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Critical Success Factors and Their Application to DoD Weapon System Acquisition

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December 2006

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Department of Defense weapon systems are growing more complex and expensive and the services are under increasing pressure from Congress to improve the cost schedule and performance of their weapons programs. The purpose of this project was to investigate and provide an overview of issues within the DoD acquisition system and provide information to assist program managers in dealing with some of the challenges they face. The goal of this project was to identify Critical Success Factors and determine if they could be applied to DoD acquisition programs in order to improve the acquisition process and provide program managers with a tool to assist them with managing a complex program.

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CRITICAL SUCCESS FACTORS AND THEIR APPLICATION TO DOD WEAPON SYSTEM ACQUISITION

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

Department of Defense weapon systems are growing more complex and expensive and the services are under increasing pressure from Congress to improve the cost schedule and performance of their weapons programs. The purpose of this project was to investigate and provide an overview of issues within the DoD acquisition system and provide information to assist program managers in dealing with some of the challenges they face. The goal of this project was to identify Critical Success Factors and determine if they could be applied to DoD acquisition programs in order to improve the acquisition process and provide program managers with a tool to assist them with managing a complex program.

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I. INTRODUCTION

Over the past half century weapons systems have grown increasingly complex and expensive. In 2002 the DoD spent $110 billion to research, develop and acquire a wide array of weapons systems.[1] In 2005, weapons system procurement accounted for $144 billion in spending and by 2009 it is estimated that the DoD will spend $185 billion.[2]

2001		2006	
Program	Cost	Program	Cost
F/A-22 Raptor aircraft	$65.0 billion	Joint Strike Fighter	$206.3 billion
DDG-51 class destroyer ship	$64.4 billion	Future Combat Systems	$127.5 billion
Virginia class submarine	$62.1 billion	Virginia class submarine	$80.4 billion
C-17 Globemaster airlift aircraft	$51.1 billion	DDG-51 class destroyer ship	$70.4 billion
F/A-18E/F Super Hornet fighter aircraft	$48.2 billion	F/A-22 Raptor aircraft	$65.4 billion
Total	**$290.8 billion**	**Total**	**$550.0 billion**

Source: DOD (data); GAO (analysis and presentation).

Figure 1. Total Cost of DoD's Top Five Programs in Fiscal Years 2001 and 2006 (in 2006 Dollars)(From: Government Accountability Office [GAO], GAO-06-257T, 2006)

Figure 1 shows the DoD's top five programs from 2001 to 2006 and the associated cost growth among them. The figure shows significant cost growth among those programs and shows that the top five programs have almost doubled in cost from $290.8 billion to $550.0 billion in the past five years. In 2006 the Government Accountability Office made the following observation:

[1] Government Accountability Office, *Major Challenges and Program Risks*, GAO-03-98, 2003, 50.

[2] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 3.

> current military operations, such as those in Afghanistan and Iraq, consume a large share of DOD resources and are causing faster wear on existing weapons. Refurbishment or replacement sooner than planned is putting further pressure on DOD's investment accounts.
>
> At the same time DOD is facing these problems, programs are commanding larger budgets. DOD is undertaking new efforts that are expected to be the most expensive and complex ever and on which DOD is heavily relying to fundamentally transform military operations. And it is giving contractors increased program management responsibilities to develop requirements, design products, and select major system and subsystem contractors. Figure 1 shows that just 5 years ago, the top five weapon systems cost about $291 billion combined; today, the top five weapon systems cost about $550 billion.[3]

With the large monetary value and implications for National defense, it is easy to see why Congress and the DoD have placed much emphasis on oversight of weapon system acquisition. In developing major weapon systems, program managers have the daunting task of balancing many factors that decide the cost, schedule and performance of their programs. There are many aspects that can affect weapon system programs, both positively and negatively. Many of these factors that affect a program cannot be controlled by the program manager. Factors such as political turmoil, changes in budget priorities and personnel changes within the DoD can all have disastrous consequences on a program. Many of these factors are outside the scope of what a program manager is expected to manage. This research will examine the program factors in which the program manager has some control.

Analyzing data from research conducted by the GAO and other relevant sources will lead to the identification of key factors that contribute to the success or failure of a weapon system programs.

