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**REVIEW OF THE
JOINT CAPABILITY INTEGRATION AND
DEVELOPMENT SYSTEM (JCIDS)
AND THE
NATIONAL SECURITY SPACE
ACQUISITION PROCESS (NSSAP)**

THESIS

Joyce A. Gamache, First Lieutenant, USAF

AFIT/GRD/ENS/06-01

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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AFIT/GRD/ENS/06-01

REVIEW OF THE JOINT CAPABILITY INTEGRATION AND DEVELOPMENT
SYSTEM (JCIDS) AND THE NATIONAL SECURITY SPACE ACQUISITION
PROCESS (NSSAP)

THESIS

Presented to the Faculty

Department of Systems Engineering and Management

Graduate School of Engineering and Management

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Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Research and Development Management

Degree of Master of Science in Space Systems

Joyce A. Gamache, BS

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March 2006

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SYSTEM (JCIDS) AND THE NATIONAL SECURITY SPACE ACQUISITION
PROCESS (NSSAP)

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Abstract

Space systems are a critical enabler of the net-centric operation warfare (NCOW) needed to achieve victory in the Global War on Terrorism (GWOT). The effective acquisition of affordable systems is vital to our National Security Strategy. Space systems play an important role throughout a wide spectrum of military and civil operations. Several challenging factors unique to space systems development are the high level of technological complexity, a broad joint user base, and the reliance on seamless interoperable systems to achieve superior capabilities for US warfighters. This research examines the interaction between the Joint Capabilities Integration and Development System (JCIDS) and the National Security Space Acquisition Process (NSSAP) through a qualitative case study and identifies ways to improve this interaction by answering investigative questions and providing recommendations to be tested in future research.

Dedication

To

RNG & ALG

—Thank You—

Acknowledgments

I would like to express my sincere appreciation to my faculty advisor, Dr. Stephan Brady, for his guidance, support, and overwhelming patience throughout the course of this research effort. I would also like to thank my committee members, Mr. Ken Farkas and Mr. Mike Farmer, for sharing their expertise and reviewing my research.

I am indebted to the many acquisition professionals who spent their valuable time explaining the processes and procedures they used in their organization to support various aspects of the acquisition process.

Joyce A. Gamache

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REVIEW OF THE JOINT CAPABILITY INTEGRATION AND DEVELOPMENT SYSTEM (JCIDS) AND THE NATIONAL SECURITY SPACE ACQUISITION PROCESS (NSSAP)

I. Introduction

1.1 Space System Criticality

Space systems are a critical enabler of the net-centric operation warfare (NCOW) needed to achieve victory in the Global War on Terrorism (GWOT). A joint mix of ground, airborne, and space systems are required. Joint airborne and space assets are required to achieve persistent, global intelligence, surveillance, and reconnaissance (ISR) coverage. Joint ground, airborne, and space assets are required to implement the Global Information Grid Bandwidth Expansion (GIG-BE) and are required for earth and space environment awareness. Space is the only alternative for global position, navigation, and timing (PNT) coverage. The affordable and timely acquisition of space systems is vital to a net-centric National Security Strategy.

Some claim that the process for acquiring effective military space systems (and military acquisitions at large) is broken, while others claim that the process works because US systems are still superior to those of other nations. DoD's concept of maintaining superiority through constant transformation makes this argument moot by recognizing that opportunities for improvement must be seized when presented.

Aside from the important role that space systems play across the spectrum of military and civil operations, space system acquisition must be continually reviewed and maintain a state of transformation to overcome several factors unique to space system acquisition.

1.2 Background

The Department of Defense (DoD) decision support systems guide the process of identifying the need for, acquiring, and financing materiel solutions when appropriate. These systems include the Joint Capabilities Integration & Development System (JCIDS), the Defense Acquisition System (DAS) or National Security Space Acquisition Process (NSSAP) for space systems, and the Planning, Programming, Budgeting, and Execution (PPBE) Process.

Typically, DoD efforts to improve the overall process of acquiring a system have focused on only one of the decision support systems at a time, although the problems with the entire process may be attributed to how the decision support systems interact, rather than the internal structure of a single decision support system. The most recent wave of reform measures affected the JCIDS and DAS. In May 2003, DoD reissued the DoD 5000 series, including the DoD Directive 5000.1, DoD Instruction 5000.2, and DoD Defense Acquisition Guidebook with the major change being that evolutionary acquisition was identified as the preferred strategy for managing an acquisition program. In June 2003, the Chairman of the Joint Chiefs of Staff (CJCS) 3170 series was reissued, replacing the Requirements Generation System (RGS) with the Joint Capability Integration and Development System (JCIDS). The latest reform measure was the creation of the NSSAP and its guiding documentation, the National Security Space Acquisition Policy 03-01 (NSSAP 03-01), directing acquisition policy specifically for space systems.

1.3 Overview

This thesis looks at the interaction between the JCIDS and the NSSAP and identifies ways to improve these processes. The remainder of this chapter will present the problem the thesis attempts to address and provide a brief description of the scope, methodology, limitations, and significance of this research. Chapter Two will provide a literature review of current acquisition research, literature, and process documentation focusing on those items directly related to the JCIDS and NSSAP. Chapter Three will describe the methodology for theory building from the qualitative case study. The case study will be based on available literature, documentation, and interviews conducted in this research. The results and recommendations will be presented and discussed in Chapter Four. Conclusions and future research recommendations will be presented in Chapter Five.

1.4 Problem

This thesis attempts to answer the question: what changes need to be made to enable more effective interaction between the National Security Space Acquisition Process (NSSAP) and the Joint Capabilities Integration & Development System (JCIDS) to field affordable space systems?

Ten investigative questions will be answered through the literature review and interviews to aid in developing recommendations to the above problem. Those questions include:

- What are the goals of an EA strategy?
- What is an evolutionary acquisition (EA) strategy?
- How is an EA strategy implemented?
- What development processes are alternatives to evolutionary acquisitions?
- What are capability-based acquisitions?

- What are the goals of a capability-based strategy?
- How are capability-based acquisitions implemented?
- How does the acquisition workforce view the documentation of JCIDS and NSSAP processes?

1.5 Scope

The scope of research is within the capability level and program level. The capability level includes capabilities that are delivered in a hierarchical and/or networked system-of-systems or independent system. From the capability level, identifying possible areas for improvement within JCIDS requires examination of an Analysis-of-Alternatives (AoA) trade capability, the definition of capability areas, and the DoD Architecture Framework (DoDAF).

At the program level, this thesis examines the ability for a system's horizontal integration with other systems, the integration of increments with other increments, and the ability of the acquisition strategy to reflect the entire scenario. For specific examples, interviewees were asked to comment on any of three programs. Those programs were the NAVSTAR Global Positioning System (GPS), the Space Based Infrared System (SBIRS), and the Transformational Satellite Communication (TSAT) System.

1.6 Methodology

This thesis uses a qualitative case study to frame the gap between a capability-based JCIDS and NSSAP and identify trade spaces in a number of areas which may improve the interaction between the systems. The literature review examined research to date on the topic of project management, including both commercial and military practices, as well as available documentation of the DoD process and specific cases. Additional information was gathered from field interviews with various organizations

involved in the process. After analyzing the interview and documentation data, a theory and recommendations are presented to the acquisition workforce in this thesis. The thesis will be verified and validated in defense.

1.7 Limitations

There are several limitations worth stating, although other limitations surely exist. The first is that only the interaction between the JCIDS and the DAS is examined. The Planning, Programming, Budgeting, and Execution (PPBE) Process is not examined to reduce the complexity of the thesis and because the PPBE Process is largely out of the DoD's control.

Another limitation is the unique focus on space systems. The results produced may vary with non-space programs. Space systems are excellent candidates to make improvements in their acquisition process, due to their history of cost overruns and schedule slips. In this thesis space system affordability is defined simply as completing a program within budget. Also, the seeming willingness to develop a system that addresses their specific needs as exemplified by the adoption of the NSSAP 03-01, and the characteristics of their systems that make capability-based "requirements," systems-of-systems architectures, and evolutionary strategies so appropriate makes this research appropriate.

Finally, the resulting recommendations, although based on the acquisition workforce interviews and documentation and reviewed in defense, will be untested in case study.

1.8 Significance

This work is highly significant because of its timely relevance and scope. The question of how to improve the acquisition process is arguably one of the most important questions facing the space community, acquisition community, and DoD at large – it is a key component of defense transformation. The resulting recommendations may serve as an outline of a blueprint for modifying the acquisition process to accommodate the new concept of capability-based acquisitions.

II. Literature Review

2.1 Introduction

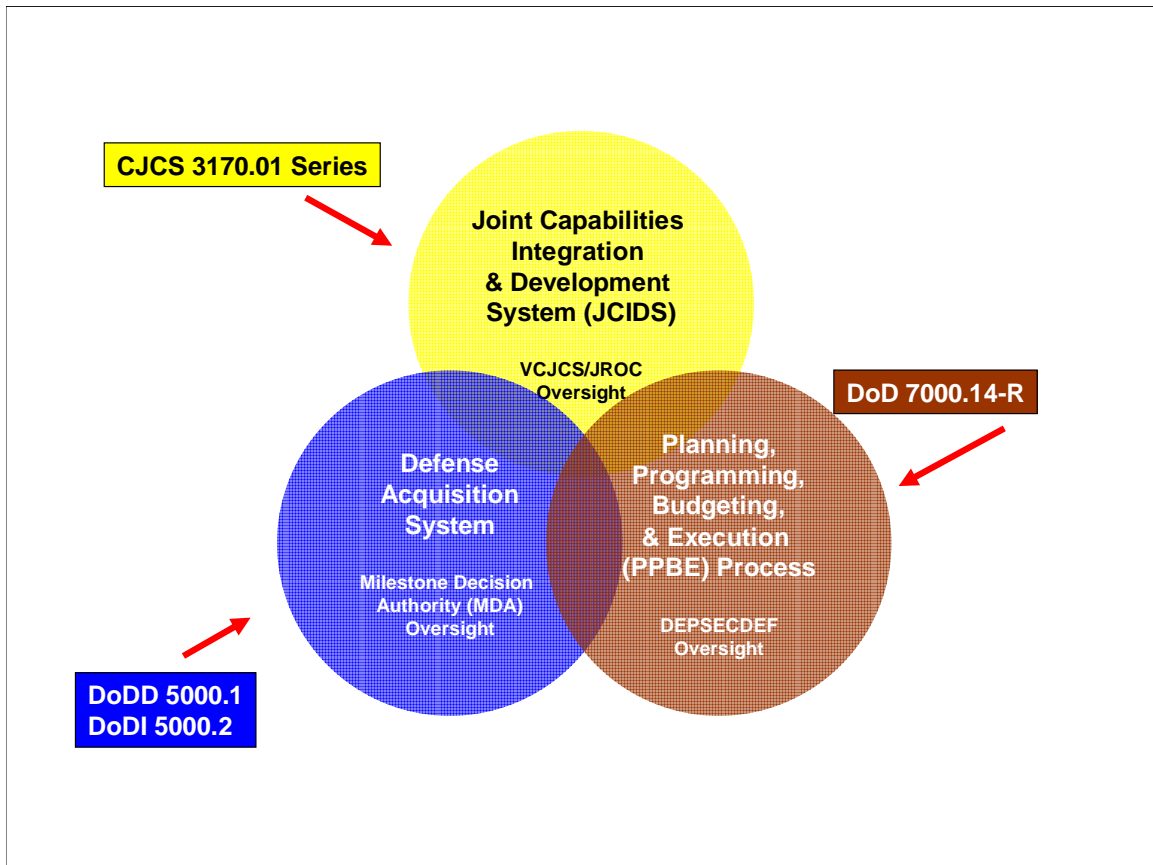
This chapter will address the events and ideas leading to the development of the current Joint Capabilities Integration and Development System (JCIDS) and National Security Space Acquisition Process (NSSAP) as described in the Chairman of the Joint Chiefs of Staff (CJCSI) Instruction/Manual (I/M)3170.01 and National Security Space Acquisition Policy 03-01 (NSSAP 03-01). The chapter will provide a brief overview of the current decision support systems that make up the Acquisition, Technology, and Logistics process before highlighting some of the major ideas that characterize and history of the JCIDS and NSSAP, current areas of concern and research, and official documentation.

2.2 DoD Decision Support Systems

According to the Defense Acquisition Guidebook (DAG, 2004), the purpose of the Department of Defense (DoD) Decision Support Systems is that “the three systems provide an integrated approach to strategic planning, identification of needs for military capabilities, systems acquisition, and program and budget development.” The three systems include the Joint Capabilities Integration and Development System (JCIDS), the Defense Acquisition System (DAS) for non-space programs or the National Security Space Acquisition Process (NSSAP) for space programs, and the Planning, Programming, Budgeting, and Execution (PPBE) Process. Each of these three systems are governed by different documentation and authorities, but frequently affect the same

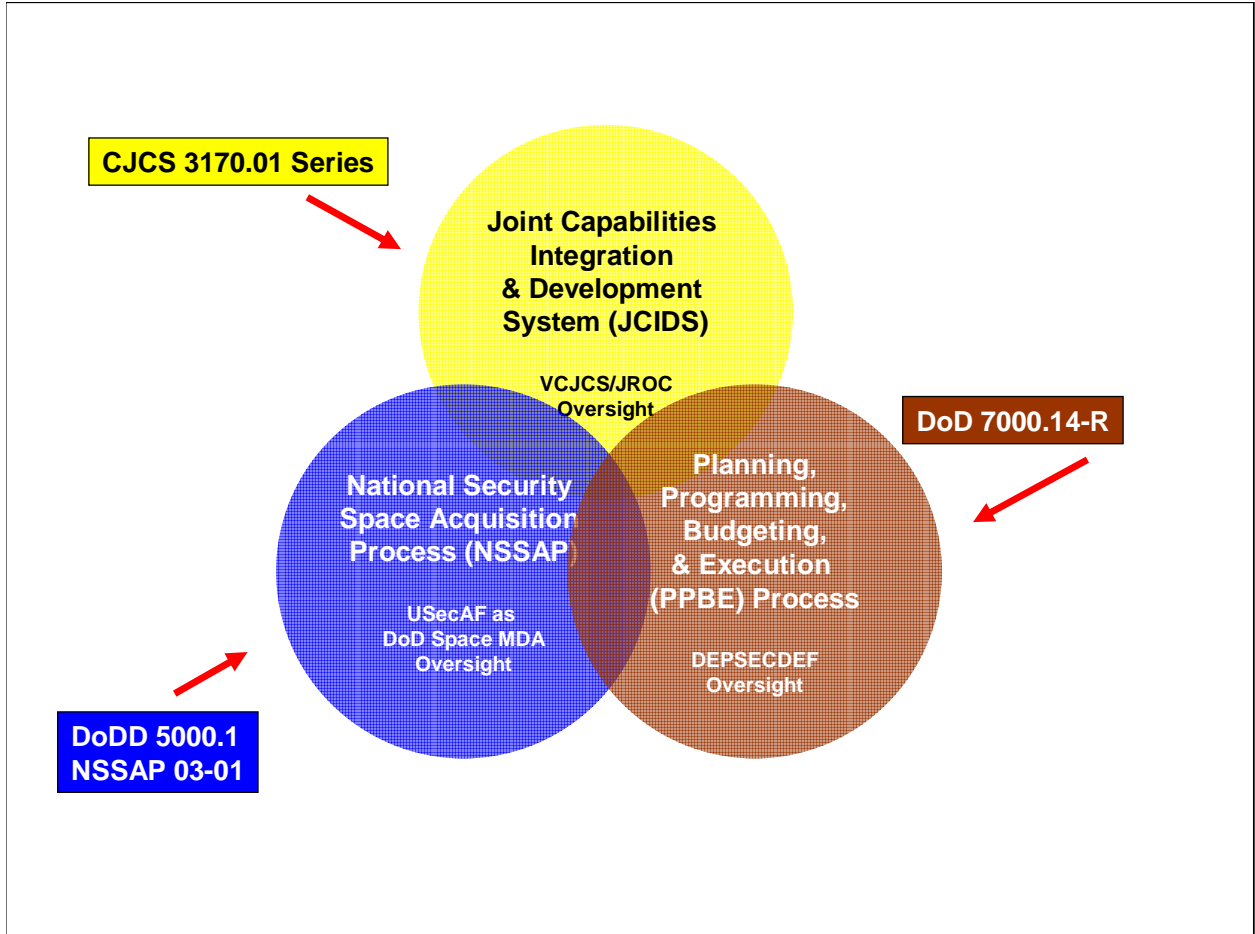
people and events throughout the life time of an acquisition program, as illustrated by the use of a Venn Diagram in Figure 2.01.

Figure 2.01 – DoD Decision Support Systems (DAG, 2004)



As mentioned previously, the appropriate acquisition decision support systems for DoD space systems is the National Security Space Acquisition Process which replaces the Defense Acquisition System, or blue circle on the lower left, in the figure above. Also, some sources refer to the PPBE Process as the PPBE System (PPBES) such as the OSD Comptroller’s website. These terms will be used interchangeably throughout this document. A correct illustration of the decision support systems for space would look something like the image in Figure 2.02.

Figure 2.02 – DoD Decision Support Systems – Space (after DAG, 2004)



In reality, the center overlap portion of the diagram is much larger and represents the area where all acquisition programs fall. Constant interaction and coordination between all three systems results in the most effective acquisition programs (NSSAP 03-01, 2004).

