highlighted issues similar to one 2008 report that recommended fundamental changes to the acquisition system. After detailing the cost and schedule growth of the DoD's major defense acquisition program portfolio, this report, titled "Charting a Course for Lasting Reform", reiterated the GAO's concerns regarding the requirements and budgeting processes of the DoD.[77] With respect to the requirements process, the GAO restated its concern that the process failed to have the flexibility to meet changing warfighter needs and did not prioritize approved requirements with respect to each other. A new criticism was concern that most approved requirements were still service-unique, suggesting that the DoD was missing out on potential joint warfighter solutions. With respect to the budget process, this report restated the concern that too many programs are competing for funding, increasing pressure to underestimate costs.

This GAO report did introduce some new ideas. The first was the establishment of three 'knowledge points' for program decision making. These were not intended to replace the traditional DoD decision milestones, rather they were levels of knowledge required to establish successful programs. First, requirements must be stable and the resources required to acquire the product (based on a reasonable estimate approach) must be in place and match the required capability. Second, critical design reviews should be conducted when 90% of the final

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[76] GAO (2009a). GAO-09-616T
[77] GAO (2009b). GAO-09-663T.

engineering drawings are complete and some level of prototype demonstration confirms performance to ensure a stable design is being used as the program basis. Third, as the program transitions to production, the manufacturing processes must be stable and mature (and not still under development) to provide repeatable production outcomes.[78] While these are not necessarily directly relatable to this research, the approach is commendable and should drive more positive acquisition outcomes if implemented.

As has been the case for nearly 20 years, the GAO continued to review the DoD Acquisition System and publish reports in 2010. One of these reports, "Managing Risk to Achieve Better Outcomes" continued to recite the themes of the 2008 and 2009 reports with respect to problems in the requirements, budgeting, and "Little a" acquisition processes and the state of the overall acquisition workforce.[79] The difference in this report was the connection that the GAO drew between risk choices and acquisition outcomes. There are three important examples that relate to the research at hand. First, the report stated that "[s]ignificant contract cost increases can and do occur as the scope of the requirements change or become better understood by the government and contractor".[80] Second, the report concluded that programs that start development with mature technologies experience 30% less cost growth than programs that begin the development phase with immature technologies. Finally, the report devoted a significant amount of discussion to the problems with matching the contract type (fixed-price, cost-reimbursable, etc.) to the level of risk expected in the acquisition. If the contract type is not appropriate for the phase of acquisition, the Government could potentially pay significantly more

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[78] GAO (2009b). GAO-09-663T.
[79] GAO (2010a). GAO-10-374T.
[80] GAO (2010a). GAO-10-374T (page 3).

than necessary for the goods and services received. The report cited the Joint Strike Fighter program for potentially improperly using a cost-reimbursable contract for a production contract, stating that if the level of risk for producing significant quantities is high enough to justify that type of contract, the program may not be ready for production.[81] Beyond these three statements, the report also provided an example of problems with programs that have long development phases. It cited the Army's Future Combat System as an example of a program with a long development phase, where the program was initiated knowing that the final definition of requirements would not be complete until six years into program execution.[82]

In another 2010 report, the GAO discussed its analysis of several major defense acquisition programs that were delivering positive acquisition outcomes at the beginning of 2008.[83] This review continued to echo the themes from 2008 and 2009 regarding the need for improvements in the DoD's requirements, budgeting, and acquisition processes, in particular noting that these processes were not effective in working together to deliver positive acquisition outcomes.

With that re-iterated, the GAO then examined the active portfolio of major defense acquisition programs as reported in the December 2007 Selected Acquisition Report. Of the 63 programs reviewed, only 13 (21%) were considered to be executing in a stable and effective manner relative to the initial development cost and schedule estimates. There were some key factors that correlated to these programs. First, these were typically smaller programs, collectively accounting for only 9% of the total dollar value of DoD major defense acquisition

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[81] GAO (2010a). GAO-10-374T.
[82] GAO (2010a). GAO-10-374T (page 4).
[83] GAO (2010b). GAO-10-522.

programs. Second, for the programs that were in production (with development complete), the development phase was generally 2 years shorter than those rated as either moderately or highly unstable.[84]

This report then examined five programs in particular that exhibited positive acquisition outcomes: the Small Diameter Bomb (SDB) Increment 1, the Joint Direct Attack Munition (JDAM), the Standard Missile 6 (SM-6), the P-8A Multi-mission Maritime Aircraft, and the High Mobility Artillery Rocket System (HIMARS). [Note: It is interesting to see that four of the five programs singled out for review in this report were munition-related weapons systems, not aircraft, ship, or vehicle programs.] In its review, the GAO noted several ways that these programs were successful. The SDB Increment 1 and SM-6 programs worked hard to keep the program focused on affordable and achievable solutions and kept other agencies from adding unnecessary requirements.[85] Another example cited was that these five stable programs "inspired confidence" resulting in stable funding.[86] The GAO did note, however that just because programs experience stable funding does not mean that they will result in successful outcomes. In a third example from the SM-6 program, the GAO reported on a strategy to add schedule margin to the areas of greatest schedule risk and avoid starting development work earlier than dictated by the program's successful completion of earlier work.[87]

In other information discussed in this GAO report on stable programs, two other key ideas relating to this research were presented. First, the SDB Increment 1 program made some early programmatic decisions relating to requirements that deferred capability to later program

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[84] GAO (2010b). GAO-10-522.
[85] GAO (2010b). GAO-10-522.
[86] GAO (2010b). GAO-10-522 (page 27).
[87] GAO (2010b). GAO-10-522.

increments. In particular, the report states that the decision was made to "defer the more difficult mobile target capability to a later program".[88] The program management recognized that this requirement might drive the cost and schedule of the SDB Increment 1 and moved the requirement into a second program. In a second example, the GAO cited prior history with the Army's Armed Reconnaissance Helicopter (ARH) program's initial planning. The GAO noted that the ARH program's cost and schedule estimates were downward directed by leadership and "developed without an understanding of the issues or a thorough vetting with relevant industry stakeholders".[89] This may have been a contributor to the program's cost growth (more than twice the original estimate) at the time it was cancelled.[90]

The GAO also reviewed the US Marine Corps' Expeditionary Fighting Vehicle (EFV) during 2010.[91] While the program started development in 2001 and conducted its first operational assessment testing in 2006, problems during that testing resulted in a stretch of the development program of another 4 years. The GAO also concluded that the program might not be able to "complete all required test hours on schedule and under operational conditions".[92] The GAO cited many uncertainties in the potential testing, several of which result from the late completion of design work that may be concurrent with production of the test vehicles. The actual amount of testing required was still not certain, with estimates ranging from 5,500 hours to 11,500 hours, a huge range given that the operational assessment was less than two years away.[93] The GAO concluded that if the low estimate was chosen and testing completed

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[88] GAO (2010b). GAO-10-522 (page 16).
[89] GAO (2010b). GAO-10-522 (page 23).
[90] GAO (2010b). GAO-10-522.
[91] GAO (2010c). GAO-10-758R.
[92] GAO (2010c). GAO-10-758R (page 11).
[93] GAO (2010c). GAO-10-758R.

successfully, there remained potential that hidden defects that would have been discovered in the more robust 11,500 hour testing could remain in the design as the program moved to production. Despite the reasonable initial period for the development, the program's new schedule and potential test difficulties have driven the GAO to recommend that the DoD review the program to see if the EFV "remains a required asset".[94]

Finally, in another 2010 GAO report assessing the instability of Missile Defense programs, the GAO reported primarily on the earned value management system performance and compliance of 14 contract efforts under the Missile Defense umbrella.[95] The Missile Defense Agency (MDA) oversees DoD's largest acquisition program, valued at over $7B annually. Like other DoD organizations, the MDA uses earned value management systems to provide a baseline from which to track program cost and schedule performance. Two of the programs under MDA authority have experienced significant problems, making the data in their earned value management system databases of questionable value.[96] The experience of the Ground Missile Defense program is of relevance to this research.

The Ground Missile Defense program was initiated in 2002, and was still in the middle of its development phase in 2007 when program issues led to a restructure. In 2009, while still in development seven years after initiation, the requirements and focus of the program were significantly changed, leading to the third program restructure in three years, indicating a highly unstable program.[97]

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[94] GAO (2010c). GAO-10-758R (page 8).
[95] GAO (2010d). GAO-10-676.
[96] GAO (2010d). GAO-10-676.
[97] GAO (2010d). GAO-10-676.

2.1.5 House Armed Services Committee Panel Report, 2010

As Congress was focusing on the WSARA of 2009, the House of Representatives Armed Services Committee chartered the Panel on Defense Acquisition Reform to undertake a separate, year-long review and provide recommendations for improvement. Similar to the findings of the DAPA, the Panel found that the DoD Acquisition System has not kept pace or adapted to the changes in the overall defense environment. In particular, acquisition timelines for weapons systems are too long (measured in decades instead of years) and the system is poorly designed for the acquisition of information technology and services. The Panel's recommendations also focused on aspects of DAPA's "Big A": changes to the requirements, financial management (budgeting) and acquisition processes (DAPA's "Little a"), as well as improving the acquisition workforce and addressing industry concerns.[98]

While much of the discussion and many of the recommendations of the Panel on Defense Acquisition Reform deal with the acquisition of services and information technology (which is highly interrelated with the acquisition of weapon systems and all clearly related to the DoD Acquisition System), there are several significant findings relative to this research and the recommendations of the DAPA. One finding was that the DoD's typical plan to acquire large, new systems (ships, aircraft, and vehicles), combined with the desire to incorporate the most recent, cutting-edge technology often results in long developmental acquisition cycles. The Panel also found that these long developmental cycles led to an increase in the attempt to make the resulting new systems incorporate and address the needs of multiple users, which then compounds the problems and further extends the development cycle. Another conclusion was

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[98] Andrews, R., et. al., (2010).

that the requirements system itself was responsible for inserting large numbers of complex, technical requirements that exacerbated already long developmental acquisition timelines. Yet another finding concluded that the DoD's reliance on obligation and expenditure goals led to program instability and could ultimately cause unintended cost increase. Finally, the Panel report includes several recommendations for improvement of the DoD's acquisition workforce, addressing yet another of the focus areas of the DAPA.[99,100]

However, not all of the recommendations of the Panel were in line with the concepts of the DAPA and previous acquisition reform ideas. In particular, the Panel recommended strengthening the DoD's Office of Performance Assessment and Root Cause Analysis (PARCA). This office, created in response to Section 103 of the WSARA of 2009[101], was set up by OSD to address major defense acquisition programs in the manner intended by the law. The Panel report suggests increasing the role of the PARCA to address all DoD acquisition programs and to increase its focus on performance assessment of entire acquisition outcomes (cost, schedule, performance, policy adherence, and workforce success).[102] This definitely runs counter to the recommendations of the DAPA (which would have reduced and/or eliminated the OSD acquisition oversight bureaucracy)[103] and is even somewhat counter to the Panel reports earlier statement that the "Department's leaders should be focused on identifying and addressing the acquisition systems strengths and weaknesses, not on second guessing the programmatic decisions made by those in the field."[104]

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[99] Andrews, R., et. al., (2010).
[100] Kadish, R.T., et. al. (2006).
[101] Public Law 111-23 (2009). Title I, Paragraphs 103.
[102] Andrews, R., et. al., (2010).
[103] Kadish, R.T., et. al. (2006).
[104] Andrews, R., et. al., (2010). Page 2

2.1.6   Other Relevant Acquisition Literature

In a 2000 survey of acquisition metrics, the team of Swank, Alfieri, Gailey, and Reig

reviewed the cost, schedule, and performance of programs that were in the Engineering,

Manufacturing, and Development (EMD) acquisition phase between 1980 and 1999.[105]   Their

review showed that while there is significant variability, most programs during the era in

question finished with cost and schedule overruns of 100% or less (i.e. they cost or finished

EMD less than twice the originally planned values). While this is not a good track record, their

conclusion is that it was not particularly bad given the performance of other contemporary

programs. Most of their work attempted to glean leading indicators of cost and/or schedule

growth from data available in DoD Selected Acquisition Reports (required annual documents for

major defense acquisition programs). Their principle conclusion in this area was that programs

that reported slips to the schedule, particularly key test events, early in the development cycle

were likely to experience poor acquisition outcomes.[106]   Swank (et. al.) found that the average

length of the EMD for the programs in their study was over 8 years. In addition, they reported

that cost growth usually resulted from other problems on the program. They found that evidence

of cost growth by itself, independent of other problems, was rare. [107]

Coleman, Summerville, and Dameron (2003) evaluated programs for a correlation

between cost and schedule and cost growth and schedule growth using the 1993 Selected

Acquisition Report database.[108]   Their review encompassed some of the same programs as the

review by Christensen, Searle, and Vickery, but the conclusion of this study of 59 programs was

[105] Swank, W.J., Alfieri, P.A., Gailey III, C.K., and Reig, R.W. (2000).
[106] Swank, W.J., Alfieri, P.A., Gailey III, C.K., and Reig, R.W. (2000). Page iii.
[107] Swank, W.J., Alfieri, P.A., Gailey III, C.K., and Reig, R.W. (2000).
[108] Coleman, R.L., Summerville, J.R., and Dameron, M.E. (2003).

that 64.4% of the programs studied had schedule growth and that the overall average was a growth in schedule of 30%. This research arrived at the expected conclusion that a program's schedule cannot be predicted by its cost, nor can a program's cost be predicted by its schedule. The only relationship found between cost growth and schedule growth was a general tendency for programs to behave in similar manners if they are completed early, are completed on-time, or are completed late.[109]

Brown, Flowe, and Hamel (2007) studied the impact of interdependencies on the likelihood of a program experiencing cost or schedule baseline breaches.[110] Their research into the outcomes of 84 ACAT I weapon programs concluded, with statistically significant results, that joint programs (defined as those that partnership with another major defense acquisition program) were twice as likely to have schedule breaches and three times as likely to have cost breaches relative to their acquisition program baselines. They also examined the relationship of other factors, such as program size (measured in dollars), acquisition phase (development or production), and age (years since formal Milestone B approval). None of these other factors were statistically significant in revealing the likelihood of cost or schedule breaches.[111]

In 2009, OSD conducted a Program Management Certification Study to understand the training and experience of ACAT I and ACAT II program managers.[112] Based on interviews with 55 senior acquisition officials from across the services, the study sought to develop an understanding of how well DoD program managers felt they were trained to deal with problems that typically arise on defense programs. Specifically, each person interviewed was asked for

[109] Coleman, R.L., Summerville, J.R., and Dameron, M.E. (2003).
[110] Brown, M.M., Flowe, R.M., and Hamel, S.P. (2007).
[111] Brown, M.M., Flowe, R.M., and Hamel, S.P. (2007). Pages 20-24.
[112] OSD (2009).

their inputs regarding 22 specific areas. The results were broken down into three general areas (Training Topics, Training Methods, and Acquisition Experience), with specific recommendations for improving each of these three areas presented. For the purposes of this research, the important portion of this study is the findings of the interviews, not the ultimate recommendations for improving training.

Notably, only half of the program managers surveyed felt that they were adequately trained to deal with the challenges in eight of the 22 areas. Even more concerning is that four of the areas program managers felt confident about were related to activities that do not have direct inputs into program outcomes (responding to military service inquiries, responding to OSD inquiries, responding to inquiries from outside the DoD, and using Government financial reports). Two of the areas with specific relationships to this research that achieved the 50% mark in the survey (both earning 51% agreement in the surveys), were changes in technical requirements and test and evaluation challenges. [113]

In this OSD survey, there were some very notable program management areas that failed to have 50% of the program managers agree they had appropriate training and experience. These include: changes in directed funding, changes in directed schedules, dealing with user requirements, software management challenges, unexpected cost growth, cost control challenges, and risk management challenges. Most concerning, a mere 31% of the program managers surveyed felt that they were adequately trained to oversee contractor performance. [114] Overall, these results are especially disconcerting, as these problem areas are similar, if not the same as the areas highlighted by many previous commissions, studies and GAO reports.

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[113] OSD (2009). Page 5.
[114] OSD (2009). Page 5.

2.1.7 USD(AT&L) Memo, September 14, 2010

On September 14, 2010, Honorable Ashton Carter, USD(AT&L), issued a 17-page memorandum outlining his guidance to the acquisition community regarding the Secretary of Defense's initiative to increase the efficiency of the DoD.[115] This document highlighted five focus areas with a total of 23 initiatives which are listed in Table 6. The theme of this memorandum was to "do more without more"[116], highlighted the importance of DoD acquisition which is responsible for $400B of the $700B DoD budget. The $400B is split roughly 50%/50% between the acquisition of goods and the acquisition of services.[117]

The 23 initiatives in this memorandum are an interesting combination. Several echo themes from earlier acquisition reform initiatives, and others seem to be counter to prior findings and potentially in conflict with other initiatives. For the purposes of this work, the Services acquisition initiatives will not be addressed. However, with Services acquisition accounting for half of the DoD acquisition budget, this area is ripe for further investigation and research.

The Target Affordability and Control Cost Growth focus area has five initiatives, each of which is related to prior acquisition reform activities. The first initiative in this area, mandate affordability as a requirement, compels affordability targets be established during the program's concept development phase and treated as key performance parameters (i.e. design parameters

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[115] USD(AT&L) Memorandum (2010).
[116] USD(AT&L) Memorandum (2010). Page 1.
[117] USD(AT&L) Memorandum (2010).

Focus Area	Initiatives
Target Affordability and Control Cost Growth	- Mandate affordability as a requirement - "Should Cost" versus "Will Cost" management - Eliminate redundancy of programs - Stable, economic production rates - Shorter program timelines
Incentivize Productivity and Innovation in Industry	- Reward contractors for successful supply chain & indirect expense management - Increase use of Fixed-Price Incentive Firm contracts - Adjust progress payments to incentivize performance - Pilot the Navy's Preferred Supplier Program DoD-wide - Protect defense technology base & reinvigorate independent research and development
Promote Real Competition	- Competitive Strategy at each program Milestone - Remove obstacles to competition - Increase Small Business role
Improve Tradecraft in Services Acquisition	- Senior Manager for Services in each service - Uniform language for services across DoD - Emphasize services acquisition excellence - Increase Small Business role in services
Reduce Non-Productive Processes and Bureaucracy	- Reduce number of OSD-level reviews - Eliminate low-value-added statutory processes - Reduce by half the volume and cost of Congressional Reporting - Reduce non-value added overhead imposed on industry - Ensure DCMA and DCAA work is complementary - Increase use of forward pricing rate recommendations

Table 6: 14 Sep 10 USD(AT&L) Memorandum Focus Areas and Initiatives

that must be met and cannot be negotiated down).[118] As the program matures, a system engineering tradeoff analysis must be presented to show how primary attributes and abilities vary with cost to inform decision making, ensuring cost targets can be maintained. In many ways, this is in line with Title II of the WSARA of 2009, which required cost and schedule information be considered as part of the requirements process.[119] The new USD(AT&L) mandate is stronger

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[118] USD(AT&L) Memorandum. (2010).
[119] Public Law 111-23. (2009). Title II.

than the WSARA language, forcing the requirements determining agencies to consider cost as a primary consideration.

Another initiative under the first focus area involves the concept of "should cost" versus "will cost". The USD(AT&L) memorandum emphasizes that most cost estimates today are "will cost" assessments based on historical predictions and the current way of doing business. The memorandum directs the DoD to also develop "should cost" estimates that account for improvements in manufacturing technology, continuous process improvement and lean manufacturing implementations, and ensuring that the program is still delivering value at cost each year, not just allowing costs to increase because that was "programmed" in the budget.[120] This also relates to the WSARA of 2009, in particular the direction under Title I to create an office of the Director of Cost Analysis and Program Evaluation responsible for cost estimates for major defense programs.[121] Recent news coverage of this new initiative has focused on the possibility that the lack of qualified cost estimation personnel may delay how soon and how effectively this initiative is implemented.[122]

The last initiative in this area, to shorten program timelines,[123] is directly in line with the recommendations of the DAPA for time-certain development.[124] Both recommend that focus on ensuring that a reasonable set of requirements is developed that can be acquired with the resources provided within a set time horizon.

In the Incentivize Productivity and Innovation in Industry area, there are two initiatives that relate to prior discussions in this research. First, the focus on the use of Fixed-Price

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[120] USD(AT&L) Memorandum (2010).
[121] Public Law 111-23 (2009). Title I
[122] Bennett, J.T. (2010).
[123] USD(AT&L) Memorandum. (2010).
[124] Kadish, R.T., et. al. (2006).

Incentive Firm contracts[125] appears to be a reversal of the pendulum from a preference for cost-plus contracts. This was predicted by Cancian in 1995[126], as discussed earlier in Section 2.1.1. Second, the extension of the Navy's Preferred Supplier Program as a pilot program throughout the DoD seems to be in conflict with the intent of Paragraph 202 of Title II of the WSARA of 2009. This paragraph directs that programs plan for competition at the prime contractor and subcontractor levels throughout the life cycle of the program.[127] According to the memo, the Navy's program allows contractors with demonstrated superior performance over time to receive sole-source contracts (contracts without competition).[128] Further, this appears to be in conflict with the next focus area of the memorandum, Promote Real Competition.

In this third focus area, Promote Real Competition, all three initiatives have some basis in prior acquisition reform discussions. The first two recommendations are focused on competition, both ensuring competitive strategies are in place and removing obstacles to competition.[129] These ideas are definitely in line with the recommendation of Paragraph 202 of Title II of the WSARA of 2009 which mandates competition throughout the life cycle of the product.[130] The third recommendation, increasing the role of small business, is one of the conflicting goals discussed by Cancian. In this case, it is the DoD that is emphasizing a social engineering construct (small business preference) rather than Congress, but the conflicting guidance and potential effect on the personnel executing the contracts is the same.[131] This initiative does,

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[125] USD(AT&L) Memorandum. (2010).
[126] Cancian, M. (1995).
[127] Public Law 111-23 (2009). Title II, Paragraph 202.
[128] USD(AT&L) Memorandum. (2010).
[129] USD(AT&L) Memorandum. (2010).
[130] Public Law 111-23 (2009). Title II, Paragraph 202.
[131] Cancian, M. (1995).

however, support one of the DAPA initiatives to eliminate barriers for non-traditional suppliers to participate in the DoD acquisition system.[132]

Finally, the last focus area, Reducing Non-Productive Processes and Bureaucracy[133], was a key concept of the DAPA.[134] While most of the initiatives discussed in the memorandum were not covered by the DAPA, these are focused on reducing the reporting burden on program managers and eliminating oversight by the USD(AT&L) staff. The memorandum explicitly states that the OSD acquisition staff and supporting military headquarters staffs are being evaluated to eliminate possible non-value added burden, an effort the DAPA would applaud.[135]

2.1.8 Relating Acquisition Reform Initiatives to Acquisition Programs

As noted earlier, the Packard Commission left a lasting legacy of centralized control of acquisition programs with decentralized execution.[136] Unfortunately, many of the acquisition reform recommendations over the years have focused either on major defense acquisition programs or at areas of the centralized control bureaucracy. Left unsaid is how to relate the day-to-day activities and observations of the decentralized execution acquisition workforce to these reform activities.

One approach is the top-down, centralized control concept. This can be straightforward, as in the new preference for Fixed-Price Incentive Firm contracts.[137] Contracting officers at the program level will have to consider this type of contract first, and the rationale for using

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[132] Kadish, R.T., et. al. (2006).
[133] USD(AT&L) Memorandum. (2010).
[134] Kadish, R.T., et. al. (2006).
[135] USD(AT&L) Memorandum. (2010).
[136] Reeves, S.V. (1996).
[137] USD(AT&L) Memorandum. (2010).

something different will have to be explained and approved by the centralized control structure (the offices of the USD(AT&L)).

In other cases, though, the decentralized program execution personnel are left to on their own. When this happens, it is the responsibility of the program managers, financial managers, contracting officers, logistics personnel, and the engineers to exercise their judgment during program execution. What methods are available to these personnel to find and detect program execution problems and then relate them to the potential issues in the larger acquisition system that are causing the issues to manifest? One possible approach, identifying patterns of failure in programs, was developed by the Carnegie Mellon University's (CMU) Software Engineering Institute (SEI).

2.2 CMU SEI Acquisition Archetypes

MIT's course in Cost Estimation and Measurement Systems (ESD.361) in Fall 2009 exposed students to the CMU SEI Acquisition Archetypes. The SEI, using their experience with actual software development programs, generated these archetypes using a systems thinking approach to help software developers recognize, diagnose, and avoid these patterns of behavior that lead to poor program outcomes.[138] They developed system dynamics models to examine the patterns of behavior and analyze the potential countermeasures to avoid the repercussions of the typical behaviors.[139] The results are documented on their website in the form of 11"White Papers", each of which describes a separate dynamic pattern of behavior.[140]

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[138] CMU SEI (2007I)
[139] Levin L, and Novak, B. (2008).
[140] CMU SEI (2007I)

For the purposes of this research, only 10 of these archetypical patterns in software development are analyzed for their relationship with the larger DoD Acquisition System. The one that is omitted, "Brooks' Law"[141], was considered to be too software specific for the analysis. This archetype relies on the adage developed by F.P. Brooks that "adding manpower to a late software project makes it later.[142] However, in many respects, this behavior pattern is similar to another one of the archetypes, "Firefighting", where personnel are added to projects in an attempt to keep them on schedule or to solve program problems.[143] Therefore, in order to keep this research focused on patterns relevant to the entire DoD Acquisition System, the "Brooks' Law" archetype was combined with the "Firefighting" archetype for the purposes of conducting surveys and analyzing results.

2.2.1 "Underbidding the Contract"[144]

This SEI archetype describes a pattern of failure that results from potential contractors knowingly proposing to complete the work required by a particular effort for less than their internal estimates indicate is required. There are three major factors involved in this behavior pattern. First, the contractor must develop their estimate for the work required to complete the effort based on the scope of work defined by the initial Request for Proposal (RFP). Second, the contractor will try to determine the amount of funding available to complete the effort, either from such disclosure in the initial RFP or, in the case of a DoD effort, the funding available is a matter of public record in budget submissions to Congress and/or the signed DoD Appropriations Act for the current year. Finally, the contractor will determine if bidding less than their

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141 CMU SEI (2007a).
142 Brooks, F.P. Jr. (1975).
143 CMU SEI (2007d).
144 CMU SEI (2007k).

estimated costs will be required to either fit the available funding profile or be required to ensure their ability to win the work in a competitive environment. As DoD budgets get tighter in the coming years, the pressure for contractors to win will increase, making the ability to recognize this behavior pattern extremely important.

In this instance, the SEI's description vignette is very generic and does not include a specific focus only on software development efforts.[145] As such, it is easy to extend the applicability of this Archetype beyond software development to the larger DoD Acquisition System. In particular, the vignette also alludes to ways the contractors could be planning to recoup their potential losses from underbidding, to include plans to earn back their losses on future production contracts, which is applicable to both software and hardware development efforts.

2.2.2 "Longer Begets Bigger"[146]

The SEI archetype contends that the establishment of programs with long development phases will contribute to the likelihood that it will eventually suffer from cost and/or schedule slips. Two factors are posited. First, a planned long development period allows more time for requirements creep, where either the original user or potential other users seek to include new capabilities in the product that were not envisioned when the program was initiated. Second, the environment that the program was conceived in will be significantly different than the environment that the product will ultimately be used in (because of the progression of time, changes in society, and the march of technology), resulting in changes to the program requirements. The result of this behavior pattern is a development atmosphere where the

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[145] CMU SEI (2007k).
[146] CMU SEI (2007f).

development details (capabilities to be provided) become more important than meeting the

original cost or schedule goals.

In this case, the SEI archetype description vignette is focused on the history of a military

helicopter program.[147] As such, the authors recognized that it was relevant to the larger DoD

Acquisition System, and there is no need to argue that this Archetype needs to be extended

beyond just software development efforts.

2.2.3 "Everything for Everybody"[148]

This SEI archetype describes a behavior pattern where a program tries to meet the diverse

needs of a large group of potential users (either initially, or who join the program during

execution). Integrating all of these requirements into one system drives the complexity of the

end product through a large number of external interfaces. Ultimately, the diverse set of

requirements from multiple users (potentially from multiple services) forces the program to have

much more capability than would be required to meet the needs of a single user. Constantly

monitoring and ensuring compliance with this large number of interfaces, some of which might

be changing with time, can lead to development problems resulting in cost and/or schedule

growth.

The SEI archetype example describes a large software program with users from multiple

programs and services.[149] As the program evolves, some program participants leave the program

due to cost and/or schedule issues, and the program struggles to meet the needs of the remaining

users due to the loss of planned program funding. The history of the DoD is replete with

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[147] CMU SEI (2007f).
[148] CMU SEI (2007b).
[149] CMU SEI (2007b).

examples of hardware programs that initially began as joint programs but eventually became single-service programs. Therefore, it seems reasonable to extend the applicability of this Archetype to the larger DoD Acquisition System, where costs and schedules are impacted by the addition or subtraction of other potential users (or services).

2.2.4 "The Bow Wave Effect"[150]

The SEI archetype describes this pattern of failure as the deferral of complex requirements to later releases for software development. As requirements are deferred, functionality and some required background processes or systems are deferred with them. This makes the later phases much more difficult to accomplish because introduction of these capabilities requires a complete redesign of the system, not an incremental upgrade as planned. This results in cost and schedule problems for the later increments, and can lead to the abandonment of the remainder of the project in some cases.

The SEI "Bow Wave Effect" archetype description uses a software development example to describe how this happens.[151] Recent changes (2008) to DoD acquisition policy have emphasized incremental development, similar to multiple releases with increased functionality for software programs.[152] Extending this to the larger DoD acquisition system, this can lead to failure through the deferral of needed and/or complex system upgrades to a later planned (or even an unplanned) system increment.

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[150] CMU SEI (2007j)
[151] CMU SEI (2007j)
[152] DoDI 5000.02. (2008).

2.2.5 "Firefighting"[153]

This pattern of failure is the reaction by either the Program Management Office (PMO), the Contractor, or both to dedicate resources to a certain task that is either behind schedule or an emergent problem.[154] The reason this leads to failure is that the personnel used to attack the problem task are diverted from other tasks that are currently planned to be executed. This puts those tasks behind schedule, creating a vicious cycle of behind schedule tasks. The archetype description implies that this reaction is purely the contractor's response, however DoD agencies often react in very similar ways.

The SEI "Firefighting" archetype description uses a software development example to describe how this happens.[155] The concept of firefighting in product development has been discussed in literature dating back at least to 2001.[156,157] As such, is seems evident that this concept is also applicable to the larger DoD acquisition system.[158] Further, firefighting is not limited only to programs in the development phase, but rather it can also be evident in programs in the production phase.

2.2.6 "Staff Burnout and Turnover"[159]

This SEI archetype describes a behavior pattern that can evolve from "Firefighting" (described in 2.2.5) or from the program simply trying to catch up from prior schedule shortfalls due to technical problems. As the program struggles to meet deadlines or to recover from prior quality issues, the pressure (and resulting stress) increases on the personnel assigned to the

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[153] CMU SEI (2007d).

[154] CMU SEI (2007d).

[155] CMU SEI (2007d).

[156] Repenning, N.P. (2001).

[157] Repenning N. P., Goncalves, P., & Black, L. (2001).

[158] Levin, L. and Novak, B. (2008).

[159] CMU SEI (2007i).

program. Overtime becomes the norm, and the long hours begin to take a physical and psychological toll on the staff. As this pattern repeats, program personnel become disillusioned and reach the "burnout" phase. Once this point is reached, the likelihood of transferring to other programs becomes higher. This results in the loss of experienced personnel on the program and further increases the stress levels on those that remain who are required to maintain the schedule and conduct training to get the new personnel "up-to-speed". Together, all of these things manifest themselves in cost increases, schedule slips, and quality lapses.

The vignette used by the SEI archetype focuses on the development of a software infrastructure program for an agency.[160] However, the patterns of behavior described in the vignette are equally applicable to any type of program, not just a software development program. It is just as likely that the scenario described, missing milestones resulting in overtime and weekend work, could occur on a hardware development program for any number of reasons (such as slower than expected technology maturity efforts or misunderstood requirements). Further, the applicability of the scenario is not limited to the development phase of a program. Some production programs have interim milestones, and the same behavior pattern can emerge in these programs when these milestones are missed due to parts shortages, quality issues, or other production-related issues.

2.2.7 "Program Management Office (PMO) versus Contractor Hostility"[161]

The SEI archetype describes this pattern of failure as the point in the PMO/Contractor relationship when a series of "tit-for-tat retaliations" occur in response to actions taken by the other party that are perceived as being harmful to their own interests. Once this pattern starts,

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[160] CMU SEI (2007i).
[161] CMU SEI (2007g).

any actions on the part of one party that could be perceived by the other party as "getting them an advantage" will be perceived wrongly. What once began as a relationship focused on mutual prosperity and common goals dissolves as the distrust between the parties increases with each perceived retaliatory action.

The Software Engineering Institute PMO versus Contractor Hostility archetype states that a strong relationship between the contractual parties is crucial to a successful software development program.[162] In this instance, though, the description vignette only includes vague references that indicate a software development project was the example used to describe the archetype. Simply changing these vague references from "releases" to "hardware increments" does not change this archetype description in any way, which demonstrates its applicability to any acquisition program, DoD or otherwise.

2.2.8 "Robbing Peter to Pay Paul"[163]

This SEI archetype describes a macro-level behavior of product acquisition systems that are managing a portfolio of programs (i.e. multiple efforts simultaneously). Inevitably, some programs are proceeding according to their cost and schedule plans, while others are either ahead of or behind their cost/schedule goals for various reasons,. This results in either the need for, or excess of, funds in specific programs within the organization's portfolio. Adding to the source of confusion in this area, DoD funding has some unique aspects, tied to the availability of funds for obligation (intention to spend) and expenditure (actual payment for services). As a result, the funding shortfalls of some programs combined with the Congressionally limited availability of funds creates an environment where failing to meet the required financial execution rates

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[162] CMU SEI (2007g).
[163] CMU SEI (2007h).