A. PROJECT OBJECTIVES

The primary objective of this project is to identify Critical Success Factors (CSF) that lead to the success or failure of a program. My intent is to provide the acquisition

[3] Government Accountability Office, *DoD Acquisition Outcomes-A Case for Change*, GAO-06-257T, 2006, 3.

professional some guidelines to identify success factors in managing complex DoD weapon system programs. If a professional is aware of and is able to identify the Critical Success Factors that this research identifies, then the acquisition professional will be able to employ strategies and gain personal attributes that positively influence the success of future programs. By identifying both the technical and educational/experience factors in DoD acquisition programs, acquisition professionals will be better able to improve the acquisition process in an informed and realistic manner.

B. RESEARCH QUESTIONS

1. Primary Research Question

What are the Critical Success Factors (CSF) that influence the successful acquisition of DOD weapon system programs?

2. Secondary Questions

- How do we define the success of an acquisition program?
- What aspects lead to the successful acquisition of a DOD weapon system?

C. SCOPE OF PROJECT

This research will:

- Identify Critical Success Factors that are applicable to DoD acquisition programs
- Provide DoD acquisition professionals an identification of Critical Success Factors that have been proven to positively influence the success of DoD major acquisition programs.

D. ORGANIZATION

Chapter II will discuss the background of program management in the DoD as well as the history of weapons system development. This chapter will also examine the major changes that have affected the acquisition process. It will also address the parties involved in the process that influence the outcome of programs.

Chapter III will present data on Critical Success Factors that affect a program. The research will focus on research published by acquisition professionals and the

Government Accountability Office (GAO) as well as past weapons programs and analyze factors and events within those programs. This project will identify factors that had a major effect on the success or failure of the program.

Chapter IV analyzes the data presented from Chapter 3 and compares that data to identify any correlations between the research that has been conducted the GAO reports and any other evidence.

Chapter V presents the conclusions and the recommendations regarding program managers and their programs.

II. BACKGROUND

During World War II the acquisition of weapons systems was a relatively simple process compared to today. During that period, a need was identified, a contractor chosen and a product was produced, usually in very large quantities. The weapons were relatively simple to produce by today's standards, and that simplicity resulted in weapon systems that could be produced in large quantities by companies that had little experience manufacturing weapons. For instance, during WWII roughly 50,000 M4 "Sherman" tanks were produced for the US and its allies.[4] These tanks were relatively simple and easy to produce in large numbers. By contrast, the M1 "Abrams" series tank has only been produced in quantities of about 8,800 over a twenty five-year period.[5] The M1 tank contains computerized fire control systems and other digital systems as well as software that have greatly increased the capability of each tank. This capability is why the US forces are the best in the world, but with the increased capability comes increased complexity. The same increase in complexity we see in tanks can be seen in other systems as well, including aircraft. Currently, the F22 and F18 aircraft are the premier fighter aircraft in the US arsenal. These aircraft use computers to control flight control surfaces in what is known as fly-by-wire. These systems are very complex compared to the planes that were flying even 20 years ago and these complex weapon systems are being produced in decreasingly smaller quantities. As Figure 2 illustrates, weapon systems are growing in cost and as the cost grows the buying power is reduced resulting in fewer items being purchased.

[4] R.P. Hunnicutt. Patton: A History of the American Main Battle Tank. 1984, Presidio Press, 65.

[5] http://www.fas.org/man/dod-101/sys/land/m1.htm, M1 Abrams Tank Production, 01 December 2006.

Program		Initial estimate	Initial quantity	Latest estimate	Latest quantity	Percent of unit cost increase
Joint Strike Fighter		$189. 8 billion	2,866 aircraft	$206.3 billion	2,458 aircraft	26.7
Future Combat Systems		$82.6 billion	15 systems	$127.5 billion	15 systems	54.4
F-22A Raptor		$81.1 billion	648 aircraft	$65.4 billion	181 aircraft	188.7
Evolved Expendable Launch Vehicle		$15.4 billion	181 vehicles	$28.0 billion	138 vehicles	137.8
Space Based Infrared System High		$4.1 billion	5 satellites	$10.2 billion	3 satellites	315.4
Expeditionary Fighting Vehicle		$8.1 billion	1,025 vehicles	$11.1 billion	1,025 vehicles	35.9

Source: GAO analysis of DOD data. Images sourced in their respective order: JSF Program Office; Program Manager, Unit of Action, U.S. Army; F-22A System Program Office; (Left) © 2003 ILS/Lockheed Martin, (right) © 2003 The Boeing Company; Lockheed Martin Space Systems Company; General Dynamics Land Systems.