2.2.1 Joint Capabilities Integration and Development System (JCIDS)

The top, yellow circle represents the Joint Capabilities Integration and Development System (JCIDS). Oversight for the JCIDS is provided by the Vice Chairman of the Joint Chiefs of Staff and the Joint Requirements Oversight Council. The CJCSI CJCSM 3170.01 provide guidance for the JCIDS. The JCIDS is “the systematic

method established by the Joint Chiefs of Staff for assessing gaps in military joint warfighting capabilities and recommending solutions to resolve these gaps” (DAG, 2004).

2.2.2 National Security Space Acquisition Process (NSSAP)

In the above figures, the lower left, blue circle represents the Defense Acquisition System (DAS) or the National Security Space Acquisition Process (NSSAP). The DAS is the process that guides acquisition programs (DAG, 2004) that meet capability deficiencies recognized by the JCIDS. The NSSAP does this for space systems by taking into account the differences between space systems and terrestrial (including air) systems. Specifically, “the NSS model emphasizes the decision needs for ‘high-tech’ small quantity NSS programs, versus the DoD 5000 model that is typically focused on making the best large quantity production decision. The funding profile for a typical NSS program is usually front-loaded when compared to a production-focused system. This requires the key decisions for a NSS program to be phased earlier than the typical DoD 5000 milestone decisions” (NSSAP 03-01, 2004).

Oversight is the responsibility of the Milestone Decision Authority (MDA), like in the traditional Defense Acquisition System (DAS) for non-space programs. However, unlike the DAS, the MDA for space programs is the Under Secretary of the Air Force (USecAF). The National Security Space community includes the national intelligence community’s (IC) space programs, in addition to the DoD’s space programs. However the IC acquisition policy is the National Reconnaissance Office (NRO) Directive 82-2b, Acquisition Management - Directive 7, while DoD systems are governed by the National

Security Space Acquisition Policy (again, NSSAP) 03-01 in place of the DAS's DoDI 5000.2.

The National Security Space Acquisition Process for DoD Space Systems is still governed by DoD Directive 5000.1 in addition to NSSAP 03-01. The relationship with DoDI 5000.2 appears to be less clear. NSSAP 03-01 (2004) makes mention in section 3.3 of the space MDA's right to waiver or exempt space programs from having to follow provisions of DoDI 5000.2 if a program submits a memorandum applying for such a waiver or exemption. That excerpt is listed below:

3.3 DoDI 5000.2 Waiver and Exemption

The Space Milestone Decision Authority is authorized to approve waivers and exemptions to provisions of DoD instructions or publications, as defined by DoD Directive 5025.1, to the extent that the instruction or publication, and its subject matter, are under the jurisdiction of USD(AT&L). To use this process, SPD/PMs can request a waiver through their PEO and CAE via a memo to the DoD Space MDA. Once the DoD Space MDA has granted the waiver and exemption, it remains valid for the life of the program unless the DoD Space MDA rescinds the waiver. (The DoD Space MDA waiver authority does not include DoDD 5000.1 or other DoD Directives.) For DoD Space Non-MDAPs, the appropriate CAE or CAE-designated representative (e.g., PEO) has the authority to establish basic acquisition practices and to act as the MDA following DoDI 5000.2 or this policy with approved waiver. (NSSAP 03-01, 2004)

However, a memorandum from the Under Secretary of the Air Force states that “the NSS Acquisition Policy 03-01 falls under the authority of DoD Directive 5000.1 and will be used for DoD Space Major Defense Acquisition Programs, replacing processes and procedures described in the DoD Instruction 5000.2 under the jurisdiction of the

Under Secretary of Defense for Acquisition, Technology and Logistics (USD-AT&L)” (USecAF, 2003).

2.2.3 Planning, Programming, Budgeting, and Execution (PPBE) Process

The Planning, Programming, Budgeting, and Execution (PPBE) Process is “the Department's strategic planning, program development, and resource determination process. The PPBE process is used to craft plans and programs that satisfy the demands of the National Security Strategy within resource constraints” (DAG, 2004). Oversight for the PPBE Process is provided by the Deputy Secretary of Defense. Guidance is provided by DoD 7000.14-R.

Although the PPBE Process is one of the three DoD decision support systems, only the interaction between the JCIDS and the NSSAP will be examined in this research. The PPBE Process has greater external interaction than the other two systems in determining how the process operates. Plus, setting aside the PPBE Process narrows the scope of the research to something more manageable given the time constraint to complete the research.

2.3 Themes in Literature

Throughout the course of literature review, several themes or points of discussion became evident. These themes were consistent among the majority of reviewed articles, though not necessarily grouped in the same manner. The following sections provide a brief summary of some of the most common themes related to the JCIDS and NSSAP.

Those themes are:

- Acquisition Reform
- Transformation, Modernization, and Recapitalization

- Capabilities v. Requirements
- Technology
- Evolutionary Acquisitions
- Alternative System Development Strategies

2.3.1 Acquisition Reform

One characteristic of today's National Security Space Acquisition Process is its emergence from a 20-year reform effort. Table 2.01 shows updates to the three decision support systems that make up the process of identifying needs and providing solutions to the warfighter. Behind the updated documents in the table are countless memorandums, directives, codes, instructions, guides, references, architecture frameworks, public laws, circulars, and orders supporting various aspects of, or replaced by, the guiding documents. Even without knowing all of these interim, supporting, or amending documents, a pattern in reform is evident from the top-level documents alone. For example, the decision support documents of 1991 remained unchanged until 1996. The documents from 1996 were changed by 1999 and have been changed every year since. Not only have the documents been reissued, but the document-types and names of the decision support system have changed since 1999.

Why the emphasis on reform? "We have experienced breaches in nearly every major acquisition program and these breaches are unacceptable" (Lord, 2006). Breaches mean violations of the terms specified in the Acquisition Program Baseline (APB) of a program, pertaining to cost, schedule, and performance. In other words, many of our systems are over cost, behind schedule, and failing to meet original performance requirements.

This is not news to the space community. Air Force Space Command's (AFSPC) quarterly journal High Frontier, dedicated its entire January issue to the subject of space

Table 2.01 – Changes in the Decision Support Systems in the Last Fifteen Years

1991	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1991	Planning, Programming, Budgeting System DoDD 7045.14, 1984
1992	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1991	Planning, Programming, Budgeting System DoDD 7045.14, 1984
1993	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1991	Planning, Programming, Budgeting System DoDD 7045.14, 1984
1994	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1991	Planning, Programming, Budgeting System DoDD 7000.14, 1994
1995	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1991	Planning, Programming, Budgeting System DoDD 7000.14, 1994
1996	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1996	Planning, Programming, Budgeting System DoDD 7000.14, 1994
1997	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1996	Planning, Programming, Budgeting System DoDD 7000.14, 1994
1998	Requirements Generation System CJCS MOP 77	Acquisition Management System DoD 5000 Series, 1996	Planning, Programming, Budgeting System DoDD 7000.14, 1994
1999	Requirements Generation System CJCS 3170 Series, 1999	Acquisition Management System DoD 5000 Series, 1996	Planning, Programming, Budgeting System DoDD 7000.14, 1994
2000	Requirements Generation System CJCS 3170 Series, 1999	Defense Acquisition System DoD 5000 Series, 2000	Planning, Programming, Budgeting System DoDD 7000.14, 2000
2001	Requirements Generation System CJCS 3170 Series, 2001	Defense Acquisition System DoD 5000 Series, 2000	Planning, Programming, Budgeting System DoDD 7000.14, 2001
2002	Requirements Generation System CJCS 3170 Series, 2001	Defense Acquisition System DoD 5000 Series, 2002	Planning, Programming, Budgeting System DoDD 7000.14, 2002
2003	Joint Capabilities Integration & Decision System CJCS 3170 Series, 2003	Defense Acquisition System DoD 5000 Series, 2003 & National Security Space Acquisition Process NSSAP 03-01, 2003	Planning, Programming, Budgeting, and Execution Process DoDD 7000.14, 2002
2004	Joint Capabilities Integration & Decision System CJCS 3170 Series, 2004	Defense Acquisition System DoD 5000 Series, 2003 & National Security Space Acquisition Process NSSAP 03-01, 2004	Planning, Programming, Budgeting, and Execution Process DoDD 7000.14, 2002
2005	Joint Capabilities Integration & Decision System CJCS 3170 Series, 2005	Defense Acquisition System DoD 5000 Series, 2003 & National Security Space Acquisition Process NSSAP 03-01, 2004	Planning, Programming, Budgeting, and Execution Process DoDD 7000.14, 2002

acquisitions, past, present, and future. Within the 56 pages, 13 senior space professionals described past problems and circumstances and present day factors that have led to the outcome of today's "over cost, behind schedule, and below performance" reality for many space programs. Both Gen Lord and LtGen Hamel sited events in the 1990s as contributors to today's problems. "Acquisition reform errors of the 1990s left us with a severe lack of expertise in cost estimating, system engineering, and program management" (Lord, 2006). And, "in the early 1990s, the Cold War ended, defense budgets were cut...the Air Force systemically cut back its development and acquisition workforce and delayed its recapitalization plans" (Hamel, 2006). They also pointed out improvements that could or had already been made and all presented an impression of hopefulness for the future. BrigGen Pawlikowski concluded her article by summarizing the space acquisition community's mission. "We must deliver systems that are fully integrated into effects capability even if that means leading multiple diverse programs within a concurrent development environment. This is our mission in support of our warfighters; failure is not an option. The space acquisition community is postured to meet this mission. We will overcome the devastating effects of the experiments in acquisition reform in the 1990s."

Many of the authors cited a number of reports on acquisition reform when discussing the basis for their recommendations. While the experiences and opinions of senior leadership is valuable, these reports are the most rigorous research on the subject of acquisition reform. In the last twenty years, countless organizations and panels have looked at the issues surrounding acquisition reform, such as the 1986 Blue Ribbon Commission—"Packard Commission," the 1990s DSB reports, the 2000 Launch Broad

Area Review, the 2001 Space Commission Report—“Rumsfeld Commission,” the 2003 Defense Science Board—“Young Panel,” and most recently the 2005 Defense Acquisition Performance Assessment (DAPA) Project. In addition to all of these, the Government Accountability Office (GAO) has provided a number of valuable reports pertaining to space acquisition reform.

The following sections examine those findings and recommendations that pertain specifically to the JCIDS and NSSAP and were present in other articles and research. One item that was not present in literature, other than in the commission report, but was a frequent topic in interviews was a recommendation from the Young Panel. The Young Panel recommended that the space funding profile should represent 80% for development and production and 20% for operations and maintenance with a 25% margin for program managers. Another interesting characteristic of the recommendations and problems identified by senior leadership and expert panels is that at times the findings are very similar to those of the past and at other times, the exact opposite action is prescribed. For example, the concept of Total System Performance Responsibility (TSPR) was a strategy used to procure SBIRS, based on 1994 DAS policy (then called Acquisition Management System). LtGen Michael Hamel commented that “the responsibility for program management was largely shifted to, and shouldered by, the defense industry. The construct was known as Total System Performance Responsibility, wherein industry was expected to deliver end-to-end systems. Defense contractors were given broad authority to interpret performance requirements, define system designs, establish statements of work and deliverable items, and use commercial ‘best practices.’” (Hamel, 2006) LtGen Hamel continued to say that the concept resulted in lack of government oversight and

mission failure. However, in 2003, Dr. Addelston made a compelling case for using it to allow contractors to develop end-to-end system-of-systems based on a government CONOPS (Addelston, 2003). This fluctuation may reflect the difficulty in developing a comprehensive system that is still flexible or it may indicate that something else is wrong other than the system.

2.3.2 Transformation, Modernization, and Recapitalization

Another theme prevalent in many articles focusing on all processes associated with DoD acquisitions, is the concept of “Transformation.” Transformation simply means to change or modernize many aspects of the DoD to be more flexible to threats (Myers, 2001). The DefenseLink Transformation website provides the following overview to describe transformation:

The Sept. 11, 2001, terror attacks on the United States accelerated the need to transform to better meet the challenges of the 21st century, thus, sustain American competitive advantage in warfare.

Transformation is foremost a continuing process that does not have an end point. It is meant to create or anticipate the future. Transformation is meant to deal with the co-evolution of concepts, processes, organizations and technology. Change in any one of these areas necessitates change in all.

Transformation is meant to create new competitive areas and new competencies. It is meant to identify, leverage and even create new underlying principles for the way things are done. Transformation is meant to identify and leverage new sources of power. The overall objective of these changes is simply – sustained American competitive advantage in warfare. (DefenseLink Transformation Website, 2006)

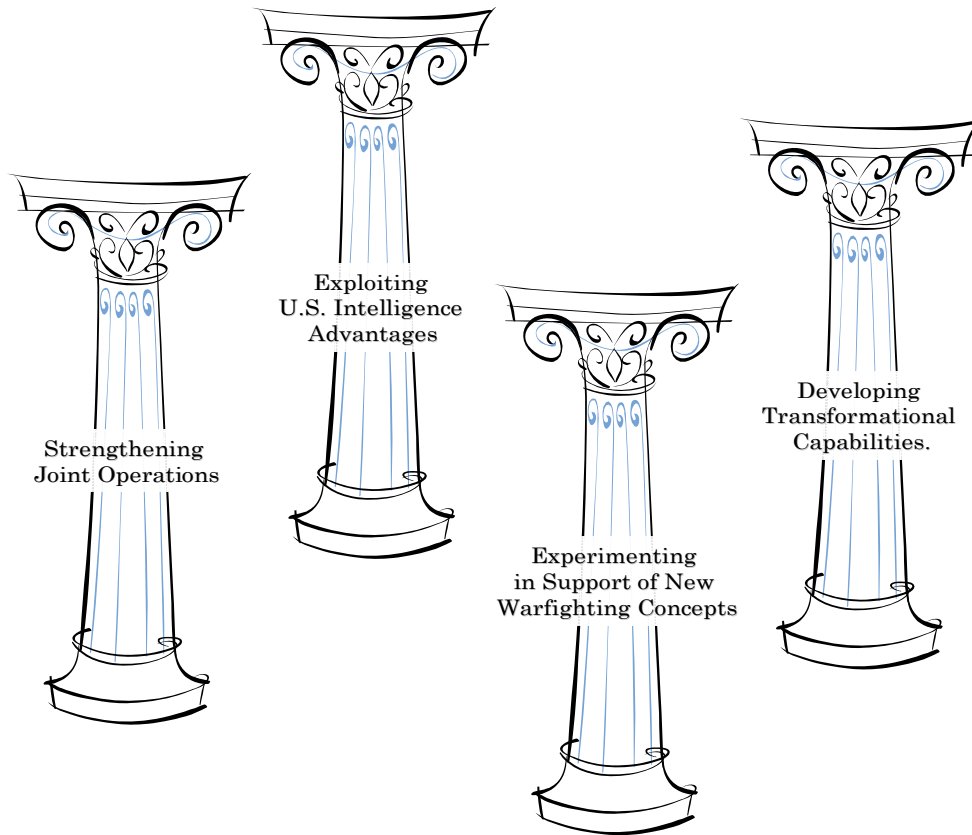
Transformation was not born from the 9-11 terror attacks. It was included in the Space Commission's January 2001 Report. The Space Commission defined it similarly as to "develop, deploy, and maintain the means to deter attack on and to defend vulnerable space capabilities...this requires a deterrence strategy for space, which in turn must be supported by a broader range of space capabilities" (Space Commission, 2001). The Space Commission defined these capabilities necessary to space transformation as: Deterrence and Defense, Policy for Space Assured Access to Space and On-Orbit Operations, Space Situational Awareness, Earth Surveillance from Space, Global Command, Control and Communications in Space, Defense in Space, Homeland Defense, and Power Projection In, From, and Through Space (Space Commission, 2001).

In fact, the concept of transformation, or modernization, has been around for some time. A Feb 1995 DoD news release on the FY 1996-97 Defense Budget quoted Secretary Perry saying that the budget would be used in part for "prudent weapons modernization" (DoD, 1995). The article later substituted recapitalization for modernization when it said that "The new budget plans also begin the 'recapitalization' of U.S. forces--that is, the modernization of weapons and equipment, after several years in which the Department lived off its Cold War stocks of equipment" (DoD, 1995). And even as recently as June of 2005, while testifying before the Senate Armed Services Committee (SASC) during his confirmation hearing, Gen Moseley stated that recapitalization of the aging aircraft fleet was his third priority (third to improving joint warfighting and strengthening Air Force people) (Gettle, 2005).

The concepts of modernizing, recapitalization, and transformation as synonyms is not new. However, today's usage implies that recapitalization specifically applies to modernizing weapon systems after a period of allowing systems to remain at the status quo and fall behind state of the art. Transformation has also become more clearly defined. In 2003, the Secretary of Defense published the Transformation Planning Guidance. Within the document, Secretary Rumsfeld stated that transformation is more than modernizing weapon systems in that it includes continually transforming our people, processes, and military forces “so that our armed forces are always several steps ahead of any potential adversary” and can react quickly to whatever the threat may be including terrorist attacks, cyber-war attacks, traditional state-on-state attacks, etc. (DoD TPG, 2003).

The document also specifies that transformation efforts will occur in three areas: how we fight, how we do business, and how we work with others (DoD TPG, 2003). Transforming how we fight means supporting the four pillars of transformation identified in the 2001 QDR and pictured in Figure 2.03.