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(obligation and/or expenditure of funds) makes a program vulnerable to funding reductions. These kind of unplanned funding changes require programs to restructure their plans, disrupting current efforts. Further, if the funds are not restored when needed by the program, these changes can significantly impact program outcomes, potentially increasing cost and schedule.

Here again, the SEI description vignette references an IT system development program.[164] Simply changing the reference from an "IT system" to a "hardware" program would extend the argument to the larger DoD Acquisition System. In point of fact, the GAO reported this behavior is commonplace in the DoD, with the Services, OSD, and Congress all involved in the process.[165]

2.2.9 "Feeding the Sacred Cow"[166]

The SEI archetype describes how some programs become so important to their organization that the leadership perceives that the program must succeed for the organization to succeed. This turns the program into a "sacred cow" in the organization. Once such a perception is attached to a program, any problems that emerge during its execution result in immediate actions toward resolution (moving personnel, freeing facilities, or providing funding), likely at the expense of other programs in the organization's portfolio. When and if concerns are raised regarding the program's viability or progress, these are usually dismissed by focusing on the importance of the program to the organization, thus creating a self-fulfilling prophecy of program importance.

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[164] CMU SEI (2007h).
[165] GAO (2008b). GAO-08-782T.
[166] CMU SEI (2007c).

The "Sacred Cow" archetype uses an IT business system as its example in the description vignette.[167] However, like many of the other Archetypes, this one can easily be extended to the larger DoD Acquisition System by replacing the "IT system" with a "hardware development program". There are many examples, but none quite as vivid as the United States Air Force and DoD's support of the F-22 program. In 2006, Kagan likened the cost of one F-22 to the average annual cost of 3000 Army personnel, ground forces that were critical to success in ongoing operations in Iraq and Afghanistan at the time. Despite the relative costs and benefits, the Bush administration, supported by the DoD and the USAF, pushed for and were successful in acquiring more F-22s in that year.[168]

2.2.10 "'Happy Path' Testing"[169]

The final SEI archetype discussed in this research describes the pattern of failure that results from creating scripted test scenarios that verify correct performance assuming correct inputs. This type of testing can results from several different scenarios. One possibility was that the testing was never intended to be robust (i.e. checking for performance in a variety of scenarios under less than optimum conditions) - otherwise known as the "head in the sand" approach. Another, more likely possibility is that the program ran into difficulties earlier in the development phase, resulting in the reduction of funds available for testing while keeping the overall program "on cost". This simply sacrifices initial fielded performance for the sake of maintaining the program's cost performance. Ultimately, this approach (tightly scripted testing)

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[167] CMU SEI (2007c).
[168] Kagan, F.W. (2006).
[169] CMU SEI (2007e).

is likely to allow defects into the field which will have to be fixed, resulting in rework to solve the problems and "fixes" to the fielded items.

The archetype description alludes to a software program as example with references to system test scripts and help desks, but it was not explicit that the system being described was a software effort.[170] Again in this case, it is reasonable to extend the argument to the DoD Acquisition System by replacing the software system with a hardware system such as an airplane, tank, or ship. Tightly scripted testing would allow the product to successfully demonstrate all required performance features, assuming that rational, correct inputs were made to the system. However, once the system is released to a variety of users not familiar with the system, incorrect inputs could easily result in poor or unexpected performance that must be corrected by the developer.

2.3   Summary and Findings

The history of attempts to influence and reform the acquisition of hardware for the United States Department of Defense is as old as the country itself. In particular, since World War II there has been a strong focus on delivering materiel to the warfighter at the best value to the taxpayer. Many of the laws and reviews passed were focused on the conduct of the department's major defense acquisition programs (ACAT I programs with oversight responsibility primarily conducted by the USD(AT&L)). In 2010, these major programs only account for 20% of the DoD's acquisition spending.[171] Despite the recommendations of numerous commissions and panels, the DoD acquisition system of 2010 still experiences some of the same problems it encountered in the mid-1980s.

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[170] CMU SEI (2007e).
[171] Andrews, R., et. al., (2010).

The Carnegie Mellon University's Software Engineering Institute developed a series of patterns of behavior that they believe are prevalent in the acquisition of software.[172] A major hypothesis of this research is that those archetypical patterns of failure are relevant not only to the acquisition of software, but to the larger DoD Acquisition System as well.

2.3.1 Relationships of CMU SEI Archetypes to Acquisition Reform Literature

The CMU SEI archetypes manifest themselves in what the DAPA would term the "Little a" acquisition system (day-to-day operations).[173] Further, examination of the acquisition reform literature and assessments by the Government Accountability Office since 2006 indicates that these archetypes are evident in the DoD Acquisition System. For example, Cancian's (1995) conclusions regarding contractor oversight could have a potential link to both the "Firefighting" and "PMO versus Contractor Hostility" archetypes.[174]

The House Armed Services Committee Panel on Defense Acquisition Reform[175] noted several findings that are in line with the CMU SEI archetypes. The Panel's finding regarding long developmental acquisition cycles is directly in line with the CMU SEI "Longer Begets Better" archetype, and its finding regarding how these long developmental cycles result in the need to address the needs of multiple users is similar to the CMU SEI "Everything to Everybody" archetype. Another Panel finding that ties together the CMU SEI "Longer Begets Better" archetype and the findings of the DAPA regarding the requirements process[176] was the conclusion that the requirements system itself was responsible for inserting large numbers of complex, technical requirements that exacerbated already long developmental acquisition

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[172] CMU SEI (2007l).
[173] Kadish, R.T., et. al. (2006).
[174] Cancian, M. (1995).
[175] Andrews, R., et. al., (2010).
[176] Kadish, R.T., et. al. (2006).

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timelines. Finally, the Panel's findings on the implications of obligation and expenditure data are very much in line with the findings of the CMU SEI "Robbing Peter to Pay Paul" archetype.

In the 2008 review of the Joint Strike Fighter[177], the GAO found that there was a significant backlog of unfunded requirements is a signature of "The Bow Wave Effect". The length of the initial program, and the fact that it has already slipped by 15% is a potential indicator of the "Longer Begets Bigger" archetype. The fact that the program has spent 66% of its funding while only completing 50% of the work may be evidence of "Firefighting" by using resources planned for current work to accomplish work that is behind schedule or remains incomplete. Finally, the changes the Joint Strike Fighter program is planning for its test program, combined with the reduction in planned test assets appears to be a prelude to the "'Happy Path' Testing" archetype.

In its 2008 report recommending changes to the acquisition environment, the GAO described a potential requirements-funding process interaction path through which the DoD inadvertently might be causing the "Underbidding the Contract" archetype.[178] Also, the finding in the report regarding budget instability and movement of funds between programs is a clear admission that the CMU SEI archetype "Robbing Peter to Pay Paul" is alive and well in the DoD Acquisition System.

The 2009 GAO report on improving acquisition outcomes[179] found that the DoD might be missing out on potential joint warfighting solutions due to the mostly service-unique requirements that were approved. The "Everything to Everybody" archetype would suggest that

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[177] GAO (2008a). GAO-08-569T
[178] GAO (2008b). GAO-08-782T.
[179] GAO (2009b). GAO-09-663T.

reducing complexity and limiting interfaces might actually help contain cost and schedule growth, presenting an interesting paradox. The fact that too many programs are competing for a small pool of funding, resulting in increased pressure to underestimate costs can be an unanticipated driver in the "Underbidding the Contract" archetype.

In their 2010 reporting, the GAO continued to develop findings related to the CMU SEI archetypes. The 2010 report on "Managing Risk to Achieve Better Outcomes" [180] found that the Army's Future Combat System would not complete requirements definition until six years into the execution of the developmental program, fitting the pattern of the CMU SEI "Longer Begets Bigger" archetype.

The 2010 GAO report on strong program leadership [181] conclusion that shorter development time correlated with positive program outcomes lends credence to the idea that avoiding the "Longer Begets Bigger" archetype behavior is a contributor to program success. In the same report, the GAO noted that SDB Increment 1 and the SM-6 programs avoided the "Everything to Everybody" behavior pattern by working hard to keep the program focused on affordable and achievable solutions and kept other agencies from adding unnecessary requirements. The ability of the successful programs studied in this report to instill confidence and maintain stable funding helped successful programs avoid the "Robbing Peter to Pay Paul" archetype. Finally, the report related the story of the Armed Reconnaissance Helicopter which did not develop a realistic cost or schedule estimate at the beginning of the program. This behavior by the Army may have inadvertently caused "Underbidding the Contract" and may have contributed to the program's ultimate cancellation.

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[180] GAO (2010a). GAO-10-374T.
[181] GAO (2010a). GAO-10-374T (Page 4).

In their 2010 review of the US Marine Corps' EFV program, the GAO noted the program was stretched by four years after some initial test problems.[182] In this case, what could have been a program that delivered capability in 5-6 years turned into a program fell into the patterns of the "Longer Begets Bigger" archetype. All of the GAO conclusions on the programs test plans and changes to those test plans indicate that the "'Happy Path' Testing" archetype may yet come into play with this program.

The GAO's 2010 review of MDA programs found that the Ground Missile Defense program was undergoing significant changes seven years after the initiation of program development.[183] This experience again demonstrates that programs conceived with long development cycles are likely to encounter program issues, as described by the "Longer Begets Bigger" archetype.

The findings of Swank, Alfieri, Gailey, and Reig also have implications for the current research.[184] First, the reported EMD schedule length was considerably longer than the 5-6 years that DAPA later recommended,[185] and could be an indicator of programs that were initiated under a "Longer Begets Bigger" archetype. However, it is their conclusion that the long development horizon precludes program managers from assessing whether or not key requirements would eventually be met that is most relevant. Combining these two thoughts, the "Longer Begets Bigger" archetype complicates the ability to develop early warning mechanisms to diagnose development problems early in the cycle. Second, their conclusion that cost growth was usually the result of other program problems, rather than an isolated problem, highlights the

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[182] GAO (2010c). GAO-10-758R.
[183] GAO (2010d). GAO-10-676.
[184] Swank, W.J., Alfieri, P.A., Gailey III, C.K., and Reig, R.W. (2000).
[185] Kadish, R.T., et. al. (2006).

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need to understand the program dynamics in a comprehensive manner. While not isolated, schedule problems that drive CMU SEI archetype behaviors such as "Firefighting" and "The Bow Wave Effect" can ultimately result in cost growth, indicating early ability to recognize these patterns could pay dividends.

Coleman, Summerville, and Dameron found that programs that experience extended schedules have some amount of cost growth.[186] If the CMU SEI archetype patterns of "Longer Begets Bigger" and "Everything to Everybody" are found to be relevant to the DoD Acquisition system, their impact (schedule growth) can be expected to result in an increase in overall program costs as well.

Brown, Flowe, and Hamel's research highlighted that joint programs were twice as likely to have schedule breaches and three times as likely to have cost breaches.[187] This work reinforces the idea that number of interfaces drive program complexity, as highlighted by the CMU SEI "Everything to Everybody" archetype.

The findings the OSD study on program manager certification will also be inter-related to the findings of this research work.[188] Failure to be properly trained in overseeing contractor performance could potentially lead to several of the archetype patterns of behavior ("Firefighting", "The Bow Wave Effect", "Staff Burnout and Turnover", and "PMO versus Contractor Hostility") being missed or misdiagnosed by program managers. Another example is that program managers not properly trained to understand test and evaluation challenges can easily fall into the "'Happy Path' Testing" pattern of behavior. On the other hand, archetype

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[186] Coleman, R.L., Summerville, J.R., and Dameron, M.E. (2003).
[187] Brown, M.M., Flowe, R.M., and Hamel, S.P. (2007). Pages 20-24.
[188] OSD (2009).

patterns of behavior such as "Robbing Peter to Pay Paul" and "Feeding the Sacred Cow" often result in directed funding and schedule changes, for which many program managers feel undertrained.

Based on the discussion above, a correlation of the CMU SEI archetypes to the literature they can be linked to is presented in Table 7. There seems to be substantial evidence to support the premise that the CMU SEI Archetypes may apply to DoD acquisition programs.

CMU SEI Archetype	Literature Review Relationship
Underbidding the Contract	GAO-08-782T; GAO-09-569T; GAO-10-522
Longer Begets Bigger	HASC Report 2010; GAO-08-569T; GAO-10-374T; GAO-10-522; GAO-10-758R; GAO-10-676; Swank (et. al.) Coleman, Summerville, and Dameron;
Everything for Everybody	HASC Report 2010; GAO-08-62R; GAO-09-663T; GAO-10-522; Brown, Flowe, and Hamel
The Bow Wave Effect	GAO-08-569T; GAO-10-522; Swank (et. al.); Cameron, Summerville, and Dameron; OSD 2010
Firefighting	Cancian; GAO-08-569T; GAO-10-522; Swank (et. al.); OSD 2010
Staff Burnout and Turnover	OSD 2010
PMO vs Contractor Hostility	Cancian; OSD 2010
Robbing Peter to Pay Paul	HASC Report 2010; GAO-08-62R; GAO-08-782T; GAO-10-522; OSD 2010
Feeding the Sacred Cow	OSD 2010
'Happy Path' Testing	GAO-08-569T; GAO-10-758R; OSD 2010

Table 7: Archetype Cross Reference to GAO Reports and Other Acquisition Literature

2.3.2 Research Questions

Based on the review of Acquisition Reform initiatives, the CMU SEI archetypes, and the potential links between them, four research questions were identified for this thesis.

2.3.2.1 Research Question #1

Are the 10 Acquisition Archetypes (Patterns of Failure) identified by CMU's SEI and

discussed in detail above applicable to the larger DoD Acquisition system, and not just software

acquisition? This question directly relates the patterns of failure identified by CMU's SEI to the larger DoD Acquisition System. The hypothesis of this research is that all 10 of the patterns of failure are applicable to the larger DoD Acquisition System.

2.3.2.2 Research Question #2

Do the 10 Acquisition Archetypes (Patterns of Failure) lead to significant, measurable cost and/or schedule growth? This question drives the relevance of the research. If the patterns of failure are prevalent in the larger DoD Acquisition System, but do not lead to significant, measurable cost and/or schedule growth, then other factors are driving acquisition outcomes. However, if there is a preponderance of significant, measurable cost and/or schedule growth in programs that have experienced these acquisition patterns, then there is value in enhancing the awareness of front-line and senior acquisition personnel to these behaviors and ways that they can be avoided. This research hypothesizes that when these behavior patterns are present on DoD Acquisition Programs, they will result in statistically significant, measurable cost and/or schedule growth.

2.3.2.3 Research Question #3

Are the 10 Acquisition Archetypes (Patterns of Failure) linked to the root causes of acquisition program cost and schedule growth identified by recent Acquisition Reform initiatives (such as the Defense Acquisition Performance Assessment[189] (DAPA) and 2009/2010 GAO reports)? In examining the 10 patterns of failure in preparation for this research, it is evident that there is potential for a large overlap between the root causes of the behavior patterns and the root causes of poor acquisition outcomes identified by the DAPA, the GAO, and other entities

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[189] Kadish, R., et. al. (2006).

striving to improve results through acquisition reform initiatives. This question seeks to clarify those relationships, helping to link identifiable program behaviors (patterns of failure) that may or may not have resulted in significant, measurable cost and/or schedule growth with areas of the larger DoD Acquisition targeted for large-scale reform. If the research results in positive correlation, this could indicate areas ripe for research and development of early-warning mechanisms or potential additions to acquisition training to help ensure early recognition, diagnosis, and avoidance of these behaviors. The hypothesis of this research is that there is a strong link between the identified causes of these patterns of behavior and the root causes of poor acquisition outcomes that are being addressed by the major acquisition reform recommendations of the DAPA, the GAO, and others.

2.3.2.4 Research Question #4

Is there any correlation between these Acquisition Archetypes relative to program size, lead service, or joint program status? This question examines whether the program size, lead service, or "jointness" of a program has any bearing on the likelihood that it will experience these acquisition behavior patterns. For this question, positive correlation will be considered as a likelihood of occurrence significantly higher than the mean likelihood of occurrence for the entire survey population. Positive correlation to a specific service might indicate a cultural problem within that service that fosters the negative outcome. Positive correlation to a smaller size program could indicate personnel issues associated with those programs (i.e. problems with manning level, training, and/or aptitude of personnel assigned). Positive correlation to "joint" programs would point to the fact that managing multi-service programs increases the complexity of the task and increases the potential for these patterns of failure to manifest themselves. This

research hypothesizes that there is no correlation between the patterns of failure and the program size, lead service, or "joint" status of a program.

One finding from some of the early acquisition reform pieces has direct relevance to this research question. Based on their work, Christensen, Searle, and Vickery concluded that Air Force programs were more susceptible to cost overruns than programs managed by the Army and Navy.[190] This finding conflicts with the hypothesis of this research that there is no correlation between lead service and the CMU SEI archetypical behaviors, and will be tested in this research again.

2.3.3 Study Limitations

This research is focused on looking for evidence that the CMU SEI archetypes are present in DoD Acquisition programs and whether these patterns of behavior could eventually be useful as tripwire indicators of potential poor acquisition outcomes. As such, there are some limitations that are not addressed by this study approach. First, research constraints limit the amount of identifying data that can be collected. With that in mind, no attempt will be made to gather individual program names. This limits the scope to simply an assessment of overall program size (as indicated by Acquisition Category) and does not take into consideration any aspect of the overall system size or its complexity. Both of these factors could eventually bias the results, but there is no reasonable way to obtain these data without potentially breaching the "individually-identifying" criteria. Further, this research is not a comprehensive look at the structure of the DoD Acquisition System or an in-depth analysis of how it works. Rather, this research is simply attempting to examine behavior patterns within programs and determine what,

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[190] Christensen, D.S., Searle, D.A., and Vickery, C. (1999).

if any, relationship exists between those patterns and ultimate acquisition outcomes. If statistically significant correlation between behavior and measurable cost or schedule growth exists, it does not mean that the behavior is the sole reason for the poor outcome, rather that it is likely one significant factor in that outcome.

2.3.4   Other Considerations

Finally, there are some other questions that can be raised regarding the literature review that are beyond the scope of this research. In particular, three queries present themselves.

First, did the Federal Acquisition Reform Act of 1996 requirement to reduce the number of acquisition personnel exacerbate the problems with the increased oversight requirements levied by the Packard Commission?[191,192] Pursuing this link would determine if the remaining acquisition personnel were overwhelmed with both the contract management issues and the increased reporting requirements, which ultimately fed a cycle of program failures.

Second, the GAO has been presenting their best practices in acquisition in reports to Congress for the past three years. In particular, their findings are that programs with a business case based on proven technology, adequate design knowledge, sufficient funding, a reasonable schedule managed by stable leadership and an adequately trained acquisition staff have the best chance to succeed.[193] If these factors indeed lead to successful program outcomes, has the DoD used these concepts as the basis for new acquisition programs initiated since 2008?

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[191] Grasso, V.B. (2002).
[192] Reeves, S.V. (1996).
[193] GAO (2009b) . GAO-09-663T.

Finally, services acquisition now represents roughly half of the DoD acquisition budget.[194] Is there any opportunity to examine services acquisition to identify areas for improvement? Are there links between acquisition reform initiatives and services acquisition issues that need to be explored? Are the acquisition archetypes developed by CMU's SEI relevant to services acquisition "as is"? If not, are there potential patterns that could be identified in services acquisitions that could serve as early warning mechanisms to help avoid poor program execution outcomes?

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[194] Under Secretary of Defense (AT&L) Memorandum, *Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending*, September 14, 2010).

Chapter 3 – Research Method

In order to examine the relationship between the CMU SEI Acquisition Archetypes and actual DoD programs, a survey was developed to collect data from acquisition personnel. This section discusses the survey and the raw results obtained from respondents.

3.1 Survey

The survey was hosted through SurveyMonkey™, an on-line survey tool that can be accessed by anyone with an internet connection and the website location. The survey approach used was approved by the MIT Committee On the Use of Humans as Experimental Subjects (COUHES). A copy of the MIT COUHES approval letter is available in Appendix B.

3.1.1. Survey Description

The survey consisted of three sections: an informed consent agreement, an 8-question collection of demographic data, and the main body of 38 questions regarding the presence of the CMU SEI Acquisition Archetypes in the programs to which the respondents were currently or most recently assigned. A complete version of the text of the on-line survey is presented in Appendix C.

3.1.1.1 Informed Consent

In accordance with COUHES procedures, the first section of the survey was an informed consent agreement. Potential respondents were informed of the approximate time commitment required to complete the entire survey and the method in which the survey would be presented (check box response and/or open response areas). They were reminded that the survey would support anonymous research into the DoD Acquisition System and would support a thesis project at the Massachusetts Institute of Technology. Specific conditions and stipulations were

presented regarding the confidentiality and voluntary nature of the survey and the relationship between the survey, MIT, and the DoD Acquisition System. Potential respondents were required to choose between a "Yes" or "No" response to the informed consent page. If the respondent chose "Yes", they were directed into the remaining portion of the survey. If the respondent chose "No", they were directed to the survey's completion and "thank you" page.

3.1.1.2 Demographic Data

The second section of the survey collected demographic data on the respondents to allow for data analysis. Eight questions were used to generate the demographic data, allowing for analysis in multiple different combinations. Five of the questions focused on individual information (but not personally identifying information) and the other three questions focused on information about the program to which the individual was currently or most recently assigned.

In the area of individual information, there were five questions. First, the respondent was asked to identify themselves as either a member of the military, as a government civilian, or as a contractor. Second, they were asked about which service they were associated with (Air Force, Army, US Marine Corps, Navy, US Coast Guard, or other). DoD civilians and contractors would identify the service they supported or if they worked for the Office of the Secretary of Defense. DoD civilians and contractors supporting the Joint Staff or Combatant Commands would respond with "other". Third, the respondent was asked to provide their number of years of acquisition experience. This was done by providing ranges of service, beginning with 0-2 years of acquisition experience, then 2-5 years of experience, then progressing in bands of 5-years of experience, culminating in a category of 20+ years of experience. The fourth question relating to individual information asked for the number of years they were assigned to the program to which

they are currently or were most recently assigned. In a fashion similar to the years of experience, the bands were 0-2 years, 2-5 years, 5-10 years, and more than 10 years. The fifth and final individual question inquired about the role the respondent currently performed on their program. Possible responses were System Program Manager (overall person in charge of the program), Deputy Program Manager, mid-level program manager, financial management, contracting, engineering, or logistics.

The program specific information was collected via three questions. First, the Acquisition Category of the program was requested, with the choices being ACAT I (which included ACAT ID, ACAT IAM, ACAT IC, and ACAT IAC), ACAT II, ACAT III, or other. Second, the type of program was requested, with the options being primarily a hardware, software, or services program. Third, the respondents were asked if their program was designated a "Joint" program. If they responded affirmatively, there were two follow-up questions to identify what service was designated as the "lead" service and what other services participated in the program.

3.1.1.3 Archetype-specific Questions

Following the entry of the demographic data, the survey moved into the principle data collection area, the questions that related to the CMU SEI Acquisition Archetypes. Respondents were reminded that their responses were to be provided with respect to the program they described in the demographic data and only for their personal experience during the most recent two years (or less if appropriate). Each CMU SEI archetype was described in a two-to-three line description. For nine of the 10 CMU SEI archetypes, the respondent was asked if the described behavior had occurred on their program. Three follow-up questions were posed if the response

was positive ("yes"). The first of these questions asked if the behavior led to a significant, measurable increase in program cost. The second asked if the archetypical behavior led to a significant, measurable increase in the program's schedule. The final subsidiary question provided several potential root causes for the behavior and asked the respondent to choose all root causes that they believed were applicable. If the respondent believed that the root cause of the behavior was not listed, an open response area was provided.

These potential root causes were derived from three sources. First, the CMU SEI archetypes contain system dynamic models that posit root causes of the behavior described. Second, the researcher conducted a "Five-Why" analysis of the patterns of failure based on his personal experience. Finally, the potential root causes developed through the first two methods were compared to the areas developed during the acquisition reform literature review, where significant overlap occurred.

For the tenth archetype, the respondent was asked if their program was treated in the fashion described by the CMU SEI "Feeding the Sacred Cow" archetype. If they responded affirmatively, one follow-up question was posed, asking for their input on the root cause for being treated in that fashion. Like the other nine archetypes, if the respondent did not believe that the root cause was listed as a possible choice, an open response prompt was provided. A screen shot of one of these archetype descriptions and subsidiary questions is provided in Figure 3 below. The entire text of the survey is presented in Appendix B.

Acquisition Patterns of Failure in Defense Acquisition   Exit this survey

        57%

Considering
1) only the current program you are assigned to (the one you answered the demographic data about); and
2) only your last two years (or less) experience on that program

Please read the following description and answer the corresponding questions as applicable

E   Firefighting

Firefighting occurs when personnel assigned to projects expected to complete in the future are diverted from those tasks to solve problems or complete tasks that need to be solved/completed immediately to meet the contractual delivery schedule.

* 1. Has this behavior occurred on your current program?

   ○ Yes

   ○ No

    2. If yes, please answer the following questions:

    Did firefighting lead to a significant, measurable increase in program cost?

     ○ Yes

     ○ No

    3. Did firefighting lead to a significant, measurable lengthening of the program schedule?

     ○ Yes

     ○ No

    4. Based on your experience, what were the root causes of this behavior (check all that apply)?

    ☐   Government failed to appropriately define the program's requirements

    ☐   Contractor did not sufficiently understand program requirements

    ☐   Contractor underestimated program risk

    ☐   Contractor did not assign sufficient personnel to tasks to complete work on time

    ☐   Contractor did not assign correct types of personnel to tasks

    ☐   Contractor underestimated technology maturity at program initiation

    ☐   Contractor struggled integrating technologies into program context

    ☐   Contractor focused on meeting contractual cost or schedule incentive

    Other (please specify)

    [_____]

              Prev   Next

Figure 3: Screen Capture of "Firefighting" Archetype Survey Questions

3.1.2. Survey Validation

The survey was validated by directing it to four individuals with acquisition experience known to the reseacher. Each of these four personnel responded to the survey and provided feedback directly to the researcher regarding the utility and validity of the survey approach. Unanimously, these initial four respondents agreed the survey was valid in its approach, the questions were clearly written, and the data collection method was appropriate. Since there is no specific way to correlate the responses of these four individuals with the larger data set, their responses have been maintained in the final data set.

3.1.3. Survey Respondents

In contrast to the OSD Program Management Certification Study (OSD 2009) which collected data from senior program managers (military officers in the grade of Colonel and above and DoD Government Civilians with 'equivalent' ranks),[195] this survey was targeted at mid-level acquisition personnel who might be more familiar with the day-to-day behaviors reflected in the CMU SEI archetypes. To gain access to a pool of these acquisition personnel as potential respondents, contact was made with the Defense Acquisition University (DAU) director for the Program Management 352 (PMT-352) class. PMT-352 was chosen as because it is a class required for Program Management certification as part of the DoD's implementation of the Defense Acquisition Workforce Improvement Act (DAWIA).[196] The PMT-352 course director agreed to allow access to class participants via the individual class leaders. An e-mail was sent to the individual instructors with an introductory message for the survey and a survey link that was to be provided to the students.

Other participants were obtained using personal network connections of the researcher in the Army, Navy, and Air Force acquisition workforce. In a similar fashion, contact was made with those individuals requesting if they were willing to provide a survey link to some of the people they work with and/or who work for them. If the people responded positively, an e-mail was sent to them with an introductory message for the survey and a survey link that was to be provided to their co-workers.

To maintain anonymity, respondents were provided with the introductory message and the SurveyMonkey™ website address through the class instructors or other contacts. As much

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[195] OSD (2009).
[196] Public Law 101-510. (1990). Sections 1701-1764 of Title 10, United States Code.

as possible, there was no contact between the researcher and the respondents (except in the cases where the intermediary independently decided to take the survey).

3.2 Descriptive Statistics

Responses were collected via the SurveyMonkey™ website over a four month period. Because of the method of distribution of the survey announcement and introductory message, it is not possible to determine exactly how many people were afforded the opportunity to take the survey, but based on feedback from the contacts used by the researcher to distribute the survey, roughly 150 people were offered the survey link. Of these, 65 responded during the data collection period. This notionally represents a 43% response rate for a voluntary survey of Government employees.

The data presented in this section will parallel the structure presented in Section 3.1. A breakdown of the demographic data is presented first in Section 3.2.1. This includes analysis of both the individual data and the program data. This will be followed in Section 3.2.2 with a presentation of the results of the 10 sets of Archetype-specific question sets.

3.2.1 Demographic Data Results

As noted above, there are two areas of demographic data that are presented. The first is the individual demographic data and the second is the program demographic data. All 65 respondents provided inputs for both the individual and program demographic data with one exception. One respondent answered all the questions but left the "program role" response blank.

3.2.1.1 Individual Demographic Data

In the area of individual information, there were five questions. First, the respondent was asked to identify themselves as either a member of the military, as a government civilian, or as a contractor. The result is shown in Figure 4.
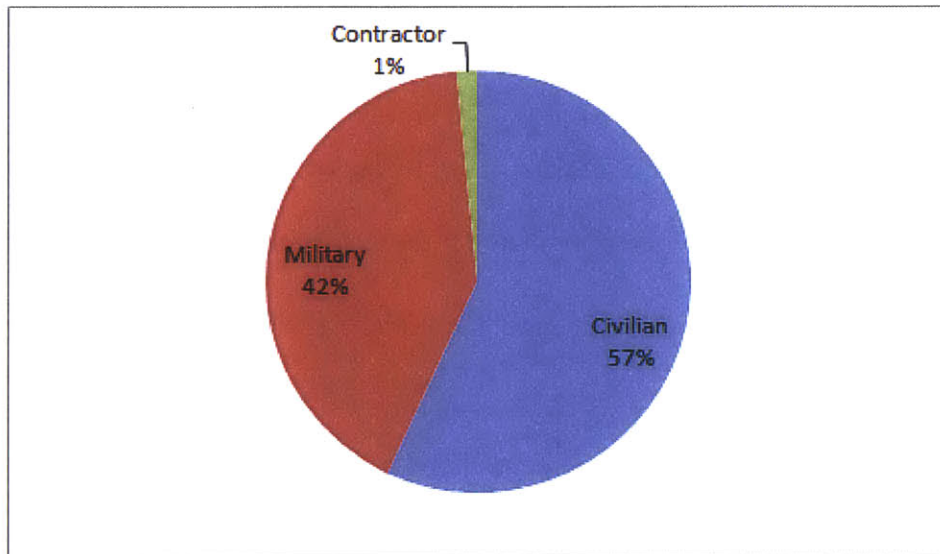
Figure 4: Top-Level Demographic Breakdown

The second question asked about which service they were associated with (Air Force, Army, US Marine Corps, Navy, US Coast Guard, or other). DoD civilians and contractors would identify the service they supported or if they were working for the Office of the Secretary of Defense (OSD). DoD civilians and contractors supporting the Joint Staff or Combatant Commands would respond with "other". The results are presented in Figure 5.
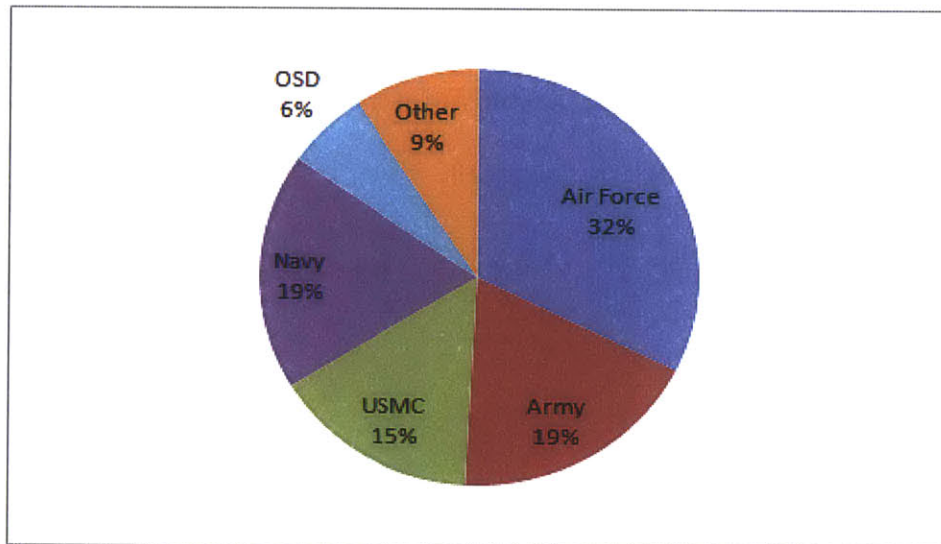
Figure 5: Service-Level Demographic Results

Third, the respondent was asked to provide their number of years of acquisition experience. This was done by providing ranges of service, beginning with 0-2 years of acquisition experience, then 2-5 years of experience, then progressing in bands of 5-years of experience, culminating in a category of 20+ years of experience. The results are presented in Figure 6.
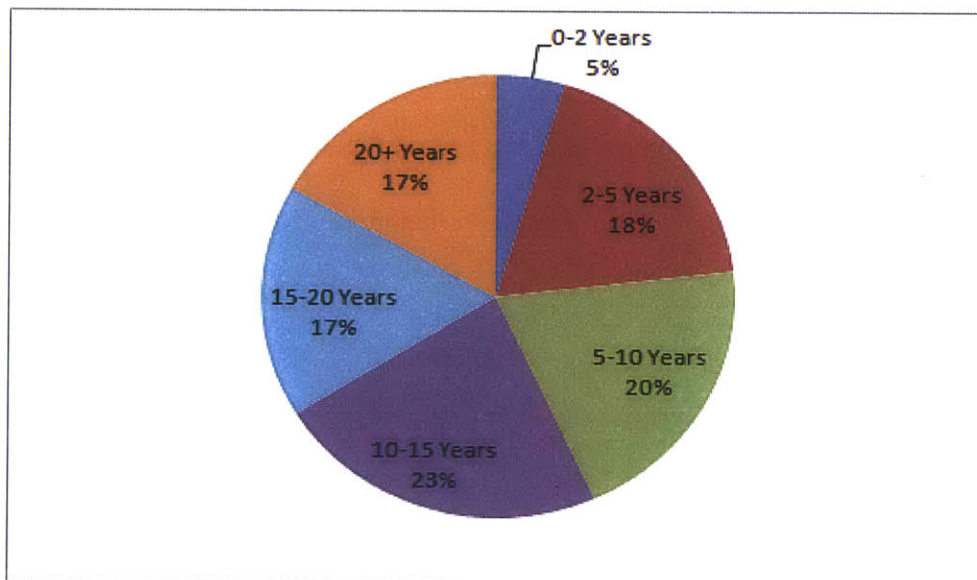
Figure 6: Years of Service Demographic Results

The fourth individual information question asked for the number of years they were assigned to the program to which they are currently or were most recently assigned. In a fashion similar to the years of experience, the bands were 0-2 years, 2-5 years, 5-10 years, and more than 10 years. The results are shown in Figure 7.
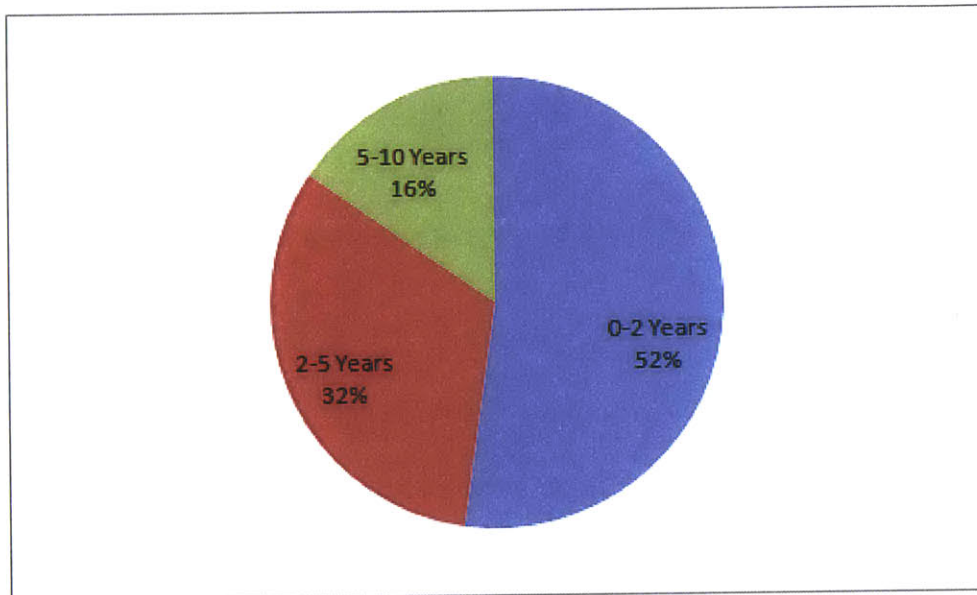
Figure 7: Time on Program Demographic Result

The fifth and final individual question inquired about the role the respondent currently performed on their program. Possible responses were System Program Manager (overall person in charge of the program), Deputy Program Manager, mid-level program manager, financial management, contracting, engineering, or logistics. The results are shown in Figure 8.