Figure 2. Examples of DoD Programs with Reduced Buying Power (2006) (From: GAO, GAO-06-585T, 2006)

As Figure 2 illustrates as the cost of development and production go up the services make trade-offs that lead to reduced numbers of systems purchased. When the services decide to by fewer systems the cost per unit goes up dramatically because the contractors fixed costs are spread over fewer units.

The increasing complexity of weapons systems along with the ever increasing demand on the federal budget has put enormous pressure on DoD acquisition programs. As the complexity of weapons has gone up so has the cost of the weapons. This complexity of weapons systems also causes the increase in development time. The increases to both the cost and schedule must be balanced with the performance of the weapon. How much performance can we afford? How long will it take to develop the technology to give us that level of performance? The answers to these questions provide the trade-offs that must be made in any program.

A. THE STAKEHOLDERS

There are many people and organizations that influence the outcome of a DoD program. To understand the environment program managers must work within we have to first understand the people and organizations that influence their programs. The diagram below shows some of the most influential people and organizations.

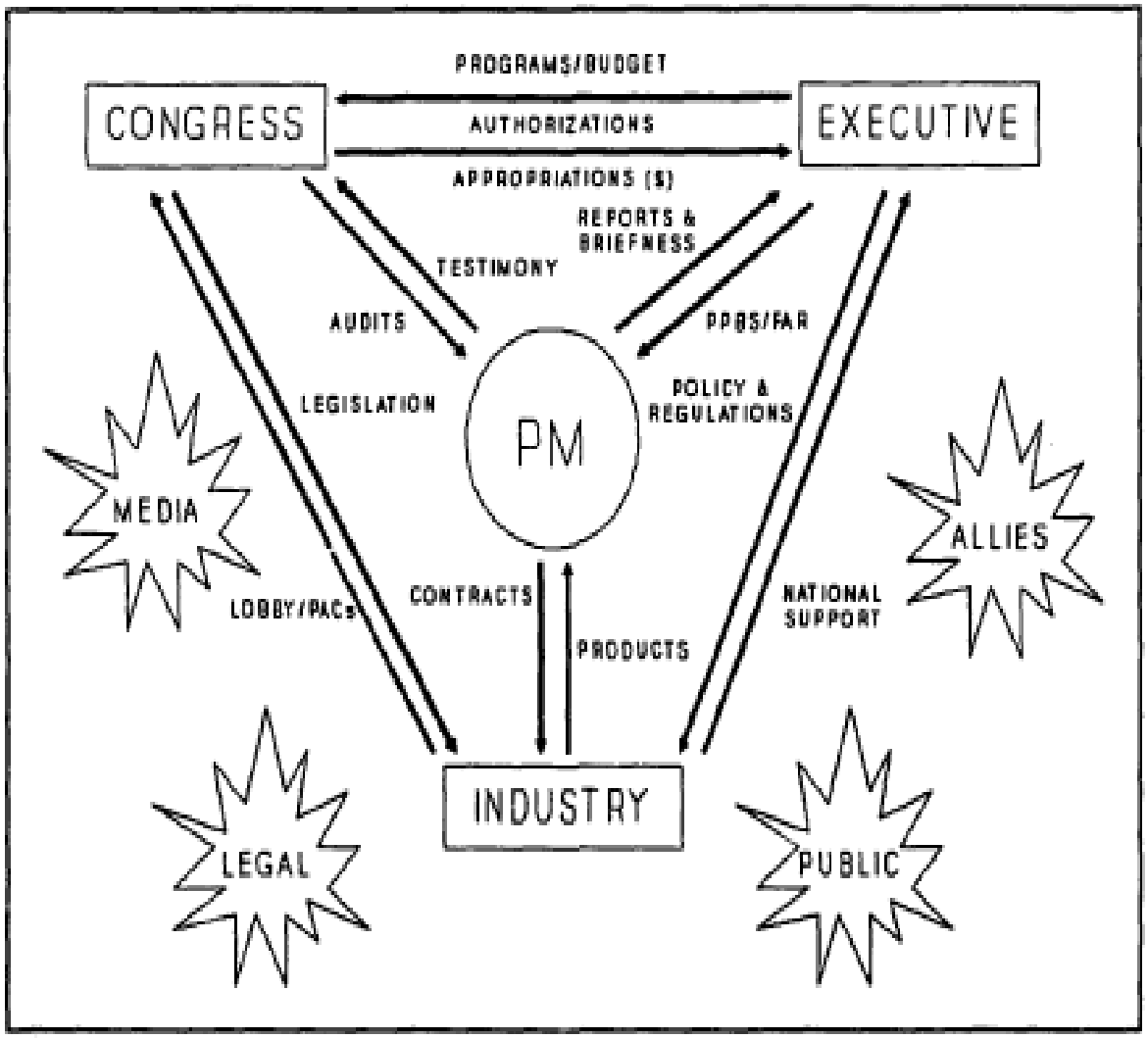

Figure 3. Tortured Triangle. (From: Introduction to Defense Acquisition Management, 2003)

The tortured triangle shows the three main groups that have varying degrees of influence over a program and how the groups are intertwined and try to exert power over one another. The defense industry exerts influence through the lobbying of members of