Figure 2.03 – 2001 QDR Transformation Pillars (DoD TPG, 2003)



The Office of Force Transformation has established the following five goals, which closely mirror those of the 2001 QDR and support the pillars. Those goals are listed below:

1. Make force transformation a pivotal element of national defense strategy and DoD corporate strategy effectively supporting the four strategic pillars of the national military strategy.
2. Change the force and its culture from the bottom up through the use of experimentation, transformational articles (operational prototyping) and the creation and sharing of new knowledge and experiences.
3. Implement Network Centric Warfare (NCW) as the theory of war for the information age and the organizing principle for national military planning and joint concepts, capabilities and systems.

4. Get the decision rules and metrics right and cause them to be applied enterprise wide.
5. Discover, create or cause to be created new military capabilities to broaden the capabilities base and mitigate risk. (Office of Force Transformation Website, 2005)

Transforming how we do business includes a number of efforts; most notable is “adaptive planning, a more entrepreneurial, future-oriented capabilities-based resource allocation planning process, accelerated acquisition cycles built on spiral development, output-based management, and a reformed analytic support agenda” (DoD TPG, 2003). Furthermore, reforming the acquisition process is a top priority (DoD TPG, 2003). “The Department [of Defense] is reducing acquisition cycle time and aligning acquisition with a new capabilities-based resource allocation process built around joint operating concepts. Instead of building plans, operations and doctrine around individual military systems as often occurred in the past, henceforth the Department will explicitly link acquisition strategy to future joint concepts in order to provide the capabilities necessary to execute future operations” (DoD TPG, 2003).

Acquisition reform, whether a new concept or not, was clearly needed as demonstrated by the multitude of GAO, DSB, and other special panels chartered to look at the Acquisition process discussed in section 2.2.1. That need was brought to the forefront after the events of 9-11 demonstrated interagency communication weaknesses and drastically different threats than DoD had prepared for through traditional methods of adjusting Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF). Therefore, the concept of transformation, though introduced before 9-11, gained substantial support because it represented more than system

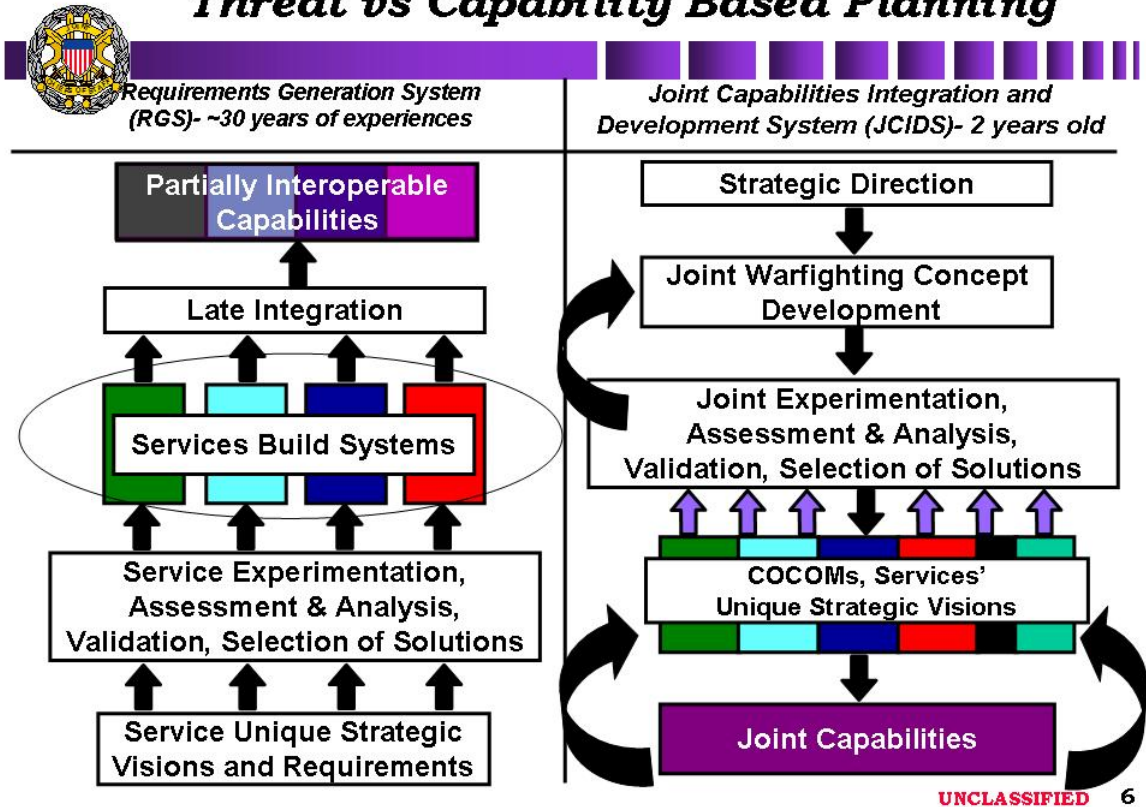
modernization or recapitalization. It also emphasized joint activities, the development of a net-centric environment, and promoting changes across the DOTMLPF spectrum.

2.3.3 Capabilities v. Requirements

In May of 2003, the Joint Capabilities Integration & Development System (JCIDS) replaced the Requirements Generation System (RGS) decision support system. According to a briefing given by the Joint Staff, the former RGS had a number of shortcomings including producing stove-piped systems that were not integrated with other systems; producing service oriented requirements, rather than joint focused; lacking an objective construct for proposal analyses; duplication of efforts in smaller programs; and unprioritized joint warfighting needs. (Joint Staff / J8, 2005) Figure 2.04 compares the former RGS with the new JCIDS.

Figure 2.04 – RGS v. JCIDS Comparison (Joint Staff / J8, 2005)

Threat vs Capability Based Planning



In addition to the top-down, joint-approach, an additional JCIDS characteristic is the prevalent use of the term “capability” and the reduced use of the term “requirements.” This has led to discussion on what exactly is meant by capability and related terms such as capability-based acquisitions. The governing document for the JCIDS process, CJCSI 3170 defines a capability [as] “the ability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks” (CJCSI 3170, 2005). Air Force Instruction 10-601, *Capabilities Based Requirements Development*, defines capability as “the ability to execute a specified course of action. It is defined by an operational user and expressed in broad operational terms in the format of an initial capabilities document (ICD) or a DOTMLPF change recommendation. In the case of materiel proposals, the definition will progressively

evolve to DOTMLPF performance attributes identified in the [capability development document] CDD and the [capability production document] CPD” (AFI 10-601, 2004). The DoD Dictionary defines capability as “the ability to execute a specified course of action. (A capability may or may not be accompanied by an intention.)” AFI 63-101, *Operations of Capability Based Acquisition System* and AFPD 63-1, *Capability-Based Acquisition System* do not define or refer to definitions of a capability.

The failure to adopt joint capability-based acquisitions in implementation and across services was noted in a recent report by the Government Accountability Office, titled “DoD Management Approach and Process Not Well-Suited to Support Development of Global Information Grid (GIG).” In the report, the GAO stated that “DoD program management and acquisition oversight tend to focus on individual programs and not necessarily on synchronizing multiple programs to deliver interdependent systems at the same time, as required to achieve the intended capability” (GAO, 2006).

An additional characteristic of the JCIDS is the option of using an architecture made of family-of-systems (FoS) or system-of-systems (SoS) as solutions. CJCSI identifies FoS and SoS as follows:

Family of Systems - A set of systems that provide similar capabilities through different approaches to achieve similar or complementary effects. For instance, the warfighter may need the capability to track moving targets. The FoS that provides this capability could include unmanned or manned aerial vehicles with appropriate sensors, a space-based sensor platform or a special operations capability. Each can provide the ability to track moving targets, but with differing characteristics of persistence, accuracy, timeliness, etc.

System of Systems - A set or arrangement of interdependent systems that are related or connected to provide a given capability. The loss of any part of the system will significantly degrade the performance or capabilities of the whole. The development of a SoS solution will involve trade space between the systems as well as within an individual system performance. An example of a SoS would be a combat aircraft. While the aircraft may be developed as a single system, it could incorporate subsystems developed for other aircraft. For example, the radar from an existing aircraft may be incorporated into the one being developed rather than developing a new radar. The SoS in this case would be the airframe, engines, radar, avionics, etc. that make up the entire combat aircraft capability. (CJCSI 3170.01, 2005)

The concept of joint, net-centric, SoS or FoS architectures has caused a number of organizations to take a look at several areas within DoD acquisitions aside from those associated with the oversight and review processes detailed in CJCSI 3170 and NSSAP 03-01. In February of 2004, the National Defense Industrial Association (NDIA) Systems Engineering Division Modeling & Simulation (M&S) Community published their findings on M&S support and how it related to the new DoD 5000 series. The report had:

- 13 findings on the systems engineering process
- 35 findings regarding M&S
- four recommendations on the use of M&S
- 12 recommendations on enabling the use of M&S (NDIA, 2004)

In April of 2005, the Aerospace Corporation published a draft rewrite of Military Standard 499C, *Systems Engineering*—its first update since 1974. The document is one example of LtGen Hamel’s “comprehensive fixes” at Space and Missile Systems Center (SMC). “These comprehensive fixes include reestablishing systems engineering discipline, critical development processes, tailored military specifications and standards...” (Hamel, 2006). In addition to the implications of capability-based

acquisitions on SE and M&S, testing and evaluation (T&E) is also under review. Col Eileen Bjorkman is the Joint Test & Evaluation Methodology (JTEM) Feasibility Study Director charged with “developing methods and processes for testing in a Joint environment” (Bjorkman, 2005). As is the case with many Joint Acquisition activities, Bjorkman says that relationships need to be established among competing processes and organizations (Bjorkman, 2005).

2.3.4 Technology

The role of technology in the acquisition processes was another strong theme for discussion in the literature. These discussions included the military lag behind the commercial world in technological advancements, DoD’s lag behind national space systems, and incorporating immature technology into DoD systems.

A number of articles and reports highlighted a need “to give DOD access to those technologies, products, and processes which are dominated by the commercial market place. Electronics, software, computer systems, telecommunications, and flexible manufacturing are example areas where commercial technology is far more advanced than military technology” (DSB 1993).

Some articles stated that there was too much technology development during the acquisition life cycle. In a speech given to a graduating class of the Defense Systems Management Course, Mr. John Wilson said that the Acquisition community needed to consciously separate technology development from acquisition (Johnson, 1999).

The 1993 DSB sited one problem with the acquisition process as “assuming ‘this will be the last new system for the next two decades,’ and including all new (often unproven) technology at the start of full-scale development, and adding new requirements

to this same system over time” (DSB, 1993). Similarly, Mr. Wilson said “Because we expect each generation of technology to be a revolutionary leap ahead of the last generation, we try to fund requirements ten to fifteen years in the future. As the F-22 example demonstrates, not only does this practice cause us to design systems based on our best guess of future threats and technology, which is often inaccurate, but it also extends cycle times by making us repeatedly revise the program to incorporate new developments” (Johnson, 1999). This problem begs the question: should defense system technology be revolutionary or evolutionary?

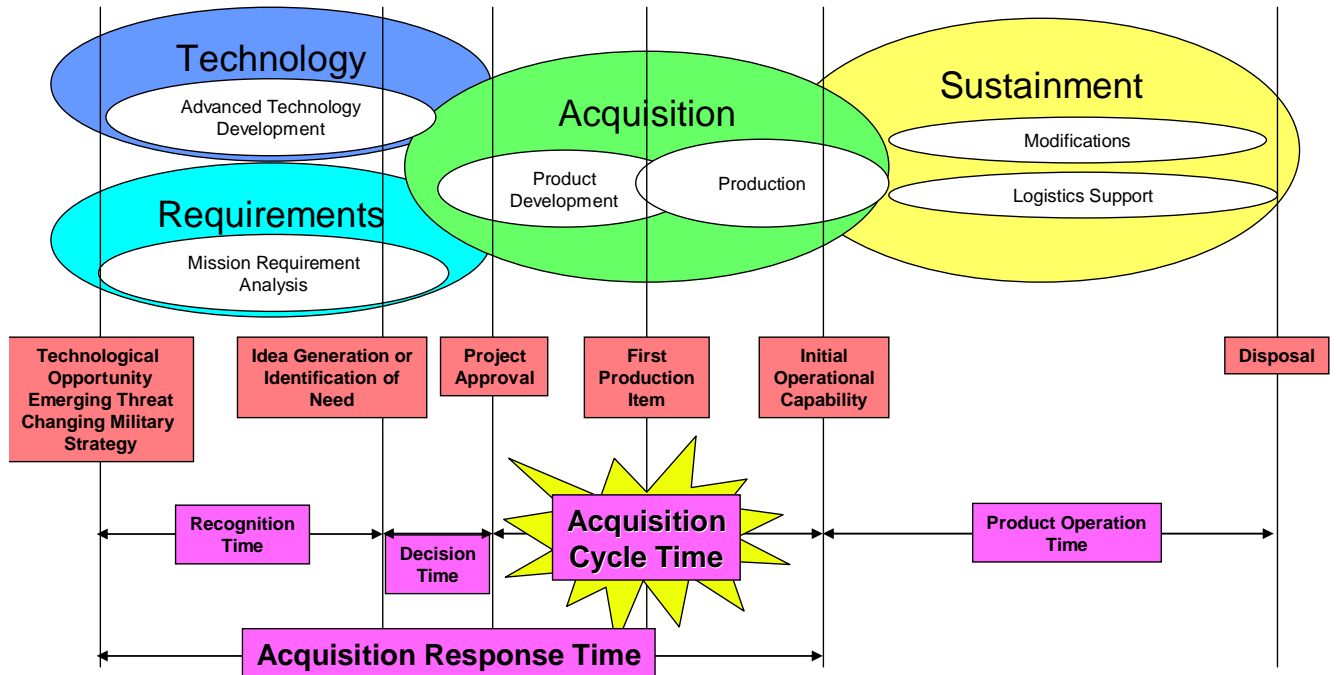
According to the 1999 DSB, “there have been few revolutionary programs in the past, that have succeeded without the strong support of the owning Service. Major change almost always involves some leadership group who perceives a pending crisis. If the DoD wants to make change, it must recognize the difficulty of sustaining funding support for revolutionary changes, and then provide the leadership for giving such programs funding stability” (DSB 1999). Gen Hamel, among others (Sugar, 2006) (Stevens, 2006), feel that “program stability is essential if we are to avoid continuous re-planning and re-baselining, which inevitably causes delays and cost growth” (Hamel, 2006).

2.3.5 Evolutionary Acquisitions (EA)

Many believe that an evolutionary strategy, as opposed to a single step strategy providing revolutionary change, will solve Acquisition’s problem of lengthy acquisition cycle time. The Packard Commission stated that “an unreasonable long acquisition cycle of 10 to 15 years for major weapons systems is a central problem from which most other acquisition problems stem” (Packard, 1986) including obsolete technology, cost growth,

and “gold plated” defense systems (Packard, 1986). Cycle time is the length of time it takes to go from program initiation to initial operational capability (IOC) (Johnson, 1999). Figure 2.05 depicts the concept of acquisition cycle time according to the 1999 DSB.

Figure 2.05 – Acquisition Cycle Time (DSB, 1999)



“Rather than aiming for a 100% solution that takes 20 years to complete, they will strive for an 80% solution that can be fielded to the troops faster and at affordable prices.”

(Farrell, 2002) DoD supported this notion by stating that Evolutionary Acquisition (EA) was the preferred method for acquiring weapon systems in the 2003 reissuance of the

DoD 5000 series. The NSSAP 03-01 followed suit, also stating that EA was the preferred method for developing space systems.

What is EA? According to DoDI 5000.2,

An evolutionary approach delivers capability in increments, recognizing, up front, the need for future capability improvements. The objective is to balance needs and available capability with resources, and to put capability into the hands of the user quickly. The success of the strategy depends on consistent and continuous definition of requirements, and the maturation of technologies that lead to disciplined development and production of systems that provide increasing capability towards a materiel concept.... The approaches to achieve evolutionary acquisition require collaboration between the user, tester, and developer. They include:

Spiral Development - In this process, a desired capability is identified, but the end-state requirements are not known at program initiation. Those requirements are refined through demonstration and risk management; there is continuous user feedback; and each increment provides the user the best possible capability. The requirements for future increments depend on feedback from users and technology maturation.