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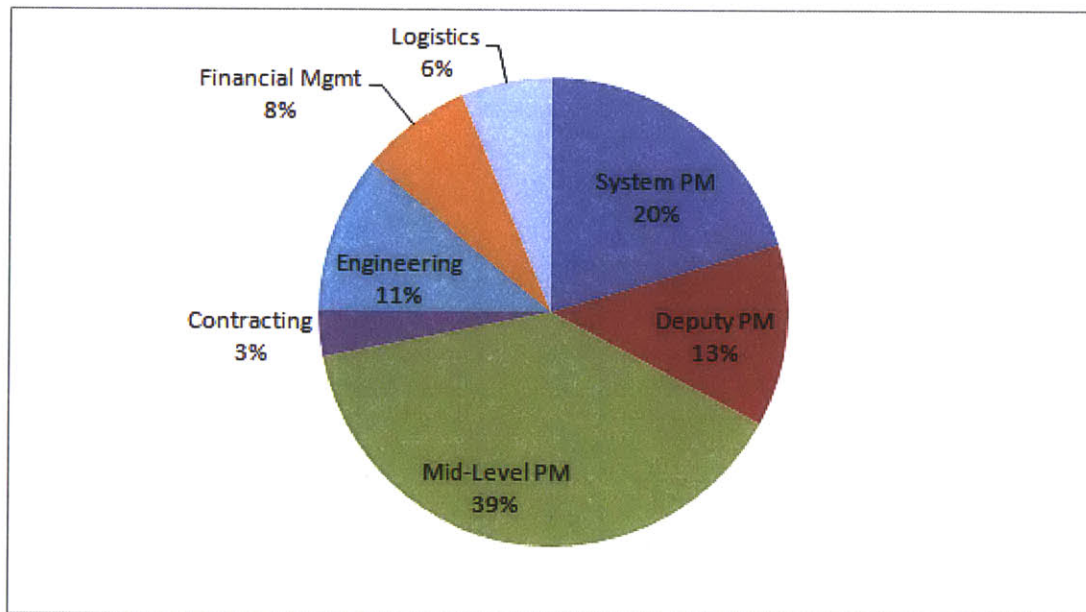
Figure 8: Program Role Demographic Results

There are many combinations of these demographic data that could be created. One way of combining these attributes is to examine the relationship between Civilians, Military, Contractors, the organization they work for, and the number of years of experience they have. This cross-correlation is presented in Table 8. A second cross-match is to look at the Time on the Program by organizational affiliation. This breakdown is shown in Table 9. Finally, the relationship of organizational affiliation and program role is shown in Table 10.

Category	Service	Experience	Count
Civilian	Air Force	0-2 Years	0
		2-5 Years	1
		5-10 Years	0
		10-15 Years	3
		15-20 Years	1
		20+ Years	1
	Army	0-2 Years	0
		2-5 Years	0
		5-10 Years	2
		10-15 Years	3
		15-20 Years	0
		20+ Years	1
	USMC	0-2 Years	0
		2-5 Years	2
		5-10 Years	2
		10-15 Years	0
		15-20 Years	1
		20+ Years	0
	Navy	0-2 Years	0
		2-5 Years	2
		5-10 Years	1
		10-15 Years	0
		15-20 Years	5
		20+ Years	2
	OSD	0-2 Years	0
		2-5 Years	1
		5-10 Years	0
		10-15 Years	1
		15-20 Years	0
		20+ Years	2
	Other	0-2 Years	0
		2-5 Years	0
		5-10 Years	1
		10-15 Years	0
		15-20 Years	1
		20+ Years	4

Category	Service	Experience	Count
Military	Air Force	0-2 Years	1
		2-5 Years	1
		5-10 Years	5
		10-15 Years	4
		15-20 Years	3
		20+ Years	1
	Army	0-2 Years	1
		2-5 Years	2
		5-10 Years	1
		10-15 Years	2
		15-20 Years	0
		20+ Years	0
	USMC	0-2 Years	1
		2-5 Years	3
		5-10 Years	0
		10-15 Years	0
		15-20 Years	0
		20+ Years	0
	Navy	0-2 Years	0
		2-5 Years	0
		5-10 Years	1
		10-15 Years	1
		15-20 Years	0
		20+ Years	0

Category	Service	Experience	Count
Contractor	USMC	10-15 Years	1

Table 8: Category, Service, and Years of Experience

0-2 Years	Air Force	14
	Army	6
	USMC	6
	Navy	4
	OSD	3
	Other	1
2-5 Years	Air Force	5
	Army	5
	USMC	4
	Navy	1
	OSD	1
	Other	5
5-10 Years	Air Force	2
	Army	1
	USMC	0
	Navy	7
	OSD	0
	Other	0

Table 9: Years on Program versus Organizational Affiliation

System PM	Air Force	3	Engineering	Air Force	2
	Army	3		Army	1
	USMC	2		USMC	2
	Navy	2		Navy	2
	OSD	1		OSD	
	Other	2		Other	
Deputy PM	Air Force	5	Financial Management	Air Force	4
	Army	1		Army	
	USMC			USMC	1
	Navy	1		Navy	
	OSD	1		OSD	
	Other			Other	
Mid-Level PM	Air Force	6	Logistics	Air Force	
	Army	6		Army	1
	USMC	4		USMC	1
	Navy	6		Navy	1
	OSD	1		OSD	
	Other	2		Other	1
Contracting	Air Force	1			
	Army				
	USMC				
	Navy				
	OSD				
	Other	1			

Table 10: Program Role and Organizational Affiliation

3.2.1.2   Individual Demographic Data Analysis

The status breakdown (military, civilian, or contractor) provided a reasonable mix of

respondents, with more civil servants (57%) responding than military (42%) or contractors (1%).

For simplicity of reporting future results, the one respondent that was a Marine Corps contractor

will be categorized with the civilians in data reporting.

From Table 8, it is seen that the civilian/contractor participants generally had more

experience than the military respondents. Only 12 of the 38 civilian/contractors (32%) had less

than 10 years of experience, while the remaining 26 had more than 10 years of experience. On

the other hand, 16 of the 27 military (59%) had less than 10 years of acquisition experience, with

the remaining 11 having more than 10 years experience in the field. This outcome seems to

make sense, as the civil servant acquisition personnel are intended to provide long-term stability,

while military members are generally younger and have pressure to broaden their experience

base beyond just one career field.

The variety of respondents organizational affiliation was reasonable, as well. Using the

Defense Acquisition University's PMT-352 class provided a good sample across all services and

organizations. The sample was weighted heaviest toward Air Force personnel (32%), with the

other three services represented nearly evenly (Army 19%, Marine Corps 15%, and Navy 19%).

OSD personnel represented 6% of the sample, with respondents choosing Other (notionally the

Joint Staff or members of the Combatant Commands) representing the final 9%. For simplicity,

these two categories (OSD and Other) will be combined for reporting, providing five

organizational possibilities, reasonably distributed in the sample. [Note: All of the respondents

noting their affiliation as "Other" were civilians, and their experience was very deep (five of the

six personnel in this category reported more than 15 years of experience.] One reason for the skew toward Air Force personnel is that all of the personnel used to validate the survey (and whose responses are included in the overall results) were Air Force personnel.

As noted in the Section 3.1.3, this survey was targeted at mid-level acquisition personnel who might be more familiar with the day-to-day behaviors reflected in the CMU SEI archetypes. Twenty-five (25) of the personnel responding to the survey (38%) described themselves as mid-level program managers and 54 of the 65 overall respondents (83%) indicated they had less than 20 years of acquisition experience. Since it typically requires a 20-year career in the military to reach the rank of Colonel or the grade of GS-15 in civil service, those individuals with less than 20 years of experience would represent the mid-level acquisition personnel that are not typically surveyed by OSD or the GAO. Again, using the DAU PMT-352 class as a primary response-gathering method helped to reach the target audience for the survey.

As might be expected from a survey that gathers most of its responses from a class focused on Program Management (PMT-352), the vast majority of the sample are program managers (72% indicating they were System Program Managers, Deputy Program Managers, or Mid-Level Program Managers). The rest of the sample was spread between contracting personnel (3%), engineers (11%), financial managers (8%), and logistics personnel (6%). This provides a good cross-section of the acquisition community from which to draw the survey, but the large skew toward program managers means that no career-field specific results should be drawn (other than about program managers).

With respect to time on their program, the majority of the personnel responding (52%) indicated they had been assigned to their current program (about which they responded to the

survey) for less than two years. Another 32% reported being assigned to their current program for between two and five years, while only 16% stated they had been associated with their program for more than five years. This also seems reasonable, based on the experience of the researcher. Most military members spend less than three years associated with an individual program, and indeed, 20 of the 27 military respondents (74%) had spent less than two years on their program (with only one military member reporting more than five years associated with their program). As noted above, civil servants and contractors are generally used to provide long-term stability for programs. This is borne out by the fact that 60% of the civilian/contractor respondents had more than 2 years experience on their current programs.

Overall, the individual demographic data appear reasonable relative to the general acquisition population. Possible analysis divisions are: Status (military (42%) or civilian/contractor(58%)), Organization (Air Force (32%), Army (19%), Marine Corps (15%), Navy (19%), or OSD/Other (15%)), Years of Experience (<5 (23%), 5-10 (20%), 10-15 (23%), 15-20 (17%), or >20(17%)) and Program Role (Program Management (72%) versus Other Roles (28%)). Unfortunately, due to the small overall sample size, second- and third-order combinations are not appropriate (i.e. Air Force Civilians or Army Civilian Program Managers).

3.2.1.3   Program Demographic Data

The program specific information was collected via three questions. First, the Acquisition Category of the program was requested, with the choices being ACAT I (which included ACAT ID, ACAT IAM, ACAT IC, and ACAT IAC), ACAT II, ACAT III, or other. The results are shown in Figure 9.
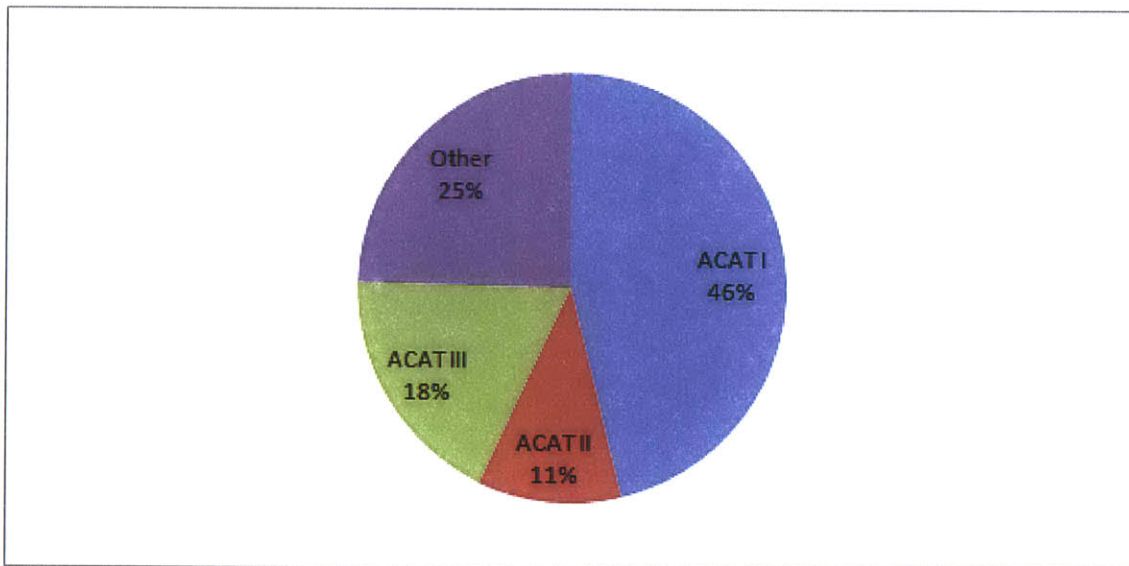
Figure 9: Acquisition Category (ACAT) Breakdown of Programs

The second program-specific question asked for the major type of product being acquired by the program. The options were hardware (meaning more than 50% of the program was hardware), software, or a services program. The results are presented in Figure 10.

Finally, the respondents were asked if their program was designated a "Joint" program. If they responded. The results of that question are shown in Figure 11. For the 17 respondents that were working on joint programs, the designated "lead" service breakdown is shown in Figure 12.

Similar to the individual information, it is possible to show how these program-specific data are related. Table 11 presents the breakdown of programs by Acquisition Category, primary product category, and the number of joint programs (with lead service identified).
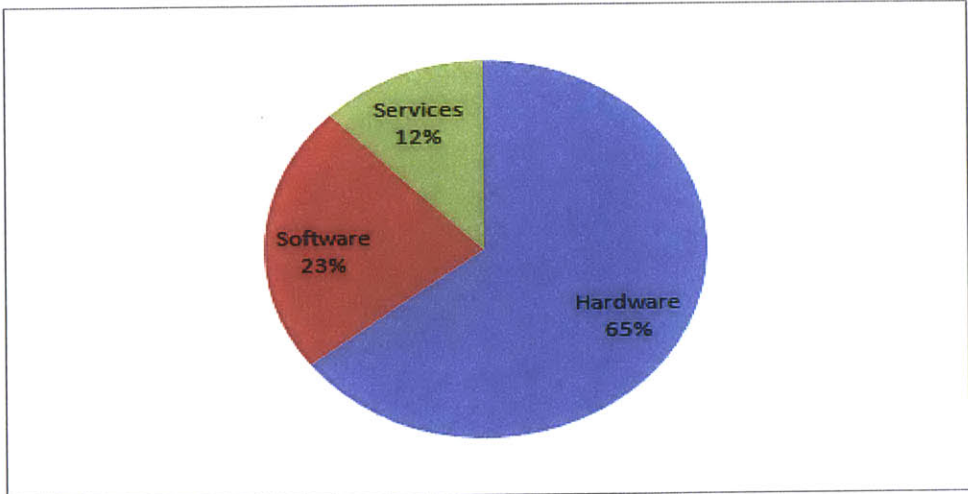
Figure 10: Primary Product Being Acquired By Programs
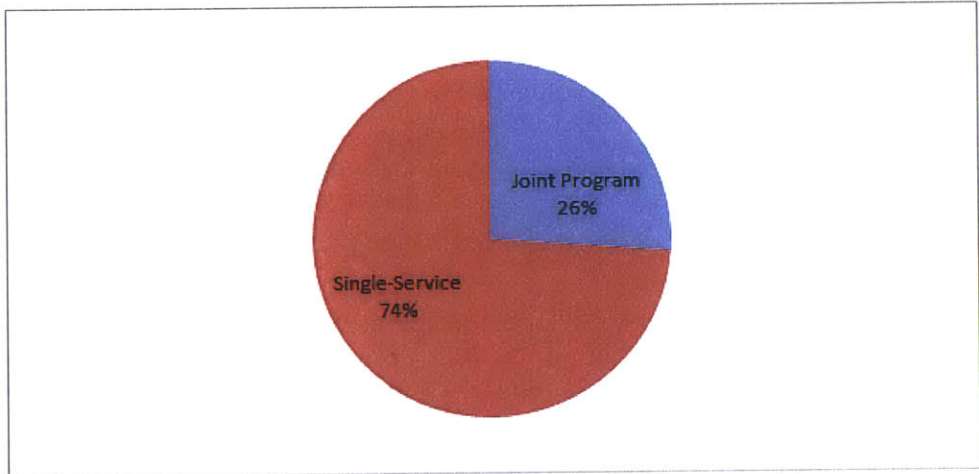
Figure 11: Joint Service Program Demographics
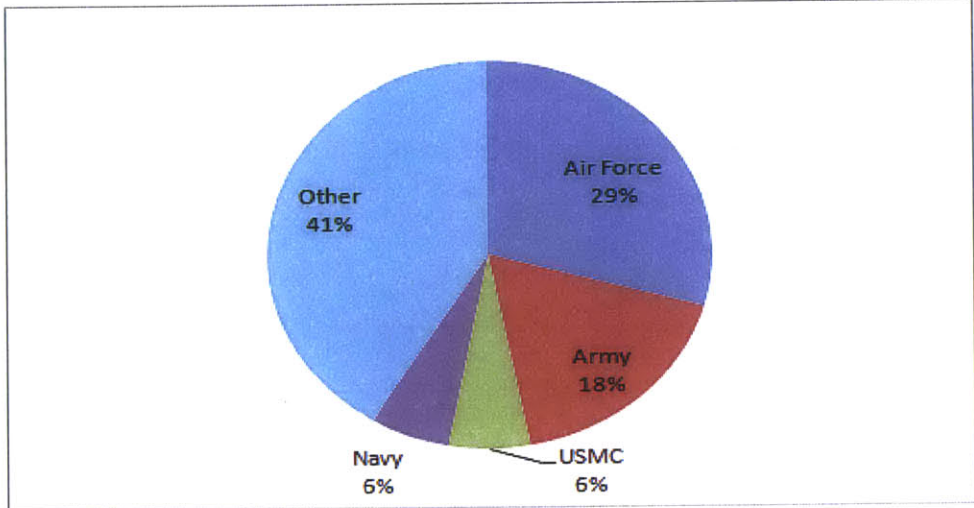
Figure 12: Lead Service Breakdown for Joint Programs

ACAT I	Hardware	20	5 Joint (3 AF, 1 Navy, 1 Other
	Software	8	3 Joint (3 AF)
	Services	2	1 Joint (AF)
ACAT II	Hardware	6	2 Joint (AF)
	Software	1	1 Joint (Other)
	Services	0	
ACAT III	Hardware	10	1 Joint (Army)
	Software	1	
	Services	1	
Other	Hardware	6	2 Joint (Army)
	Software	5	
	Services	5	2 Joint (USMC, Other)

Table 11: Detailed Breakdown of Program Data

3.2.1.4   Program Demographic Data Analysis

The results of the survey regarding program size (Acquisition Category level) were

interesting. Thirty (30) of the respondents (46%) indicated they worked on an ACAT I program.

Seven (11%) stated they worked on ACAT II programs and 12 (18%) supported ACAT III

programs. A surprising 25% reported their program size as "other", and these were nearly

equally distributed between hardware (6 programs), software (5 programs), and services (5

programs). There are several possibilities for this. The individuals could work on technology

demonstrations, rapid fielding initiatives, or small programs referred to as projects. Because of

the small overall sample size and the particularly small number of responses in the ACAT II and

ACAT III categories, the results will be divided into three categories: ACAT I, ACAT II/III, and

Other.

The overwhelming majority of the respondents (65%) declared they supported hardware

acquisition programs. The definition provided for hardware stated that more than 50% of the

effort results in the acquisition of a physical asset, so while there may be significant software

content inside these hardware programs, the primary goal is to acquire a physical asset. Nearly a quarter (23%) worked on software acquisition programs, while the remaining 12% were engaged with Services acquisitions. Interestingly, five of the eight respondents that were involved with Services programs indicated their program size was "Other". This could indicate a definitional problem for program size relative to Services acquisitions. This area has already been identified in Section 2.3.3 as an area for possible further research, but this could be another item to be added. In general, the results of the product type question do not seem to be unfairly skewed. Therefore, all three categories will be maintained for breakdown analysis, though drawing broad conclusions based on the smaller Services acquisition sample within the survey population is not appropriate.

As noted by the House Armed Services Committee Panel on Defense Acquisition Reform, Services acquisition is a huge part of the DoD's acquisition portfolio, representing nearly $200B in expenditures in 2010.[197] The small number of survey participants (12%) that reported working in Services acquisition could mean that the results of the survey underestimate problems in the Services arena and is another source for potential survey bias. One area for possible future research would be to survey Services programs to determine if they are adequately categorized for size, if the personnel supporting those programs are properly trained for Services acquisitions, and if the same, or similar, patterns of behavior result in poor acquisition outcomes for Services acquisitions. Clearly, the USD(AT&L) believes that there is a need to focus on Services acquisition, as he specifically aimed one of the five main thrusts of his

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[197] Andrews, R., et. al., (2010).

recent memorandum (with four targeted initiatives) at improving Services tradecraft in DoD acquisition.[198]

As expected, the majority of the programs supported by the survey respondents were single-service programs. Only 26% of the survey participants worked on "Joint" programs. Because of the small number of respondents, the breakdown of "Joint" programs by Lead Service does not lend itself to analysis with any strong statistical background. Therefore, the only category breakdown for this area will be Joint or Single-Service.

It was very interesting that of the 17 "Joint" programs reported, seven identified the Lead Service as "Other". Because of the anonymous nature of this survey, it is not possible to contact these respondents to determine more information about these responses. Therefore, this unexpected result provides an area for further investigation in subsequent studies.

One of the premises of the research motivation was that ACAT I programs were staffed with more experienced personnel and that ACAT II/III programs were more of a training ground for younger acquisition personnel. The data gathered are presented in Table 12 below, based on using the midpoint of each range (or 20 in the case of the 20+ years category) to determine the median Years of Experience. The data tend to support motivation's premise, though not as strongly as expected. Interestingly, the least experienced set of respondents supported "Other" programs, indicating that technology demonstrations and small projects that do not meet the requirements for size of an ACAT III program are a significant training ground for acquisition personnel.

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[198] USD(AT&L) Memorandum. (2010).

Program Size	Years of Experience		Median
ACAT I	< 5 Years	8	15.00
	5-10 Years	1	
	10-15 Years	6	
	15-20 Years	8	
	20+ Years	7	
ACAT II/III	< 5 Years	3	12.50
	5-10 Years	5	
	10-15 Years	6	
	15-20 Years	2	
	20+ Years	3	
Other	< 5 Years	4	7.50
	5-10 Years	7	
	10-15 Years	3	
	15-20 Years	1	
	20+ Years	1	

Table 12: Breakdown of Program Status by Years of Experience

Overall, the program demographic data appear reasonable relative to the general acquisition population. Possible analysis divisions are: Program Size (ACAT I, ACAT II/III, or Other), Product type (Hardware, Software, Services), and Program Type (Single-Service or Joint). Like the individual data, due to the small overall sample size, second- and third-order combinations (i.e. ACAT II Services or Joint ACAT III Software) are not appropriate for drawing statistical conclusions.

3.2.2 Archetype Question Results

Each CMU SEI archetype was described in a two-to-three line description. Respondents were reminded that their responses were to be provided with respect to the program they described in the demographic data and only for their personal experience during the most recent two years (or less if appropriate). The respondent was asked a "Yes" or "No" question if that behavior had occurred on their program. If the respondent did not answer the question, the result was considered to be "No". In all but one case, three follow-up questions were posed if the

response was positive ("Yes"). The first of these questions asked if the behavior led to a significant, measurable increase in program cost. The second asked if the archetypical behavior led to a significant, measurable increase in the program's schedule. The third subsidiary question asked the respondent to provide potential root causes of the behavior. For each archetype behavior, possible root causes were provided for the respondent to confirm and an open response area was also provided. [Note: The root cause responses were not mutually exclusive, and the respondent was asked to check all that apply and to provide their assessment of a root cause if it was not listed.] In the one separate case ("Feeding the Sacred Cow" archetype), only the question asking the respondent to postulate potential root causes of the behavior was asked.

Overall, the results indicate that these archetypes are present in the larger DoD Acquisition System, with response rates ranging from 17% to 57%. Figure 13 below shows the overall percentage of respondents that identified the archetype behavior on their program.
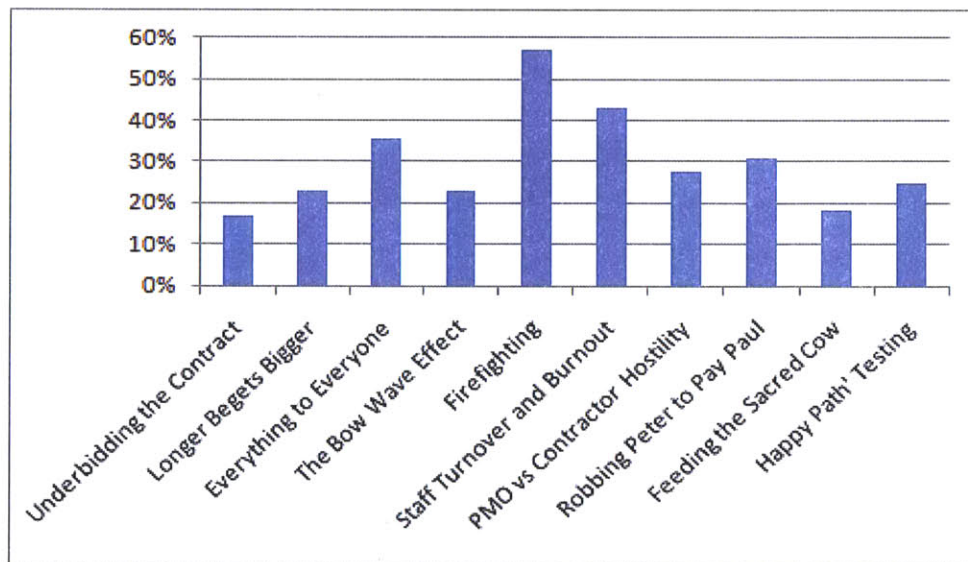
Figure 13: Percentage of Respondents Identifying Each Archetype

When the respondents identified the behaviors, they claimed it led to measurable cost growth over a range from 32% of the time to 82% of the time. Similarly, when the respondents

identified the behavior, they claimed it led to measurable schedule growth over a range from 43% of the time to 91% of the time. Figure 14 below shows the percentage of respondents who identified measurable cost and/or schedule growth if they noted the behavior had occurred in their program. The next ten sections of discuss the findings related to each archetype in depth.
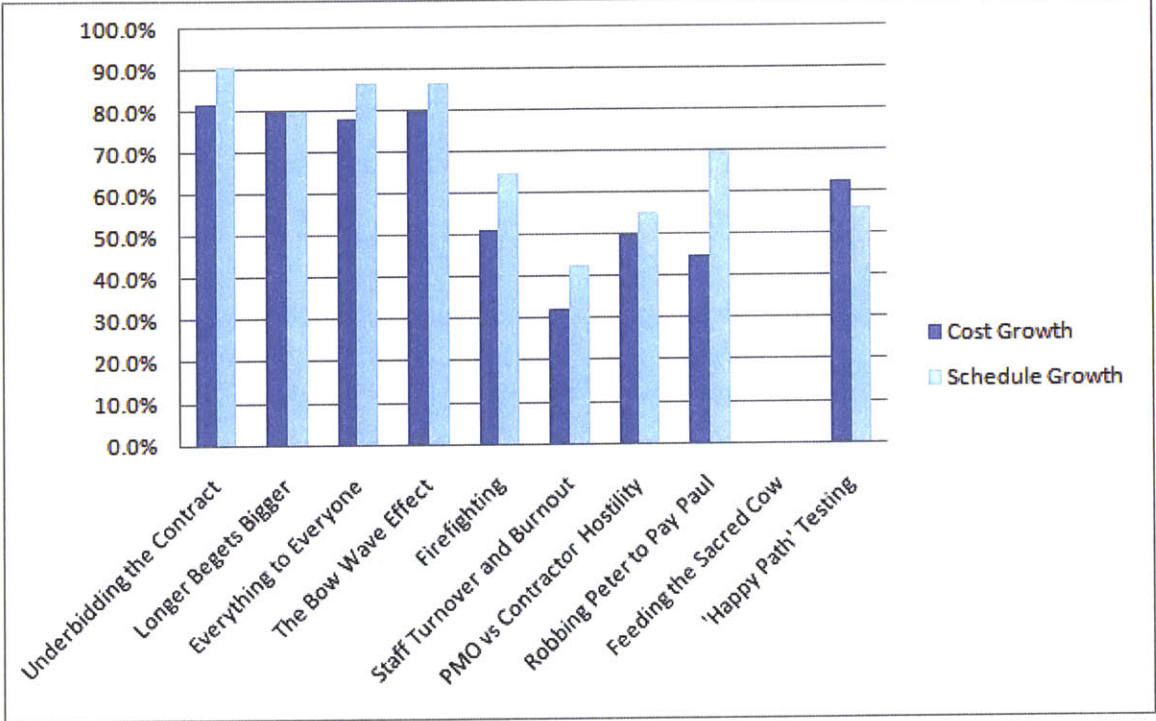
Figure 14: Percentage Identifying Measurable Cost or Schedule Growth if Archetype Noted

3.2.2.1   Underbidding the Contract Archetype Responses

The first primary question set of the survey asked the respondent to think about the "Underbidding the Contract" archetype.[199] All but one of the respondents answered this question. Eleven (11) respondents (16.9%) confirmed seeing this behavior in their program. Of these, nine agreed that the behavior led to measureable cost growth on the program (81.8%) and ten agreed that the behavior led to measurable schedule growth on the program (90.9%).

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[199] CMU SEI (2007k).

The 11 respondents that confirmed seeing this type of behavior were provided with a list of six possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. On average, each respondent indicated slightly more than two likely root causes. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 15. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 13. Responses that were obtained from the Open Response area are preceded by an "(OR)".
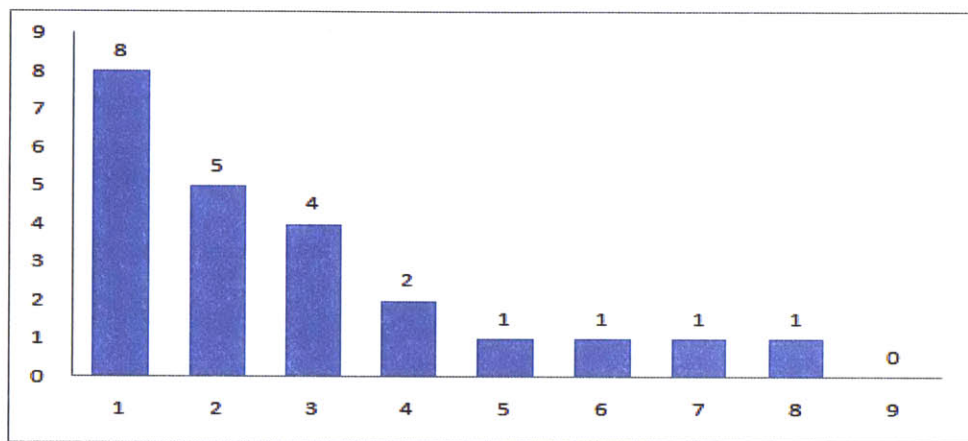
Figure 15: Pareto Chart of Root Causes for "Underbidding the Contract"

#	Description	# Times Cited
1	Contractor failed to understand the program risk	8
2	Government failed to understand program risk	5
3	Contractor under pressure to win fewer contracts available	4
4	Government failed to appropriately define the program's requirements	2
5	Government unable to appropriately validate contractor proposal	1
6	(OR) Underestimated the technical requirements even though they have the skill set	1
7	(OR) We were not able to "officially" recognize the fact the contractor was bidding on several other contracts and that when won had a significant resource/funding shortage	1
8	(OR) Gov't & Contractor acquisition strategy that failed to recognize the importance of near term cash flow & ROI for a contractor and changing DoD climates -- relied on future success to offset early losses that didn't happen	1
9	Government proposed inappropriate contract type for program phase	0

Table 13: Descriptions of Root Causes for "Underbidding the Contract"

3.2.2.2   Longer Begets Bigger Archetype Responses

The second major question division of the survey asked the respondent to think about the "Longer Begets Bigger" archetype.[200] Again, all but one of the respondents answered this question. Fifteen (15) respondents (23.1%) confirmed this behavior had occurred in their program. Of these, twelve agreed that the behavior led to measureable cost growth on the program (80%). Another twelve respondents (but not necessarily the same 12) also agreed that the behavior led to measurable schedule growth on the program (80%).