congress and the executive branch using tactics such as campaign contributions and political favors in order to influence both the executive branch and congress to win support for programs that produce weapon systems developed by the contractor. The executive branch exerts its power through control of the DoD and the services. The executive branch (the services and DoD) sets its priorities through the official policies and strategies (National Military Strategy, National Security Strategy, Quadrennial Defense Review, etc.) and the budget process (Planning Programming Budgeting Execution System, Future Years Defense Planning Guidance, Program Objectives Memorandum, etc.). The executive branch also exerts influence by appointments and the placement of key personnel to oversee the process within the DoD and the services. While it is called the Presidents' budget, without Congressional approval, no funding is authorized or allocated for the programs. This is the main control that Congress has for influencing weapon system acquisition. With the ever increasing complexity and cost of weapon systems Congress has continued to try to exert more control over the acquisition process. Congress has continually called for changes in the way weapons systems are acquired. In an attempt to control spending, Congress keeps a close watch on the DoD and weapon system programs. The following chart shows the weapon systems cost overruns faced by the DoD since the 1970s and the initiatives made by Congress, the Executive Branch and DoD to address problems with the acquisition process.

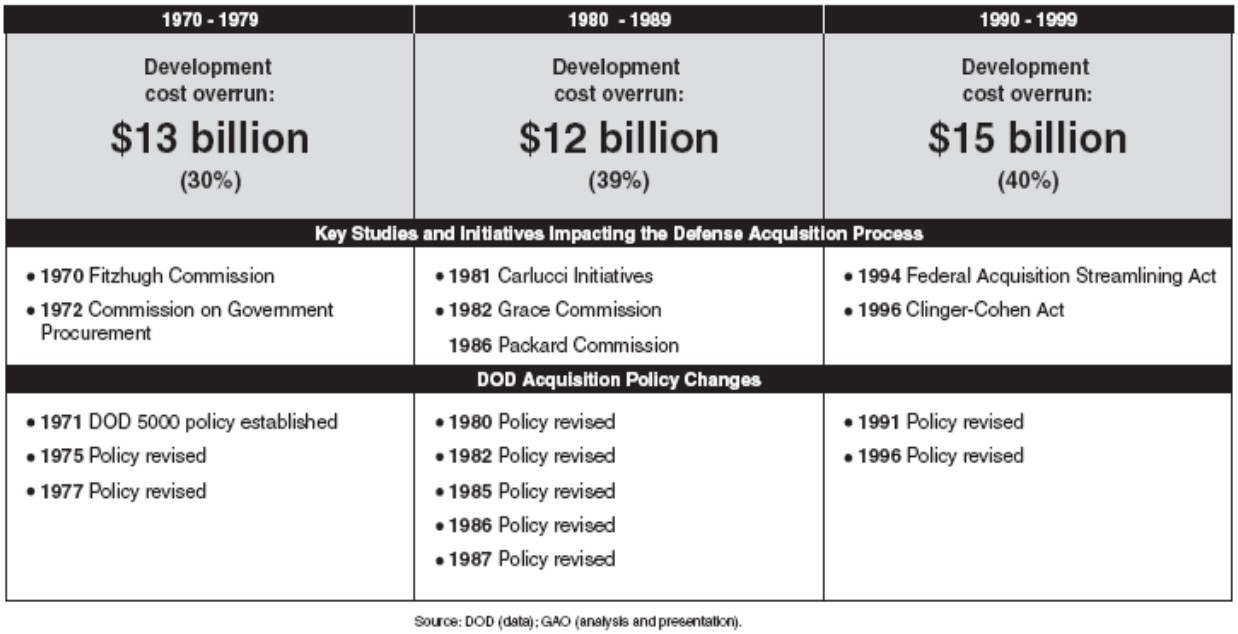

Figure 4. Development Cost Overruns by Decade (in Fiscal Year 2005 Dollars) and Key Reform Efforts. (From: GAO, GAO-06-368, 2006)