Incremental Development - In this process, a desired capability is identified, an end-state requirement is known, and that requirement is met over time. (DoDI 5000.2, 2003)

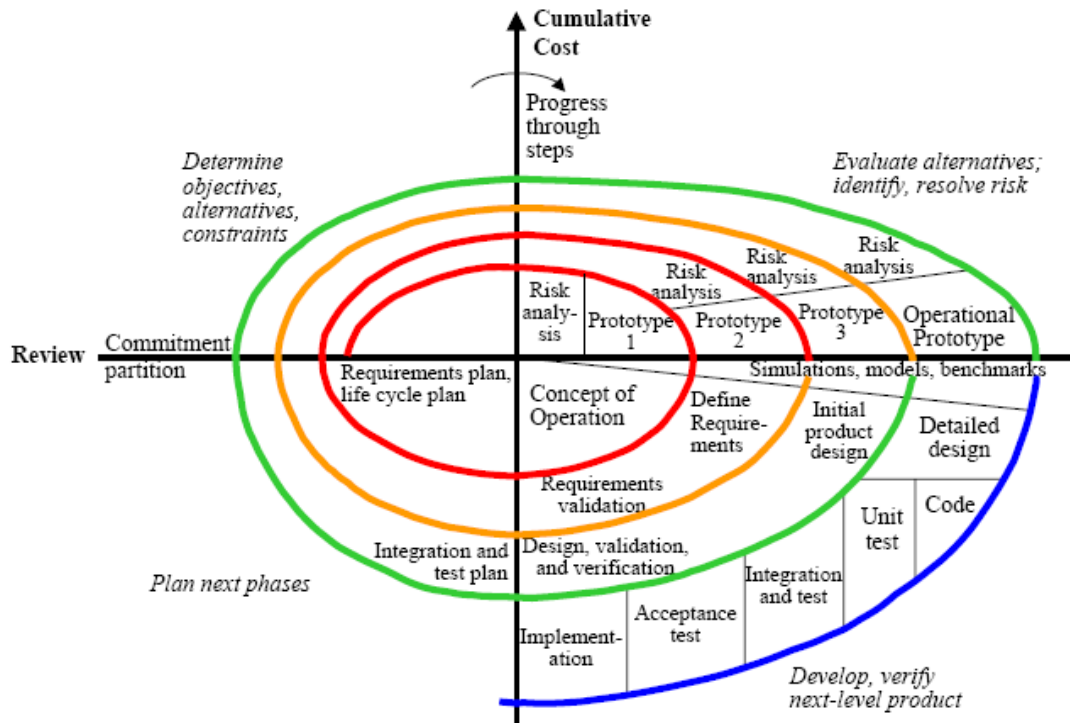
NSSAP 03-01 defines EA similarly and goes on to say that “evolutionary acquisition has been a cornerstone for space system development since the early 1960’s” (NSSAP, 2004) even though the recognition in DoD has been fairly recent and can be traced back to DoD computer system acquisition (Farkas, 2003).

Traces of an evolutionary concept can be found dating back to the 1930s when Walter Shewhart of Bell Labs proposed a series of small “Plan-Do-Study-Act” cycles, a

concept referred to as PDSA, to improve the quality of products. (Larman, 2003) W. Edwards Deming, also a quality expert, promoted PDSA in the 1940s and included it in his 1986 book *Out of the Crisis* (Deming, 1986). In the 1950s, the X-15 hypersonic jet incorporated an iterative and incremental development, or IID, strategy. NASA credited some of the success of the project to the IID strategy. The IID strategy was also used on NASA's software for the Project Mercury program (Larman, 2003). It was in the mid-1950s that IID became widely accepted in the software programming community. In 1976, Tom Gilb introduced the concept of evolutionary project management and in the mid-1980s TRW's Barry Boehm coined the term "Spiral Development" (Larman, 2003). Figure 2.06 illustrates Boehm's concept of spiral development.

In the spiral model, the desired capability is achieved at the end of the entire spiral. Boehm's model releases prototypes for testing, but does not consider them to be solutions. Some consider the spiral model to be a system production model (Unger, 2003) but apply different steps than the one developed by Boehm. Unger describes product development models that use time or budget constraints to mark the end of a development phase. The automobile industry for example, makes a number of upgrades or modifications in about 18 months, fast enough to have a new edition of the Ford Explorer available each year. This is an example of time-block product development and an evolutionary strategy, but it is made possible through a fairly mature prototype that remains constant. Software engineering is another industry that releases mature prototypes without requiring too many spirals.

Figure 2.06 – Spiral Development (Boehm, 2001)



The National Security Space Acquisition Process' application treats prototypes as militarily useful, improved capability systems that may or may not be brought to the same level as the final capability, when the spiral is completed. The ability to bring an earlier system to the same level as a new system presents problems for space systems since only software can be upgraded on a launched satellite at this time. Capability is generally added in following generations of satellites by designing them to be backward compatible with earlier generations.

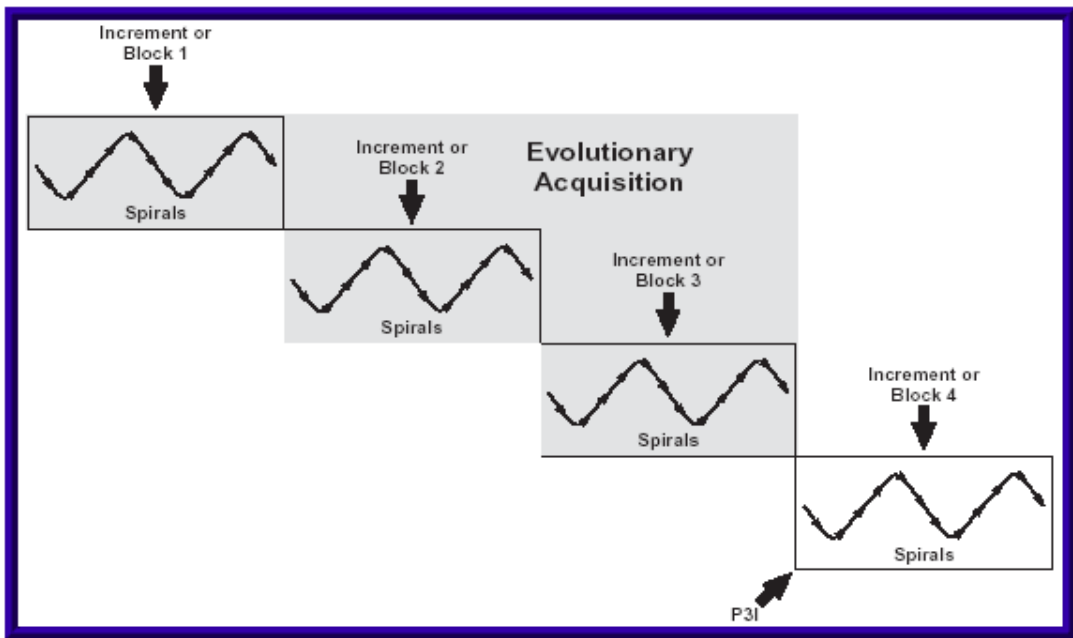
This may seem similar to block development or preplanned product improvement (P3I) and in some ways, it is; which is why the space community says that they have been using EA strategies for years (NSSAP 03-01, 2004). Pete Aldridge published the following definitions:

Increment or Block - A militarily useful and supportable operational capability that can be effectively developed, produced or acquired, deployed, and sustained. Each increment of capability will have its own set of thresholds and objectives set by the user.

Preplanned Product Improvement - A traditional acquisition strategy that provides for adding improved capability to a mature system. (Aldridge, 2002)

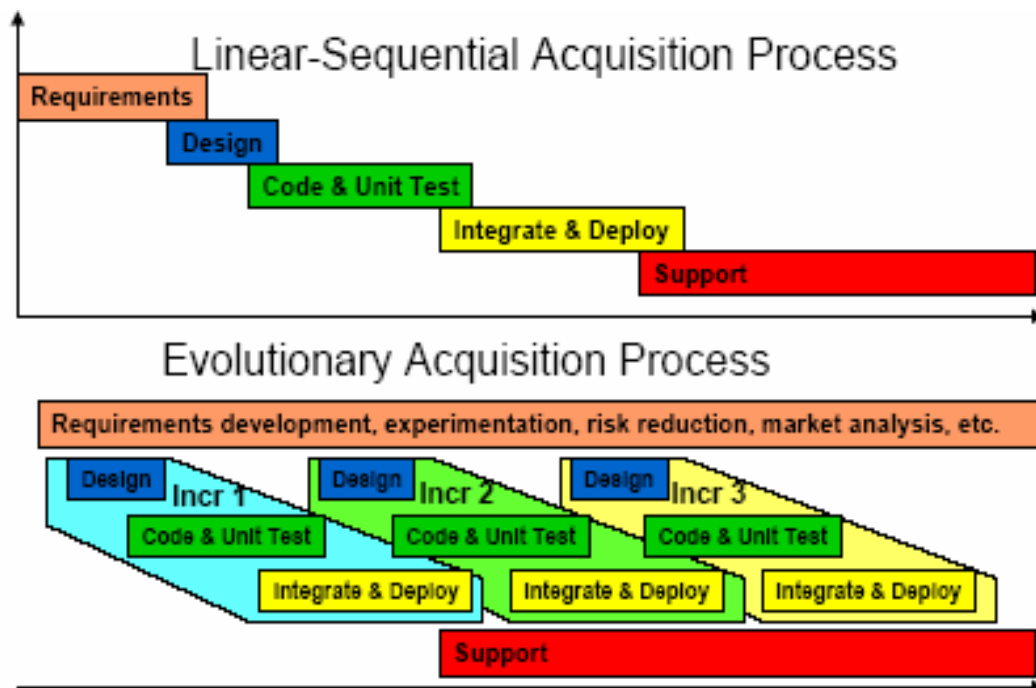
In DoD's application of EA, EA (spiral or incremental), block development, and P3I ALL result in blocks or increments. The difference is in the expected capability. EA shoots for an 80% solution upgraded over time, block shoots for a 100% solution with each successive block, and P3I shoots for a 100% solution with planned upgrades to follow (Farkas & Farmer, 2005). Figure 2.07 is from Crosstalk Magazine and *attempts* to capture these concepts (Crosstalk, 2002).

Figure 2.07 – EA Visualization (Crosstalk, 2002)



Mr. David Brown, of the Technology and Engineering Department in the Defense Acquisition University (DAU), briefed the following figure at the 2005 Space Systems Engineering and Acquisition Excellence Forum.

Figure 2.08 – Linear Sequential Acquisition Process v. Evolutionary Acquisition Process (Brown, 2005)



2.3.6 System Development Strategies

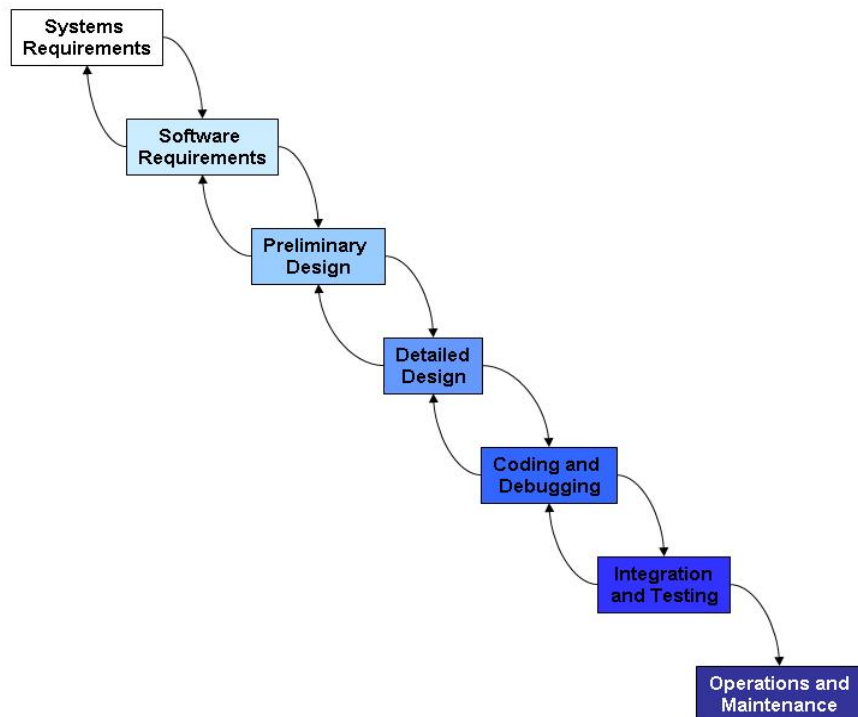
To software and systems engineers, as well as civilian project managers, traditional, spiral, and incremental development are defined and illustrated differently than the DoD definitions. To the DoD, the use of spiral or incremental development is determined by knowledge of an end state. DoD deploys improved usable systems at the end of a development phase. Adding to some of the confusion, aside from definitions differing from the systems engineering community or commercial practices, is the inconsistency in images to portray DoD's definitions. The following sections address

various development strategies used commercially, grounded in systems engineering, software development, and project management practices.

The Project Management Institute summarizes a number of development methods in a paper titled “Software Development and Linearity.” The paper describes “generally accepted” (Wideman, 2003) program management practices in software development, which is appropriate for all DoD space systems because of their software complexity and the push towards interoperability in a joint community through netcentricity.

The first model discussed is the waterfall model, picture in Figure 2.09; the waterfall model is also pictured in Figure 2.09 as the linear-sequential acquisition process. Wideman describes “good” and “not so good” features of the waterfall model.

Figure 2.09 – The Waterfall Model (Buede, 2000)



Good Features:

- The waterfall approach has been around for a long time, and many people are familiar and comfortable with it.
- It is simple and easily understood.
- It does recognize the need to move one stage at a time and recycle back to the previous stage to validate the stage outcome. (Wideman, 2003)

Not So Good Features:

- The waterfall model approach does not satisfy the requirement for executive control.
- It is very difficult to manage under conditions of complexity.
- In the waterfall approach, integration and testing is generally left until the end. That's when "all the chickens come home to roost," with disastrous effect on project cost and schedule. (Wideman, 2003)

The second model discussed is the "Vee Model" pictured in Figure 2.10. The National Reconnaissance Office (NRO) uses a similar model. That model is pictured in Figure 2.11 with an overlay showing when key reviews take place.

Good Features:

- Most people who have an engineering background are very comfortable with the systems approach.
- It is very good wherever it is possible to describe, i.e. specify, the requirements with high degree of certainty
- The acquiring authority requires a thoroughly well-documented track record or audit trail
- Consequently, it is popular with big government departments,...
- Where money is not the limiting criteria, though competitive bidding might be. (Wideman, 2003)

Not So Good Features:

- The process is heavy on documentation.
- It assumes that it is possible to arrive at near-perfect documentation that is complete, and is truly representative of the ultimate "requirements,"...
- And can be frozen, and the authors, i.e. the stakeholders, can be held accountable to those requirement specifications. (Wideman, 2003)

Figure 2.10 – The Vee Model (Buede, 2000)

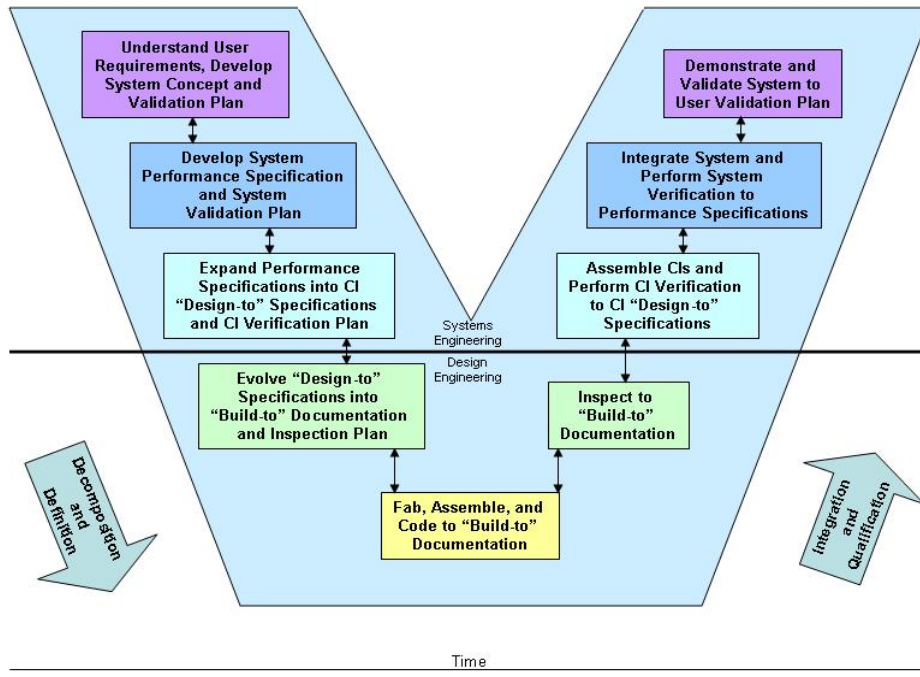
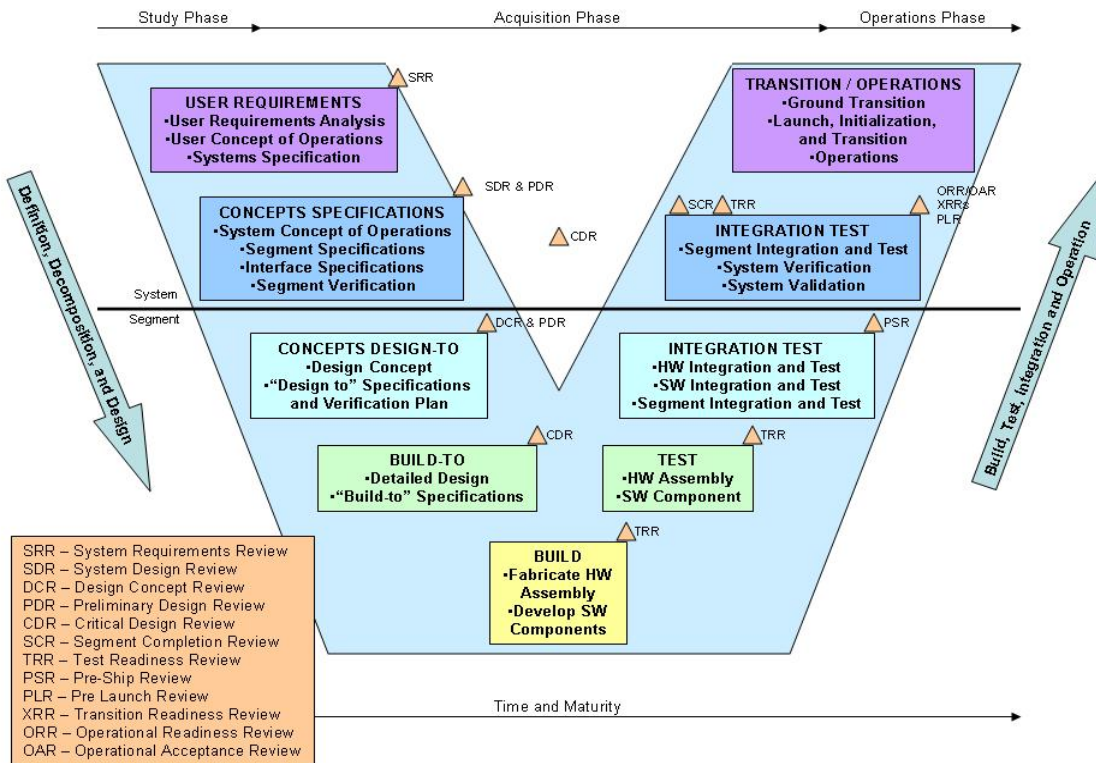


Figure 2.11 – The NRO Vee Model (NRO, 2000)



The third model discussed is the spiral model. Wideman points out that spiral development means different things to different people (Wideman, 2003) but takes the most classical view in his interpretation that it consists of four management processes with four cycles through those processes (Wideman, 2003). The four phases are: identify, design, construct, and evaluate. The four cycles are:

Proof-of-concept cycle — define the business goals, capture the requirements, develop a conceptual design, construct a "proof-of-concept", establish test plans, conduct a risk analysis. Share results with user.