The 15 respondents that confirmed seeing this type of behavior were provided with a list of five possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The mean number of potential root causes identified by the respondents was 2.26. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 16. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 14. Responses that were obtained from the Open Response area are preceded by an "(OR)".

Figure 16: Pareto Chart of Root Causes for "Longer Begets Bigger"

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[200] CMU SEI (2007f).

Disclaimer -- The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Air Force, the Department of Defense, or U.S. Government.

#	Description	# Times Cited
1	Contractor struggled integrating technologies into program context	9
2	Government failed to appropriately define the program's requirements	8
3	Contractor underestimated technology maturity at program initiation	7
4	Contractor failed to understand program risk	5
5	Poor financial execution rates result in rescission of program funding	3
6	(OR) Government didn't have enough funding and Contractor didn't have enough experienced engineers	1
7	(OR) Late engineering drawings, longer, inefficient mod, misjudged airworthiness risk, misjudged flight test time	1

Table 14: Descriptions of Root Causes for "Longer Begets Bigger"

3.2.2.3 Everything to Everybody Archetype Responses

The third question section of the survey asked the respondent to think about the "Everything to Everybody" archetype.[201] Once again, all but one of the respondents answered this question. Twenty-three (23) respondents (35.4%) agreed this behavior had occurred in their program. Of these, 18 felt that the behavior led to measureable cost growth on the program (78.3%) and 20 agreed that the behavior led to measurable schedule growth on the program (87%).

The 23 respondents that confirmed seeing this type of behavior were provided with a list of four possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The mean number of potential root causes identified was 1.78 per respondent. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 17. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 15. Responses that were obtained from the Open Response area are preceded by an "(OR)".

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[201] CMU SEI (2007b).

Figure 17: Pareto Chart of Root Causes for "Everything to Everybody"

#	Description	# Times Cited
1	Requirements changed after program initiation to accommodate additional users	15
2	Government failed to appropriately define the program's requirements	9
3	Contractor failed to understand complexity driven by multiple external interfaces	7
4	Requirements added to obtain approval for program initiation	5
5	(OR) Requirements added because PM thought it was important without impact to additional cost and schedule	1
6	(OR) Technology improvements and obsolescence issues also have impacted growth	1
7	(OR) New weapon integrated on a new aircraft (JSF) with new interfaces	1
8	(OR) Adding the requirements was not too bad it was the government's approval process that added months and increased cost significantly	1
9	(OR) Perception by the end-user that they need everything just in case	1

Table 15: Description of Root Causes for "Everything to Everybody"

3.2.2.4   The Bow Wave Effect Archetype Responses

The fourth primary question set of the survey asked the respondent to think about the "The Bow Wave Effect" archetype.[202] Only one of the respondents did not answer this question. Fifteen (15) respondents (23.1%) perceived this behavior had occurred in their program. Of these, 12 agreed that the behavior led to measureable cost growth on the program (80%).

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[202] CMU SEI (2007j).

Further, 13 respondents felt that the behavior led to measurable schedule growth on the program (86.7%).

The 15 respondents that confirmed seeing this type of behavior were provided with a list of seven possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The mean number of potential root causes identified per survey was 2.4. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 18. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 16. For this question, there were no open responses received.
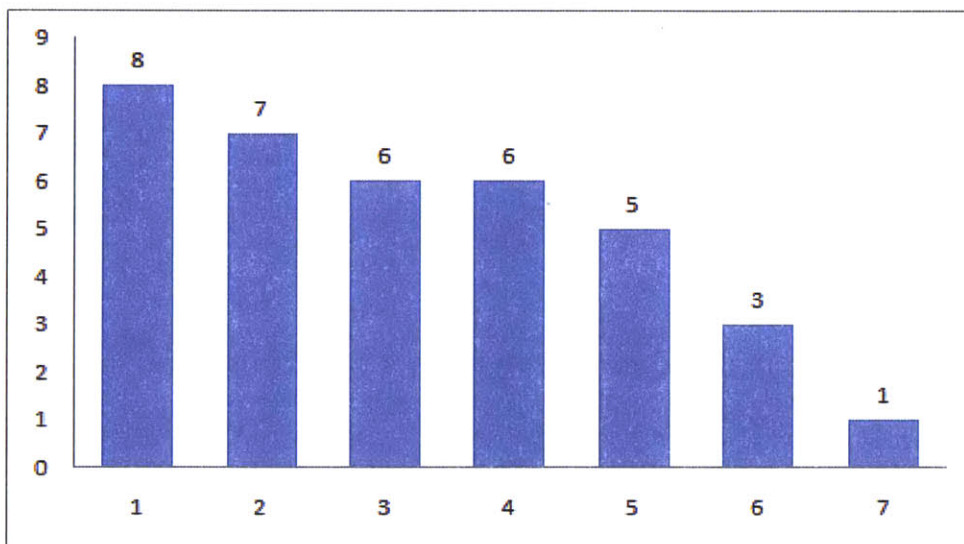
Figure 18: Pareto Chart of Root Causes for "The Bow Wave Effect"

#	Description	# Times Cited
1	Contractor underestimated program risk	8
2	Government failed to understand program risk	7
3	Government failed to appropriately define the program's requirements	6
4	Contractor underestimated technology maturity at program initiation	6
5	Late contract award results in funding profile that does not match contractor's plan	5
6	Contractor struggled integrating technologies into program context	3
7	Contractual cost or schedule incentives outweigh performance requirements	1

Table 16: Description of Root Causes for "The Bow Wave Effect"

3.2.2.5   Firefighting Archetype Responses

The fifth principle question portion of the survey asked the respondent to think about the "Firefighting" archetype.[203] Two of the respondents did not answer this question. Thirty-seven (37) respondents (56.9%) confirmed this behavior had occurred in their program. Of these, 19 agreed that the behavior led to measureable cost growth on the program (51.4%), and another 24 respondents also agreed that the behavior led to measurable schedule growth on the program (64.9%).

The 37 respondents that confirmed seeing this type of behavior were provided with a list of eight possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The mean number of potential root causes identified per survey was 2.24. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 19. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 17. Responses that were obtained from the Open Response area are preceded by an "(OR)".
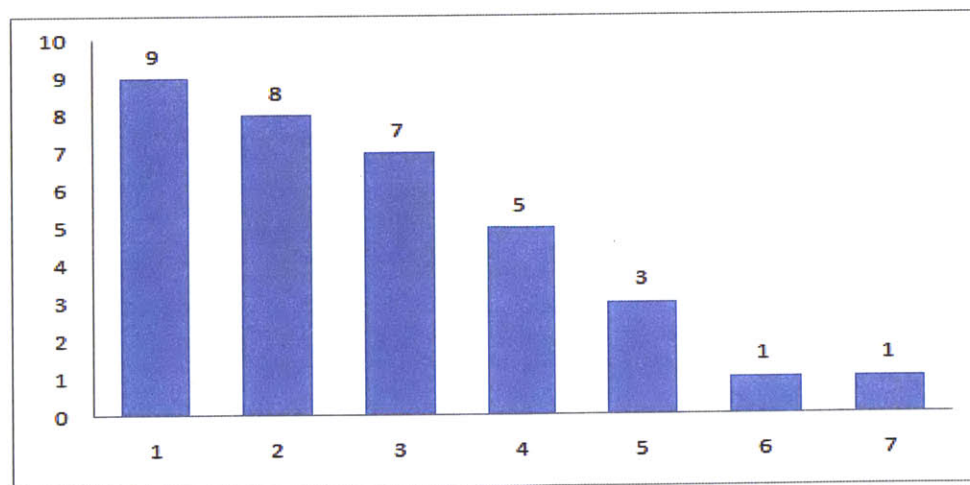
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[203] CMU SEI (2007d).

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Figure 19: Pareto Chart of Root Causes for "Firefighting"

#	Description	# Times Cited
1	Government failed to appropriately define the program's requirements	14
2	Contractor underestimated program risk	14
3	Contractor did not assign sufficient personnel to tasks to complete work on time	13
4	Contractor did not assign correct types of personnel to tasks	11
5	Contractor struggled integrating technologies into program context	9
6	Contractor focused on meeting contractual cost or schedule incentive	6
7	Contractor did not sufficiently understand program requirements	6
8	Contractor underestimated technology maturity at program initiation	5
9	(OR) The government, as a whole, constantly was changing direction as to what it wanted to do, causing the PM basically defend the program the government orginally wanted and then unable to decide which way it wanted to change it to	1
10	(OR) Contractor personnel were redirected to higher priority program in trouble	1
11	(OR) Technical risk; slack was built into schedule	1
12	(OR) Government stakeholders didn't clarify their concerns until late in MDD	1
13	(OR) Gov't did not assign sufficient personnel to tasks	1

Table 17: Description of Root Causes for "Firefighting"

3.2.2.6   Staff Burnout and Turnover Archetype Responses

The sixth question set of the survey asked the respondent to think about the "Staff Burnout and Turnover" archetype.[204]   On this question set, three of the respondents failed to answer this question. Twenty-eight (28) respondents (43.1%) believed this behavior had occurred in their program. Of these, nine perceived that the behavior led to measureable cost growth on the program (32%) and 12 respondents also agreed that the behavior led to measurable schedule growth on the program (43%).

The 28 respondents that confirmed seeing this type of behavior were provided with a list of seven possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The average number of potential root causes identified per survey respondent was 1.57. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 20. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 18. Responses that were obtained from the Open Response area are preceded by an "(OR)".
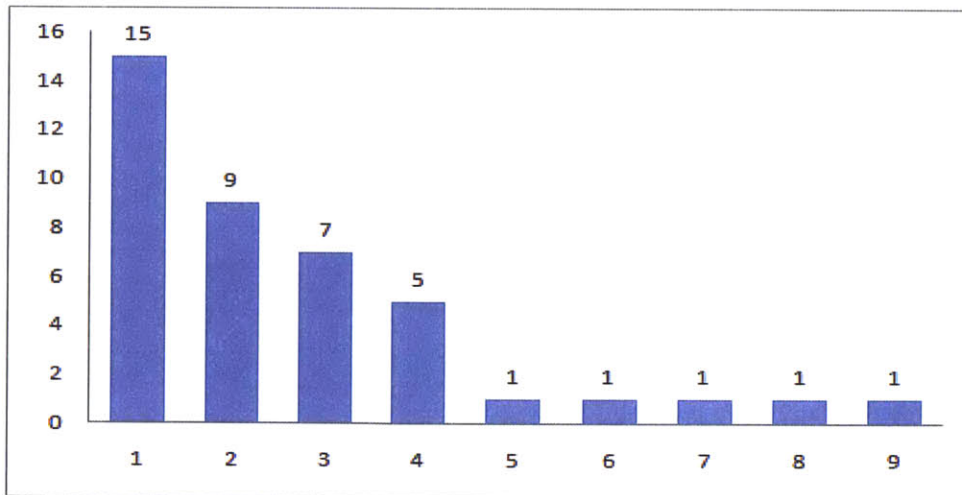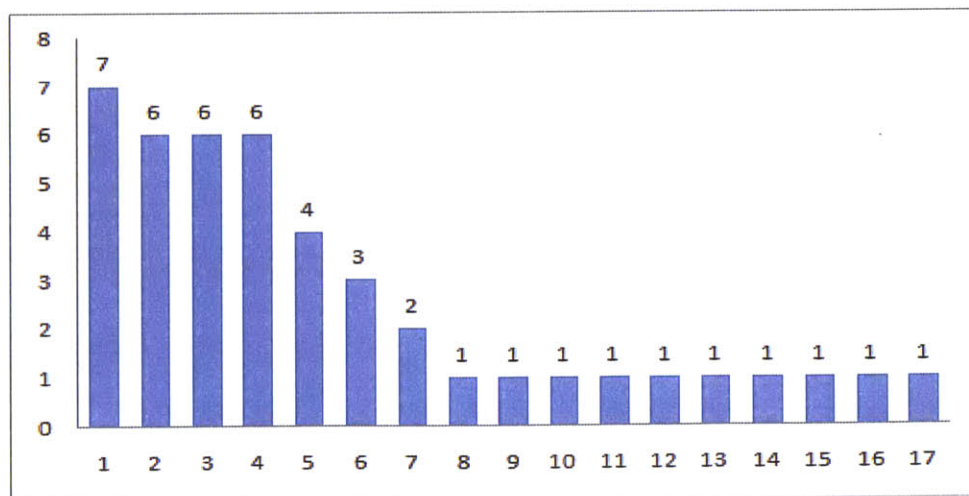

Figure 20: Pareto Chart of Root Causes for "Staff Burnout and Turnover"

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[204] CMU SEI (2007i).

#	Description	# Times Cited
1	Contractor did not assign correct types of personnel to tasks	7
2	Contractor focused on meeting contractual cost or schedule incentive	6
3	Contractor did not assign sufficient personnel to tasks to complete work on time	6
4	Program encountered significant problems during testing requiring fix or redesign	6
5	Contractor struggled integrating technologies into program context	4
6	(OR) Government did not assign sufficient personnel for program support (paraphrasing three open responses)	3
7	Government proposed inappropriate contract type for program phase	2
8	Contractor underestimated technology maturity at program initiation	1
9	(OR) Program Mgt Office "cleaned house" and replaced most key positions. The new persons "second guessed" every previous decision	1
10	(OR) Tremendous levels of HQ oversight leads to excessive reporting	1
11	(OR) Additional quantities and performance requirements contributed to burnout	1
12	(OR) Does not lead to cost/schedule increase, in many cases peoples careers are affected as they are not allowed to move and broaden	1
13	(OR) The PMO & contractor, after significant amounts of being pulled in so many directions so many times burned out and lost their sense of urgency	1
14	(OR) Base Realignment and Closure Commission	1
15	(OR) Congressional Oversight	1
16	(OR) Poor selection of leadership for ACAT ID program	1
17	(OR) Contractor removed technical personnel from program and lost design continuity as project went into the testing phase	1

Table 18: Description of Root Causes for "Staff Burnout and Turnover"

3.2.2.7   PMO versus Contractor Hostility Archetype Responses

The seventh principle question division of the survey asked the respondent to think about the "PMO versus Contractor Hostility" archetype.[205] Four of the respondents did not answer this question. Eighteen (18) respondents (27.7%) felt that this behavior had occurred in their program. Of these, nine agreed that the behavior led to measureable cost growth on the program (50%). Further, 10 of the respondents also agreed that the behavior led to measurable schedule growth on the program (55.6%).

The 18 respondents that confirmed seeing this type of behavior were provided with a list

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[205] CMU SEI (2007g).

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of five possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The average number of potential root causes identified per survey respondent was 1.44. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 21. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 19. Responses that were obtained from the Open Response area are preceded by an "(OR)".
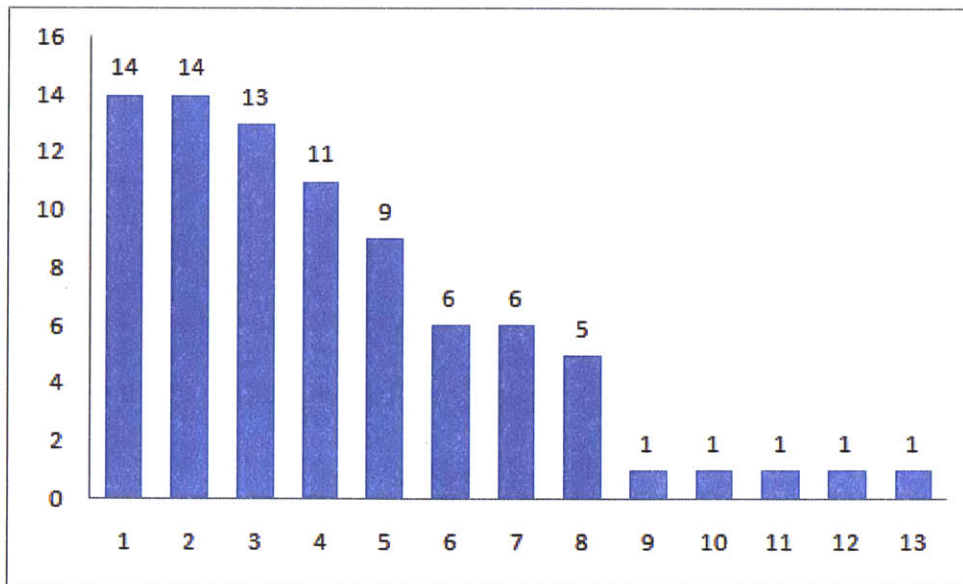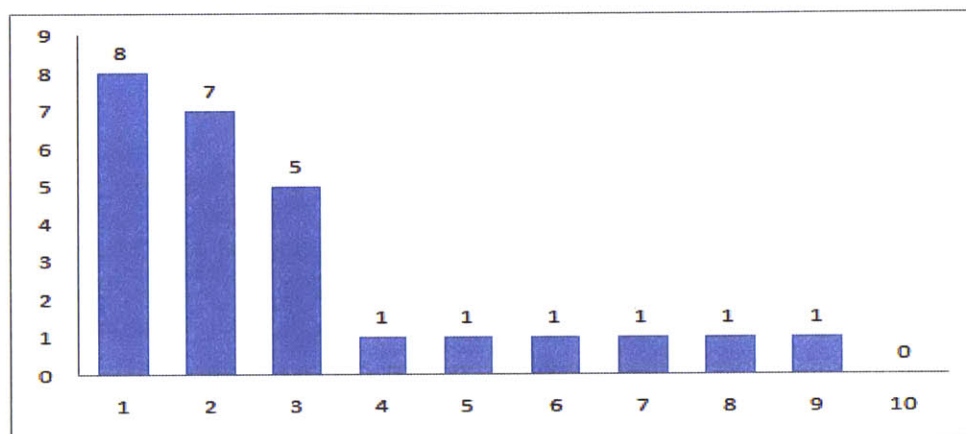

Figure 21: Pareto Chart of Root Causes for "PMO vs Contractor Hostility"

#	Description	# Times Cited
1	Contractor focused on meeting contractual cost or schedule incentive	8
2	Contractor focused on getting into production to perpetuate business base	7
3	Government failed to appropriately define the program's requirements	5
4	Government did not include any performance incentives in the contract	1
5	(OR) More prevelant on FFP contracts. Any discovery is now considered contract change. Systems Engineers are not needed, however lawyers are needed	1
6	(OR) Flawed "commercial like" acq strategy	1
7	(OR) Contractor moved program manager to better opportunity. He was replaced with a bad apple...who was eventually removed. This lead to a lot of turmoil and wasted management effort	1
8	(OR) Contractor focused blame away from self to preserve fee; tried to REA govt to reduce contractor caused cost/schedule growth	1
9	(OR) Program had three contractors; contractor parties were tripping over the established working relationships and not communicating appropriately	1
10	Government proposed inappropriate contract type for program phase	0

Table 19: Description of Root Causes for "PMO vs Contractor Hostility"

3.2.2.8   Robbing Peter to Pay Paul Archetype Responses

The eighth portion of the survey asked the respondent to think about the "Robbing Peter to Pay Paul" archetype.[206] Again, four of the respondents chose not to answer this question. Twenty (20) respondents (30.8%) saw this behavior in their program. Of these, nine agreed that the behavior led to measureable cost growth on the program (45%). Fourteen (14), however believed that the behavior led to measurable schedule growth on the program (70%).

The 20 respondents that confirmed seeing this type of behavior were provided with a list of four possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The average number of potential root causes identified per survey respondent was 1.55. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 22. The list of the responses corresponding to the numbers in the Pareto Chart is shown immediately below in Table 20. Responses that were obtained from the Open Response area are preceded by an "(OR)".
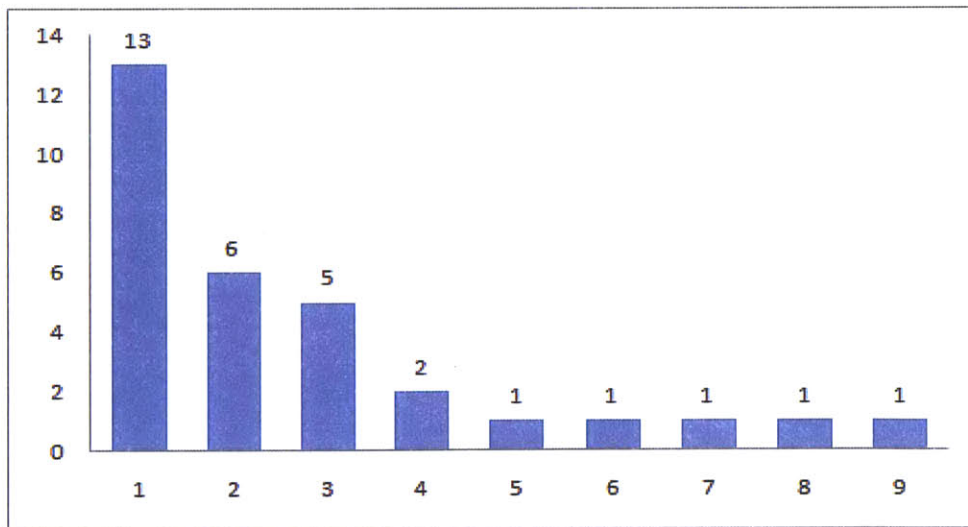
Figure 22: Pareto Chart of Root Causes for "Robbing Peter to Pay Paul"

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[206] CMU SEI (2007h).

#	Description	# Times Cited
1	Unable to meet financial execution goals due to continuing resolution/funds release	13
2	Funding profile does not match contractor's plan	6
3	Contractor behind schedule inadequate number of personnel assigned to program	5
4	Unable to meet financial execution goals due to late contract award due to protest	2
5	(OR) Impact with acquiring new Navy financial system and IT rules with obligating funds	1
6	(OR) Underestimation of program development cycle..specifcally, fitting a cycle to funding stream	1
7	(OR) Underfunded programs. Base budget too small	1
8	(OR) Inadequate resources to obligate funds	1
9	(OR) Delay in contract award due to test failures (success required for DAB approval to award next production contract)	1

Table 20: Description of Root Causes for "Robbing Peter to Pay Paul"

3.2.2.9   Feeding the Sacred Cow Archetype Responses

The ninth section of the survey asked the respondent to think about the "Feeding the Sacred Cow" archetype.[207] Once again, all but four of the respondents answered this question, which had a different format from the other nine sections of the survey. Twelve (12) respondents (18.5%) felt that their program had been treated in this manner. This question was the only one that did not ask the respondent about whether this archetype led to measurable cost or schedule growth.

The 12 respondents that confirmed seeing this type of behavior were provided with a list of three possible root causes and a free response area to input any root cause that they believed was applicable, but not listed. The average number of potential root causes identified per survey respondent was 1.25. A Pareto Chart of the number of times each possible root cause was identified in the survey was selected is shown below in Figure 23. The list of the responses

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[207] CMU SEI (2007c).

corresponding to the numbers in the Pareto Chart is shown immediately below in Table 21.

Responses that were obtained from the Open Response area are preceded by an "(OR)".
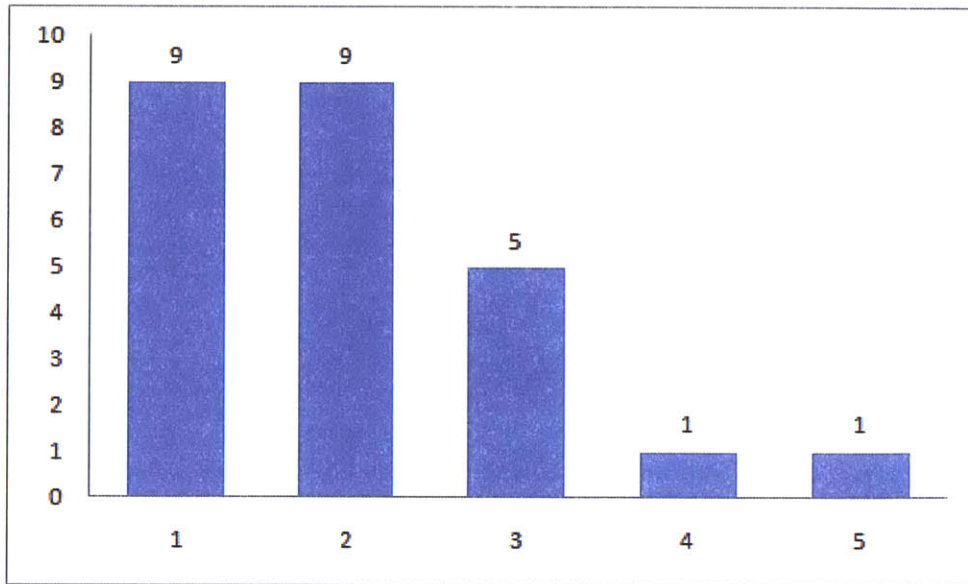
Figure 23: Pareto Chart of Root Causes for "Feeding the Sacred Cow"

#	Description	# Times Cited
1	No other program can provide capability of program	9
2	DoD/Service have invested heavily on program to date	9
3	Delay in fielding capability will significantly impact ability to support fielded forces	5
4	(OR) Program has proven to be the most efficient way to modernize C4I on submarines	1
5	(OR) Intense Congressional interest ensures I always have adequate funding	1

Table 21: Description of Root Causes for "Feeding the Sacred Cow"

3.2.2.10 'Happy Path' Testing Archetype Responses

The final division of the survey asked the respondent to think about the "'Happy Path' Testing" archetype.[208] For this last set of questions, four respondents did not provide inputs.

Sixteen (16) respondents (24.6%) confirmed this behavior had occurred in their program. Of

these, 10 agreed that the behavior led to measureable cost growth on the program (62.5%) and

nine felt that the behavior led to measurable schedule growth on the program (56.3%).

The 16 respondents that confirmed seeing this type of behavior were provided with a list

of six possible root causes and a free response area to input any root cause that they believed was

applicable, but not listed. The average number of potential root causes identified per survey

respondent was 1.93. A Pareto Chart of the number of times each possible root cause was

identified in the survey was selected is shown below in Figure 24. The list of the responses

corresponding to the numbers in the Pareto Chart is shown immediately below in Table 22.

Responses that were obtained from the Open Response area are preceded by an "(OR)".
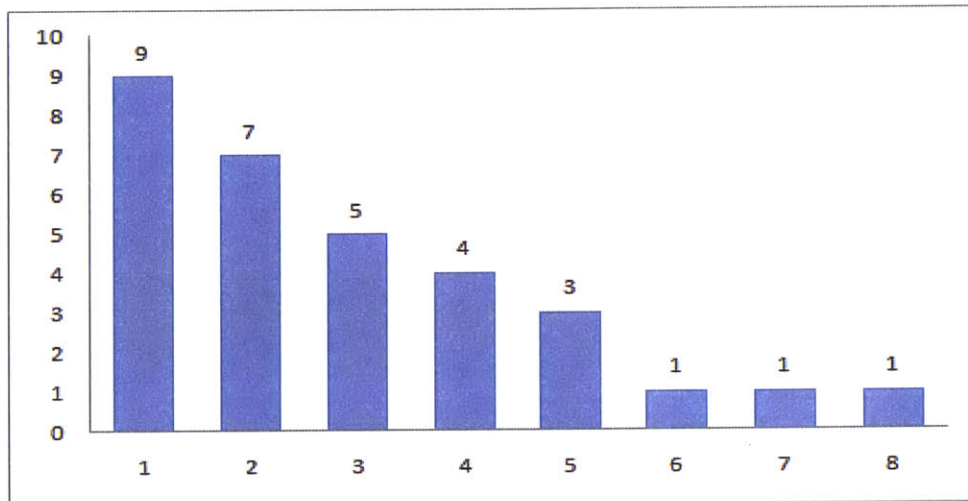
Figure 24: Pareto Chart of Root Causes for "'Happy Path' Testing"

#	Description	# Times Cited
1	Government poorly defined test program	9
2	Government failed to appropriately define the program's requirements	7
3	Contractor poorly defined test program	5
4	Government unable to delay fielding decision, shortening time for testing	4
5	Operational environment too expensive to replicate	3
6	Contractor unable to control schedule, shortening time for testing	1
7	(OR) Government test range was too busy to fully exercise system and didn't make proper upgrades to test advanced features	1
8	(OR) Government and contractor wanted weapon system fielded so it would not be cancelled by senior legislators	1

Table 22: Description of Root Causes for "'Happy Path' Testing"

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Chapter 4 – Analysis

This Chapter seeks to develop the understanding of the pure descriptive statistics obtained from the survey regarding the CMU SEI archetypes. Each of the CMU SEI archetype question sets will be examined in detail. This analysis will directly address the four research questions from Section 2.3.2. In particular, the first analysis for each question set will determine if the archetype has been reported with statistical significance. Following this, each archetype will be examined to see whether it led to reported measurable cost of schedule growth with statistical significance. Next, the connection between the reported root causes of the archetypical behavior and the areas being addressed by recent acquisition reform activity will be examined. Finally, relationships between the archetypes and the demographic data will be studied for any relationship.

For the purposes of the analysis of statistical significance for Research Questions 1 and 2, p-value testing was accomplished. For binomial distributions, statistics packages calculate the probability that the observed occurrence actually happened (based on sample size, number of successes, and the probability of observing the behavior). The p-value represents the probability of observing a more extreme response (either positive or negative) than the observed result.[209] For a 95% confidence that the result was statistically significant, the p-value must be less than 0.05.

To determine p-values, there are several conditions which must be met.[210] First, responses must be mutually exclusive and completely exhaustive. In the case of this survey, the "Yes" or "No" questions provided a mutually exclusive and completely exhaustive response set.

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[209] Hopkins, W.G. (2009).
[210] Hopkins, W.G. (2009).

The trials must be independent, meaning that no individual's response depends on the answer provided by another respondent. This condition is also met by the survey, as each person is responding with their personal observations and is not required to consult or answer similarly to any other individual. Finally, the probability of success (likelihood of noting the behavior) must be constant. For this survey, the probability of identifying the behavior was assumed to be 50%. All p-values were calculated using the online Binomial Mass Function calculator available from the University of Baltimore's website.[211]

With the small sample size accumulated in this survey and the probability of identifying the behavior fixed at 50%, it would require that 40 respondents noted the pattern of behavior for the finding to be considered statistically significant. However, if the probability of identifying the behavior is lowered, the number of respondents identifying the behavior becomes less to show statistical significance. Figure 25 below shows the sensitivity of the number of "Yes" responses required for statistical significance for 50%, 33%, 25%, and 20% probabilities of identifying the behavior. However, in the absence of any data to predict this reasonably, the likelihood of identifying the behavior was fixed at 50%.

[211] Arsham, H. (2010).
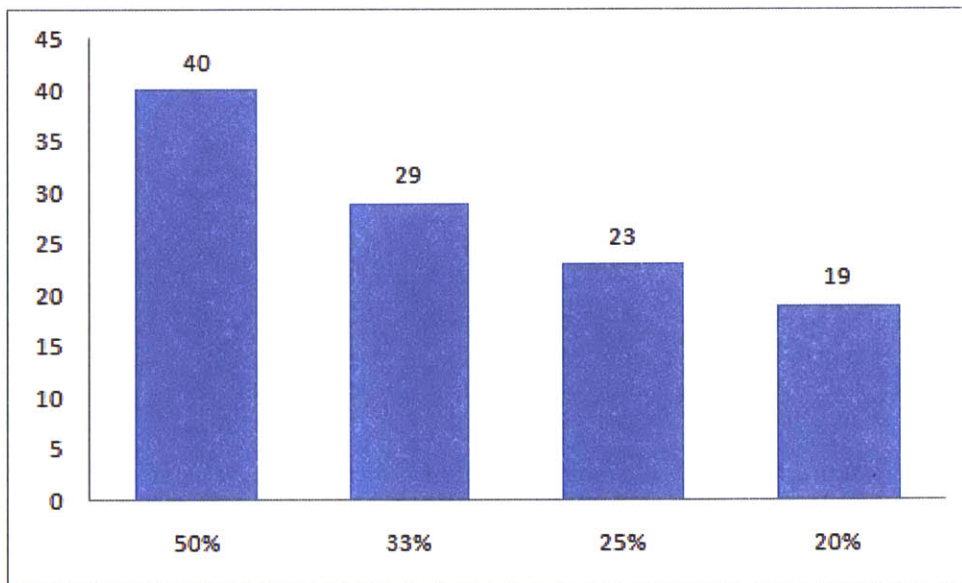
Figure 25: Sensitivity of Statistical Significance versus Likelihood of Identifying Behavior Pattern

Since the largest number of respondents noting any one pattern was 37 (p-value 0.16), none of the overall patterns of behavior are considered statistically significant. However, understanding the potential magnitude of the effect is often more important than whether the behavior is statistically significant.[212] Therefore, each section will discuss the magnitude of the occurrence of the behavior, and leave the determination of statistical significance for the reporting of measurable cost or schedule growth that resulted from the behavior.

For the statistical analysis to determine if there is any correlation between Program Size, Lead Service, or "Joint" Status of the program, a chi-square test was conducted. The chi-square test is used for categorical data to determine if there is a difference in the observed proportion of the sample and the expected proportion of the sample. This testing assumes that the null hypothesis is that there is no relationship between the two variables (in this case the program-specific characteristic being studied and the noted presence of the archetype in question). If the

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[212] Hopkins, W.G. (2009).