First-build cycle — derive system requirements, develop logic design, construct first build, evaluate results. Share results with user.

Second-build cycle — derive subsystem requirements, produce physical design, construct second build, evaluate results. Share results with user.

Final-build cycle — derive unit requirements, produce final design, construct final build, test all levels. Seek user acceptance. (Wideman, 2003)

Good Features:

- In this approach, the entire application is built working with the user.
- Any gaps in requirements are identified as work progresses into more detail.
- The process is continued until the code is finally accepted.
- The diagrammatic representation, i.e. the spiral, does convey very clearly the cyclic nature of the process.
- And it also conveys the progression through the project life plan. (Wideman, 2003)

Not So Good Features:

- This approach requires serious discipline on the part of the users.
- If the users are not responsible for the schedule and budget, as very often they are not, executive control can be difficult.
- For a software developer working under a firm-price contract, it may be impossible.
- The model depicts four cycles. However, if cycles are added indefinitely for “just one more tweak” then eventually...Everyone gives up in frustration!

- Or, the time and money runs out.(Wideman, 2003)

Like Wideman, Boehm and Brown both warn against incorporating too many spirals, or creating a program management “death spiral” (Brown, 2004) resulting in running out of patience, time, and money; however, DoD’s definition of spiral development makes no stipulation as to the end date for a capability or system development.

Buede discusses a fourth development model that seems to more closely resemble the chart published by the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) illustrating the interaction between the three decision support systems. This model describes incremental development using the Vee Model and is pictured below in Figure 2.12. Under this model, a useful subset of the system is produced initially followed by upgrades and system expansions until the entire system is operational. (Buede, 2000) This definition seems most similar to the DoD definition for Spiral and Incremental Development, without referring to the user’s role or knowledge of the desired end state. Buede also points out that while some people believe that one needs to choose between the traditional Vee or the Spiral model, research has shown “that the spiral activities can be mapped onto the Vee model without swapping any activities in time.” Both the Iterative Vee and the Spiral-mapped Vee are pictured below in Figures 2.12 and 2.13.

Figure 2.12 – The Iterative Vee (Buede, 2000)

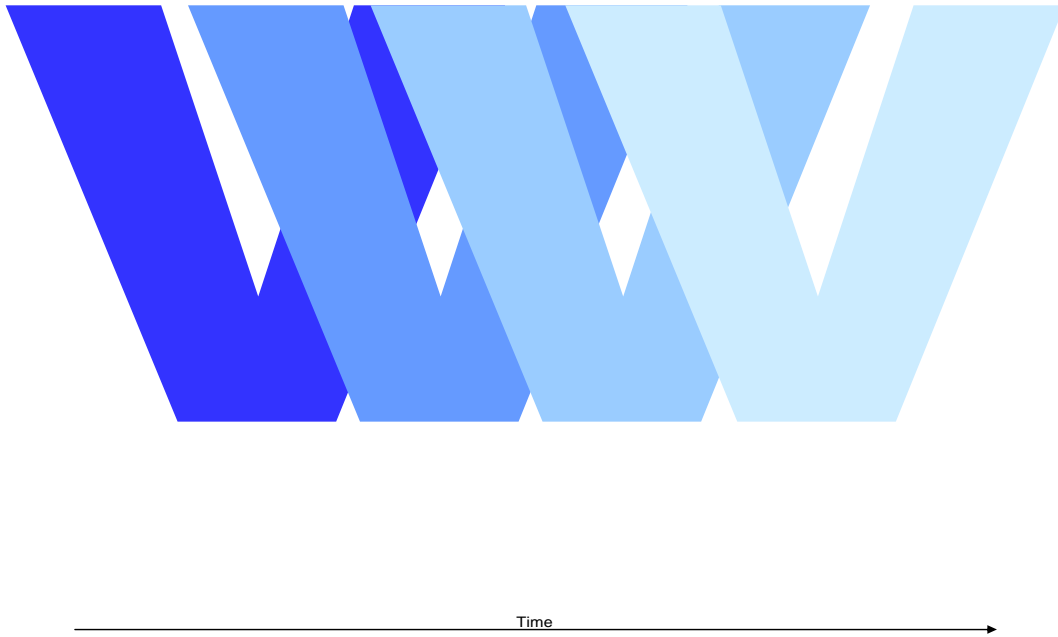
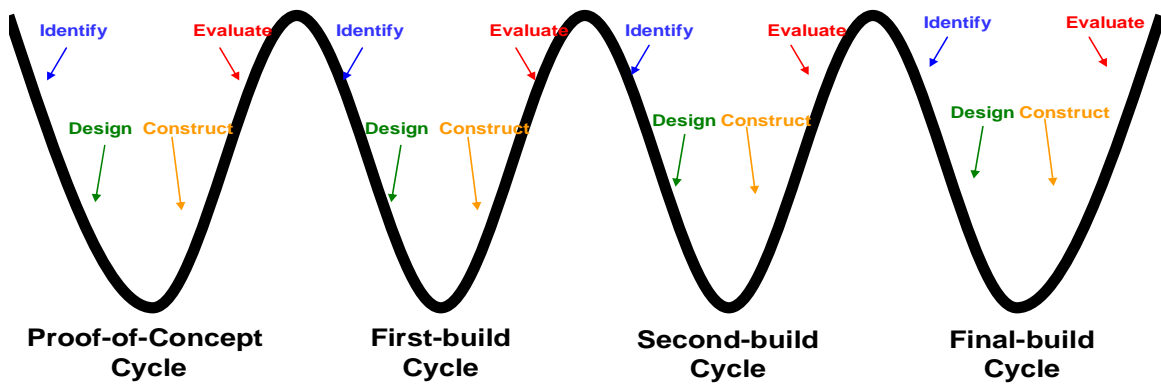


Figure 2.13 – The Spiral-mapped Vee (after Buede, 2000)



2.4 Summary

This chapter introduced the DoD decision support system, with an emphasis on the JCIDS and NSSAP. Documentation, research, and articles pertaining to these decision support systems was reviewed and presented by major theme, for the purpose of answering the investigative questions listed in Chapter One and shaping the additional research described in Chapter Three.

Acquisition challenges have existed since the days of George Washington (Lord, 2006). But the string of modifications, some minor and many major, indicate that acquisition reform is a real issue because an acceptable policy has not been developed or has not been implemented properly.

The 2001 QDR and 2003 Transformation Planning Guidance identify very clearly, a number of objectives for DoD transformation—acquisitions included. Those objectives are further highlighted in the JCIDS and NSSAP guiding documentation and can be summarized as joint operations, intelligence exploitation (through netcentricity), developing new warfighting concepts (capability-based), and delivering new capability (evolutionary). However, supporting documentation specifying implementation of these concepts appears to be absent or to not have been considered such as the need for capability management of SoS engineering (SoSE). This absence causes confusion between capabilities and requirements and between evolutionary acquisitions and its development processes, and results in no significant operational change in space system procurement. Technology issues were also discussed—specifically the debate between using evolutionary or revolutionary strategies to incorporate technology. The literature review closed with a brief explanation of how DoD and the commercial world define an

evolutionary strategy and system development strategies to develop the technical composition of a system.

III. Methodology

3.1 Introduction

This chapter will address the qualitative procedure, the research design type, the researcher's role, the data collection procedures, the data analysis procedures, and the steps taken to verify the research.

3.2 A Qualitative Procedure

The format of this chapter has been closely modeled after Creswell's account of a qualitative procedure in Chapter Nine of his book titled *Research Design: Qualitative and Quantitative Approaches* (Creswell, 1994). This methodology will describe a qualitative procedure, the case study design, the researcher's role, the data collection procedures, the data analysis procedures, and the steps taken to verify the research.

3.2.1 Why Qualitative?

The purpose of this research is to identify how effective the integrated deployment of the CJCSI 3170 and the NSSAP 03-01 has been for national space systems. This problem requires a qualitative approach for a number of reasons, supported by Morse.

Characteristics of a qualitative research problem are: (a) the concept is 'immature' due to a conspicuous lack of theory and previous research; (b) a notion that the available theory may be inaccurate, inappropriate, incorrect, or biased; (c) a need exists to explore and describe the phenomena and to develop theory; or (d) the nature of the phenomenon may not be suited to quantitative measures (Morse, 1991).

Such a problem as the one examined in this research fits a number of the above characteristics in one way or another, but most significantly fits characteristics a and c.

As the literature review in chapter two has shown, there is very little scientific research that has been conducted on the matter. While some literature on product development is available, usually pertaining to the commercial world, the overall concept of identifying military deficiencies and translating those into solutions is extremely limited. Much of the literature looking at this problem seems to focus on identifying broad problems with the entire system and lacks a validated proposal of theory or solutions, and is limited to the authors' experiences.

As for characteristic b, this research makes no suggestion that the existing process and acquisition theory is “inaccurate, inappropriate, incorrect, or biased.” Instead, it attempts to simply identify the effectiveness of implementation at this point for three space programs and if applicable, identify areas for improvement.

Due to the complexity of the process and the need for more research on the subject, this research is not suited for a quantitative approach at this time—not to say that a quantitative approach will never be applicable. Quantitative approaches are excellent for removing or accounting for biases and assumptions, if those are known and can be controlled.

3.2.2 The Assumptions of Qualitative Designs

Although a qualitative approach is definitely appropriate for the proposed problem, it is important to understand the assumptions that accompany such an approach.

Merriam describes those as follows.

1. Qualitative researchers are concerned primarily with **process**, rather than outcomes or products.
2. Qualitative researchers are interested in **meaning**—how

people make sense of their lives, experiences, and their structures of the world.

3. The qualitative researcher is the **primary instrument** for data collection and analysis. Data are mediated through this human instrument, rather than through inventories, questionnaires, or machines.

4. Qualitative research involves **fieldwork**. The researcher physically goes to the people, setting, site, or institution to observe or record behavior in its natural setting.

5. Qualitative research is **descriptive** in that the researcher is interested in process, meaning, and understanding gained through words or pictures.

6. The process of qualitative research is **inductive** in that the researcher builds abstractions, concepts, hypotheses, and theories from details (Merriam, 1988).

These assumptions will be readily apparent in the next section describing the design type.

3.3 The Type of Design

3.3.1 Specific Qualitative Design

There are a number of research strategies that apply to problems involving the social sciences. Determining which strategy to use depends on the form of the research question, the researcher's ability to control surrounding events, and whether or not the focus is on contemporary events (Yin, 2003). For the problem proposed, a case study will best answer the question because a case study answers how and why questions, does not require control of the environment, and focuses on contemporary events (Yin, 2003). In contrast, an experiment could answer the same questions and focus on contemporary events as well, but would require control of the environment. A historical strategy could also answer the same questions and not require control of the environment, but would not

focus on contemporary events. These methods can be quantitative or qualitative; however for the reasons mentioned in the previous section, the case study will be qualitative in its application to this problem. Yin (2003) defines case studies with two propositions:

1. A case study is an empirical inquiry that
 - investigates a contemporary phenomenon within its real-life context, especially when
 - the boundaries between phenomenon and context are not clearly evident
2. The case study inquiry
 - copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
 - relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
 - benefits from the prior development of theoretical propositions to guide data collection and analysis (Yin, 2003)

3.3.2 Characteristics of the Design

Case studies have five important components (Yin, 2003) that will be discussed in the context of the problem this research addresses. Those components are a study's questions, propositions, unit of analysis, links between the data and propositions, and the criteria for interpreting the findings.

Study Questions. The study question is the focus of the research. In this case, the research attempts to answer how effective the integrated deployment of the CJCSI 3170 and the NSSAP 03-01 has been for national space systems.

Study Propositions. Propositions direct the focus of research and are frequently present in social science research, unless the purpose of the research is exploratory. In that case, such propositions are unnecessary because the exploration topic has already been selected and does not require focus. There are three propositions within this

research effort. Those propositions are: (1) organizations at different levels in the process may have a different understanding of what the new guidance proposes; (2) space systems, following the same guidance, may implement the guidance differently; (3) the decision process required for such guidance to be effective is inadequate.

Unit of Analysis. The unit of analysis to be studied is each stake holding organization in the approval chain for a new system to be developed or an existing system to be modified, based on an identified capability deficiency. These organizations will be identified in the context of three space systems, making this a multiple case study.

The last two components, *Linking Data to Propositions* and *Criteria for Interpreting the Findings* will be discussed as Data Analysis Procedures in section 3.6.

3.4 The Researcher's Role

3.4.1 Past Experiences of Researcher

In June of 2002, the researcher was assigned to the MILSATCOM (Military Satellite Communications) Joint Program Office (MJPO). The Joint Program Office had a number of interesting roles in addition to being a traditional System Program Office (SPO). The organization was comprised of personnel from the Air Force, Army, and Navy, reflecting their joint interest in the mission and success of the programs. MJPO did not house a single satellite; rather, the program office was responsible for the management of a number of satellite programs in various stages of development, co-located at Los Angeles AFB and Hanscom AFB. Additionally, the MJPO managed the acquisition of the necessary terminals to communicate with the satellites, being developed at Hanscom AFB. A program office managing both the satellites and their respective terminals was traditionally referred to as a "basket SPO." Today, that scenario

is more frequently described as an office managing a system-of-systems (SoS). Similarly, a program office managing a number of similar functioning systems, such as communication satellites (although they ultimately perform different missions at different frequencies), is said to be an office managing a family-of-systems (FoS).

3.4.2 Selection Steps

Understanding the acquisition process, the author identified a number of organizations to interview both vertically and horizontally. By vertical, organizations were selected along an approving chain of command from top to bottom, requirements generation to operator use. In this manner, data could be analyzed at all phases of an acquisition program. By horizontal, the author asked the same questions at all levels, for three different space programs. This would indicate if policies were implemented to the same extent, or documented for exceptions, throughout space programs. Programs in different phases of the acquisition process, meaning that some were initiated before and after the policy change, were selected to maximize testing the extent of implementation.

Both organizations and programs selected for research were selected based on criteria that would lead to diversified results enabling comparison. Specific interview participants were selected based on the author's contacts and "snowball sampling"—asking the interview participants who they thought should be contacted. Although snowball sampling is considered to have a number of biases when studying social interactions, those biases are mitigated by the fact that social relationships were not being studied and outweighed by the value that snowball sampling can provide when it is difficult to find interview participants.

3.4.3 Human Subjects and Ethical Issues

Interview participants can be difficult to find for a number of reasons, but in this particular case, one reason may be the fear of retribution resulting in negative consequences since interview participants are being asked to comment on the effectiveness of policies created by superiors. For this reason, all personal information will remain completely confidential throughout the entire process, including thesis publication and any related articles that may result. Additionally, the research was approved through the Air Force Institute of Technology's Human Subject Research Approval process. This information was provided to the interview participant in an interview invitation letter and before the interview was actually conducted. The interview invitation letter is located in Appendix A.

3.5 Data Collection Procedures

3.5.1 Parameters of Data Collection

Individuals from all levels of the Joint Capability Integrated Development System (JCIDS) and the National Security Space Acquisition Process (NSSAP), as described in Figure 2.02, were interviewed on location, whenever possible. Specifically, individuals have been identified from the following offices.

- National Security Space Office (NSSO)
- Secretary of the Air Force Directorate of Space Acquisitions (SAF/USA)
- Headquarters Air Force Deputy Chief of Staff for Air & Space Operations (AF/XO)
- Headquarters Air Force Space Command Directorate of Requirements (AFSPC/A5)
- Global Positioning System (GPS) Program Office, System Engineers
- Space Based Infrared System (SBIRS) Program Office, System Engineers, Users
- Transformational Communications Satellite (TSAT) Program Office, System Engineers

- Aerospace Corporation
- Space and Missile Systems Center (SMC) Acquisition Center of Excellence (ACE)
- Defense Systems Management Course (DSMC) Instructors
- Air Force Institute of Technology (AFIT) Instructors
- Defense Acquisition University (DAU) Instructors

The questions were focused on these individuals' roles in the acquisition process, before and after the implementation of CJCSI 3170 and NSSAP 03-01, as well as how they view the roles of others. The questions also focused on the implementation of the policies.