χ^2 value calculated is greater than the critical value (determined from tables based on level of statistical significance desired and number of degrees of freedom), then the null hypothesis is rejected and there is a relationship between the variables being studied.[213]

For the purposes of this research, the level of significance, α, was chosen to be 0.05, similar to the critical value determined for p-value testing. Numerous statistics books, on-line calculators, and programs such as Microsoft® Excel have tables with the critical values of χ^2. For the variables under study, the critical value is shown in Table 23. All chi-square calculations used in this research were performed using the "StatTools" Statistics Add-In for Microsoft® Excel, Version 5.5.[214]

Variable	Critical Value for α=0.05
Program Size	5.991
Lead Service	9.488
"Joint" Status	3.841

Table 23: Critical Value of α for Program Demographic Analysis

There was a broad spread of the number of archetypes noticed on each program, with several respondents identifying none of the archetypes and some identifying as many as nine on their current program. The average number of behavior patterns identified per respondent was 3.00 and the standard deviation was 2.31. Figure 26 below shows a histogram of the number of archetypes identified per respondent.

[213] Greenwood, P.E. and Nikulin, M.S. (2004).
[214] Palisade Corporation. (2010).
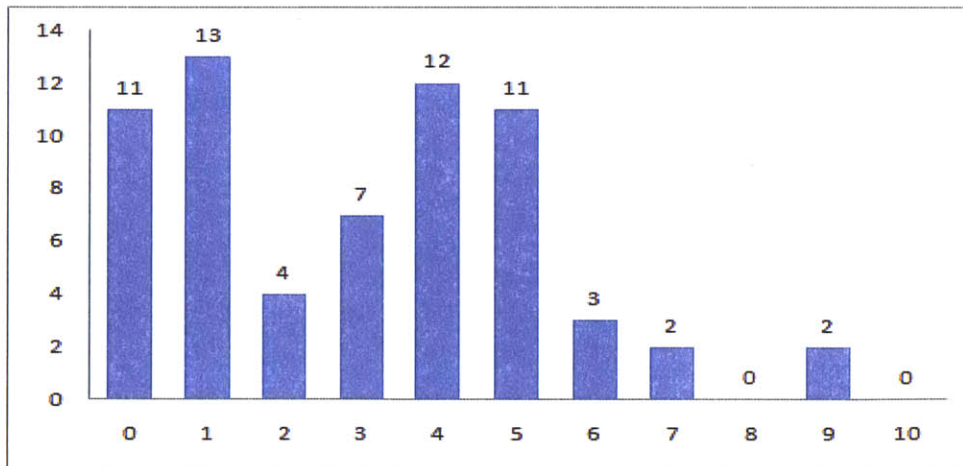
Figure 26: Number of Archetypes Identified By Respondent

The only true gauge of whether this type of response is reasonable is to compare the results of the ACAT I responses to the GAO's 2010 report on Stable Weapons Programs (GAO-10-522). This report analyzed the status of 63 Major Defense Acquisition Programs as of 2008, and reported that only 21% of them were considered stable (meaning on track to meet cost and schedule goals).[215] From the survey results, of the 30 responses from ACAT I programs (which can be equated to Major Defense Acquisition Programs), four (13%) reported observing none or only one of the archetypes (which did not lead to either cost or schedule growth). Two other responses (7%) indicated only one archetype present in their program, but both reported either measurable cost or schedule growth. Given that the results from the sample of ACAT I programs obtained via this survey have a reasonable match with the data collected from 63 Major Defense Acquisition Programs by the GAO, the sample appears valid.

4.1   "Underbidding the Contract" Response Analysis (Raw Data in Section 3.2.2.1)

The first research question relevant to this archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. Only 11 of the 65 respondents (the lowest

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[215] GAO (2010b). GAO-10-522.

percentage for any of the archetypes) believed that the "Underbidding the Contract" behavior happened on their program. As noted above, this result is not statistically significant in its own right. However, the fact that nearly 17% of respondents identified this behavior indicates it is an area that acquisition personnel should be vigilant to diagnose and avoid if possible.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 11 that saw the behavior, nine agreed that this behavior led to measurable cost growth (p-value 0.03) and ten agreed that "Underbidding the Contract" led to measurable schedule growth on their program (p-value 0.006). These results are statistically significant, and mean that if the behavior is noted, there is more than a 95% likelihood that the program will experience both cost and schedule growth.

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. Below is the Pareto Chart of the potential root causes, repeated from Section 3.2.2.1 for clarity (Figure 27), and it is followed Table 24 that has the description of the root cause along with the acquisition reform activities that are potentially addressing this area.
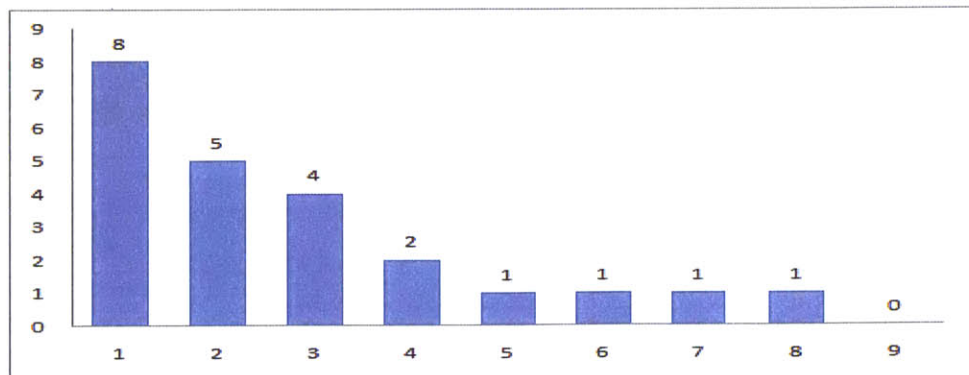
Figure 27: Pareto Chart of Root Causes for "Underbidding the Contract"

Disclaimer -- The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Air Force, the Department of Defense, or U.S. Government.

Description	Acquisition Reform Activities
1 - Contractor failed to understand the program risk	GAO-10-374T
2 - Government failed to understand program risk	GAO-10-374T
3 - Contractor under pressure to win fewer contracts available	USD(AT&L) 14 Sep 10 Memo
4 - Government failed to appropriately define the program's requirements	DAPA; GAO-08-62R; WSARA 2009
5 - Government unable to appropriately validate contractor proposal	DAPA; WSARA 2009; USD(AT&L) 14 Sep 10 Memo
6 - (OR) Underestimated the technical requirements even though they have the skill set	GAO-10-374T
7 - (OR) We were not able to "officially" recognize the fact the contractor was bidding on several other contracts and that when won had a significant resource/funding shortage	
8 - (OR) Gov't & KTR acquisition strategy that failed to recognize the importance of near term cash flow & ROI for a contractor and changing DoD climates -- relied on future success to offset early losses that didn't happen	
9 - Government proposed inappropriate contract type for program phase	USD(AT&L) 14 Sep 10 Memo

Table 24: Relationship of "Underbidding the Contract" Root Causes to Acquisition Reform Activities.

The two most common root causes, "Contractor failed to understand the program risk" and "Government failed to understand program risk" have their foundation in the recommendations from the 2010 GAO study on *Managing Risk to Achieve Better Outcomes*. In this report, the GAO suggests that cost and schedule growth occurs as both the government and contractor develop a better understanding of the scope of the requirements, and suggests that this should be done in advance of the contract award by using mature technologies.[216]

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[216] GAO (2010a). GAO-10-374T.

The response "Contractor under pressure to win fewer contracts available" was first identified by Grasso as a potential problem,[217] and subsequently noted in a recent report from The RAND Corporation on space systems cost estimation. In this report, RAND researchers concluded that one of the impacts of the contractor consolidations in the 1990s was that the remaining contractors were under immense pressure to win one of the small number of contracts available. As a result, these contractors were "tempted to underbid contracts to win them."[218] Carter focused on it in his 14 Sep 10 memorandum when he hinted the DoD Acquisition Community must "Do More Without More".[219] The USD(AT&L) memorandum would address this problem with a better understanding of the "should cost" for the contract. This would require the Government to do more up-front analysis of the contractor's proposal and a careful comparison to the independently developed "should cost" estimate to ensure that the contractor is proposing a reasonable cost (and not just accept significant underbids as being good for the Government).

For this archetype, there were two root causes identified by the respondents in the open response area provided that do not appear to have a direct relationship to current acquisition reform activity. The first of these, "We were not able to "officially" recognize the fact the contractor was bidding on several other contracts and that when won had a significant resource/funding shortage", is a procedural issue that will have to be addressed within the acquisition regulations for source selection activities. At the same time, though, it is also related to the idea that the contractor is competing for a limited number of programs, and therefore

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[217] Grasso, V.B. (2002).
[218] Younossi, O., et.al. (2008).
[219] USD(AT&L) Memorandum. (2010).

proposes their best people for a number of possible contracts. If they win multiple contracts simultaneously where the people were bid against several (as indicated by the respondent), then there will be a shortage of personnel leading to schedule (and potentially cost) increases. The second unaffiliated open response, "Government & Contractor acquisition strategy that failed to recognize the importance of near term cash flow & Return on Investment (ROI) for a contractor and changing DoD climates -- relied on future success to offset losses that didn't happen", is also something that has to be addressed by the source selection and contracting regulations. Currently, there are multiple options for creating progress payments during a contract, and the government and contractor must work together to develop a plan that accounts for business realities (ROI). However, the emphasis on increasing competition at the prime contract and sub-contract levels throughout the life cycle of the product will impact decisions such as the one referenced here.[220] The threat of continuous competition throughout the life cycle will make contractors focus on the current contract and not underbid the early contracts with the intent of making large profits later once the Government is locked-in to a sole-source relationship.

Of interest is the fact that none of the respondents identified "Government proposed inappropriate contract type for program phase" as a probable root cause for the "Underbidding the Contract" behavior. The literature search revealed that there has been a very cyclic approach to contract type, alternating between Firm-Fixed Price and Cost-Plus over the past 30-40 years (see Section 2.1.1). The recent USD(AT&L) 14 Sep 2010 memorandum again changes the current policy preference for contract type (to Fixed-Price Incentive Fee).[221] Further research

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[220] Public Law 111-23 (2009). Title II.
[221] USD(AT&L) Memorandum. (2010).

should be conducted to determine if this change is really needed and if the approach proposed adequately addresses any perceived problems.

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 25 below shows the breakdown of each of these demographic areas of interest for the 11 respondents that identified the "Underbidding the Contract" behavior.

Program Size	# Yes	# No
ACAT I	7	23
ACAT II/III	2	17
Other	2	14

Lead Service	# Yes	# No
AF	5	16
Army	1	11
USMC	2	8
Navy	1	11
Other	2	8

"Joint" Status	# Yes	# No
Single	9	39
Joint	2	15

Table 25: "Underbidding the Contract" Demographic Breakdown

The data shown in Table 25 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 26.

Variable	Chi-Square Value	Critical Value
Program Size	1.652	5.991
Lead Service	2.103	9.488
"Joint"Status	0.436	3.841

Table 26: Chi-Square Values for "Underbidding the Contract"

Based on these results, the calculated chi-square value is less than the critical value, and therefore the null hypothesis is not rejected. This means that based on the sample taken, there is no statistical relationship between either program size, lead service, or "joint" status for the "Underbidding the Contract" archetype.

4.2   "Longer Begets Bigger" Response Analysis (Raw Data in Section 3.2.2.2)

The first research question for the "Longer Begets Bigger" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. Fifteen of the 65 respondents believed that the "Longer Begets Bigger" behavior happened on their program. As noted above, this result is not statistically significant in its own right. However, the fact that nearly 25% of respondents identified this behavior indicates that this is an area that acquisition personnel must consider and try to avoid when defining an acquisition program. Further, this remains an emphasis area for DoD Acquisition Reform activities, as both the DAPA and recent GAO reports have commented on the need to shorten acquisition timelines.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 15 respondents that noted the "Longer Begets Bigger" behavior, 12 agreed that this behavior led to measurable cost growth (p-value 0.018) and 12 (but not the same 12) agreed that Longer Begets Bigger behavior led to measurable schedule growth on their program (p-value also 0.018). These results are statistically significant, and mean that if the behavior is noted, there is more than a 95% likelihood that the program will experience both cost and schedule growth (actually more than a 98% likelihood, in this case).

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. The respondents felt that all five of the offered potential root causes were applicable, in varying degrees, and offered two open responses. The same Pareto Chart from Section 3.2.2.2 is repeated below as Figure 28 for clarity. It is followed by Table 27 describing the corresponding descriptions and their relationship to current acquisition reform activities.

Figure 28: Pareto Chart of Root Causes for "Longer Begets Bigger"

Description	Acquisition Reform Activities
1 - Contractor struggled integrating technologies into program context	GAO-08-62R; GAO-10-374T
2 - Government failed to appropriately define the program's requirements	DAPA; GAO-08-62R; WSARA 2009
3 - Contractor underestimated technology maturity at program initiation	GAO-08-62R; GAO-10-374T
4 - Contractor failed to understand program risk	GAO-10-374T
5 - Poor financial execution rates result in rescission of program funding	DAPA, HASC 2010
6 - (OR) Government didn't have enough funding and Contractor didn't have enough experienced engineers	USD(AT&L) 14 Sep 10
7 - (OR) Late engineering drawings, longer, inefficient mod, misjudged airworthiness risk, misjudged flight test time	

Table 27: Relationship of "Longer Begets Bigger" Root Causes to Acquisition Reform Activities

Two of the four most cited root causes for the "Longer Begets Bigger" behavior noted by the survey participants involved technology, either its maturity level or the contractor's ability to integrate it successfully into the program. DAPA noted that technology is one of the most important areas for the DoD, and not surprisingly is integral to maintaining our technological advantage.[222] That said, the respondents to this survey agreed with the GAO in its conclusion that the DoD needs to initiate programs using mature technology which could address both of the root causes. The GAO has been expressing this as a best practice for the past several years.[223, 224]

The second most cited root cause for "Longer Begets Bigger" is the Government's inability to properly define the program's requirements. This was an area that both the DAPA[225] and the House Armed Services Committee Panel on Defense Acquisition Reform[226] focused on, because it is part of the "Big A" DoD Acquisition system, but outside the specific control of the "Little a" acquisition process of the program manager. The GAO also cited having clearly defined and controlled requirements as a key to success and a best practice.[227] While it is too early to tell if it will have the desired impact, the WSARA of 2009's requirement to include the Combatant Commanders as part of the requirements process (a partial implementation of the DAPA recommendations) may bring a more focused, operational, and urgent approach to the initial definition of program requirements.[228]

Similar to the top two responses to the "Underbidding the Contract" archetype, the final proposed root causes of the top four responses deals with understanding risk. As noted in

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[222] Kadish, R., et. al. (2006).

[223] GAO (2007). GAO-08-62R.

[224] GAO (2010a). GAO-10-374T.

[225] Kadish, R., et. al. (2006).

[226] Andrews, R., et. al., (2010).

[227] GAO (2007). GAO-08-62R.

[228] Public Law 111-23 (2009). Title I.

Section 4.1, the GAO maintains that programs must learn to manage risk better, starting with a clear understanding of the requirements and using mature technologies to start programs.[229]

The only root cause offered by a respondent that did not have a direct correlation to current acquisition reform activity was "Late engineering drawings, longer, inefficient mod, misjudged airworthiness risk, misjudged flight test time." This root cause seems to indicate that the program grew in schedule because of poor performance by the contractor (late engineering drawings, inefficient mod), but also includes an element of failure to understand the program risk that resulted in the "misjudged airworthiness risk".

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 28 below shows the breakdown of each of the demographic areas of interest for the 15 respondents that identified the "Longer Begets Bigger" behavior.

Program Size	# Yes	# No
ACAT I	7	23
ACAT II/III	3	16
Other	5	11

Lead Service	# Yes	# No
AF	6	15
Army	2	10
USMC	2	8
Navy	3	9
Other	2	8

"Joint" Status	# Yes	# No
Single	11	37
Joint	4	13

Table 28: "Longer Begets Bigger" Demographic Breakdown

[229] GAO (2010a). GAO-10-374T.

The data shown in Table 28 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 29.

Variable	Chi-Square Value	Critical Value
Program Size	1.172	5.991
Lead Service	0.767	9.488
"Joint"Status	0.003	3.841

Table 29: Chi-Square Values for "Longer Begets Bigger"

Based on these results, the calculated chi-square value is less than the critical value, and therefore the null hypothesis is not rejected. This means that based on the sample taken, there is no statistical relationship between either program size, lead service, or "joint" status for the "Longer Begets Bigger" archetype.

4.3 "Everything to Everybody" Response Analysis (Raw Data in Section 3.2.2.3)

The first research question for the "Everything to Everybody" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. Twenty-three (23) of the 65 respondents believed that the "Everything to Everybody" behavior happened on their program. As noted above, this result is not statistically significant in its own right. However, the fact that over 35% of respondents identified this behavior indicates acquisition personnel should learn to recognize and avoid this behavior because of its detrimental impact to programs. Like the "Longer Begets Bigger" behavior, this area is also emphasized in current DoD Acquisition Reform activities, as the DAPA, recent GAO reports, and the WSARA of 2009 have addressed the need to adequately define requirements and control requirements creep.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 23 respondents that noted the "Everything to Everybody" behavior, 18 agreed that this behavior led to measurable cost growth (p-value 0.005). Another 20 respondents agreed that Everything to Everybody behavior led to measurable schedule growth on their program (p-value 0.0002). As both of these results have p-values less than 0.05, they are statistically significant. Further, the p-values for both cost growth and schedule growth are less than 0.01, meaning that if the "Everything to Everybody" behavior is present on the program, there is more than a 99% likelihood that the program will experience both cost and schedule growth.

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. The respondents felt that all four of the offered potential root causes were applicable, in varying degrees, and offered five open responses. The same Pareto Chart from Section 3.2.2.3 is repeated below as Figure 29 for clarity. It is followed by Table 30 describing the corresponding descriptions and their relationship to current acquisition reform activities.
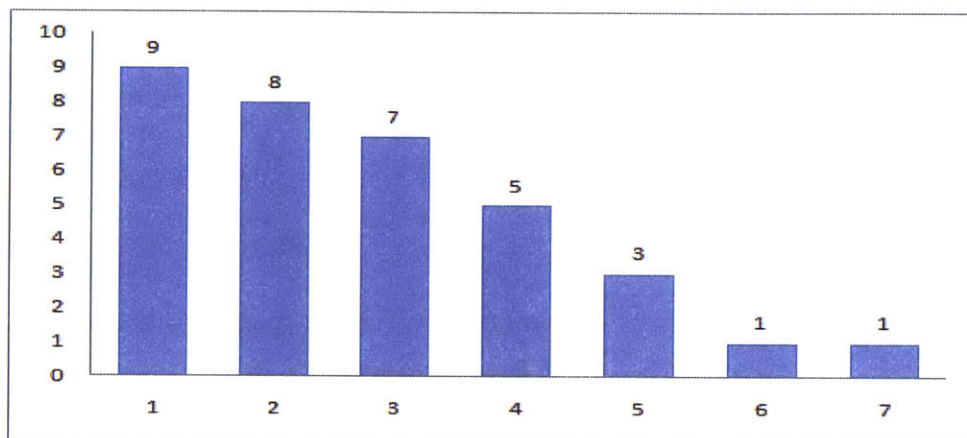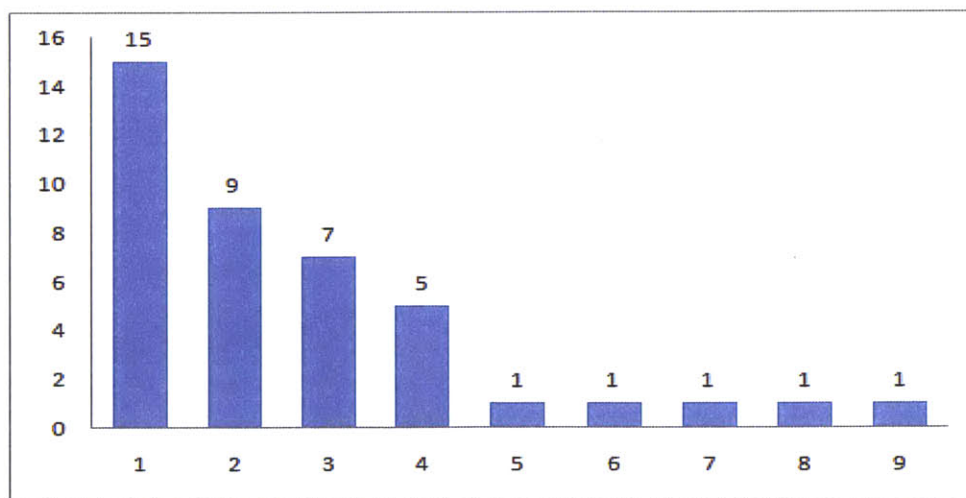

Figure 29: Pareto Chart of Root Causes of "Everything to Everybody"

Description	Acquisition Reform Activity
1 - Requirements changed after program initiation to accommodate additional users	DAPA; GAO-08-62R; WSARA 2009; HASC 2010
2 - Government failed to appropriately define the program's requirements	DAPA; GAO-08-62R; GAO-10-374T; WSARA 2009
3 - Contractor failed to understand complexity driven by multiple external interfaces	WSARA 2009
4 - Requirements added to obtain approval for program initiation	HASC 2010
5 - (OR) Requirements added because PM thought it was important without impact to additional cost and schedule	DAPA; GAO-08-62R; WSARA 2009
6 - (OR) Technology improvements and obsolescence issues also have impacted growth	DAPA; GAO-08-62R; GAO-10-374T
7 - (OR) New weapon integrated on a new aircraft (JSF) with new interfaces	
8 - (OR) Adding the requirements was not too bad it was the government's approval process that added months and increased cost significantly	DAPA; GAO-08-62R; WSARA 2009
9 - (OR) Perception by the end-user that they need everything just in case	WSARA 2009

Table 30: Relationship of "Everything to Everybody" Root Causes to Acquisition Reform Activities

Much like the some of the top responses to the "Longer Begets Bigger" archetype questions, the top two root causes, cited more than all others combined, deal with requirements. In addition, four of the open responses are in many ways linked to the same concept, an increase in the number of requirements during the execution of the program. Combined, these responses should not be a surprise, given the nature of the archetype which suggests that programs grows in cost and schedule due to the attempt to please everyone by including their requirements. The clear signal here is that the House Armed Services Committee Panel on Defense Acquisition Reform[230] and DAPA's[231] emphasis on addressing the requirements process of the "Big A"

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[230] Andrews, R., et. al., (2010).
[231] Kadish, R., et. al. (2006).

Disclaimer -- The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Air Force, the Department of Defense, or U.S. Government.

Acquisition System and the GAO's recital of best practices relative to ensuring stable requirements during program execution[232,233] are right on target.

The third most cited root cause for this behavior was failure by the contractor to understand the complexity driven by multiple external interfaces. While this initially looks like a failure to understand program risk (which is part of the problem), the underlying root causes is in the failure to properly perform systems engineering. The WSARA of 2009 is attempting to address this within the DoD by elevating the role of the Director of System Engineering within the USD(AT&L) hierarchy.[234] This will increase the emphasis placed on the creation and updating of the Systems Engineering Plan that must be approved by the USD(AT&L) staff before obtaining Milestone approval for Major Defense Acquisition Programs. These documents are created by the Program Office staff, but usually have support from the contractor as well. One recommendation from this research is that these Systems Engineering Plans need to clearly address the challenges of external interfaces.

The fourth most cited root cause was "Requirements added to obtain approval for program initiation." This pattern exemplifies the "Everything to Everybody" archetype by including everyone's requirements just to get a program started. The current process, the Joint Capabilities Integration and Development System (JCIDS), defines the roles of the participants and the process used to establish requirements for DoD programs.[235] While the Andrews, et.al. House Armed Services Committee Report of 2010 also suggested that this is a problem[236], there

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[232] GAO (2007). GAO-08-62R.
[233] GAO (2010a). GAO-10-374T.
[234] Public Law 111-23 (2009). Title I.
[235] Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170-01G (2009).
[236] Andrews, R., et. al., (2010).

does not appear to be any current acquisition reform activity focused on revising or changing the JCIDS process that would address this concern.

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 31 below shows the breakdown of each of the demographic areas of interest for the 23 respondents that identified the "Everything to Everybody" behavior.

The data shown in Table 31 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 32.

Program Size	# Yes	# No
ACAT I	13	17
ACAT II/III	4	15
Other	6	10

Lead Service	# Yes	# No
AF	7	14
Army	6	6
USMC	0	10
Navy	6	6
Other	4	6

"Joint" Status	# Yes	# No
Single	13	35
Joint	10	7

Table 31: "Everything to Everybody" Demographic Breakdown

Variable	Chi-Square Value	Critical Value
Program Size	2.567	5.991
Lead Service	7.850	9.488
"Joint"Status	5.532	3.841

Table 32: Chi-Square Values for "Everything to Everybody"

Based on these results, the calculated chi-square value is less than the critical value for both program size and lead service, and therefore the null hypothesis is not rejected for these variables. This means that based on the sample taken, there is no statistical relationship between either program size or lead service for the "Everything to Everybody" archetype.

However, for the "Joint" Status demographic, the calculated chi-square value is greater than the critical value. This means that the null hypothesis is rejected, indicating that there is some relationship between "Joint" status and the presence of the "Everything to Everybody" archetype. Digging into the data generated by the StatTools 5.5 program[237], the reason that this relationship appears to be present is based on a higher than expected presence of the archetype in "Joint" programs (identified 10 times, but would be expected to be present only 6 times based on the sample size and number of respondents identifying the behavior). As this was a 2x2 analysis, this corresponded to a lower than expected presence of the behavior pattern in "single service" programs (identified 13 times, but expected to be seen 17 times). This finding seems to make sense, as the behavior pattern is based on having a diverse set of requirements from multiple ("joint") users which leads to more capability and complexity than would be required to meet the needs of a single user.

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[237] Palisade Corporation. (2010). "StatTools 5.5: Statistics Add-In For Microsoft® Excel". Ithaca NY.

4.4   "The Bow Wave Effect" Response Analysis (Raw Data in Section 3.2.2.4)

The first research question for "The Bow Wave Effect" archetype is whether the pattern

of behavior occurs in the larger DoD Acquisition System. Fifteen (15) of the 65 respondents

believed that "The Bow Wave Effect" occurred on their program. This result is not statistically

significant. However, the fact that nearly 25% of respondents identified this behavior pattern

suggests that it is something that acquisition personnel should learn to identify, understand, and

be able to avoid when possible. One thing that should be watched carefully in acquisition

programs employing the DoDI 5000.02-favored evolutionary (or spiral) acquisition approach[238]

is whether this concept unwittingly leads to "The Bow Wave Effect" where the more difficult

requirements are delayed to later portions of the program, jeopardizing the ability to deliver the

entire capability planned.

The second research question attempts to determine if this behavior, if noted in DoD

Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 15 respondents

that noted "The Bow Wave Effect", 12 agreed that this behavior led to measurable cost growth

(p-value 0.018). A separate 13 respondents agreed that "The Bow Wave Effect" led to

measurable schedule growth on their program (p-value 0.004). Once again, both of these results

have p-values less than 0.05, therefore they are statistically significant. Further, the p-values for

both cost growth and schedule growth are less than 0.02, meaning that "The Bow Wave Effect",

when present, leads to more than 98% likelihood that the program will experience both cost and

schedule growth.

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[238] DoDI 5000.02 (2008).

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. The respondents felt that all seven of the offered potential root causes were applicable, in varying degrees, and no open responses were received. The same Pareto Chart from Section 3.2.2.4 is repeated below as Figure 30 for clarity. It is followed by Table 33 describing the corresponding descriptions and their relationship to current acquisition reform activities.

Figure 30: Pareto Chart of Root Causes of "The Bow Wave Effect"

Description	Acquisition Reform Activity
1 - Contractor underestimated program risk	GAO-10-374T
2 - Government failed to understand program risk	GAO-10-374T
3 - Government failed to appropriately define the program's requirements	DAPA
4 - Contractor underestimated technology maturity at program initiation	GAO-08-62R; GAO-10-374T
5 - Late contract award results in funding profile that does not match contractor's plan	
6 - Contractor struggled integrating technologies into program context	GAO-08-62R; GAO-10-374T
7 - Contractual cost or schedule incentives outweigh performance requirements	

Table 33: Relationship of "The Bow Wave Effect" Root Causes to Acquisition Reform Activities

For "The Bow Wave Effect" archetype, the two most cited root causes were the same as the top two root causes of the "Underbidding the Contract" archetype. While stable requirements and technological maturity are not the only factors that lead to risk in programs, they are significant contributors as suggested by the GAO.[239]

Similar to earlier findings, the Government's failure to properly define the program's requirements is another oft-cited reason for "The Bow Wave Effect". Relative to this pattern of behavior, however, the issue is not that the requirements have not been defined properly at the highest levels (as addressed by DAPA[240] and House Armed Services Committee Panel on Defense Acquisition Reform[241]), rather it is that program management has either not defined the requirements properly for the current delivery increment or has made poor choices in the allocation of work to ensure the requirements are met. The only acquisition reform recommendation targeted at this was from the DAPA, which recommended that program managers be delegated the authority to defer "non-key" requirements to later increments in order to ensure a DAPA priority, time-certain development.[242]

Again, similar to several of the prior archetypes, the level of technological maturity was a key factor in "The Bow Wave Effect". The respondents once again confirmed the GAO conclusion that the DoD needs to initiate programs using mature technology, something that the GOA has expressed as a best practice since at least 2008.[243, 244]

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[239] GAO (2010a). GAO-10-374T.
[240] Kadish, R., et. al. (2006).
[241] Andrews, R., et. al. (2010).
[242] Kadish, R., et. al. (2006).
[243] GAO (2007). GAO-08-62R.
[244] GAO (2010a). GAO-10-374T.

Although it was proposed as a potential root cause by the survey, the connection between late contract award and "The Bow Wave Effect" was not expressly clear. One-third of the respondents that identified "The Bow Wave Effect" (5/15) identified this as a problem. More research into this area should be considered to determine what this link manifests and what possible countermeasures could be employed.

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 34 below shows the breakdown of each of the demographic areas of interest for the 15 respondents that identified "The Bow Wave Effect" behavior.

Program Size	# Yes	# No
ACAT I	10	20
ACAT II/III	1	18
Other	4	12

Lead Service	# Yes	# No
AF	5	16
Army	3	9
USMC	2	8
Navy	3	9
Other	2	8

"Joint" Status	# Yes	# No
Single	12	36
Joint	3	14

Table 34: "The Bow Wave Effect" Demographic Breakdown

The data shown in Table 34 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 35.

Variable	Chi-Square Value	Critical Value
Program Size	5.208	5.991
Lead Service	0.163	9.488
"Joint"Status	0.382	3.841

Table 35: Chi-Square Values for "The Bow Wave Effect"

Based on these results, the calculated chi-square value is less than the critical value, and therefore the null hypothesis is not rejected. This means that based on the sample taken, there is no statistical relationship between either program size, lead service, or "joint" status for "The Bow Wave Effect" archetype.

4.5 "Firefighting" Response Analysis (Raw Data in Section 3.2.2.5)

The first research question for the "Firefighting" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. The highest number of respondents, 37, identified that "Firefighting" happened on their program. Once again, this result is not statistically significant in its own right. Repenning's work (2001) suggests that firefighting is a likely occurrence in a multi-project product development system.[245] This essentially resembles the DoD acquisition system, where the DoD utilizes small numbers of large companies as its prime contractors. Each of these prime contractors is in effect a multi-project product development system, and therefore subject to firefighting. With over 55% of respondents identifying this behavior, it reinforces Repenning's conclusion and suggests that it is imperative for acquisition personnel to be able to recognize and deter this behavior.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 37 respondents that noted "Firefighting" behavior, 19 felt that it led to measurable cost growth (p-value 0.5).

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[245] Repenning, N.P. (2001).

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With a p-value of 0.5, this means that roughly 50% of programs experiencing "Firefighting"
behavior will experience cost growth, and that result is NOT statistically significant. Twenty-
four of the 37 respondents agreed that "Firefighting" led to measurable schedule growth on their
program (p-value 0.049). This result is statistically significant, indicating a 95% likelihood of
measurable schedule growth when "Firefighting" occurs. Given how close the p-value is to the
0.05 cut-off for statistical significance, this question should be revisited if another survey sample
is obtained to determine the true correlation between schedule increase and this behavior using a
different (and larger) sample.