3.5.2 Types of Data Collected, Rationale, and Protocol

The interviews were comprised of, but not limited to, a standard set of questions located below and again in Appendix B. The semi-structured format of the interview provided both structure for analytical purposes, as well as the flexibility to ask follow up questions for clarity that may be applied to understanding a specific organization's role or perspective.

The standard script included a heading, instructions, standard research questions, and participant-specific and/or follow-up questions. The interview participant's responses were recorded, whenever possible via digital tape recorder. However, if the interview participant preferred, they were able to complete the interview through an e-mail dialogue. Although, differences in data collection method are generally not preferred (unless analyzing the method), the value in the collection of responses from various organizations outweighs the bias that may be introduced through the difference in collection method. All recorded interviews were transcribed into an interview record.

Additionally, the interviewer, in this case the author, took written notes to indicate a record of points of interest or points requiring follow-up.

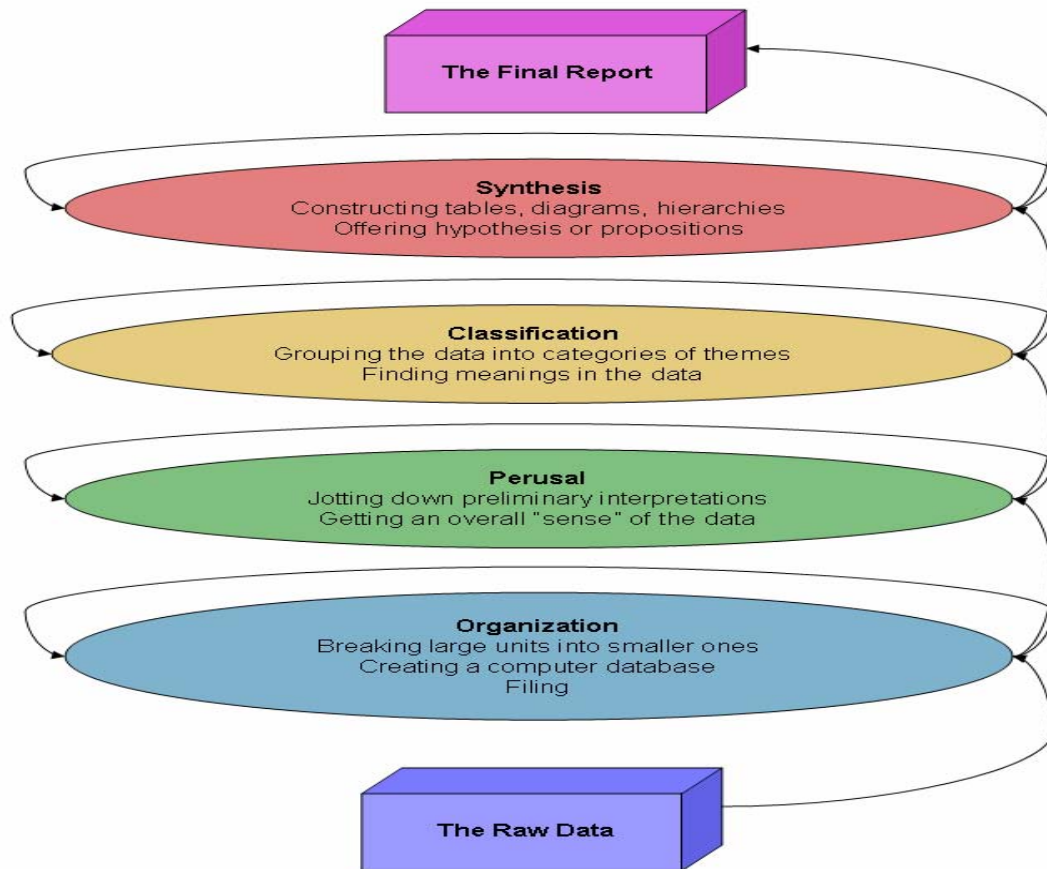
3.6 Data Analysis Procedures

Like many other aspects of qualitative case study research, there is no “right way” to analyze data (Tesch, 1990; Creswell, 1994); rather, there is no *one* right way. There are a number of accepted guidelines that can ease the emergence of themes, patterns, and theories. Creswell (1994) suggests a spiral model, aptly appropriate considering the subject matter, in which raw data is continually reviewed with a different focus each time refining the data and making it usable. These categories and a brief description of each are identified in Figure 3.01. Tesch (1990) describes a similar, more detailed process in eight steps listed below.

1. Get a sense of the whole. Read through all of the transcripts carefully. Perhaps jot down some ideas as they come to mind.
2. Pick one document (one interview)—the most interesting, the shortest, the one on the top of the pile. Go through it asking yourself, What is this about? Do not think about the “substance” of the information, but rather its underlying meaning. Write thoughts in the margin.
3. When you have completed this task for several informants, make a list of all topics. Cluster together similar topics. Form these topics into columns that might be arrayed as major topics, unique topics, and leftovers.
4. Now take this list and go back to your data. Abbreviate the topics as codes and write the codes next to the appropriate segments of the text. Try out this preliminary organizing scheme to see whether new categories and codes emerge.

5. Find the most descriptive wording for your topics and turn them into categories. Look for reducing your total list of categories by grouping topics that relate to each other. Perhaps draw lines between your categories to show interrelationships.
6. Make a final decision on the abbreviation for each category and alphabetize the codes.
7. Assemble the data material belonging to each category in one place and perform a preliminary analysis.
8. If necessary, recode your existing data. (Tesch, 1990)

Figure 3.01 – Creswell’s Data Analysis Spiral (after Creswell, 1994)



These processes reflect Dr. Eisenhardt's (1989) position that case studies can be used to build theories if they remain open-ended. Consequently, developing a more structured analysis is difficult without knowing the results of such data collection. In this case, data analysis occurs simultaneously with data collection, data interpretation, and report writing (Creswell, 1994). Therefore, data analysis consists of recognizing themes that may indicate how effective the integrated deployment of the CJCSI 3170 and the NSSAP 03-01 has been for national space systems.

3.7 Verification Steps

Verification is often considered an indication of truly scientific research (Creswell, 1994) but is difficult to formalize in qualitative research. Consider some of the assumptions and desired results of a qualitative process. The research is usually descriptive of a process that the researcher has limited access to; in other words, the researcher can not examine every single case at every point in time with everyone involved. The research is also inductive in that the researcher frequently uses it to build hypotheses, theories, and models to be tested.

With this in mind, it is understandable that some researchers suggest using terms such as "authenticity" and "trustworthiness"; however both Creswell (1994) and Miles and Huberman (1994) suggest using terms of validity and reliability. Miles and Huberman have also compiled a number of reflective questions that are useful in assessing validity and reliability. Some of Miles and Huberman's questions are listed below that will be used in this research.

3.7.1 Internal Validity

Creswell and Merriam define internal validity as “the accuracy of the information and whether it matches reality.” Internal validity will be achieved by providing a number of the interview participants with the research results and asking them to comment on their accuracy in addition to a review of Miles and Huberman’s questions.

3.7.2 External Validity

External validity or transferability or fittingness indicates how “generalizable” the conclusions of a study may be (Miles and Huberman, 1994). There appears to be some difference in opinion as far as whether it is good to have a large or a small amount of generalizability. According to Merriam, “the intent of qualitative research is not to generalize findings, but to form a unique interpretation of event.” Miles and Huberman take a more balanced approach, commenting that some generalizability is good because there is meaning from the research for more people. However, if the findings are too general, they begin to lose their importance.

3.7.3 Reliability

According to Miles and Huberman (1994), “the underlying issue here is whether the process of the study is consistent, reasonably stable over time and across researchers and methods.” This research builds-in reliability by examining three different space programs, using the same protocol. “In case study research, in which the investigator explores multi-site cases, one can examine whether the same patterns or events or thematic constructs are replicated in different settings” (Creswell, 1994).

Table 3.01 – Miles and Huberman’s Validity and Reliability Questions (Miles & Huberman, 1994)

Internal Validity / Credibility / Authenticity	External Validity / Transferability / Fittingness	Reliability / Dependability / Auditability
2. Does the account “ring true,” make sense, seem convincing or plausible, enable a “vicarious presence” for the reader?	1. Are the characteristics of the original sample of persons, settings, processes (etc.) fully described enough to permit adequate comparisons with other samples?	1. Are the research questions clear, and are the features of the study design congruent with them?
5. Are the presented data well linked to the categories of prior or emerging theory? Do the measures reflect the constructs in play?	3. Is the sampling theoretically diverse enough to encourage broader applicability?	2. Is the researcher’s role and status within the site explicitly described?
8. Are areas of uncertainty identified? (There should be some.)	5. Do the findings include enough “thick description” for readers to assess the potential transferability, appropriateness for their own settings?	3. Do findings show meaningful parallelism across data sources (informants, contexts, times)?
10. Have rival explanations been actively considered? What happened to them?	6. Does a range of readers report the findings to be consistent with their own experiences?	4. Are basic paradigms and analytic constructs clearly specified?
12. Were the conclusions considered to be accurate by original informants? If not, is there a coherent explanation for this?	7. Are the findings congruent with, connected to, or confirmatory of prior theory?	5. Were data collected across the full range of appropriate settings, times, respondents, and so on suggested by the research questions?
	11. Does the report suggest settings where the findings could fruitfully be tested further?	8. Were data quality checks made (e.g. for bias, deceit, informant knowledgeability)?
	12. Have the findings been replicated in other studies to assess their robustness? If not, could replication efforts be mounted easily?	9. Do multiple observers’ accounts converge, in instances, settings, or times when they might be expected to?
		10. Were any forms of peer or colleague review in place?

3.8 Summary

In this chapter, the author addressed various aspects of a qualitative procedure, specifically why it was selected for this research and the assumptions that must accompany a qualitative procedure. The multiple case study was announced as the research design type. The definition of a case study and described characteristics of such a design type indicated the appropriateness of selection for answering the research question: how effective the integrated deployment of the CJCSI 3170 and the NSSAP 03-01 has been for national space systems. The researcher's role was described within the context of the researcher's related experience before the research, and the researcher's role of selecting cases and participants. The data collection procedure and analysis procedures were also described. Data collection consisted of horizontal and vertical interviews from a number of organizations across multiple programs and with differing approval authority. Data analysis was completed by drawing themes from multiple reviews of the data. The research was verified with measures to address internal and external reliability, in addition to reliability. The results of this methodology are discussed in Chapters Four and Five.

IV. Results and Discussion

4.1 Introduction

In addition to reviewing relevant research, articles, commission reports, and guiding documentation, interviews were conducted across a number of organizations involved in the acquisition process. These organizations included system acquirers, users, air and space requirement developers, architecture designers, space policy directors, and experts from the Defense System Management Course, Defense Acquisition University, and Air Force Institute of Technology. Due to the policies of the Investigative Research Board, the specific comments can not be published if they can be attributed to an individual. Since individuals, frequently used personal examples and were guaranteed confidentiality, the results of analysis are captured through the answers to the investigative questions.

Recommendations are included in the investigative questions and in the following section. Some investigative questions were answered through another question's response and do not have a separate answer.

4.2 Investigative Question

What are the goals of an EA strategy? The goal of an evolutionary acquisition strategy is to reduce the amount of time it takes to get added appropriate capability to the user and to reduce cost growth. This is done by employing the strategy described as follows.

What is an evolutionary acquisition (EA) strategy? To the Department of Defense space community, an evolutionary acquisition strategy describes the acquisition of a number of blocks of similar items with increasing capability. The added capability is planned two to three blocks earlier than the block that the capability will be incorporated in. Reasons for added capability may be a changing threat or a change in available technology. This is especially important since DoD does not drive technological development like it did 50 years ago (Brown, 2004). Although, this is more visible outside of space systems, the development of Spaceship One and plans in Virginia and Florida for space tourism are examples of an outside and commercial driver.

While this appears to produce similar systems to those produced in the past (i.e. blocks with increasing capability), there is a different emphasis in how technology is planned. A 100% solution is no longer sought for in the first block, with additional capability added in following blocks. Instead, the first block should be about an 80% solution *and* must provide an improved capability over the current system according to the definition in NSSAP 03-01, or else not approved until mature technology is available. However, some interviewees stated that among the user community, there is a fear that an initial block will be developed to lay the groundwork for the following block to “leap frog” over the capability of the former system, but the initial block will actually take a step back in capability. Or, that the initial block may be such a slight improvement that the second block will not be procured because the value to cost ratio was so low. To the first problem, this is by NSSAP 03-01 definition, not an evolutionary acquisition. To the second problem, if the increment was achieved with the cost that was budgeted, then there would be no change in perceived value between the time the system was approved

and the first block was completed. This is possible if fairly mature technology is incorporated from the beginning, because cost estimates will be more accurate. In addition to incorporating mature technology to reduce cost, EA attempts to reduce cost by reducing risk through the selection of the development process. This is discussed in a later section.

Because an 80% solution means that there is at least 20% more coming, and even more through technology improvements where applicable, there is an increased need to make arrangements up front to allow for this capability to be added. The space community understands this well because space-based systems can not cost effectively be upgraded once launched, *at this time*. Therefore, any incremental improvements to a space system have traditionally been achieved through ground-based software and hardware upgrades for terminals or by launching backward compatible satellites to supplement an existing constellation.

None of the interviewees viewed an evolutionary acquisition strategy as a new strategy for the development of space systems. In truth, as defined in NSSAP 03-01, many of today's space systems could have operated under an evolutionary strategy. But, the results may have been different if full understanding of the goals of EA was achieved. For example, interviewees were asked to comment on the current, and past where applicable, acquisition strategies for GPS, SBIRS, and TSAT. Several interviewees referred to the initial acquisition strategy for all three programs as the "Big Bang"—meaning that the programs tried to give the user all the capability that was requested in the initial block. Some program offices seemed to realize sooner than others that this

could not be achieved within cost and schedule constraints and incorporated a more evolutionary, rather than revolutionary, strategy.

GPS was initiated before an EA strategy was the preferred strategy and used block development to procure the first blocks and models of the satellite. At the time, the strategy was not considered evolutionary, but additional capability was planned for following blocks from program initiation. GPS is now considered to be an evolutionary acquisition and the third block will employ spiral development.

SBIRS was also initiated before an EA strategy was the preferred strategy. The traditional waterfall model was used to design the system and the system was acquired through a process known as Total System Performance Responsibility (TSPR). TSPR was created to reduce lengthy and cumbersome government oversight and allow the contractor more flexibility to use best commercial practices to develop a system as long as the overall objectives were met. When the SBIRS program first breached its Acquisition Program Baseline (APB), a decision was made to switch oversight from the contractor back to the government. Additional requirements were levied on the SBIRS program office and the acquisition of SBIRS began to take a more evolutionary form in development, but not in acquisition. Necessary acquisition and operational level tasks were broken into “effectivities;” however, the completion of one effectivity did not add an improved capability because the effectivity was only effective if the whole system was operational. There are a number of differing opinions within SBIRS as to whether an evolutionary acquisition strategy, as defined in NSSAP 03-01, was ever used.

The concept for TSAT was initiated slightly before EA became the preferred strategy and one interviewee said that it would have been an incremental development

process anyway. TSAT's use of an evolutionary acquisition strategy employing incremental development was done "to show reduction of risk through early launch."

The space community's employment of an EA strategy has not achieved the desired goals for at least two reasons. The 80% solution has not really been adopted as an acceptable solution, probably because of some of the concerns described above. The second reason is that the space community is still looking for a revolutionary advancement. Transformation seems to be viewed more as a radical change than small evolving changes to modernize. Even if employed correctly, an EA strategy has many new ramifications given the transformed environment that space systems are operating in. This will be discussed in following sections on capability-acquisitions.

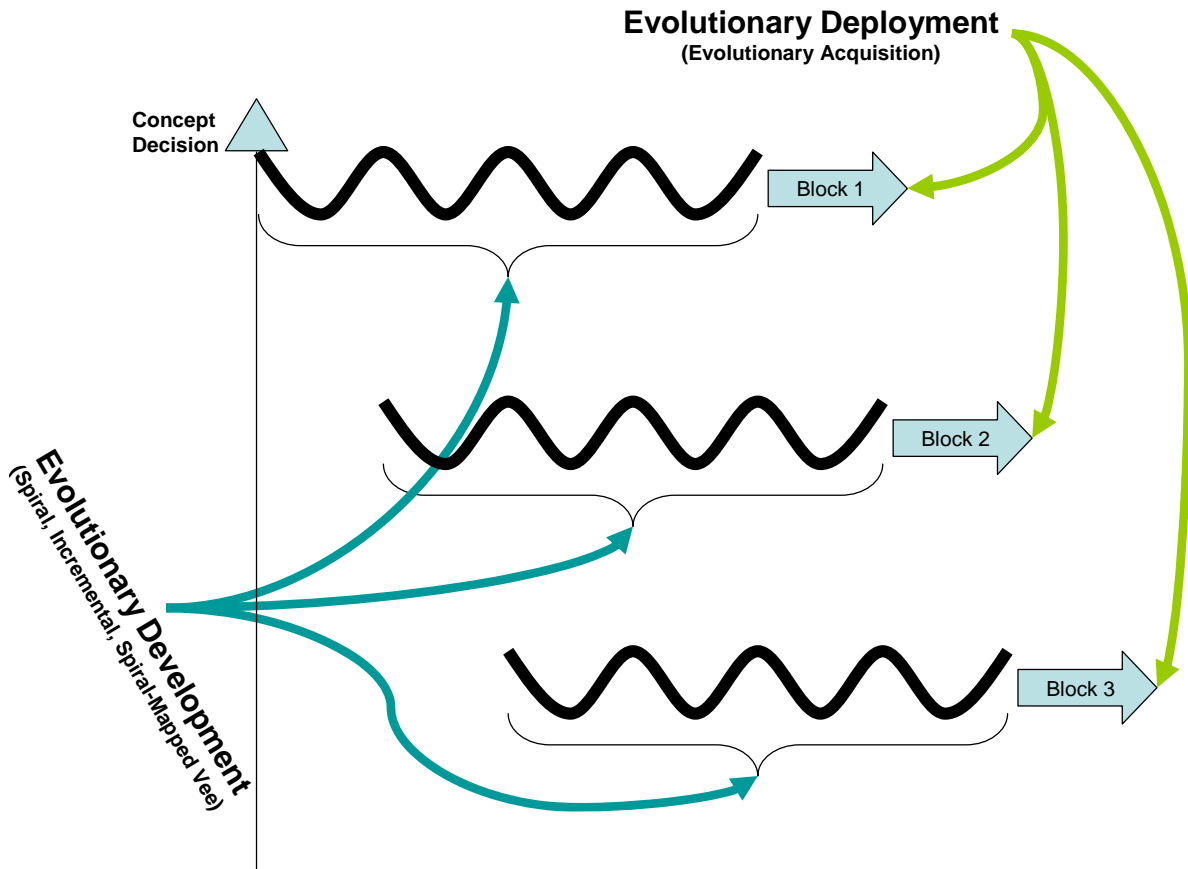
How is an EA strategy implemented? The technological portion of an acquisition strategy is implemented through a development process. For DoD space systems, the practical difference between spiral or incremental development is somewhat gray, but all of the interviewees differentiated the terms correctly by the degree to which the desired end state of a system is known. However, the development process occurs within a block, according to Figure 2.07, and the desired end state of the block that is being developed should be known. Therefore the distinguishing characteristic of degree to which the end state is known, does not really make sense when considering a block. Similarly, if considering the system instead of the block, is the desired end state ever known if the purpose of EA is to allow for changing threats or technology? This differentiation between development processes should be removed and one process, such as the spiral-mapped Vee model could be used to develop a block. The spiral-mapped Vee model is the same model depicted on the Integrated Defense Acquisition,

Technology, and Logistics Life Cycle Management Framework from 2004. This map is located in the back cover of the thesis.

There is more to an acquisition strategy than the technical development aspect. There are contractual, financial, testing, and logistical implications as well that really have not been considered in NSSAP 03-01. When asked to comment on evolutionary acquisition, one interviewee colorfully responded “What’s a spiral look like? A screw—and that’s what it means for logistics.”

As shown in the above statement, it is not uncommon for the terms evolutionary acquisitions and spiral development to be interchanged, however all of the academic-based (meaning AFIT, DAU, and DSMC) interviewees could distinguish between the terms, while users and some program office interviewees had more difficulty. This may be attributed to the fact that the terms evolutionary, spiral, and incremental are used almost interchangeably (Larman, 2003) in commercial organizations and in particular, software design and systems engineering communities. These specifically describe development processes, with the exception of software engineering which can produce useful code after one spiral. Perhaps a worthy metaphor for clarification of what DoD’s EA strategy means even for software intensive space systems is the term “evolutionary deployment.” Figure 4.01 depicts evolutionary deployment and development.

Figure 4.01 – Evolutionary Deployment v. Development (Gamache, 2006)



What development processes are alternatives to evolutionary acquisitions?

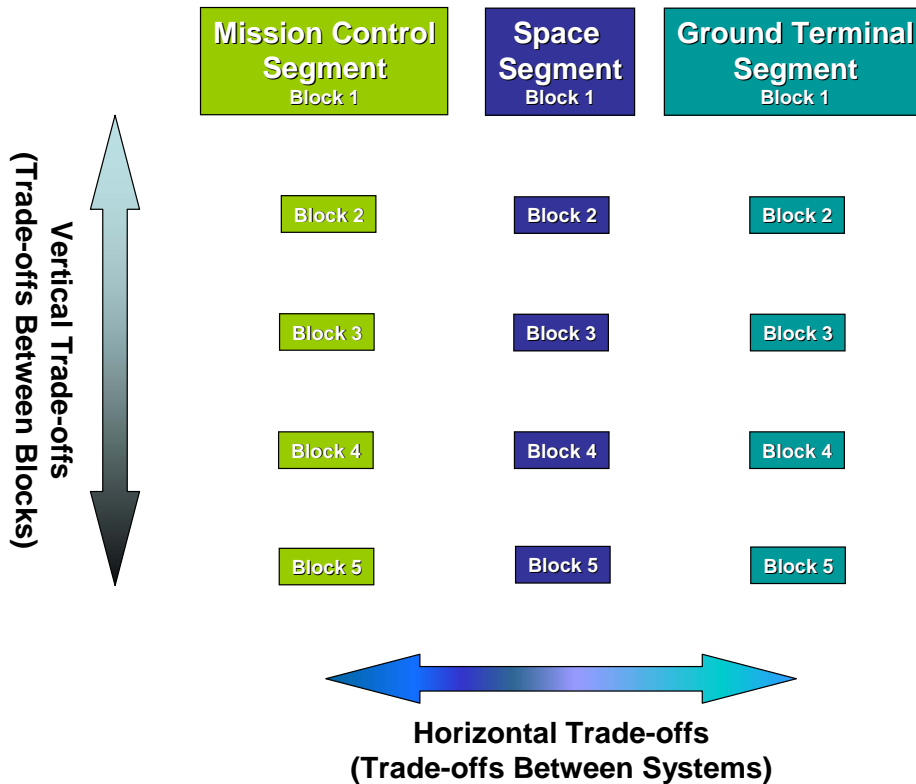
Development processes are not alternatives to acquisition strategies. As mentioned above, they represent the technical portion of a system. An alternative to an EA strategy would be one in which all desired capability was achieved in one block. This alternative could even use spiral development and not be an evolutionary acquisition system. Alternative development processes were described in Chapter Two. However, several systems engineering experts recommended that the Vee be used because it is similar to the traditional waterfall model if used once or similar to a spiral if repeated as more information about the desired capability is available.

What is a capability-based acquisition? There was a major difference in how the term capability-based acquisition was defined between literature and interviewees. Literature tended to define the term as requirements and acquisition processes focused on meeting a desired capability through a number of means, including Family-of-Systems, System-of-Systems, or a traditional platform. This concept was supported by the emphasis on interoperable systems for joint users, especially for information systems including space systems. Interviewees defined capability-based acquisitions as a requirements process that was more relaxed in the extent to which requirements were identified or defined, with the goal of giving the contractor more flexibility in how a system is developed. These two ideas are almost mutually exclusive. The literature definition is supported in policy, while the interviewees' definition is in sharp contrast to findings of several commissions investigating acquisition problems over the past twenty years. Specifically, the interoperability that is necessary to achieve a joint netcentric environment requires adherence to specific standards in several areas.

The literature definition of capability-based acquisitions has a significant impact on an evolutionary acquisition strategy. Not only do program managers have to manage a number of evolving blocks, making trade-offs between blocks to reduce risk or incorporate new technology or address a different threat. Now they must make these decisions considering the affects to other systems within a program's FoS or SoS. Disciplined systems engineering practices are more important than ever to make such vertical (between blocks) and horizontal (between systems) trade-offs. Figure 4.02 depicts horizontal and vertical trade-offs for a typical space system. Figure 4.03 depicts

the systems engineering complexity between two systems that must be interoperable to provide a specified capability.

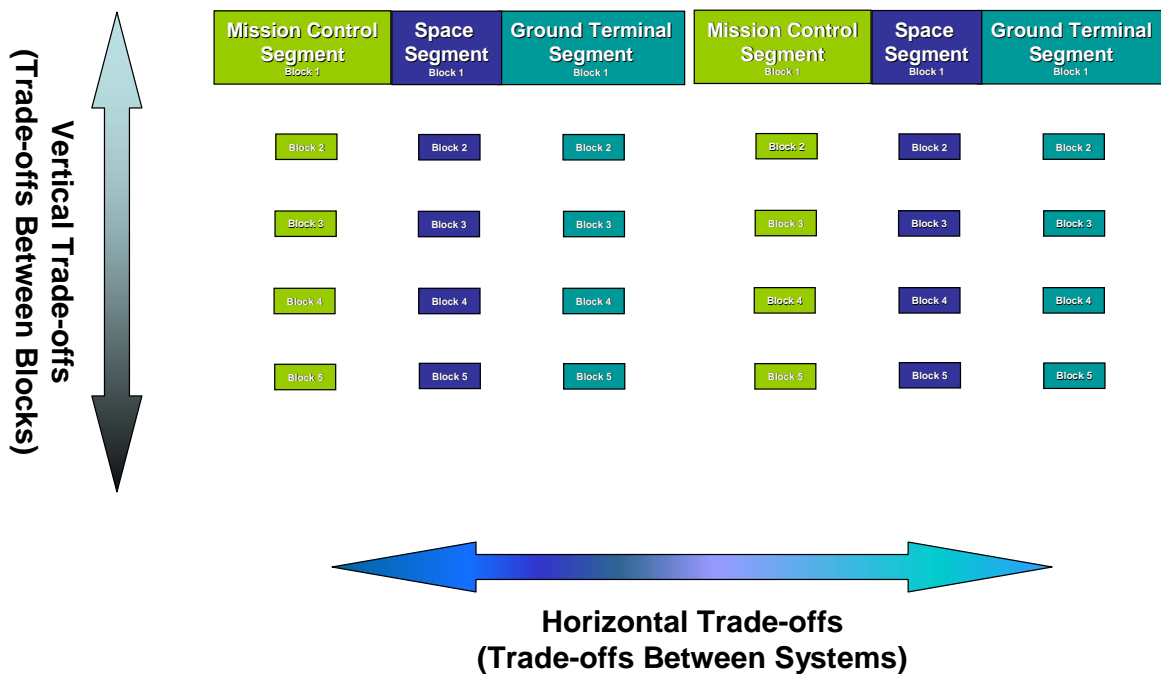
Figure 4.02 – Horizontal and Vertical Trade-offs for a Space System (Gamache, 2006)



At this time, these trade-offs are made largely by both formal and informal committees, although the committee membership differed amongst interviewee responses. Program offices and SMC at large, have chief system engineers that monitor these trade-offs and provide recommendations, but an overarching capability has no chief systems engineer or director responsible for making such decisions across platforms and services. In addition to systems engineers trained at the system, program, and capability

levels, DoD acquisitions could benefit from switching service-specific Program Executive Officers (PEO) to joint Capability Acquisition Executives (CAE). This would reduce redundancy, excessive levels of oversight and burden on the J-8, and avoid trade-off decisions being made by what one interviewee described as a room full of “500-lb gorillas.”

Figure 4.03 – Horizontal and Vertical Trade-offs for Interoperable Space Systems (Gamache, 2006)



What are the goals of capability-based acquisitions? The main goal of capability-based acquisitions is to develop acquisition solutions that are responsive to the way DoD conducts operations. Specifically, reductions in funding and changes in threats require

more agile and efficient warfighting, which can be accomplished by eliminating unneeded redundancy of efforts and people and supplementing with easier information exchange. Capability-based acquisitions accomplishes this by encouraging solutions to be joint, interoperable, and netcentric and emphasizing the development of a capability over the platform.

How are capability-based acquisitions implemented? JCIDS' guidance primarily addresses JCIDS oversight, review, and documentation of the decision support system. There is little to no appropriate implementation guidance for the program level. Aside from there not being DoD-directed acquisition policy, Air Force Instruction 63-1 "Capability-Based Acquisition System" (2003) does not give any guidance on implementation, let alone define the term. "Joint" is used only twice in the definition for warfighter and in referencing a document. AFI 63-1 also specifically states that it does not apply to space systems.

How does the acquisition workforce view the implementation of JCIDS and NSSAP documentation? None of the interviewees experienced or expected to experience a reduction in capability development time or cost overruns. Several reasons were cited by the interviewees including:

- Too much technology development after committing to a solution
- Funding profile not matching identified space system profile of 80% in development and production and 20% in operations and maintenance
- Unstable funding or not enough reserve (25%) for Program Manager flexibility
- No day-to-day operations change in JCIDS from RGS, other than joint focus which does not trickle down through Service

4.3 Recommendations

The results and discussion of the literature review, interviews, and investigative questions led to recommendations in the categories of:

- Acquisition Expertise
- Requirements Control
- Capable Technology and Industrial Base
- Realistic Budgeting

Some recommendations are applicable to system acquisition outside of the space community. Although many of these recommendations were included in the discussion section, they are consolidated in the subsequent sections.

4.3.1 Acquisition Expertise

Service PEOs need to be converted into Joint Capability Acquisition Executives (CAEs), responsible for acquiring a capability through the management of a portfolio of programs. Joint CAEs would be responsible for ensuring executable APBs for supporting programs and PMs must have adequate pre-acquisition funding to assemble people, tools and data to establish executable APBs with the CAE. Expertise could be cultivated by requiring a rotational assignment in industry and systems engineering before becoming a PM. Level three space professional certification would be a requisite for all PM and CAE positions for space systems.

4.3.2 Requirements Control

Controlling requirements is necessary for implementing an evolutionary acquisition strategy, but even more critical with the acquisition of capabilities through SoSs and FoSs. The Association for Operations Management recommends limiting key management requirements to somewhere between three and seven. With the help of the

users, CAEs must establish or accept no more than five key performance parameters (KPPs) per system supporting the overall capability, for example. This will allow program managers (PM) to have more degrees of freedom in how their portion of capability is provided. Similarly, with the help of the users, PMs should further limit the number of KPPs per block. It is true that changes in threats, technology, or available knowledge may require an additional validated KPP, however, limiting KPPs per system or increment will force system development to move forward and use following increments as they were meant to be used to shorten cycle time and account for these changes.

Requirements control can also be accomplished at the capability-level. As the expert on currently available capability, CAEs would be responsible for completing Analyses of Alternatives (AoAs) instead of Service-specific requirements organizations working with a System Program Office. To accomplish this, CAEs with system-of-systems engineering (SoSE) expertise would need to invest in accredited SoSE tools and SoS engineers with JCIDS and NSSAP Joint Program Office experience. Finally, the CAE should establish SoS measures of effectiveness (MOEs). After all, “it is important to understand that ‘metrics matter.’ We must be able to define success and measure it. On the battlefield, we can easily measure the performance of the capabilities provided through the Global Positioning System or Military Satellite Communication. We need to do the same as we develop the next generation space capabilities. We must know where, when and how we are succeeding...and failing” (Lord, 2006).

4.3.3 Capable Technology & Industrial Base

The commercial market for space has been rather unpredictable. With the consolidation of defense space contractors, the space system community needs a better mechanism to “pull” DoD science and technology investments and to provide guidance to the industrial base for independent research and development (IRAD) and capital investment, ensuring that technology matures at a steady or accelerated rate.

4.3.4 Realistic Budgeting and Funding

Budget instability was a major concern among interviewees. Two recommendations can be made based on two main causes of inaccurate budgets being not enough information or designing to not enough money.

The space system community needs a methodology for creating more accurate cost estimates of Horizontal Integration (HI), immature technologies, and space industrial base restructuring costs. Additionally, the Young Panel recommendation of an 80/20 ratio of funds with a 25% margin and not using contractor estimates in competitive situations would increase the accuracy of initial cost estimates. Requiring that SPO cost estimates and Independent Cost Estimates reconcile at KDPs would provide insight into problem areas and reduce the frequency and severity of unforeseen overrun.

Although not adequately examined due to the scope of the research, one recommendation could be made for joint systems, such as space systems and information systems, being funded out of separate joint funding, as opposed to service-specific funding.

4.4 Summary

Chapter Four summarized the results of the literature review and interviews analysis with respect to the investigative questions. Due to restrictions placed by the Human Research Board the names, organizations, and specific quotations could not be included in the published thesis. The synthesized data identified four areas of recommendations that would lead to the improvement of the interaction between the JCIDS and NSSAP.

V. Conclusion

5.1 Introduction

The results and recommendations presented in Chapter Four lay the framework for a theory to be presented. DoD's challenge is to create an environment that enables program managers' mission success by ensuring that the acquisition program baselines for all National Security Space systems are executable and stable. That environment lies within the overlap of the JCIDS, NSSAP, and PPBE Process.