The third research question seeks to identify links between the likely root causes
identified by the respondents and the areas being addressed by recent acquisition reform activity.
The respondents felt that all eight of the offered potential root causes were applicable, in varying
degrees, and offered five other possible root causes in the open response area. The same Pareto
Chart from Section 3.2.2.5 is repeated below as Figure 31 for clarity. It is followed by Table 36
describing the corresponding descriptions and their relationship to current acquisition reform
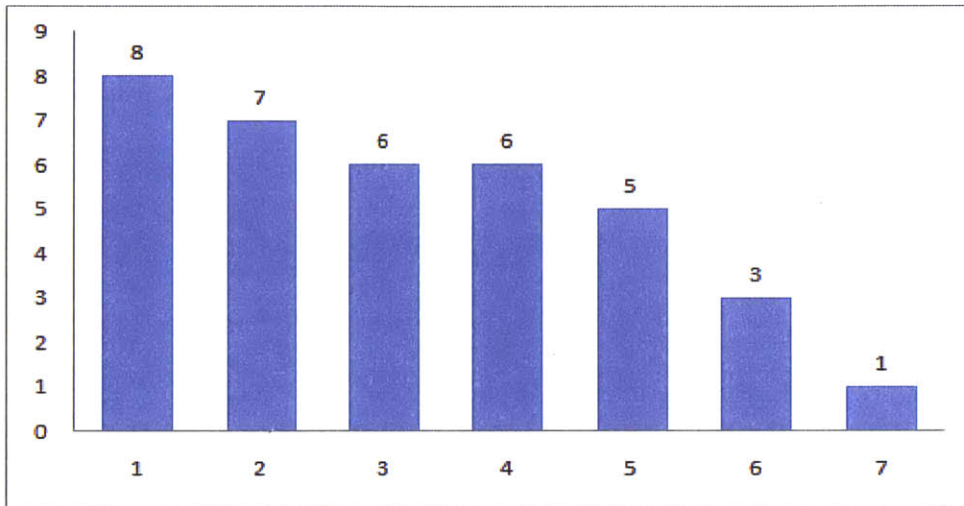activities.
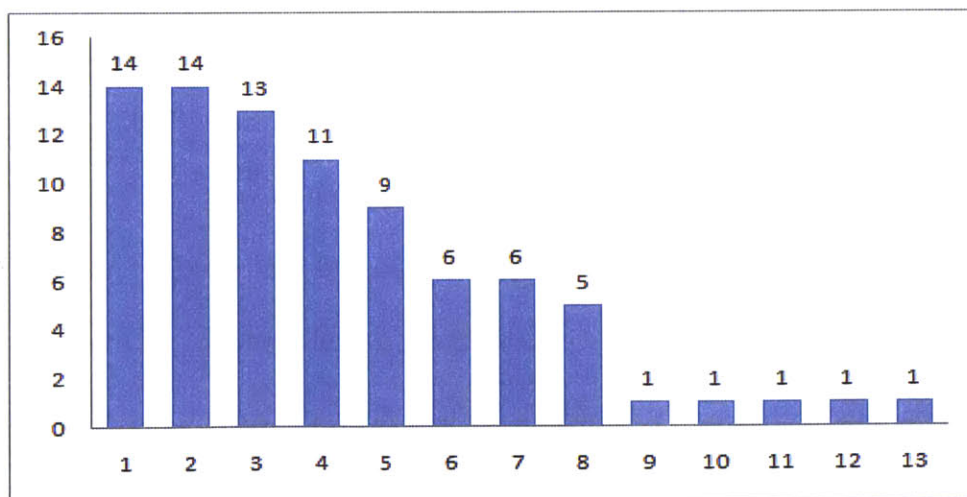
Figure 31: Pareto Chart of Root Causes of "Firefighting"

Description	Acquisition Reform Activity
1 - Government failed to appropriately define the program's requirements	DAPA; GAO-08-62R; GAO-10-374T; WSARA 2009
2 - Contractor underestimated program risk	GAO-10-374T
3 - Contractor did not assign sufficient personnel to tasks to complete work on time	
4 - Contractor did not assign correct types of personnel to tasks	
5 - Contractor struggled integrating technologies into program context	GAO-08-62R; GAO-10-374T
6 - Contractor focused on meeting contractual cost or schedule incentive	WSARA 2009
7 - Contractor did not sufficiently understand program requirements	
8- Contractor underestimated technology maturity at program initiation	GAO-08-62R; GAO-10-374T
9 - (OR) The government, as a whole, constantly was changing direction as to what it wanted to do, causing the PM basically defend the program the government originally wanted and then unable to decide which way it wanted to change it to	
10 - (OR) Contractor personnel were redirected to higher priority program in trouble	
11 - (OR) Technical risk; slack was built into schedule	
12 - (OR) Government stakeholders didn't clarify their concerns until late in MDD	
13 - (OR) Gov't did not assign sufficient personnel to tasks	DAPA

Table 36: Relationship of "Firefighting" Root Causes to Acquisition Reform Activities

Once again, three of the top five reasons for "Firefighting" were also identified as

significant root cause factors for other archetypes. As discussed several times above, clear

definition of the requirements, understanding of the risk involved in the program (cost, schedule,

and technical), and working with mature technologies are imperative to successful programs.

The next two most cited root causes for "Firefighting" were interesting. The first

suggests that the contractor did not assign sufficient personnel to accomplish the original task on

schedule. While this is clearly an opinion, tools do exist to evaluate this response. The Earned

Value Management System (EVMS) is designed to ensure an allocated, appropriate plan for the

program. Current DoD policy mandates the use of EVMS when certain contract types are used. When EVMS is mandated, there is a requirement for the contractor to produce (and the Government to approve) an EVMS baseline that identifies the tasks and resources necessary to complete those tasks. As part of the ongoing management of the program, monthly EVMS reports are produced that detail the status of each task versus the plan (from both a work completion (schedule) and cost perspective). While the WSARA of 2009 does address the EVMS area, its focus is on changing the current way the DoD analyzes EVMS data.[246] Therefore, this finding suggests a study of DoD contracts with EVMS and "Firefighting" behavior noted might be worthwhile to determine if there are potential warning signs that can be added to current EVMS analysis.

The second of these interesting, highly confirmed behaviors was that the contractor did not assign the right types of people to the tasks. Unfortunately, there is not a ready-made tool such as EVMS to assess whether the personnel assigned to tasks by the contractor have the appropriate capabilities and experience suitable to successful completion of the task on schedule. The Government must rely on the contractor for this determination, however it is incumbent upon Program Office personnel to highlight any concerns they have regarding this issue to their program management chain of command.

One of the open responses received clearly exemplified the "Firefighting" effect. The respondent stated, "Contractor personnel were redirected to higher priority program in trouble", and this individual also agreed that this "Firefighting" behavior resulted in an increase to their program's schedule. While there is no acquisition reform activity directed at either recognizing

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[246] Public Law 111-23 (2009).

or addressing firefighting, an awareness program through incorporation into the PMT-352 (and possibly earlier) acquisition training is warranted.

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 37 below shows the breakdown of each of the demographic areas of interest for the 37 respondents that identified Firefighting behavior.

The data shown in Table 37 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 38.

Program Size	# Yes	# No
ACAT I	21	9
ACAT II/III	7	12
Other	9	7

Lead Service	# Yes	# No
AF	12	9
Army	8	4
USMC	5	5
Navy	7	5
Other	5	5

"Joint" Status	# Yes	# No
Single	25	23
Joint	12	5

Table 37: "Firefighting" Demographic Breakdown

Variable	Chi-Square Value	Critical Value
Program Size	5.220	5.991
Lead Service	0.866	9.488
"Joint"Status	1.753	3.841

Table 38: Chi-Square Values for "Firefighting"

Based on these results, the calculated chi-square value is less than the critical value, and therefore the null hypothesis is not rejected. This means that based on the sample taken, there is no statistical relationship between either program size, lead service, or "joint" status for the "Firefighting" archetype.

4.6 "Staff Burnout and Turnover" Response Analysis (Raw Data in Section 3.2.2.6)

The first research question for the "Staff Burnout and Turnover" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. The second highest number of respondents, 28, identified that "Staff Burnout and Turnover" had occurred on their program. As is the case with all of the archetypes, this result is not statistically significant. However, the fact that almost 45% of respondents identified this behavior, combined with the tenor of some of the open responses, highlights that this is an area that needs to be watched closely. This researcher has personal experience with personnel experiencing heart attacks on the job. Whether this was related specifically to the "burnout" phenomenon is not clear, but the individual was constantly travelling to support the mission. This example and others like it demonstrate the need to ensure all members of the acquisition community, both Government and contractor, watch the personnel performing the work to ensure they remain healthy and productive.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 28 respondents that noted "Staff Burnout and Turnover", only nine felt that it led to measurable cost growth (p-value 0.98) and only 12 agreed that it caused measurable schedule growth on their program (p-

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value 0.83). These high p-values indicate that there is no statistical significance in these results, and that "Staff Burnout and Turnover" does not correlate with measurable cost or schedule growth.

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. The respondents felt that all seven of the offered potential root causes were applicable, in varying degrees. Further, this question elicited the most open responses (12) of any archetype, indicating that there are many possible causes for this behavior that were not postulated. The same Pareto Chart from Section 3.2.2.6 is repeated below as Figure 32 for clarity. It is followed by Table 39 describing the corresponding descriptions and their relationship to current acquisition reform activities.
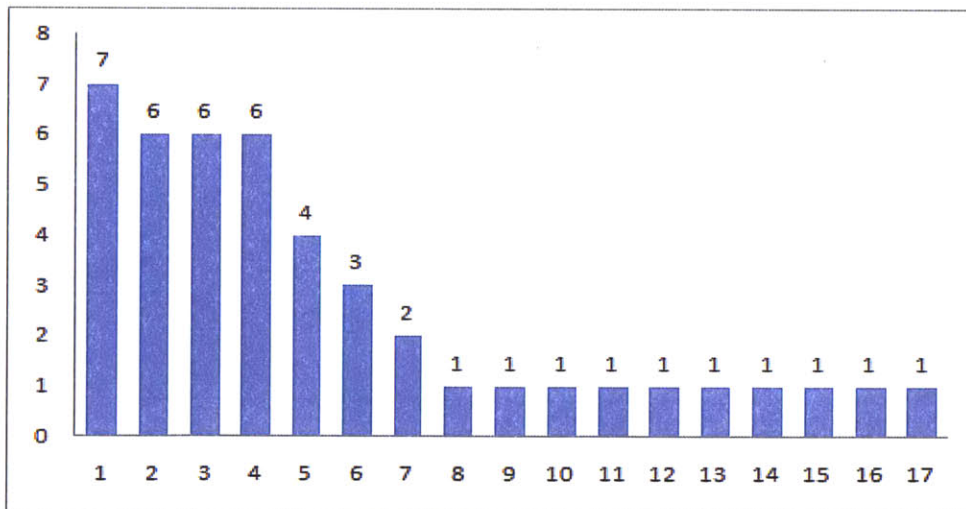
Figure 32: Pareto Chart of Root Causes of "Staff Burnout and Turnover"

Description	Acquisition Reform Activity
1 - Contractor did not assign correct types of personnel to tasks	
2 - Contractor focused on meeting contractual cost or schedule incentive	14 Sep 10 USD(AT&L) memo
3 - Contractor did not assign sufficient personnel to tasks to complete work on time	
4 - Program encountered significant problems during testing requiring fix or redesign	
5 - Contractor struggled integrating technologies into program context	GAO-08-62R; GAO-10-374T
6 - (OR) Government did not assign sufficient personnel for program support (paraphrasing three open responses)	DAPA
7 - Government proposed inappropriate contract type for program phase	14 Sep 10 USD(AT&L) memo
8 - Contractor underestimated technology maturity at program initiation	GAO-08-62R; GAO-10-374T
9 - (OR) Program Mgt Office "cleaned house" and replaced most key positions. The new persons "second guessed" every previous decision	
10 - (OR) Tremendous levels of HQ oversight leads to excessive reporting	14 Sep 10 USD(AT&L) memo
11 - (OR) Additional quantities and performance requirements contributed to burnout	DAPA
12 - (OR) Does not lead to cost/schedule increase, in many cases peoples careers are affected as they are not allowed to move and broaden	
13 - (OR) The PMO & contractor, after significant amounts of being pulled in so many directions so many times burned out and lost their sense of urgency	
14 - (OR) Base Realignment and Closure Commission	
15 - (OR) Congressional Oversight	14 Sep 10 USD(AT&L) memo
16 - (OR) Poor selection of leadership for ACAT ID program	
17 - (OR) Contractor removed technical personnel from program and lost design continuity as project went into the testing phase	

Table 39: Relationship of "Staff Burnout and Turnover" Root Causes to Acquisition Reform Activities

The two of the top four most common root causes identified for the "Staff Burnout and

Turnover" were consistent with third and fourth most common reasons for "Firefighting" –

failure of the contractor to either assign the right skilled personnel or the right amount of personnel to the tasks required. As noted in Section 4.5, there is a tool, EVMS, that can be used, and in certain situations is required to be used, to evaluate the contractor's appropriate application of manpower to the tasks. However, there is not a good tool, other than the expert judgment of the contractor and/or the program office personnel to determine if the skill set of the individuals assigned to the task is sufficient to handle the workload within the time allocated. It is clear, though, that the respondents think that both of these are strong factors causing program issues.

One of the other top four root causes for "Staff Burnout and Turnover" that were identified by the survey participants was that the "Contractor focused on meeting contractual cost or schedule incentive". In many Cost-Plus Award Fee or Cost-Plus Incentive Fee contracts, there are criteria that directly tie completion of a particular event or milestone with a specific contractual payment. If the contractor fails to complete the work on per the contractual agreed-to date, the fee cannot be earned. Many contractors automatically include these kinds of schedule-based fees as part of their profit-realization plan, so there is an extreme amount of pressure to make sure these are indeed earned. The only current activity addressing this area is the 14 Sep 10 USD(AT&L) memorandum which is placing emphasis on avoiding Cost-Plus contracts and focusing on using Fixed-Price Incentive Fee (FPIF) contracts.[247] The incentive in these FPIF contracts is not specifically tied to achieving a schedule milestone, rather it is tied to overall cost performance (allowing the Government and contractor to share both the burden of cost over-runs (up to a point) and cost under-runs).

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[247] USD(AT&L) Memorandum. (2010).

One of the other major root causes cited for this behavior involved findings from testing driving the "burnout and turnover" phenomenon. While there is no specific acquisition reform activity focused on this area, it does pose a possible recursive link with the "'Happy Path' Testing" archetype. The survey data were examined to see if the respondents who identified this as a root cause for "Staff Burnout and Turnover" also identified "'Happy Path' Testing" as occurring on their program. Of these six, only two also identified the "'Happy Path' Testing" behavior. While both of these respondents that identified both behaviors felt that the "Staff Burnout and Turnover" archetype led to measurable cost AND schedule growth, only one of these two also felt that "'Happy Path' Testing" led to either cost or schedule growth. Based on the data obtained from this survey, there is no apparent relationship between these two root causes. However, this could be an area for further research in the future.

Having already discussed the impact of technology extensively relative to previous archetypes, the next most cited root cause came from the open response area. There were three separate responses that all essentially stated that the root cause of "Staff Burnout and Turnover" related to the Government failing to assign adequate personnel to the program. This result came as a surprise, as the ultimate yardstick for measuring program success rarely depends on the program office personnel. However, none of these three individuals felt that the "Staff Burnout and Turnover" behavior led to measurable cost or schedule growth, indicating that the problem with sufficient Government personnel is a concern, but not a driver in program dysfunction. At the same time, the DAPA recommended increasing the size and of the DoD civilian workforce, and this would help address the concern identified by these respondents.[248]

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[248] Kadish, R., et. al. (2006).

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 40 below shows the breakdown of each of the demographic areas of interest for the 28 respondents that identified Staff Burnout and Turnover on their program.

Program Size	# Yes	# No
ACAT I	17	13
ACAT II/III	7	12
Other	4	12

Lead Service	# Yes	# No
AF	10	11
Army	7	5
USMC	3	7
Navy	3	9
Other	5	5

"Joint" Status	# Yes	# No
Single	20	28
Joint	8	9

Table 40: "Staff Burnout and Turnover" Demographic Breakdown

The data shown in Table 40 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 41.

Variable	Chi-Square Value	Critical Value
Program Size	4.693	5.991
Lead Service	3.808	9.488
"Joint"Status	0.149	3.841

Table 41: Chi-Square Values for "Staff Burnout and Turnover"

Based on these results, the calculated chi-square value is less than the critical value, and therefore the null hypothesis is not rejected. This means that based on the sample taken, there is no statistical relationship between either program size, lead service, or "joint" status for the "Staff Burnout and Turnover" archetype.

4.7   "PMO vs Contractor Hostility" Response Analysis (Raw Data in Section 3.2.2.7)

The first research question for the "PMO versus Contractor Hostility" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. Only 18 of the survey respondents identified that hostility was evident between the PMO and the Contractor on their program. While this result is not statistically significant, the fact that over 25% of respondents identified this behavior indicates both government and industry personnel involved in acquiring goods for the DoD should be aware that this behavior does exist and work together to ensure clear communication of intent to avoid its detrimental effects.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 18 respondents that noted "PMO versus Contractor Hostility", nine felt that it led to measurable cost growth (p-value 0.592). Separately, 10 of the 18 respondents agreed that such hostility led to measurable schedule growth on their program (p-value 0.407). Neither of these p-values indicate statistical significance, and no inference regarding "PMO versus Contractor Hostility" affecting measurable cost or schedule growth is appropriate.

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. The respondents felt that four of the five offered potential root causes were applicable, in varying

degrees, and offered five other possible root causes in the open response area. The same Pareto Chart from Section 3.2.2.7 is repeated below as Figure 33 for clarity. It is followed by Table 42 describing the corresponding descriptions and their relationship to current acquisition reform activities.
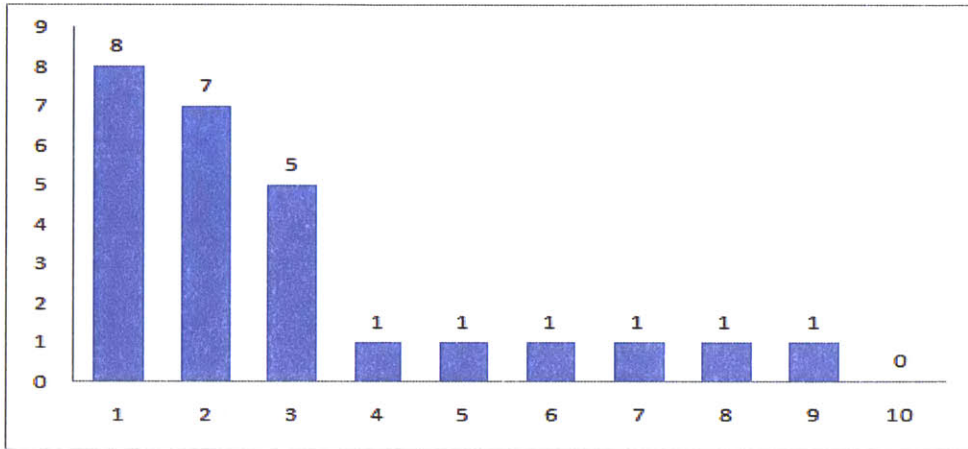
Figure 33: Pareto Chart of Root Causes of "PMO vs Contractor Hostility"

Description	Acquisition Reform Activity
1 - Contractor focused on meeting contractual cost or schedule incentive	14 Sep 10 USD(AT&L) memo
2 - Contractor focused on getting into production to perpetuate business base	14 Sep 10 USD(AT&L) memo; WSARA 2009
3 - Government failed to appropriately define the program's requirements	DAPA; GAO-08-62R; GAO-10-374T; WSARA 2009
4 - Government did not include any performance incentives in the contract	14 Sep 10 USD(AT&L) memo
5 - (OR) More prevelant on FFP contracts. Any discovery is now considered contract change. Systems Engineers are not needed, however lawyers are needed	
6 - (OR) Flawed "commercial like" acq strategy	
7 - (OR) Contractor moved program manager to better opportunity. He was replaced with a bad apple...who was eventually removed. This lead to a lot of turmoil and wasted management effort	
8 - (OR) Contractor focused blame away from self to preserve fee; tried to REA govt to reduce contractor caused cost/schedule growth	
9 - (OR) Program had three contractors; contractor parties were tripping over the established working relationships and not communicating appropriately	
10 - Government proposed inappropriate contract type for program phase	14 Sep 10 USD(AT&L) memo

Table 42: Relationship of "PMO vs Contractor Hostility" Root Causes to Acquisition Reform Activities

As discussed in Section 4.6, the most cited root cause for this behavior is that the contractor is focused on incentive clauses to earn fee. Personal experience of the researcher indicates that this pressure is intense for two reasons. First, as noted above, the company considers earning these fees as nearly guaranteed profit, and therefore there is a strong premium to do whatever it takes to earn them, even at the expense of only meeting the letter of the contract, not its intent (which is what leads to the suspicious, hostility-based behavior pattern). Second, personal bonuses for industry program managers are often attached to earning these fees, so they have a very real stake in the outcome. While everyone likes to believe in the altruistic behavior of their counterparts, this is not always the case, and these ulterior motives can

cause friction and hostility between the Government and the contractor. The 14 Sep 10 memorandum signed by the USD(AT&L) suggests that the Government to favor FPIF contracts when possible.[249] This will force a move away from Cost-Plus type contracts that use the kinds of cost and schedule incentives to motivate performance that lead to the archetypical behavior. It remains to be seen if this change will result in lower overall costs, and this area should be studied further after a sufficient body of programs have been implemented under this policy.

The second most cited root cause for this hostile behavior is also being addressed by both the USD(AT&L) 14 Sep 10 memorandum and the WSARA of 2009. The root cause cited suggests that contractors are interested in pushing programs into production so that they have a guaranteed future revenue stream as the only available production source. Both of these acquisition reform activities have a central tenet to increase competition throughout the life cycle of the contract.[250] The WSARA of 2009 goes one step further, explicitly stating that the competition it seeks is at both the prime contractor and subcontractor level throughout the life cycle.[251] By forcing production competition, these reform activities are trying to focus the contractor on delivering the best possible design from the development phase, rather than getting into production with a minimally acceptable design, only to follow up with change proposals to achieve more profit and higher performance levels after a sole-source production contract has been awarded.

Once again, the respondents have also identified the Government as complicit in igniting this behavior pattern by failing to properly define the program's requirements. In this case, the

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[249] USD(AT&L) Memorandum. (2010).
[250] USD(AT&L) Memorandum. (2010).
[251] Public Law 111-23 (2009). Title II.

ambiguous requirements put forth by the Government allow for liberal interpretation of compliance. When the contractor and the Government's definitions of compliance are different, this drives a wedge between the two sides, creating hostility. This does not lead to the best working environment, so ensuring that clearly defined requirements with unambiguous measures of merit are important factors in avoiding this behavior pattern.

The open responses received on this question mostly place the blame for the behavior pattern on the contractor (the exception being the one response suggesting that a poorly chosen commercial-like acquisition strategy led to the behavior). Unfortunately, none of the current acquisition reform activities are focused on addressing any of the areas highlighted. These responses indicate problems dealing with contractor performance, an area that only 31% of senior program managers feel they are properly trained to do[252], much less the mid-level acquisition personnel that this survey was targeted at.

There is one other interesting note on the responses to this set of questions. Like the response to the "Underbidding the Contract" archetype, none of the respondents felt that the root cause of this behavior was that the Government chose the wrong type of contract for the program phase. The USD(AT&L) 14 Sep 10 memorandum directs all major defense acquisition programs to justify their choice of contract type.[253] Given the lack of support of contract type leading to either of these detrimental behavior patterns, perhaps it is not the best use of the Government's resources to justify and review this decision point. As noted in Section 4.1, this is another area for further study.

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[252] OSD (2009).
[253] USD(AT&L) Memorandum. (2010).

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The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 43 below shows the breakdown of each of the demographic areas of interest for the 18 respondents that identified "PMO versus Contractor Hostility" on their program.

Program Size	# Yes	# No
ACAT I	11	19
ACAT II/III	5	14
Other	2	14

Lead Service	# Yes	# No
AF	8	13
Army	4	8
USMC	3	7
Navy	1	11
Other	2	8

"Joint" Status	# Yes	# No
Single	15	33
Joint	3	14

Table 43: "PMO vs Contractor Hostility" Demographic Breakdown

The data shown in Table 43 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 44.

Variable	Chi-Square Value	Critical Value
Program Size	3.069	5.991
Lead Service	3.894	9.488
"Joint"Status	1.160	3.841

Table 44: Chi-Square Values for " PMO vs Contractor Hostility "

Based on these results, the calculated chi-square value is less than the critical value, and therefore the null hypothesis is not rejected. This means that based on the sample taken, there is

no statistical relationship between either program size, lead service, or "joint" status for the "PMO vs Contractor Hostility " archetype.

4.8   "Robbing Peter to Pay Paul" Response Analysis (Raw Data in Section 3.2.2.8)

The first research question for the "Robbing Peter to Pay Paul" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. Twenty of the survey respondents identified that this behavior occurred on their program. As is the case with all of the archetypes overall, this result is not statistically significant in its own right. However, the fact that over 30% of respondents identified this behavior indicates that it is a common practice in the DoD and something that acquisition personnel should endeavor to avoid.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 20 respondents that noted "Robbing Peter to Pay Paul" behavior, nine (9) felt that it led to measurable cost growth (p-value 0.748). For the question regarding "Robbing Peter to Pay Paul" behavior leading to measurable schedule growth, 14 of the 20 respondents agreed that this occured (p-value 0.058). Neither of these p-values indicate statistical significance at the 95% confidence level, and therefore no inference regarding "Robbing Peter to Pay Paul" behavior leading to measurable cost or schedule growth is appropriate. However, the p-value for the potential for this behavior to lead to schedule growth is very close to 0.05. Therefore, a possible option for future work would be to re-examine this archetype with a different (and larger) sample to determine if the results really is statistically significant or not.

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity.

The respondents felt that all four of the offered potential root causes were applicable, in varying degrees, and offered five other possible root causes in the open response area. The same Pareto Chart from Section 3.2.2.8 is repeated below as Figure 34 for clarity. It is followed by Table 45 describing the corresponding descriptions and their relationship to current acquisition reform activities.
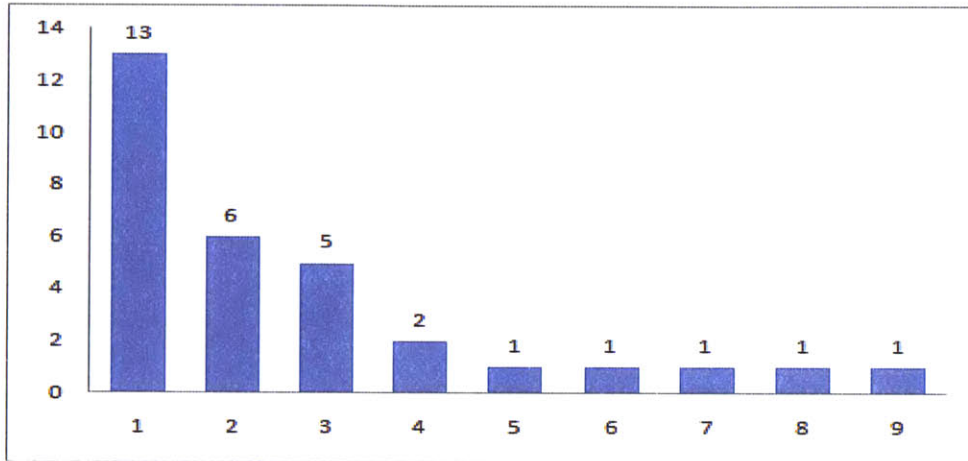
Figure 34: Pareto Chart of Root Causes of "Robbing Peter to Pay Paul"

Description	Acquisition Reform Activity
1 - Unable to meet financial execution goals due to continuing resolution/funds release	DAPA; HASC 2010
2 - Funding profile does not match contractor's plan	DAPA
3 - Contractor behind schedule inadequate number of personnel assigned to program	
4 - Unable to meet financial execution goals due to late contract award due to protest	DAPA; HASC 2010
5 - (OR) Impact with acquiring new Navy financial system and IT rules with obligating funds	
6 - (OR) Underestimation of program development cycle..specifically, fitting a cycle to funding stream	DAPA
7 - (OR) Underfunded programs. Base budget too small	14 Sep 10 USD(AT&L) memo
8 - (OR) Inadequate resources to obligate funds	DAPA
9- (OR) Delay in contract award due to test failures (success required for DAB approval to award next production contract)	

Table 45: Relationship of "Robbing Peter to Pay Paul" Root Causes to Acquisition Reform Activities

Of the respondents that identified this behavior, they overwhelmingly identified the inability to meet financial execution goals (established by the DoD, not law) as the root cause. The root causes itself offered two reasons for this (under a continuing resolution and/or late release of funds to the field). Both of these have become common behavior in recent years. As of 18 Nov 2010, the Department of Defense has been operating under a continuing resolution for more than 45 days, as Congress has not passed the Defense Appropriations Act for the 2011 Fiscal Year. The DAPA recommended a program stability fund be established to help alleviate this behavior[254], and the 2010 House Armed Services Committee Panel on Defense Acquisition Reform indicated that the emphasis on achieving obligation and expenditure goals was counterproductive.[255] Unfortunately, there does not appear to be any focus on actually changing the obligation and expenditure goals which assume release of funds at the beginning of the Fiscal Year. One possible solution might be to adjusting these obligation and expenditure goals annually based on when funds actually get distributed to the field following passage of that year's Defense Appropriations Act.

The second most cited root cause was a mis-match between the contractor's financial plan and the Government's funding profile. This can occur for many reasons, but one contributing factor is that the Government budgets are set well in advance of contract awards (sometimes several years). As programs proceed through the different acquisition phases, it is not uncommon for the funds available to be different from the funds needed. This mismatch results in either a surplus (which has poor execution rates and therefore subject to rescission discussed above) or a deficit (which requires infusion of funds to avoid having to reduce planned work to

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[254] Kadish, R., et. al. (2006).
[255] Andrews, R., et. al., (2010).

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Disclaimer -- The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Air Force, the Department of Defense, or U.S. Government.

meet the funds available). The one acquisition reform recommendation that is targeted at this area is the DAPA's suggestion to establish a program stability fund.[256] To date, however, this recommendation has not been implemented.

The third most cited root cause for this pattern of behavior was the contractor being behind schedule due to insufficient personnel assigned to the program. This is something that has to be addressed by the program manager, not acquisition reform. As discussed earlier in this Chapter, there are tools, such as the Earned Value Management System, that can help the program manager assess the contractor's progress. For contracts that don't require EVMS, a good relationship between the two program managers (Government and Contractor) will often allow frank discussion of program status relative to schedule. It is incumbent upon the Government program manager to seek answers to these kinds of questions as a good steward of the taxpayer's money.

One of the open responses indicated that test failures led to this behavior on their program. Again, in an effort to see if there was an interplay between archetypes, the answers of this respondent were compared for this archetype and for the "'Happy Path' Testing" archetype. This survey participant did not believe that "'Happy Path' Testing" occurred on their program, so it does not appear that there is any link between these two behaviors in this particular case.

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status).

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[256] Kadish, R., et. al. (2006).

Table 46 below shows the breakdown of each of the demographic areas of interest for the 20

respondents that identified "Robbing Peter to Pay Paul" behavior.

Program Size	# Yes	# No
ACAT I	10	20
ACAT II/III	4	15
Other	6	10

Lead Service	# Yes	# No
AF	7	14
Army	4	8
USMC	2	8
Navy	5	7
Other	2	8

"Joint" Status	# Yes	# No
Single	15	33
Joint	5	12

Table 46: "Robbing Peter to Pay Paul" Demographic Breakdown

The data shown in Table 46 were used to conduct chi-square analysis as discussed in the

opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no

relationship between the variable being studied and the presence of the pattern of behavior. The

calculated χ^2 value for each of the variables under study is presented in Table 47.

Variable	Chi-Square Value	Critical Value
Program Size	1.275	5.991
Lead Service	1.860	9.488
"Joint"Status	0.020	3.841

Table 47: Chi-Square Values for " Robbing Peter to Pay Paul "

Based on these results, the calculated chi-square value is less than the critical value, and

therefore the null hypothesis is not rejected. This means that based on the sample taken, there is

no statistical relationship between either program size, lead service, or "joint" status for the

"Robbing Peter to Pay Paul " archetype.

4.9 "Feeding the Sacred Cow" Response Analysis (Raw Data in Section 3.2.2.9)

The first research question for the "Feeding the Sacred Cow" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. Only 12 of the survey respondents (second lowest percentage for any archetype) identified that "Feeding the Sacred Cow" behavior was evident on their program. As is the case with all of the archetypes overall, this result is not statistically significant. With 18% of the respondents identifying this behavior, it clearly happens in the larger DoD acquisition system, but it is largely beyond the ability of mid-level, and often even senior-level, acquisition personnel to address.

The second research question, assessing whether or not this behavior leads to measureable cost and/or schedule growth on the program, was not applied to this question, as discussed in Section 3.1.1.3. The more appropriate question would be whether this behavior led to cost or schedule growth on *other* programs, but this was not within the purview of the respondents to adequately answer. The survey respondents have no way of knowing where the funds were obtained to maintain their program's status as a "Sacred Cow". This could be another area for additional research.

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. The respondents felt that all three of the offered potential root causes were applicable, in varying degrees, and offered two other possible root causes in the open response area. The same Pareto Chart from Section 3.2.2.9 is repeated below as Figure 35 for clarity. It is followed by Table 48 describing the corresponding descriptions and their relationship to current acquisition reform activities.

Figure 35: Pareto Chart of Root Causes of "Feeding the Sacred Cow"

Description	Acquisition Reform Activity
1 - No other program can provide capability of program	
2 - DoD/Service have invested heavily on program to date	
3 - Delay in fielding capability will significantly impact ability to support fielded forces	
4 - (OR) Program has proven to be the most efficient way to modernize C4I on submarines	
5 - (OR) Intense Congressional interest ensures I always have adequate funding	

Table 48: Relationship of "Feeding the Sacred Cow" Root Causes to Acquisition Reform Activities

This archetype was clearly different. Not only was it the only one that didn't fit the mold of inquiring about cost or schedule growth, the proposed root causes are not being addressed by any acquisition reform activity. The two most-cited responses, that the program is the only one that can provide the capability and that the DoD or Service has heavily invested in the program, do not specifically lend themselves to reform. For the first of these, the 14 Sep 10 USD(AT&L) memorandum may lead to reinforcement of this behavior, as it seeks to identify redundancies

between programs and eliminate them as a cost-savings measure.[257] This is something that should be watched closely, and could be an avenue of future research.

One of the two open responses was interesting. The participant stated that Congressional interest ensured the program had adequate funding. This could be because of "earmarks" in the Defense Appropriations Acts, through increases in the allocated funding lines, or as a result of Congressional representation on one of the Defense committees in either the U.S. House of Representatives or the U.S. Senate. It is not certain that any reform activity could address this Congressional behavior, but one thing that is being done under the auspices of the 14 Sep 10 USD(AT&L) memorandum is an attempt to reduce or eliminate burdensome Congressional reporting.[258] It remains to be seen if this, or the recent push by Republicans in the House and Senate to end "earmarks"[259] will have any impact on future DoD budgets.

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 49 below shows the breakdown of each of the demographic areas of interest for the 12 respondents that identified their program was treated in the manner of the "Feeding the Sacred Cow" behavior.

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[257] USD(AT&L) Memorandum. (2010).
[258] USD(AT&L) Memorandum. (2010).
[259] Wong, S., and Raju, M. (2010).

Program Size	# Yes	# No
ACAT I	6	24
ACAT II/III	3	16
Other	3	13

Lead Service	# Yes	# No
AF	3	18
Army	5	7
USMC	0	10
Navy	3	9
Other	1	9

"Joint" Status	# Yes	# No
Single	8	40
Joint	4	13

Table 49: "Feeding the Sacred Cow" Demographic Breakdown

The data shown in Table 49 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no relationship between the variable being studied and the presence of the pattern of behavior. The calculated χ^2 value for each of the variables under study is presented in Table 50.

Variable	Chi-Square Value	Critical Value
Program Size	0.138	5.991
Lead Service	7.616	9.488
"Joint"Status	0.393	3.841

Table 50: Chi-Square Values for " Feeding the Sacred Cow"

Based on these results, the calculated chi-square value is less than the critical value, and therefore the null hypothesis is not rejected. This means that based on the sample taken, there is no statistical relationship between either program size, lead service, or "joint" status for the "Feeding the Sacred Cow" archetype.

4.10 "'Happy Path'" Testing Response Analysis (Raw Data in Section 3.2.2.10)

The first research question for the "'Happy Path' Testing" archetype is whether the pattern of behavior occurs in the larger DoD Acquisition System. Sixteen of the survey

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respondents identified that this testing approach was utilized on their program. Like the other archetypes, this result is not statistically significant. Despite this, the survey shows that nearly 25% of respondents identified this behavior, indicating that it is a way that programs deal with budget reductions and cost overruns earlier in the development cycle. As something that has become somewhat common practice in the DoD, acquisition personnel need to know that this behavior can lead to problems and avoid it if at all possible.

The second research question attempts to determine if this behavior, if noted in DoD Acquisition Programs, leads to measureable cost and/or schedule growth. Of the 16 respondents that noted this testing philosophy, 10 felt that it led to measurable cost growth (p-value 0.227). For the question regarding whether "'Happy Path' Testing" led to measurable schedule growth, only 9 of the 16 respondents agreed that this occured (p-value 0.402). Neither of these p-values indicate statistical significance at the 95% confidence level, and therefore no inference regarding "'Happy Path' Testing" behavior leading to measurable cost or schedule growth is appropriate.

The third research question seeks to identify links between the likely root causes identified by the respondents and the areas being addressed by recent acquisition reform activity. The respondents felt that all six of the offered potential root causes were applicable, in varying degrees, and offered two other possible root causes in the open response area. The same Pareto Chart from Section 3.2.2.10 is repeated below as Figure 36 for clarity. It is followed by Table 51 describing the corresponding descriptions and their relationship to current acquisition reform activities.
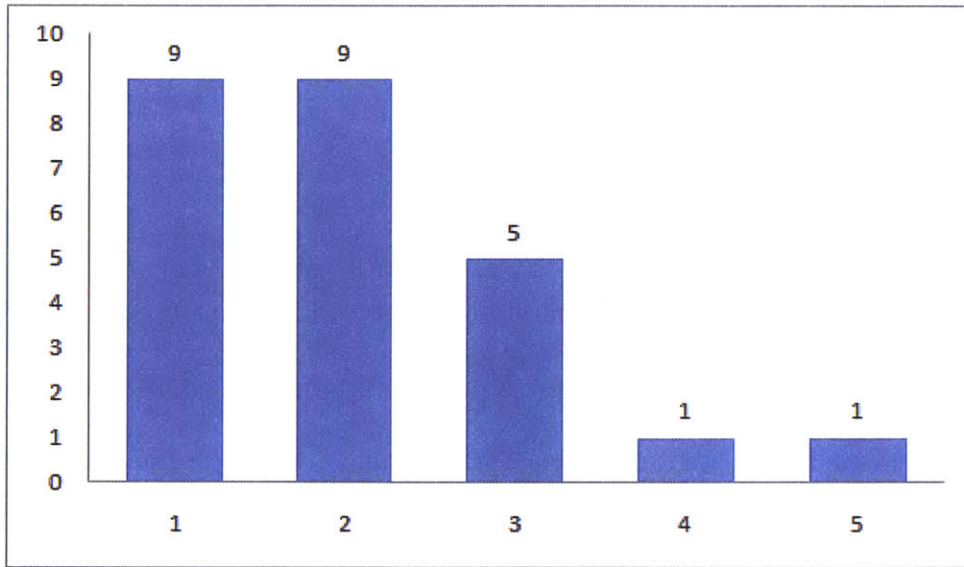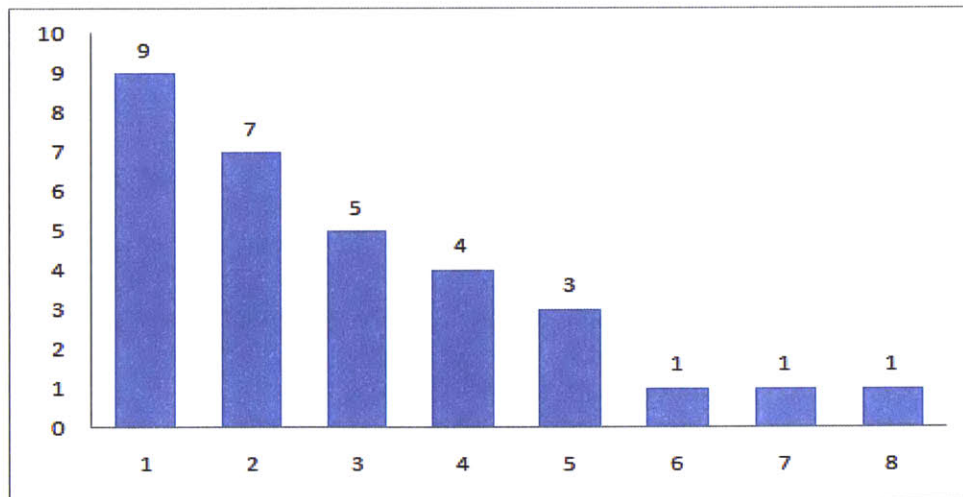
Figure 36: Pareto Chart of Root Causes of "'Happy Path' Testing"

Description	Acquisition Reform Activity
1 - Government poorly defined test program	WSARA 2009
2 - Government failed to appropriately define the program's requirements	DAPA; GAO-08-62R; GAO-10-374T; WSARA 2009
3 - Contractor poorly defined test program	WSARA 2009
4 - Government unable to delay fielding decision, shortening time for testing	
5 - Operational environment too expensive to replicate	
6 - Contractor unable to control schedule, shortening time for testing	
7 - (OR) Government test range was too busy to fully exercise system and didn't make proper upgrades to test advanced features	
8 - (OR) Government and contractor wanted weapon system fielded so it would not be cancelled by senior legislators	

Table 51: Relationship of "'Happy Path' Testing" Root Causes to Acquisition Reform Activities

The most-cited and third-most cited root cause both have to do with poorly defined test

programs, either by the Government or by the contractor. While it is not possible to divine their

exact intent, the respondents seem to be indicating that the Government and contractor test plans

were developed in such a way that they ensured early success, waiting until later in the test phase

to examine off-nominal conditions, if at all. While it will not be a panacea for this type of behavior, the WSARA of 2009 created a position for the Director of Developmental Test and Evaluation.[260] This will increase the focus on developmental testing, and should be a step in the right direction toward eliminating this phenomenon.

The second most-cited root cause was the failure of the Government to appropriately define the program's requirements. While this has been covered extensively already, the focus here is that the requirements most likely were not "testable". While it is often easy to state that capability "x" is needed, it is much more difficult to state how much of the capability is needed and how it should be measured.

The fourth most-cited cause of this behavior is very interesting. Four respondents (25% of those identifying the behavior) felt that the Government shortened the test window because of the need to field the capability. This is very concerning, as the DoD should not have a set timeline for a program that is so inflexible it cannot be delayed so that sufficient testing is completed to ensure the safety and viability of the hardware that is delivered to the warfighter.

Of the other root causes cited, two are very similar (the provided choice that the operational environment was too expensive to replicate and the open response that cited the test range was too busy and didn't make necessary upgrades to test advanced features). Both of these point to the need to ensure testability of the requirements as they are developed. If it is not possible to test the system in an operationally representative environment to ensure all features work as intended, there is a risk that the system will be fielded only to find out that it was insufficient at the worst possible time (in the middle of conflict). The WSARA of 2009, by

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[260] Public Law 111-23 (2009). Title I.

creating a role for the Director of Developmental Test and Evaluation, should help this situation.[261] This new position, working closely with the Director of Operational Test and Evaluation and the Director of DoD Test Resources, should be able to identify early the test resources needed for upcoming programs and ensure they are budgeted for and available when needed.

The fourth research question attempts to find any correlation between the respondents that noted the behavior and the individual and program-specific demographic breakdowns (particularly program size, lead organization, and whether or not the program has "Joint" status). Table 52 below shows the breakdown of each of the demographic areas of interest for the 16 respondents that identified the "'Happy Path' Testing" approach.

Program Size	# Yes	# No
ACAT I	9	21
ACAT II/III	3	16
Other	4	12

Lead Service	# Yes	# No
AF	5	16
Army	4	8
USMC	1	9
Navy	2	10
Other	4	6

"Joint" Status	# Yes	# No
Single	11	37
Joint	5	12

Table 52: "'Happy Path' Testing" Demographic Breakdown

The data shown in Table 52 were used to conduct chi-square analysis as discussed in the opening paragraphs of Section 4.0. In each case, the null hypothesis is that there is no

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[261] Public Law 111-23 (2009). Title I.

relationship between the variable being studied and the presence of the pattern of behavior. The

calculated χ^2 value for each of the variables under study is presented in Table 53.

Variable	Chi-Square Value	Critical Value
Program Size	1.268	5.991
Lead Service	3.334	9.488
"Joint"Status	0.285	3.841

Table 53: Chi-Square Values for "'Happy Path' Testing "

Based on these results, the calculated chi-square value is less than the critical value, and

therefore the null hypothesis is not rejected. This means that based on the sample taken, there is

no statistical relationship between either program size, lead service, or "joint" status for the

"'Happy Path' Testing" archetype.

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Chapter 5 – Conclusions

This chapter will summarize the findings of the analysis presented in Chapter 4 and draw relevant conclusions. It is organized around the four research questions identified in Section 2.3.2.

5.1 Research Question 1

From Section 2.3.2.1, the first research question was: *Are the 10 Acquisition Archetypes (Patterns of Failure) identified by CMU's SEI applicable to the larger DoD Acquisition system, and not just software acquisition?* The initial hypothesis of this research was that all 10 of the patterns of failure are applicable to the larger DoD Acquisition System. From the results of this research, this question can be answered in two ways. The first is whether the behavior is identified by the respondents and the second is whether there is any statistical significance associated with the level of identification. The basic assumption for this thesis was that there was a 50% likelihood of identifying the behavior. The results, using this assumption are shown in Table 54 below.

Archetype	% Identified	Statistical Significance
Underbidding the Contract	17%	No
Longer Begets Bigger	23%	No
Everything to Everybody	35%	No
The Bow Wave Effect	23%	No
Firefighting	57%	No
Staff Burnout and Turnover	43%	No
PMO versus Contractor Hostility	28%	No
Robbing Peter to Pay Paul	31%	No
Feeding the Sacred Cow	18%	No
Happy Path' Testing	25%	No

Table 54: Summary of Relevance by Archetype

The first, most notable finding is that none of the ten patterns of behavior examined in this research were found to be present at a statistically significant level. The Firefighting

archetype, identified by 57% of survey respondents, only resulted in a p-value of 0.16, clearly

not meeting the threshold of 0.05 required for statistical significance at the 95% confidence level.

Therefore, it is clear from these results that there is no ability to state categorically that these

patterns of behavior occur will occur in DoD programs, suggesting that the hypothesis should be

rejected.

As noted in the introduction to Chapter 4, both the small sample size and the likelihood

of identifying the behavior are drivers in whether the results are statistically significant. If the

likelihood of identifying the behavior is lowered, the number of respondents identifying the

behavior decreases (as shown in Figure 25 earlier). The same analysis can be done using these

new thresholds, and the results are shown in Figure 37 below. As expected, lowering the

likelihood of identifying the behaviors means that some of the archetypes are present with

statistical significance. From these results, it means that four behaviors in particular should be

watched closely: "Firefighting", "Staff Burnout and Turnover", "Everything to Everybody", and

"Robbing Peter to Pay Paul".

Archetype	% Respondents Identified	Statistical Significance if % Likelihood to ID is:			
		50%	33%	25%	20%
Underbidding the Contract	17%	No	No	No	No
Longer Begets Bigger	23%	No	No	No	No
Everything to Everybody	35%	No	No	Yes	Yes
The Bow Wave Effect	23%	No	No	No	No
Firefighting	57%	No	Yes	Yes	Yes
Staff Burnout and Turnover	43%	No	No	Yes	Yes
PMO versus Contractor Hostility	28%	No	No	No	No
Robbing Peter to Pay Paul	31%	No	No	No	Yes
Feeding the Sacred Cow	18%	No	No	No	No
Happy Path' Testing	25%	No	No	No	No

Figure 37: Summary of Relevance by Archetype with Different Thresholds

However, Hopkins, in his online textbook *A New View of Statistics*, makes an excellent

point about such testing. He contends that testing for statistical significance focuses research on

the p-value, and ignores the actual magnitude of the results.[262] This point is very important in this particular situation. The CMU SEI team that assembled the original archetypes made no claims about their statistical significance, only that the patterns reported were common in the software industry. Similarly, the results of this research indicate that the patterns identified also occur in the larger DoD Acquisition System at levels ranging from 17% of programs to as high as 57% of programs. Putting this into context, with annual DoD expenditures for hardware, software, and services on the order of $400B per year[263], these behaviors can affect between $68 and $228B of annual contracting activities. From that perspective, this research shows that the ten archetypes studied are indeed applicable and relevant to the larger DoD Acquisition system. As a result, there should be an effort to increase the awareness of acquisition personnel to these patterns of behavior so that they can recognize and avoid them, if possible.

Based on the results of the survey and further reflection, the "Feeding the Sacred Cow" archetype was not really appropriate for this research. First, the archetype does not particularly lead to cost or schedule growth on the program, rather it reflects the priority placed on the program by the DoD or Service leadership. Second, the impact of the behavior is really on other programs, about which survey participants cannot appropriately comment. A better examination of this behavior pattern would be better suited to subsequent research involving high-level DoD and Service personnel in a position to actually comment on the behavior and whether favoring certain programs affected other programs in the DoD or Service portfolio.

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[262] Hopkins, W.G. (2009).
[263] USD(AT&L) Memorandum. (2010).

5.2 Research Question 2

The second research question developed in Section 2.3.2.2 was: *Do the 10 Acquisition Archetypes (Patterns of Failure) lead to significant, measurable cost and/or schedule growth?* This research's original hypothesis was that when these behavior patterns are present on DoD Acquisition Programs, they will result in statistically significant, measurable cost and/or schedule growth. As discussed in Chapter 4, the results of this analysis are mixed, and therefore the research hypothesis should be considered on an archetype-by-archetype basis. Based on the results of this survey, four of the Archetypes led to both measurable cost AND schedule growth at statistically significant levels, one led to only measurable schedule growth at a statistically significant level, and the remaining four did not lead to statistically significant levels of cost or schedule growth. The data are summarized in Table 55 below.

Archetype	Statistical Significance If Present	
	Cost Growth	Schedule Growth
Underbidding the Contract	Yes	Yes
Longer Begets Bigger	Yes	Yes
Everything to Everybody	Yes	Yes
The Bow Wave Effect	Yes	Yes
Firefighting	No	Yes
Staff Burnout and Turnover	No	No
PMO versus Contractor Hostility	No	No
Robbing Peter to Pay Paul	No	No
Feeding the Sacred Cow	N/A	N/A
Happy Path' Testing	No	No

Table 55: Summary of Statistically Significant Cost and/or Schedule Growth by Archetype

It is appropriate here to focus on whether the evidence of cost and/or schedule growth was statistically significant, as the result of Research Questions #1 shows that there is reasonable evidence that the behaviors do occur in the overall DoD Acquisition System. For those archetypes that do lead to statistically significant poor outcomes, identifying the behavior pattern can be an early tripwire for acquisition professionals to diagnose pending problems and address

them before they manifest in cost and/or schedule growth. From these results, it appears that activities early in the program's life cycle (setting the development timeline, establishing the requirements, evaluating the contractor's bid, and organizing the work to be performed) have the most impact on the potential for cost and schedule growth. In most cases, this only makes sense, as these activities early in the life cycle have the longest period over which to manifest themselves. Each of these will be discussed further below.

The "Underbidding the Contract" archetype was found to lead to statistically significant cost and schedule growth when it was identified on a program. While there is no way to know the contract types used on the respondent's programs, most developmental contracts today involve Cost-Plus type contracts. If the contractor "knowingly underbids" the price for the work required (as stated in the question in the survey), it only makes sense that at least cost growth will occur on Cost-Plus type contracts that have separate mechanisms for providing fees over and above the cost of the work performed. While it is less intuitive, the same situation also leads to schedule growth (as time is needed to accomplish the work that was not properly bid in the first place). Based on this, it is critically important to have personnel and processes in place to adequately evaluate the contractor's proposal and identify areas of potential underbidding. The recent increase in acquisition personnel, combined with the focus that the WSARA of 2009[264] and the USD(AT&L)[265] are placing on ensuring better up-front cost estimating, should provide a new line of defense against this behavior.

The "Longer Begets Bigger" archetype, when identified, also leads to statistically significant cost and schedule growth. In general, there are several reasons for this, but foremost

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[264] Public Law 111-23 (2009).
[265] USD(AT&L) Memorandum. (2010).

among these is the change that can occur between the initiation of a development program and the actual fielding of the end product when long development times are initially planned. An illustrative example is the F-22 program.

The F-22 development program was conceived between 1981 and 1985, and the initial production quantity was planned at 750 aircraft.[266] Over the course of the program, as the environment into which the aircraft would be fielded changed, the number of aircraft authorized for production dwindled, ultimately to 187 aircraft as of 2010 (a reduction of 71%).[267] As a result, the initially planned cost per unit (total acquisition cost divided by number produced) rose from $95M[268] to $359M[269] (an increase of 169%). While there were technical problems and funding problems along the way that also affected the schedule, the most significant change was the operational environment (end of the Cold War). The F-22 story points clearly to the problems with taking a long time between concept and fielded system exemplified by the "Longer Begets Bigger" archetype.

Both the DAPA's focus on time-certain development[270] and the USD(AT&L) direction to set shorter program timelines[271] are clear steps in the right direction to avoid this behavior. At present, the concern with this approach is whether there will be an impact on the product delivered to the warfighter.

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[266] Thompson, L.B. (2001).
[267] Abrams, J. (2009).
[268] Thompson, L.B. (2001).
[269] Abrams, J. (2009).
[270] Kadish, R., et. al. (2006).
[271] USD(AT&L) Memorandum. (2010).

Traditional program management theory suggests that you can only successfully get two of the three primary variables (cost, schedule, or performance).[272] The USD(AT&L) 14 Sep 10 memorandum focuses on shorter development timelines and also demands that affordability be a requirement. With cost and schedule "fixed", it appears the only tradespace will be the performance of the product delivered. Further, Wirthlin extended this to analysis of five variables (cost, schedule, performance, transparency, and flexibility), of which he found that only three can be reliably delivered.[273] While some might argue that the 14 Sep 10 USD(AT&L) memorandum also increases transparency by increasing oversight, the overall approach (reduced reporting, increased competition, contractor performance incentives, reducing duplication between DCMA and DCAA, etc.) appears to be reducing the overall oversight burden. In Wirthlin's context, this leaves some hope for delivering high performance to the warfighter.

The survey respondents showed that the "Everything to Everybody" archetype, when present on a program, will lead to a statistically significant likelihood of measurable cost and schedule growth. This archetype affects the earliest program behavior, the initial establishment of the program requirements. The DAPA focused on this, considering the development of requirements to be one of the three key processes and six competing areas of the acquisition system.[274] The GAO has also spend considerable energy over the past three years describing its concept of best practices for acquisition programs. Among these is the establishment of program requirements that are stable and achievable.[275] Further, the GAO has recommended several other changes to the overall requirements development system, including the elimination of

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[272] Browning, T.R. (1998).
[273] Wirthlin, J.R. (2009).
[274] Kadish, R., et. al. (2006).
[275] GAO (2010a). GAO-10-374T.

duplication, prioritization between programs so resources can be properly focused, and reducing the time required to get requirements documents approved.[276]

The fourth and final archetype that, when identified, led to both statistically significant cost and schedule growth was "The Bow Wave Effect." This archetype suggests that deferral of complex requirements to later increments makes the later phases much more difficult to accomplish at a time when schedule and resources are in much higher demand.[277] At present, there are no real actions directed at this area, rather there are possible initiatives that might actually lead to this behavior pattern. First, the most recent release of the DoD Acquisition Instruction (DODI 5000.02) describes evolutionary acquisition as the model for programs.[278] This intentionally breaks the program into several increments, making it easier to defer hard requirements from the early part of the program to later increments in order to establish an initial pattern of success on the program. Second, one of the as-yet unimplemented DAPA recommendations would allow program managers to defer "non-key" requirements in order to maintain development schedules. Either separately or in combination, these two actions can inadvertently lead to a pattern of behavior that results in measurable cost and schedule growth. The House Armed Services Committee Panel on Defense Acquisition Reform remains skeptical of the merits of evolutionary acquisition, stating that this approach "has yet to demonstrate a real impact on weapons systems acquisitons."[279]

One archetype, "Firefighting", was shown in this research to lead only to statistically significant schedule growth. As noted in Section 2.2.5, there are numerous examples of

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[276] GAO (2009b) . GAO-09-663T.
[277] CMU SEI (2007j).
[278] DoDI 5000.02. (2008).
[279] Andrews, R., et. al., (2010). Page 20.

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firefighting discussions in program management literature, notably from Repenning and his colleagues, that suggest there is a link between this behavior and poor schedule outcomes..[280,281] For the small sample size that was obtained as part of this survey, the p-value was 0.049, which is very close to the threshold of 0.05. More research (using a larger sample) should be conducted to confirm this statistically significant link.

None of the other archetypes resulted in statistically significant cost or schedule growth. While this does not mean that these patterns of behavior can be ignored, it suggests that these areas should not be the focus of acquisition reform activities. Rather, the previously discussed five archetypes should be the focal point of activity to ensure the largest leverage for the resources invested. It should be noted, however, there was one behavior pattern, "Robbing Peter to Pay Paul", that had a p-value of 0.058 for its influence on measurable schedule growth. Given that this value is very close to the 0.05 threshold required for statistical significance as part of this research, further investigation (using a larger sample) should be conducted to determine if there is any correlation between this behavior and schedule growth.

5.3 Research Question 3

The third research question, introduced in Section 2.3.2.3, was: *Are the 10 Acquisition Archetypes (Patterns of Failure) linked to the root causes of acquisition program cost and schedule growth identified by recent Acquisition Reform initiatives (such as the Defense Acquisition Performance Assessment[282] (DAPA) and 2009/2010 GAO reports)?* The hypothesis of this research was that there is a strong link between the identified causes of these patterns of

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[280] Repenning, N.P. (2001).
[281] Repenning N. P., Goncalves, P., & Black, L. (2001).
[282] Kadish, R., et. al. (2006).

behavior and the root causes of poor acquisition outcomes identified by the major acquisition reform recommendations of the DAPA, the GAO, and others. The analysis here will be discussed using a modified Pareto approach with the responses to the root causes of the archetypes. For the purposes of this discussion, the root causes cited by the respondents for each of archetypes that they identified were combined and cross-referenced. The top 11 responses, consolidated across all of the archetypes, are shown in Table 56 below. The last column in the Table has an overall "area" that the root cause falls into to facilitate the following discussion.

Root Cause	Underbidding the Contract	Longer Begets Bigger	Everything to Everybody	The Bow Wave Effect	Firefighting	Staff Burnout and Turnover	PMO versus Contractor Hostility	Robbing Peter to Pay Paul	Happy Path' Testing		Total # Times Cited	Area
Government Failed to Appropriately Define Program Requirements	2	8	9	6	14		5		7		51	Requirements
Contractor Failed to Understand Program Risk	8	5		8	14						35	Risk
Contractor Failed to Assign Sufficient Personnel to Program					13	6		5			24	Execution
Contractor Struggled Integrating Technologies Into Program Context		9			9	4					22	Technology
Contractor Focused on Meeting Contractual Incentives					6	6	8				20	Execution
Contractor Underestimated Technological Maturity at Program Initiation		7		6	5						18	Technology
Contractor Failed to Assign Correct Types (Skills) of Personnel					11	7					18	Execution
Poor Financial Execution Rates Resulted in Funding Rescission		3						13			16	Funding
Requirments Changed After Program Initiation to Accommodate Additional Users			15								15	Requirements
Government Failed to Understand Program Risk	5			7							12	Risk
Government Funding Profile Does Not Match Contractor Funding Profile				5				6			11	Funding

Table 56: Top Root Causes, Consolidated across all Archetypes

The most-cited root cause, across all archetypes, was that the Government failed to appropriately define the program requirements. This was cited 51 times relative to seven of the nine archetypes (removing "Feeding the Sacred Cow" as discussed in at the end of Section 5.1).

The other response that fell into the requirements category, that requirements changed after program initiation to accommodate additional users, was cited an additional 15 times (all for the "Everything to Everybody" archetype). This combined citation (66 times) means that requirements was the most-noted area contributing to poor program outcomes.

From this analysis, it appears that the best place to start with acquisition reform initiatives in the requirements arena. The DAPA was the first major recent acquisition review to suggest that reform of the way requirements are determined is a key to improving acquisition outcomes. In its data search, the requirements process was the third most-noted area of concern in the "Big A" acquisition system. The major findings of this panel relative to requirements were that the Combatant Commanders did not play a large enough role in the requirements process, that the JCIDS process was disconnected from the level of maturity of the technologies that are essential to achieving the requirements mandated, there was no prioritization or time-phasing to the requirements developed, that the JCIDS process was too slow and complex, and that the requirements development process was disconnected from the "Little a" acquisition process.[283] To date, the only one of these that appears to have been implemented is increasing the role of the Combatant Commanders in the requirements process.[284]

The GAO has also been vocal in recent reports about the need to address the requirements process. In its "Charting a Course for Lasting Reform" report, the GAO criticized the requirements process for driving high performance, low cost, and schedule driven programs. Its conclusion is that requirements enter the acquisition system that are not fully understood and

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[283] Kadish, R., et. al. (2006).
[284] Public Law 111-23 (2009).

Disclaimer -- The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Air Force, the Department of Defense, or U.S. Government.

rely on technologies with uncertain levels of maturity.[285] In a separate report that addressed risk, the GAO reported that adequately defined requirements are the bedrock of achieving better program outcomes.[286] These oft-repeated themes have not effectively been addressed to date.

Compounding the issues with the requirements process itself, the OSD survey of program managers found that 59% of senior program managers did not believe that acquisition training was sufficient for dealing with user requirements. Another 49% felt that acquisition training did not appropriately address changes in technical requirements. It appears that additional training in these areas could significantly improve acquisition outcomes.[287]

One interesting note at this point is that the 14 Sep 10 USD(AT&L) memorandum does not address changes to the requirements process. On the face, this makes perfect sense, as the requirements development process is definitively outside USD(AT&L)'s span of control. However, as the DAPA noted, the requirements process is integral to delivering value from the "Big A" DoD Acquisition System. One positive step in this area is the House Armed Services Committee Panel on Defense Acquisition Reform recommendation earlier this year that reform of the requirements process should be a top priority for the DoD.[288]

The second most-cited root cause across all the archetypes was that the contractor failed to understand the program risks (identified 35 separate times). A companion root cause, that the Government did not understand the program risk, was also highlighted an additional 12 times. Combined, this meant that the area of risk management was noted 47 times (third highest area overall).

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[285] GAO (2009b). GAO-09-663T.
[286] GAO (2010a). GAO-10-374T.
[287] OSD (2009).
[288] Andrews, R., et. al., (2010). Page 29.

The GAO released a 21-page report earlier this year addressing "Managing Risk to Achieve Better Program Outcomes". This report highlights the major sources of risk in acquisition program as stemming from immature technologies, poorly defined requirements, a lack of disciplined systems engineering early in the program, and overly optimistic resource estimates (personnel and funding). The GAO's proposed solution is to only embark on programs that are based on proven technologies, robust designs, and that have sufficient funding, people, and time to deliver the product to the warfighter.[289] Of these recommendations, a few have been acted upon already. The WSARA of 2009 increased the visibility and role of the Director of Systems Engineering within the USD(AT&L) structure, highlighting the importance of this vital function. In addition, that Act also redefined the position of the Director of Cost Analysis and Program Evaluation, placing increased emphasis on the importance of accurate cost estimating in the DoD.[290] However, more improvements can still be made in this area.

Once again, the OSD study of senior program managers is also relevant. The study found that 51% of these senior acquisition personnel felt that current training was not sufficient in the area of dealing with risk management challenges. This finding, combined with the results of this research, point to another opportunity for improvement in the training of the acquisition workforce.[291]

It is also noteworthy that the recent 14 Sep 10 USD(AT&L) memorandum does not explicitly address anything associated with risk management as highlighted by the GAO. If anything, two of the focal points of this directive may increase the risk associated with defense

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[289] GAO (2010a). GAO-10-374T.
[290] Public Law 111-23 (2009).
[291] OSD (2009).

acquisition. The mantra of "Do More Without More" and the use of 'should cost' estimates (instead of 'will cost' estimates) will put more pressure on program mangers to accept risk in the form of reduced resources to accomplish the same mission.[292]

The third most-often identified root cause across all the behavior patterns studied was that the contractor failed to assign sufficient personnel to the program. Two other root causes associated with program execution were also highlighted (the contractor was focused on meeting contractual incentives and the contractor did not assign a workforce with the appropriate skill set). Combined, these execution issues were cited 62 times, making this the second most ripe area for improvement based on this research.

One tool that can assist acquisition personnel in this area is the Earned Value Management System. As discussed in Section 4.5, EVMS can assist in determining if the appropriate number of contractor personnel have been programmed against a task (through the Integrated Baseline Review required shortly after contract initiation) and then periodically the progress of these tasks must be reported, potentially highlighting resources shortages. Unfortunately, the only way to get clear insight into whether these people assigned to the task have the right skills is through constant contact between members of the program office and the contractor and follow-up discussions between the respective program management teams to address perceived shortfalls.

The issue with contractors focusing on meeting contractual incentives was also discussed in detail in Sections 4.5, 4.6, and 4.7. The use of Cost-Plus type contracts puts pressure on contractors to meet fee-based incentives (which they perceive as low-hanging fruit from a profit

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[292] USD(AT&L) Memorandum. (2010).

perspective). If, however, the pursuit of the incentives results in schedule growth (as appears to be the case with "Firefighting" behavior) or burnout of key, skilled workers ("Staff Burnout and Turnover"), the impact on the program can be detrimental overall. This is an area that the recent USD(AT&L) memorandum does address, suggesting that Fixed-Price Incentive Fee contracts be the preferred option (where the fee incentives are based on cost-sharing of over-runs and under-runs, rather than event-based fees).[293]

The OSD study of program managers is also instructive in this instance. Senior acquisition professions felt that the current acquisition training was not sufficient in the areas of overseeing contractor performance (stated by 69% of those surveyed in that report) and earned value challenges (cited as a deficiency by 63%). Once again, there is a significant opportunity to increase training for both junior and senior acquisition personnel in these areas to improve overall DoD acquisition results.[294]

The next area that was identified by significant numbers of respondents to this survey was technology. Contractors struggling to integrate technologies into the program was identified 22 times, and contractors underestimating the maturity of technologies at program initiation was cited another 18 times. All told, technology concerns were cited a total of 40 times.

As noted above relative to both the requirements and risk areas, understanding technology and its level of maturity is a key to program success that has been a staple of GAO literature for the past several years. Appendix 6 to the 2002 issue of the DoD's acquisition regulations has a clear set of definitions of "technology readiness levels (TRLs)".[295] While these

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[293] USD(AT&L) Memorandum. (2010).
[294] OSD (2009).
[295] DoD 5000.2-R, (2002).

are clear and have been in use for several years, the ability of acquisition personnel, both in the Government and contractor realms, to clearly identify the appropriate TRL is not well-honed. Further, as noted in the requirements discussion above, this understanding of technology maturity is even less understood by requirements personnel. The solution to this dilemma appears to be training and experience, as well as removing incentives for over-estimating technology to get programs initiated.

The final two most-cited root causes are in the area of funding. The first of these was that poor financial execution resulted in rescission of funding from the program (noted 16 times). The second was that the Government and contractor funding profiles were mismatched (identified 11 times).

This is another area that has been commented on often in recent acquisition reform discussions. The DAPA had three recommendations focused on the budgeting process, and all three are relevant to this discussion. First, the report suggested the development of a stable program funding account to keep programs from being 'raided' in order to address budget shortfalls in other areas of the DoD. Second, the DAPA recommended that the DoD reduce the number of funding transfers from programs to increase program stability. Finally, they recommended that programs be funded against cost estimates that predicted an 80% likelihood of success (versus the panel's belief that programs are currently budgeted for a 50% likelihood of success).[296] All three of these recommendations, if implemented, would address concerns identified in this research. However, at this time, none of these recommendations have been acted on.

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[296] Kadish, R., et. al. (2006).