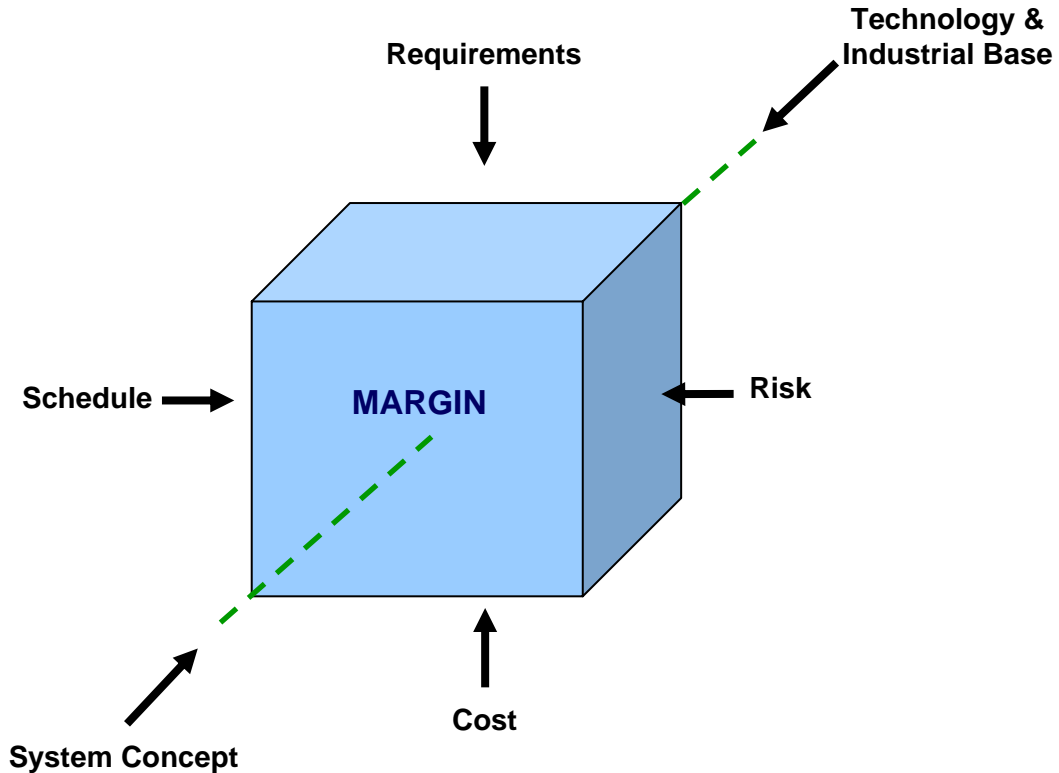
5.2 Theory Building

Once in that environment, a program manager will be faced with many decisions that must be made considering six factors, or trade space areas. Those areas for trade space are: requirements, cost, schedule, risk, system concept, and the available technology and industrial base. Figure 5.01 illustrates this concept with the margin for trade in the middle.

Previous models have presented a similar decision making box, typically considering cost, schedule, and performance (or requirements). However, research shows that many more factors play a role in determining mission success for space systems. The employment of an evolutionary strategy in the NSSAP attempts to make use of the most current, mature technologies and mitigate risk, in addition to lowering cost through risk reduction. "Pursuit of leap-ahead capabilities will need to accommodate risk reduction and technology maturation, most likely through spiral development and evolutionary progress." (Neuman, 2006) Similarly, the change to capability-based acquisitions in the JCIDS, not only affects requirement generation, but also opens the

door for employing system-of-systems (SoSs) to meet a capability deficiency, requiring attention be paid to system concept.

Figure 5.01 – The Program Manager’s Decision Making Box (Gamache, 2006)



“Like any policies, how you deal with them is key” (Coyle, 2003) and the same is true for the CJCS series and NSSAP 03-01. While the policies are fairly sound, with a number of good ideas like NSSAP 03-01’s independent program assessment (IPA), the tools, mechanisms, and people are not in place to implement the policies with their desired intent.

The recommendations presented in Chapter Four state some of the tools and how to acquire the people needed to implement such policies, enabling better interaction between JCIDS and NSSAP.

5.3 Future Research

Additional research can be conducted in a number of areas. Because JCIDS applies to all services and a number of the recommendations would affect all services, similar research should be accomplished within the sister services before attempting to correct any problems with the JCIDS. The concept of joint Capability Acquisition Executives managing architectures of SoSs and FoSs must be further developed.

As mentioned in Chapter One, a limitation of the research was that it did not address the PPBE Process. Budget stability was a major theme in the interviews and to a lesser extent in the literature; however, it was not examined in this research to keep the scope manageable. The PPBE Process should also be reviewed for space systems.

In the author's opinion, one of the most important areas of future research is in DoD's implementation practices. Specifically, one could research whether tools, mechanisms, and skilled people were in place before or after a policy was released. DoD's philosophy on the role of policies could also be defined.

Finally, the recommendations of this thesis should be tested before implemented. While literature and interview data support the recommendations, a more thorough investigation as to the implications of such recommendations should be made before implementation.

Appendix A
Interview Invitation Letter

Dear (Interview Participant's Name),

I am a graduate student at the Air Force Institute of Technology, studying Research and Development Management and Space Systems. My master's thesis research is examining the interaction between the Joint Capability Integration and Development System (JCIDS) and the Defense Acquisition System (DAS). As your schedule permits, I would like to set up an appointment to interview you about your experiences on the subject.

My research includes interviews with people throughout the acquisition process for developing the nation's space systems, from the individuals operating the resultant system to those individuals who identified the existing deficiency requiring such a system to be developed. This research will describe the degree of interaction between the JCIDS and the DAS, identify major themes, and propose recommendations for areas of improvement as these areas are discovered.

The interview will follow, but is not limited to, a standard set of questions that are included. This semi-structured approach will allow for the analysis of responses to same questions across all interviews, as well as provide for any additional information that may be helpful to understanding an organization's perspective or provide clarity. Information collected during the interview will remain confidential throughout the entire process, including the resulting thesis and related articles. The interview questions have been approved through the Air Force Institute of Technology's process for Human Subject Research Approval.

Please respond, indicating whether you are or are not willing to participate in such an interview. If willing, also indicate a time and date convenient to you and falling on or before 31 Jan 2006 for the interview to occur. With your permission, the interview will be recorded. The interview may also be administered through an e-mail dialogue if you prefer.

Thank you in advance for your time, consideration, and willingness to participate in my thesis research. If you have any questions, I can be reached by phone at 937-xxx-xxxx and by e-mail at joyce.gamache@afit.edu.

Sincerely,
Joyce Gamache

Appendix B

Survey Questions

Name and Rank:

Duty Title and Description:

Relevant Coursework (DSMC, DAU) or Seminars:

Interview Time and Method:

Instructions

You are reminded that the personal information and responses collected today will remain completely confidential. They are collected to develop themes and measure the effectiveness of the implementation of the CJCSI 3170 and NSSAP 03-01 on the Joint Capability Integrated Development System (JCIDS) and the Defense Acquisition System (DAS).

With your permission, this interview will be recorded by digital voice recorder. You will be asked the eight standard questions that were e-mailed to you earlier and may be asked additional participant-specific, follow-up questions. Please answer the seven questions with respect to GPS, SBIRS, TSAT, and any other relevant space program that you have had experience with. Thank you for participating in this research.

Standard Questions

1. Please describe your organization's role in the JCIDS & DAS processes.

2. The NSSAP 03-01 defines evolutionary acquisitions, spiral development and incremental development as follows.

EA is defined as an acquisition approach that delivers capability in increments, recognizing up front the need for future capability improvements. This approach requires collaboration among the user, tester, and developer. The two main processes to perform EA are:

a) Spiral Development. In this process, a desired capability is identified, but the end-state requirements are not known at program initiation. Those requirements are refined through demonstration and risk management, there is continuous user feedback, and each increment provides the user the best possible capability. The requirements for future increments depend on feedback from users and technology maturation.

b) Incremental Development. In this process, a desired capability is identified, an end-state requirement is known, and that requirement is met over time by development of several increments, each dependent on available mature technology.

Do the following programs employ an evolutionary acquisition (EA) strategy? If so, does the program use incremental or spiral development and why was this method selected over the alternative?

GPS –

SBIRS –
TSAT –
Other –

3. Who is responsible, and what processes or tools do they use, for making trade-offs between the capabilities provided by the system-of-systems (SoS) or family-of-systems (FoS) at the mission level, and then deciding the space system acquisition spirals or increments? What sort of documentation is required (if any) to reflect this?

GPS –
SBIRS –
TSAT –
Other –

4. Has, or will, the NSSAP 03-01 implementation of EA on space programs dramatically reduced capability timelines and space program overruns? Why or why not?

GPS –
SBIRS –
TSAT –
Other –

5. Has, or will, the CJCSI 3170 implementation of the JCIDS process dramatically reduced capability timelines and space program overruns? Why or why not?

GPS –
SBIRS –
TSAT –
Other –

6. Prior to the implementation of EA through DoDD 5000.1 and DoDI 5000.2 for the DAS and NSSAP 03-01 for space systems, what kind of acquisition process would have been undertaken?

GPS –
SBIRS –
TSAT –
Other –

7. Please review the diagrams of CJCSI 3170 and NSSAP 03-01 products and events as a function of major program phase. Please identify what has worked well and why.

GPS –
SBIRS –
TSAT –
Other –

8. Please review the diagrams of CJCSI 3170 and NSSAP 03-01 products and events as a function of major program phase. Please identify what has not worked well and why.

GPS –
SBIRS –

TSAT –
Other –

Figure 3.1 – CJCSI 3170 Products and Events as a Function of Major Phase (CJCSI 3170, 2005)

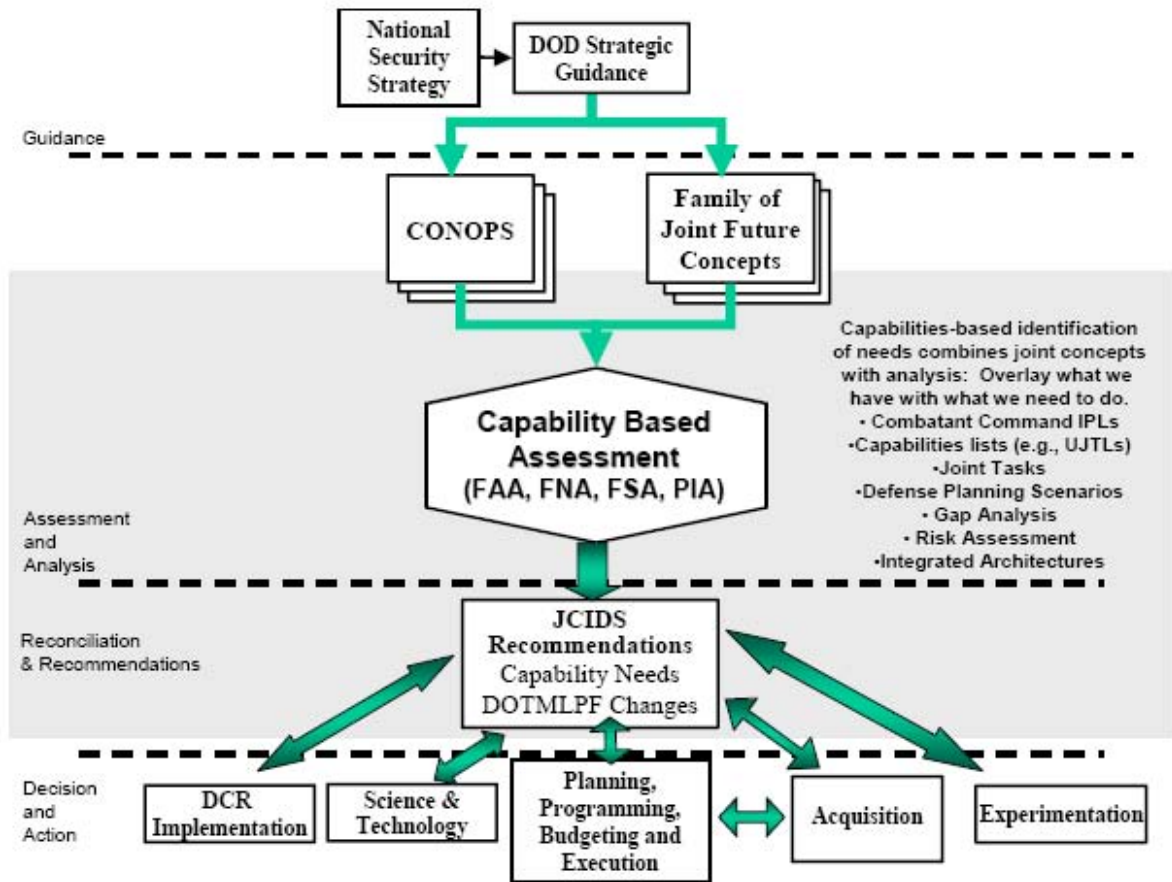


Figure 3.2 – NSSAP 03-01 Products and Events as a Function of Major Program Phase, Small Quantity System Model (NSSAP 03-01, 2004)

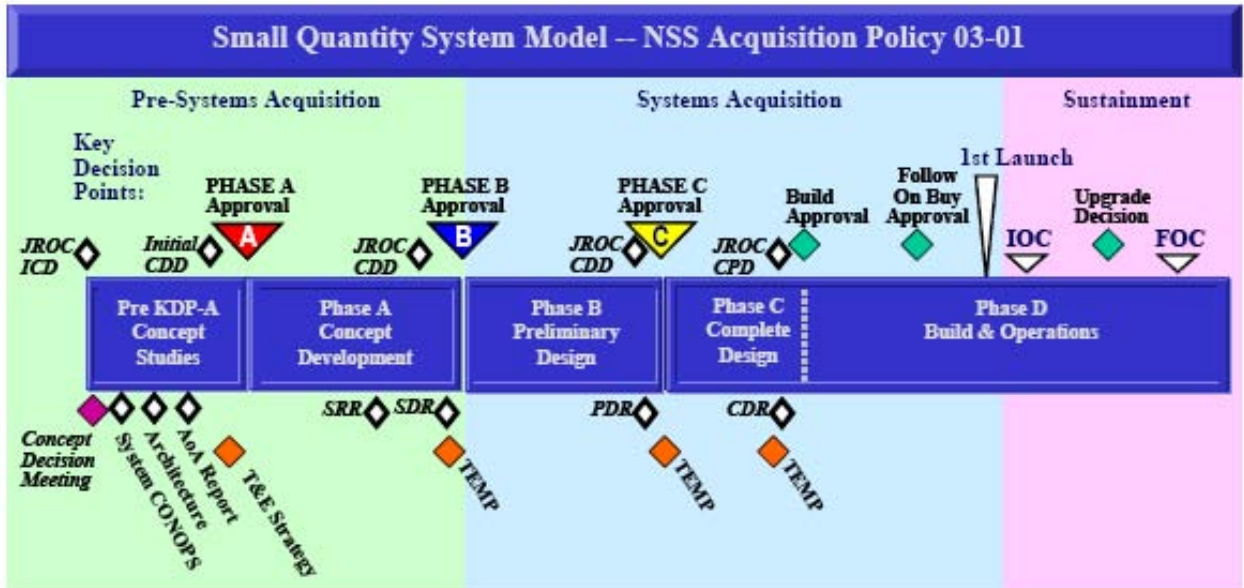
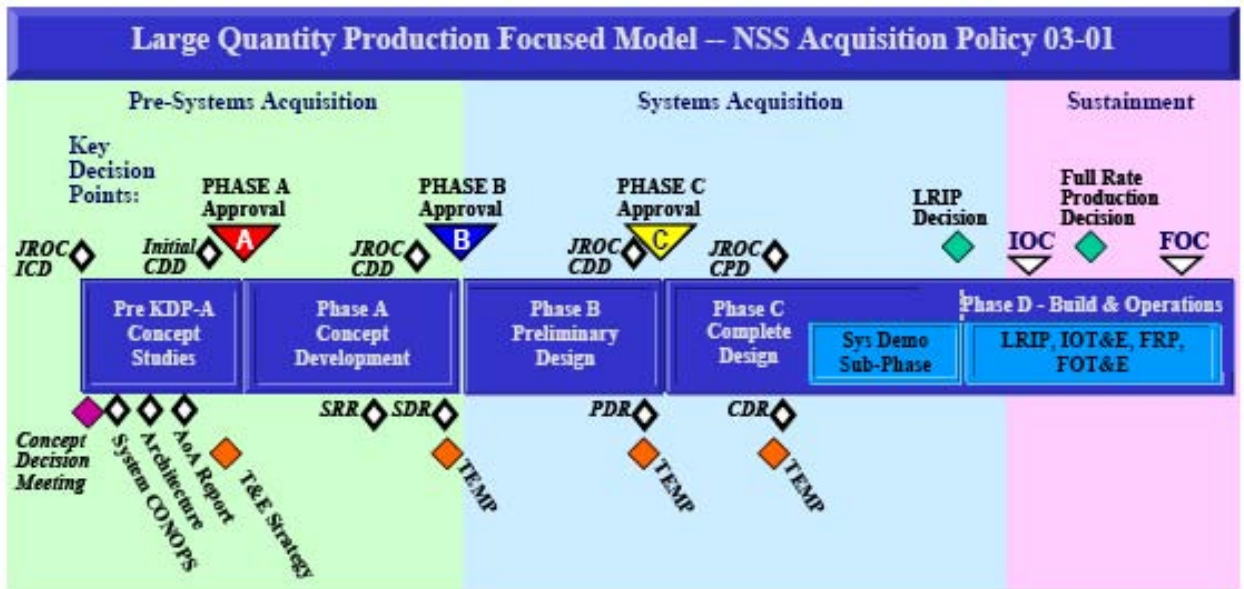


Figure 3.3 – NSSAP 03-01 Products and Events as a Function of Major Program Phase, Large Quantity System Model (NSSAP 03-01, 2004)



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Vita

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