In its March 2010 report, the House Armed Services Committee Panel on Defense Acquisition Reform also highlighted this area. In this report, the panel recommended three changes. First, current obligation and expenditure guidance should be reviewed to ensure that it does not drive spending in advance of need just to satisfy the existing benchmarks and protect program funding. Second, the OSD and Service staffs should rely more on individual obligation and expenditure plans for each program, rather than broad, across-the-board standards. Finally, training should be initiated to ensure all personnel understand the intent and limitations of the obligation and expenditure goals.[297] It is not clear at this time whether any of these recommendations have been implemented.

The OSD study of program managers also indicates that the areas of funding and cost control are some of the most problematic training areas. Training was considered insufficient in the area of unexpected cost growth (86%), cost control challenges (75%), cost estimating challenges (73%), and changes in directed funding (57%).[298] The mandate in the 14 Sep 10 USD(AT&L) memorandum to make affordability a requirement and to focus on 'should cost' instead of 'will cost' also puts a premium on understanding budgets, cost estimates, and cost growth.[299] Clearly, this is an opportunity for better training for both junior and senior acquisition personnel.

In summary, there is a strong link between the current acquisition reform recommendations and the most-cited root causes that led to the behaviors discussed in this research. Table 57 below provides a summary of those links. As noted above, there are many of

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[297] Andrews, R., et. al., (2010). Page 33.
[298] OSD (2009).
[299] USD(AT&L) Memorandum. (2010).

these recommendations that as yet remain un-implemented, especially in the two potentially

most influential areas, dealing with requirements and risk.

Root Cause	Total # Times Cited	Area	Acquisition Reform Recommendations
Government Failed to Appropriately Define Program Requirements	51	Requirements	DAPA; GAO-09-663T; GAO-10-374T; OSD Study of PMs (2009); HASC Report (2010)
Contractor Failed to Understand Program Risk	35	Risk	GAO-10-374T; WSARA of 2009; OSD Study of PMs (2009)
Contractor Failed to Assign Sufficient Personnel to Program	24	Execution	USD(AT&L) 14 Sep 10 Memorandum; OSD Study of PMs (2009)
Contractor Struggled Integrating Technologies Into Program Context	22	Technology	GAO-09-663T; GAO-10-374T
Contractor Focused on Meeting Contractual Incentives	20	Execution	USD(AT&L) 14 Sep 10 Memorandum; OSD Study of PMs (2009)
Contractor Underestimated Technological Maturity at Program Initiation	18	Technology	GAO-09-663T; GAO-10-374T
Contractor Failed to Assign Correct Types (Skills) of Personnel	18	Execution	USD(AT&L) 14 Sep 10 Memorandum; OSD Study of PMs (2009)
Poor Financial Execution Rates Resulted in Funding Rescission	16	Funding	DAPA; HASC Report (2010); OSD Study of PMs (2009)
Requirments Changed After Program Initiation to Accommodate Additional Users	15	Requirements	DAPA; GAO-09-663T; GAO-10-374T; OSD Study of PMs (2009); HASC Report (2010)
Government Failed to Understand Program Risk	12	Risk	GAO-10-374T; WSARA of 2009; OSD Study of PMs (2009)
Government Funding Profile Does Not Match Contractor Funding Profile	11	Funding	DAPA; HASC Report (2010); OSD Study of PMs (2009)

Table 57: Correlation of Root Causes to Acquisition Reform Recommendations

5.4 Research Question 4

The final research question posed in this research was: *Is there any correlation between these Acquisition Archetypes relative to program size, lead service, or joint program status?* This question examined whether the program size, lead service, or "jointness" of a program has any bearing on the likelihood that it will experience these acquisition behavior patterns. The

hypothesis of this research was that there is no correlation between the patterns of failure and the program size, lead service, or "joint" status of a program.

The analysis of the data collected discussed in Chapter 4 indicate that with one exception, this hypothesis was confirmed. The only pattern of behavior that resulted in this hypothesis being rejected was the "Everything to Everybody" archetype with respect to "joint" program status. As noted in Section 4.3, this makes sense, as joint programs are more likely to be susceptible to the addition of requirements that are specific to one user that may or may not benefit any other user. This results in time and effort spent on one customer at the expense of the rest of the customer base. Both the DAPA[300] and the House Armed Services Committee Panel on Defense Acquisition Reform[301] have recommended reform of the requirements process in the Department of Defense. Action in this arena can go a long way toward addressing this correlation.

Because of the small sample size, a brief review was conducted to determine if any of the other archetypes were considered significant at the level of significance of 0.10 (instead of the more stringent 0.05). This brief look showed that three of the archetypes met this lower requirement for statistical significance relative to program size and the "Everything to Everybody" archetype also met the lower significance level for correlation to lead service. These will be discussed very briefly.

When examining correlation between program size and the archetypes, three ("The Bow Wave Effect", "Firefighting", and "Staff Burnout and Turnover") met the lower critical value of 0.10. Both "The Bow Wave Effect" and "Staff Burnout and Turnover" were more common

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[300] Kadish, R., et. al. (2006).
[301] Andrews, R., et. al., (2010).

among ACAT I programs than would be expected, and "Firefighting" was more common than expected in ACAT II/III programs. If further research is done in this area, these findings should be re-evaluated to determine if there is a correlation with program size using a larger sample or if the result of this survey (no correlation between program size and these archetypes) is appropriate.

With respect to lead service, only one archetype met the lower threshold for statistical significance, "Everything to Everybody". In this case, the results were biased as a higher than expected number of Army and Navy programs experienced this behavior, while no US Marine Corps-led program reported this behavior when four programs would have been expected to report the behavior, based on the overall survey results. This outlier should be re-examined if further research is conducted in this area to determine if the success of the USMC programs in avoiding this behavior remains, and if so, what drives them to be so much more successful than other Services.

5.5 Summary

This research provides a contribution to the DoD Acquisition Community in several ways. First, the literature review is a good summary of recent activity to address shortcomings in the DoD Acquisition System, informed by the long history of prior attempts at acquisition reform. Second, the research indicates that the CMU SEI archetypes are indeed relevant (though not statistically significant) to the DoD Acquisition System. Third, when certain pattern of behavior are present early in a program's life cycle ("Underbidding the Contract", "Longer Begets Bigger", "Everything to Everybody", and "The Bow Wave Effect"), there is a strong, statistically significant likelihood that both cost and schedule growth will result. Finally, the

research indicates that the best place for the DoD to focus the next round of acquisition reform is in the area of requirements, confirming both the DAPA[302] and House Armed Services Committee on Defense Acquisition Reform[303] have correctly identified requirements process reform as a high-leverage investment.

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[302] Kadish, R., et. al. (2006).
[303] Andrews, R., et. al., (2010).

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Chapter 6 – Recommendations and Future Research

The concluding chapter of this thesis focuses on the future and is divided into two major sections. The first section, Recommendations, brings forward the key suggestions that should be considered for immediate implementation to help improve future acquisition outcomes. The second section, Possible Future Research, collects in one place all of the areas that were highlighted during the research process as areas that could benefit from future examination. As both Cancian[304] and the DAPA[305] noted, there are many different competing agendas in the DoD Acquisition System, thus yielding a large pool of potential research avenues.

6.1 RECOMMENDATIONS

There are five significant recommendations that are apparent as a result of this research. One involves changes to the "Big A" Acquisition System, three involve areas for improvement in the training of acquisition personnel, and the final recommendation would improve a key document required for acquisition planning.

6.1.1   Requirements Reform

While the idea is not new, the House Armed Services Committee Panel on Defense Acquisition Reform recently suggested that the Department of Defense re-examine and reform the process for determining requirements for military hardware.[306] The results of this research confirm that poorly defined requirements are the most-cited root cause of behavior detrimental to program success. Therefore, the primary recommendation of this research is for the DoD to engage in a complete revision of the requirements development process, focused on three areas.

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[304] Cancian, M. (1995).
[305] Kadish, R., et. al. (2006).
[306] Andrews, R., et. al., (2010).

First, the system needs to be able to generate timely requirements (i.e. reduce process cycle time). This comes from both the Panel's report and root causes identified by survey participants in this research effort who complained about the time the process takes to validate a requirement. Second, the revised requirements process needs to be clearly grounded in technology. While it is important for some programs to push the limits of technology to the edges of the envelope, the GAO has cited using mature technologies as a best acquisition practice.[307] It appears that this advice has remained largely unheeded to date. Third, the requirements process has to result in clear requirements that can be translated into acquisition programs with measures of merit that are unambiguous. This will address several of the findings of this research that the Government failed to properly define requirements resulting in longer development times, poorly defined test programs, and ambiguous contractual incentives.

6.1.2 CMU SEI Archetype Awareness

This research determined that the CMU SEI archetypes, while not present in statistically significant numbers, are applicable to the larger DoD Acquisition System. The original eleven archetypes are simple, two-page discussions of patterns of behavior that can occur and impact the success of programs. These should be referenced in early acquisition training programs such as Acquisition 101 and Acquisition 201 to increase awareness. Further, these could be included in the Defense Acquisition Guidebook as pitfalls to avoid. Because of the prevalence of "Firefighting" (>50%) noted by the survey participants, this should be a particular emphasis area.

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[307] GAO (2010a). GAO-10-374T.

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6.1.3   CMU SEI Archetype Focus in Mid-Level and Senior Level Training

For the five CMU SEI archetypes that resulted in statistically significant correlation with cost and/or schedule growth, there should be a concerted effort to discuss and introduce these to mid-level and senior-level acquisition personnel during mandatory training activities. Two such opportunities are the class on which most of this research was based, PMT-352, and also the next-higher required course, PMT-401. Both of these classes have full training schedules, but the CMU SEI Archetypes "Underbidding the Contract", "Longer Begets Bigger", "Everything to Everybody", "The Bow Wave Effect", and "Firefighting" could be woven into the existing curriculum. This would increase the effectiveness of these important classes by ensuring cross-DoD awareness of these behavior patterns that are proven to impact acquisition outcomes.

6.1.4   Improved Risk Training

As noted in Chapter 5, over half of the senior acquisition personnel surveyed by OSD in 2009 considered the available training in risk management challenges to be insufficient.[308] As the second most cited root cause for the patterns of behavior studied in this research, it is evident that this is a high-payoff area, cited as a problem in four of the five archetypes linked to statistically significant cost and/or schedule growth. Whether this new emphasis on risk management training is embedded within existing training opportunities (such as the classes already discussed above) or is singled out with a specialized class, the benefits should rapidly become evident.

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[308] OSD (2009).

6.1.5   Upgrades to Systems Engineering Plans

One of the oft-cited root causes for the "Everything to Everybody" archetype (that leads to statistically significant occurrence of cost and schedule growth AND is more prevalent in "Joint" programs) is the failure to understand the complexity driven into programs by multiple external interfaces. While the WSARA of 2009 is attempting to strengthen the role of the Director of System Engineering in the OSD hierarchy,[309] another method to improve the systems engineering focus in DoD acquisitions would be to increase the role of the Systems Engineering Plan, specifically by requiring significant detail regarding the interaction of the system with other systems (either in development or currently fielded). By forcing this level of discussion early in the acquisition process, potential disconnects and problems with architectures, interfaces, and data formats can be highlighted and resolved before they begin to drive cost and schedule growth.

6.2 POSSIBLE FUTURE RESEARCH

As noted in the introduction to this Chapter, there are numerous areas for potential inquiry regarding the DoD Acquisition System. The following paragraphs briefly describe other work that could be accomplished, either as stand-alone research or as follow-on work related to this research effort. Those two categories will be used as the structure for this final section of the research.

6.2.1   Stand-Alone Future Research

There are five primary areas of stand-alone research that became evident during the conduct of this research activity. Each will be discussed in brief detail below.

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[309] Public Law 111-23 (2009).

Disclaimer -- The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Air Force, the Department of Defense, or U.S. Government.

The first area of additional research involves Services programs. Both the USD(AT&L) 14 Sep 10 memorandum and the House Armed Services Committee Panel on Defense Acquisition Reform highlight "Services" as an area of significant growth and focus.[310,311] There are several areas that should be examined, considering that Services acquisition accounts for roughly $200B in the 2010 Department of Defense Budget.[312] These include: how acquisition categories (ACAT levels) are defined for Services contracts, whether the current ACAT approach for Services is appropriate, how personnel are selected to support Services programs and whether that approach is different from selecting personnel for traditional DoD programs, what (if any) specialized training personnel supporting Services acquisitions receive, what training should they receive, and what kinds of archetypical behavior patterns occur on Services programs.

A second area that was noted during this research was the area of contract type. One of the findings of the literature review was there has been a cyclic move between a preference for Cost-Plus type contracts and Firm Fixed Price type contracts over the past several decades. The recent USD(AT&L) 14 Sep 10 memorandum suggests that once again the preference is moving back to Fixed-Price contracting instruments.[313] Future research could manifest itself as a review of the choice of contract types across the DoD over a past period to determine if there is any link between the contract type chosen and cost and/or schedule growth. This would have to focus solely on whether the contract type was inappropriate, not whether other problems on the contract led to cost and/or schedule growth. This research could determine if the USD(AT&L)'s

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[310] USD(AT&L) Memorandum. (2010).
[311] Andrews, R., et. al., (2010).
[312] USD(AT&L) Memorandum. (2010).
[313] USD(AT&L) Memorandum. (2010).

focus on contract type is appropriate or only attacking a symptom of the larger problem. Additionally, once a sufficient number of programs are implemented under the auspices of the USD(AT&L) 14 Sep 10 memorandum, these programs should be studied to determine if they have resulted in lower costs (and or cost growth) than programs that used Cost-Plus type contracts.

A third area that is associated with both contracts and finance would be to examine the state of the art in cost estimation being employed in the Department of Defense. Are there other, more appropriate cost models or cost estimation techniques available that could improve the ability of the DoD to accurately forecast expected program funding needs and avoid underfunding programs or having to transfer funds into or out of programs at a later date (i.e. "Robbing Peter to Pay Paul") impacting overall program outcomes. A research project is ongoing at the Massachusetts Institute of Technology in the area of probabilistic cost modeling during the Fall 2010 and Spring 2011 terms.

A fourth area to investigate would be whether the Federal Acquisition Reform Act of 1996 requirement to reduce the number of acquisition personnel exacerbate the problems with the increased oversight requirements levied by the Packard Commission?[314,315] Pursuing this link would determine if the remaining acquisition personnel were overwhelmed with both the contract management issues and the increased reporting requirements, which ultimately fed a cycle of program failures.

Finally, another research effort that could inform the DoD acquisition community would be to examine the GAO's contention that starting programs based on more mature technologies

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[314] Grasso, V.B. (2002).
[315] Reeves, S.V. (1996).
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would improve outcomes.[316] This could be done by tracking programs that have been initiated (defined as receiving Milestone B approval) after 1 Jan 08 to see how many are based on more mature technologies (to determine how often the advice of the GAO has been heeded) and to see if these programs are indeed less prone to cost and schedule growth than their counterpart programs that are based on less technologically mature concepts.

6.2.2 Follow-on Related Research

During the course of this research, nine potential follow-up areas were highlighted. Three of these topics would directly extend this research, four would provide more insight into either the manifestation or cause of the archetypes discussed in this work and the final two deal with the further investigation of the "Feeding the Sacred Cow" archetype that did not get fully examined in this research. Each will be briefly discussed in the following paragraphs.

Additional research using the same or similar survey techniques with a larger sample size would help to truly understand several relationships. First, both the "Firefighting" and "Robbing Peter to Pay Paul" archetypes were close to the cutoff of statistical significance for leading to measurable schedule growth ("Firefighting" met the statistical significance test, while "Robbing Peter to Pay Paul" did not). Additional research with a larger sample size could clearly determine if these two archetypes have been correctly identified in this research for their contribution to measurable schedule growth. Second, there were three archetypes ("The Bow Wave Effect", "Firefighting", and "Staff Burnout and Turnover") that met the lower threshold (0.10 instead of the more stringent critical value of 0.05) for statistical correlation with program size. Follow-up surveys to extend the sample size could determine if this is coincidental but not

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[316] GAO (2010a). GAO-10-374T.

important or whether these archetypes have a true relationship with program size. Finally, the third follow-up effort could determine a similar answer regarding the relationship of the "Everything to Everybody" archetype with lead service. As was the case with program size, this archetype did not correlate with lead service at the more stringent critical value of 0.05, but did have a relationship at the 0.10 level. It would be important to examine this further with a larger sample size, as the outlier in this case was programs where the U.S. Marine Corps was the lead service. None of those programs reported this behavior, and if that result was confirmed with a larger sample size, it could be instructive to determine what US Marine Corps-led programs are doing that helps them avoid this behavior pattern.

The next four areas recommended for further research involve either the manifestation or cause of some specific behaviors. The first of these recommendations would be to conduct a study of programs that are employing evolutionary acquisition to determine if they are staying on cost and schedule during early phases by delaying the large, complex, and expensive requirements to later phases. This would represent a manifestation of "The Bow Wave Effect". Second, a study of programs could be conducted to determine if there is a link between late contract award (versus plan) and manifestation of either "The Bow Wave Effect" or "Robbing Peter to Pay Paul" behavior. Both of these archetypes cited root causes associated with funding profiles that did not match the contractor's, and late contract award is certainly one of the reasons for this kind of mismatch. This might lead to potential countermeasures that could be employed on programs with late contract awards to help keep them on track. A third recommendation that could lead to early intervention approaches would be to study programs with Earned Value Management System requirements. Interviews with both Government and contractor program

managers could identify if "Firefighting" behavior existed on the program. If it did, the EVMS data could be examined to determine if tripwires or other mechanisms could be developed to help identify and avoid this potentially destructive behavior pattern. Finally, a fourth directly-related follow-on study would be to examine programs that encountered significant testing problems to see if their history indicates a propensity for "'Happy Path' Testing" behavior and/or whether their history suggests that there was either "Staff Burnout and Turnover" or "Robbing Peter to Pay Paul" present in the program. Both of these cross-correlated patterns were noted as part of open responses from survey respondents, and further research could confirm whether such a link is appropriate or not.

Finally, the last area of research that could be examined is the "Feeding the Sacred Cow" phenomenon. There are two research areas associated with this idea. First, a detailed review of programs that were considered "high priority" by the DoD or the Services could help to determine if favoring certain programs resulted in cost or schedule impacts to the programs from which funds were taken to sustain the "Sacred Cow". This was not appropriate for this research, as the personnel self-identified their program as the "Sacred Cow" and could not adequately speak to the impact on other programs. That impact would have to come from highly-placed personnel who had some level of visibility into both sets of programs. Lastly, the opportunity exists in several years to examine the results of the 14 Sep 10 USD(AT&L) memorandum relative to eliminating redundancy between programs.[317] The purpose of this research would be to see if it inadvertently causes the "Feeding the Sacred Cow" phenomenon as the remaining programs become too large and too important for the DoD or Service to allow them to fail.

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[317] USD(AT&L) Memorandum. (2010).

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Appendix A – List of Acronyms

ACAT	Acquisition Category
ARH	Armed Reconnaissance Helicopter
C4I	Command, Control, Communications, Computers, and Intelligence
CAIV	Cost as an Independent Variable
CMU	Carnegie Mellon University
COTS	Commercial-Off-The-Shelf
COUHES	Committee On the Use of Humans as Experimental Subjects
DAB	Defense Acquisition Board
DAPA	Defense Acquisition Performance Assessment
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act (1990)
DCAA	Defense Contract Audit Agency
DCMA	Defense Contract Management Agency
DoD	Department of Defense
DODI	Department of Defense Instruction
DOT&E	Director, Operational Test and Evaluation
EFV	Expeditionary Fighting Vehicle
EMD	Engineering, Manufacturing, and Development
ESD	Engineering Systems Division
EVMS	Earned Value Management System
FAIA	Federal Acquisition Improvement Act (1995)
FARA	Federal Acquisition Reform Act (1996)
FASA	Federal Acquisition Streamlining Act (1994)
FFP	Firm-Fixed Price
FPIF	Fixed-Price Incentive Fee
FY	Fiscal Year
GAO	Government Accountability Office
HASC	House Armed Services Committee
HIMARS	High Mobility Artillery Rocket System
HQ	Headquarters
IT	Information Technology
JCIDS	Joint Capabilities Integration and Development System
JDAM	Joint Direct Attack Munition
JROC	Joint Requirements Oversight Council

JSF	Joint Strike Fighter
LRIP	Low-Rate Initial Production
MDA	Missile Defense Agency
MDD	Manufacturing Design and Development
MIT	Massachusetts Institute of Technology
OSD	Office of the Secretary of Defense
OR	Open Response
PARCA	Performance Assessment and Root Cause Analysis
PMO	Program Management Office
PM	Program Manager
PMT	Program Management (Course Identifier at the Defense Acquisition University)
RDT&E	Research, Development, Test, and Evaluation
REA	Request for Equitable Adjustment
RFP	Request for Proposal
ROI	Return on Investment
SAE	Service Acquisition Executive
SDB	Small Diameter Bomb
SEI	Software Engineering Institute (at Carnegie Mellon University)
SM	Standard Missile
TRL	Technology Readiness Level
USA	United States Army
USAF	United States Air Force
USD (AT&L)	UnderSecretary of Defense for Acquisition, Technology, and Logistics
USMC	United States Marine Corps
USN	United States Navy
WSARA	Weapon System Acquisition Reform Act (2009)

Appendix B – MIT COUHES Approval Letter

MIT Committee On the Use of Humans as
Experimental Subjects

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
77 Massachusetts Avenue
Cambridge, Massachusetts 02139
Building E 25-143B
(617) 253-6787

To:	Gregory McNew
From:	Leigh Firn, Chair COUHES
Date:	06/29/2010
Committee Action:	**Exemption Granted**
Committee Action Date:	06/29/2010
COUHES Protocol #:	1006003919
Study Title:	Patterns of Failure in Defense Acquisition: Examining Correlation to Program Size and Service

The above-referenced protocol is considered exempt after review by the Committee on the Use of Humans as Experimental Subjects pursuant to Federal regulations, 45 CFR Part 46.101(b)(2) .

This part of the federal regulations requires that the information be recorded by investigators in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. It is necessary that the information obtained not be such that if disclosed outside the research, it could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

If the research involves collaboration with another institution then the research cannot commence until COUHES receives written notification of approval from the collaborating institution's IRB.

If there are any changes to the protocol that significantly or substantially impact the rights of human subjects you must notify the Committee before those changes are initiated. You should retain a copy of this letter for your records.

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Appendix C – Text Representation of Survey Questionnaire

Acquisition Patterns of Failure in Defense Acquisition: Examining Correlation to Program Size and Service

Informed Consent
Description
This survey should not take you more than 15-20 minutes to complete.
I have freely chosen to participate in this anonymous research survey designed to provide information about experiences in the Department of Defense Acquisition System. I understand that upon completion of the research study, a thesis will be completed examining the results, and that the thesis will be available via the Massachusetts Institute of Technology for my review.

This survey is done over the Internet using a check box and/or priority ranking format. I agree to permit the Massachusetts Institute of Technology's Principal Investigators, Collaborators and Staff, to obtain, use and disclose the anonymous information provided as described below.
Conditions and Stipulations
1. I understand that all information is confidential. I will not be personally identified in any reports. I agree to complete the online survey for research purposes and that the data derived from this anonymous survey may be made available for the general public in the form of public presentations, journals or newspaper articles, and/or in books.
2. I understand the online survey involves questions about the Department of Defense Acquisition System and my experiences while participating in the Department of Defense Acquisition System. Beyond demographics, all questions will address issues concerning that system.
3. I understand that my participation in this research survey is totally voluntary, and that declining to participate will involve no penalty or loss of benefits. Choosing not to participate will not affect my employment or professional standing in any way. If I choose, I may withdraw my participation at any time. I also understand that if I choose to participate, that I may decline to answer any question that I am not comfortable answering.
4. I understand that I can contact the Massachusetts Institute of Technology research program if I have any questions about the research survey and my rights as a survey participant. I am aware that my consent will not directly benefit me, but will provide data for the Massachusetts Institute of Technology that may be used to improve the Department of Defense Acquisition System.
5. By clicking below I freely provide consent and acknowledge my rights as a voluntary research participant as outlined above and provide consent to the Massachusetts Institute of Technology to use my information in evaluating the Department of Defense Acquisition System.

Yes - I voluntarily agree to provide information for this survey and wish to continue.

No - I do not agree to provide information for this survey and wish to stop participating.

Demographic Data

1. Military / Civilian / Contractor

2. Branch of Service: AF / Army / Navy / USMC / Coast Guard / Other

3. Acquisition Experience: 0-2 Years
                            2-5 Years
                            5-10 Years
                            10-15 Years
                            15-20 Years
                            20+ Years

4. ACAT Level: ACAT I (includes 1D, 1AM, 1C, and 1AC)
                       ACAT II
                       ACAT III

5. Time Assigned to Program: 0-2 Years
                              2-5 Years
                              5-10 Years
                              10+ Years

6. Is Current Program Primarily: Hardware
                                  Software
                                  Services

7. Is Your Current Program a Joint Program?   Yes
                                                No
   If Yes, What is the Lead service? AF / Army / Navy / USMC / Coast Guard / Other
   If Yes, What other services participate? AF / Army / Navy / USMC / Coast Guard / Other

8. What is your role in your current program?   System Program Manager
                                                  Deputy Program Manager
                                                  Mid-level Program Manager
                                                  Financial Management
                                                  Contracting
                                                  Engineering
                                                  Logistics

Questionnaire:

Considering
      1) only the current program you are assigned to (the one you answered the demographic data about); and
      2) only your last two years (or less) experience on that program:

Please read the following descriptions and answer the corresponding questions as applicable.

A. Underbidding the Contract

This happens when the contractor being awarded a contract *knowingly* submitted a bid at less than their predicted cost to perform the workscope just to win the contract award.

Has the contractor on your current program *knowingly* underbid the contract?   Yes
                                                              No

Survey Mechanism: Will only prompt these questions if answer is Yes.

If yes, please answer the following questions:

Did underbidding the contract lead to a significant, measurable increase in program cost?
      Yes
      No

Did underbidding the contract lead to a significant, measurable lengthening of the program schedule?
      Yes
      No

Based on your experience, what were the root causes of this behavior (check all that apply)?
      - Contractor under pressure to win fewer contracts available
      - Government proposed inappropriate contract type for program phase
      - Government failed to appropriately define the program's requirements
      - Contractor failed to understand the program risk
      - Government failed to understand program risk
      - Government unable to appropriately validate contractor proposal
      - Other (Open Response area)

Note: The final survey may change to a rank-order for any applicable responses.

B. Longer Begets Bigger

This occurs when there is an initial expectation that there will be a long development phase on the program. This creates an atmosphere where program development details become more important than overall program execution, resulting in the inability to control the overall program cost and schedule.

Has this behavior occurred on your current program?   Yes
                                                          No

If yes, please answer the following questions:

Did this behavior lead to a significant, measurable increase in program cost?
        Yes
        No

Did this behavior lead to a significant, measurable lengthening of the program schedule?
        Yes
        No

Based on your experience, what were the root causes of this behavior (check all that apply)?
        - Government failed to appropriately define the program's requirements
        - Contractor underestimated technology maturity at program initiation
        - Contractor struggled integrating technologies into program context
        - Poor financial execution rates result in rescission of program funding
        - Contractor failed to understand program risk
        - Other (open response area)

C. Everything to Everybody

Through the program approval process or during program execution, the program scope grows due to the incorporation of requirements from many diverse potential users (beyond the original program intent). This results in a program with a large number of external interfaces, significantly increasing the program's complexity.

Has your current program experienced this type of requirements growth?   Yes
                                                                             No

If yes, please answer the following questions:

Did this increase in program requirements lead to a significant, measurable increase in program cost?
        Yes
        No

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Did this increase in program requirements lead to a significant, measurable lengthening of the program schedule?
>   Yes
>   No

Based on your experience, what were the root causes of this behavior (check all that apply)?
>   - Requirements added to obtain approval for program initiation
>   - Requirements changed after program initiation to accommodate additional users
>   - Government failed to appropriately define the program's requirements
>   - Contractor failed to understand complexity driven by multiple external interfaces
>   - Other (open response area)

D. The Bow Wave Effect

A Bow Wave occurs when expensive or time-consuming requirements are delayed and/or deferred from the current delivery increment in order to devote resources to solve current cost/schedule/performance issues.

Has this behavior occurred on your current program?   Yes
                                                           No

If yes, please answer the following questions:

Did this "bow wave effect" lead to a significant, measurable increase in program cost?
>   Yes
>   No

Did this "bow wave effect" lead to a significant, measurable lengthening of the program schedule?
>   Yes
>   No

Based on your experience, what were the root causes of this behavior (check all that apply)?
>   - Government failed to appropriately define the program's requirements
>   - Government failed to understand program risk
>   - Contractor underestimated program risk
>   - Contractor underestimated technology maturity at program initiation
>   - Contractor struggled integrating technologies into program context
>   - Late contract award results in funding profile that does not match contractor's plan
>   - Contractual cost or schedule incentives outweigh performance requirements
>   - Other (open response area)

E. Firefighting

Firefighting occurs when personnel assigned to projects expected to complete in the future are diverted from those tasks to solve problems or complete tasks that need to be solved/completed immediately to meet the contractual delivery schedule.

Has this behavior occurred on your current program?   Yes
                                                          No

If yes, please answer the following questions:

Did firefighting lead to a significant, measurable increase in program cost?
      Yes
      No

Did firefighting lead to a significant, measurable lengthening of the program schedule?
      Yes
      No

Based on your experience, what were the root causes of this behavior (check all that apply)?
      - Government failed to appropriately define the program's requirements
      - Contractor did not sufficiently understand program requirements
      - Contractor underestimated program risk
      - Contractor did not assign sufficient personnel to tasks to complete work on time
      - Contractor did not assign correct types of personnel to tasks
      - Contractor underestimated technology maturity at program initiation
      - Contractor struggled integrating technologies into program context
      - Contractor focused on meeting contractual cost or schedule incentive
      - Other (open response area)

F. Staff Burnout and Turnover

This idea describes the impact of stress induced on the program staff by short-term deadlines, significant program issues, and large amounts of required overtime to meet those deadlines and solve those problems. As these situations compound and become the norm, turnover of key program personnel impacts program performance.

Has your current program suffered burnout and turnover?   Yes
                                                          No
If yes, please answer the following questions:

Did staff burnout and turnover lead to a significant, measurable increase in program cost?
      Yes
      No

Did staff burnout and turnover lead to a significant, measurable lengthening of the program schedule?

      Yes

      No

Based on your experience, what were the root causes of this behavior (check all that apply)?

      - Government proposed inappropriate contract type for program phase

      - Contractor focused on meeting contractual cost or schedule incentive

      - Contractor did not assign sufficient personnel to tasks to complete work on time

      - Contractor did not assign correct types of personnel to tasks

      - Contractor underestimated technology maturity at program initiation

      - Contractor struggled integrating technologies into program context

      - Program encountered significant problems during testing requiring fix or redesign

      - Other (open response area)

G. Program Management Office versus Contractor Hostility

This concept describes a cyclic deterioration of the relationship between the Program Office and the contractor due to actions perceived to be self-serving and harmful to the interests of the other party.

Has this behavior occurred on your current program?   Yes

                                               No

If yes, please answer the following questions:

Did this kind of conflict lead to a significant, measurable increase in program cost?

      Yes

      No

Did this kind of conflict lead to a significant, measurable lengthening of the program schedule?

      Yes

      No

Based on your experience, what were the root causes of this behavior (check all that apply)?

      - Government proposed inappropriate contract type for program phase

      - Contractor focused on meeting contractual cost or schedule incentive

      - Government did not include any performance incentives in the contract

      - Government failed to appropriately define the program's requirements

      - Contractor focused on getting into production to perpetuate business base

      - Other (open response area)

H. Robbing Peter to Pay Paul

This happens when the financial execution rates (obligation and expenditure of funds) are less than the stated goals. As a result, funds are taken from the program execution to fund "other priorities".

Has funding been rescinded from your current program for failure to obligate and expend funds in accordance with Office of the Secretary of Defense goals?

Yes

No

If yes, please answer the following questions:

Did execution year funding rescissions lead to a significant, measurable increase in program cost?

Yes

No

Did execution year funding rescissions lead to a significant, measurable lengthening of the program schedule?

Yes

No

Based on your experience, what were the root causes of this behavior (check all that apply)?
- Unable to meet financial execution goals due to continuing resolution / funds release
- Unable to meet financial execution goals due to late contract award due to protest
- Funding profile does not match contractor's plan
- Contractor behind schedule inadequate number of personnel assigned to program
- Other (open response area)

I. Feeding the Sacred Cow

When a program becomes so important to its service or the joint community that protecting the program's funding jeopardizes the health of other programs, it can be described as a "Sacred Cow".

Has your current program been treated as a "Sacred Cow"? Yes

No

Disclaimer -- The views expressed in this thesis are those of the author and do not reflect the official policy or position of the U.S. Air Force, the Department of Defense, or U.S. Government.

If yes, please answer the following questions:

Based on your experience, what were the root causes of this behavior (check all that apply)?
    - No other program can provide capability of program
    - DoD/Service have invested heavily on program to date
    - Delay in fielding capability will significantly impact ability to support fielded forces
    - Other (open response area)

J. Happy Path Testing

This occurs when the program's developmental or operational test approach results in a tightly scripted plan that proves the system's functionality, but the testing does not necessarily replicate the "real world" conditions in which the program will be employed.

Has this test approach been used on your current program? Yes
                                            No

If yes, please answer the following questions:

Did this test approach lead to a significant, measurable increase in program cost?
    Yes
    No

Did this test approach lead to a significant, measurable lengthening of the program schedule?
    Yes
    No

Based on your experience, what were the root causes of this behavior (check all that apply)?
    - Contractor poorly defined test program
    - Government poorly defined test program
    - Government unable to delay fielding decision, shortening time for testing
    - Contractor unable to control schedule, shortening time for testing
    - Government failed to appropriately define the program's requirements
    - Operational environment too expensive to replicate
    - Other (open response area)