The Congressional budget process and the changes to priorities often result in cancellations or reductions in program budgets, which result in inefficiencies in the procurement process. When fewer defense dollars are available, decisions must be made and the results are usually fewer weapons purchased over a longer period of time. This causes an increase to the per-unit-cost of each item and causes contractor's costs to go up because they are producing an inefficient quantity of weapons.

The stakeholders listed above can have varying degrees of influence over a DoD weapons program, based on many factors. This research describes these organizations and individuals to depict the many factors that can influence a program and are outside the control of the PM. There are also many problems that affect a program from unstable funding to changes in defense priorities. These problems are usually beyond the scope of the program manager. The program manager must focus on what he can control in order to manage a successful program. This project will focus on the factors that the PM can control and determine which of those factors influence the success or failure of the program.

B. PROGRAM MANAGEMENT

What is program management? Program management is the process by which the DoD develops current weapon systems. The DAU glossary defines program management as:

> The process whereby a single leader exercises centralized authority and responsibility for planning, organizing, staffing, controlling and leading the combined efforts of participating/assigned civilian and military personnel and organizations, for the management of a specific defense acquisition program or programs, through development, production, deployment, operations, support and disposal.[6]

The concept of program management can be traced to the Air Force's ballistic missile development in the 1950 and 1960s and the Air Force Systems Command's development of publications and manuals referred to as the 375 series. In Acquiring Defense Systems, David Acker states that program management usually contain five distinct phases:

> (a) exploration and development of defense system concepts based upon a recognized mission element need; (b) demonstration and validation of selected alternative concepts; (c) design, development, limited production, test and evaluation; (d) production; and (e) Service deployment, operational support as well as planned and unplanned product improvement.[7]

This process, if executed properly ensures that every aspect of the weapon system from production to support to disposal has been identified and addressed to ensure the success of the system. While the process of program management is a complex process that produces a unique product, lessons can be learned from previous programs and implemented effectively in new programs. The majority of DoD acquisition programs experience unanticipated increases to both the cost and schedule of the programs. This research will identify internal factors from previous programs that if applied to future programs may help to reduce the incident of cost and schedule overruns. While the impact of the decisions made by the three groups of stakeholders outside the program has

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[6] Defense Acquisition University, *Glossary: Defense Acquisition Acronyms and Terms*, 2005, 22.

[7] David D. Acker, *Acquiring Defense Systems, A Quest for the Best*, Defense Systems Management College Press, 1993.

a significant effect on the "success" of a program, the PM has little control over them. On the other hand, the internal factors can be controlled by the PM.

C. DEFINING SUCCESS

How do we define the success of a program? This question is an important one to consider when evaluating the cost, schedule and performance of a program. Can a program be successful if it is completed over budget? What if it doesn't have the level of performance that was required by the user? There have been multiple studies conducted by GAO, the DoD and other agencies but most fail to define the meaning of success. While the GAO makes the claim that program managers use a formal definition for success, when it comes to budgets and funding the definition becomes ambiguous. A GAO report made the following observation:

> At DoD, success is often formally defined in similar terms as the commercial world: deliver high quality products to customers (the warfighter) at the right time and the right cost. Virtually all program managers we spoke with first defined success in terms of enabling warfighters and doing so in a timely and cost-efficient manner. But when the point was pursued further, it became clear that the implied definition for success in DoD is attracting funds for new programs, and keeping funds for ongoing programs. Program managers themselves say they spend enormous amounts of time retaining support for their efforts and that their focus is largely on keeping funds stable. They also observe that the DoD starts more programs than it can afford to begin with, which merely sets the stage for competition and resulting behaviors. As noted earlier, there are factors that contribute to how success is defined in practice, including the fact that DoD depends on annual appropriations and it must fund a wide variety of missions beyond weapon systems development.[8]

Morris and Hough addressed the topic of project success in The Anatomy of Major Projects and they commented: "Success is a slippery concept to measure-and that it has different definitions depending on who you are and what your role in the project is (and when you attempt to measure it).[9] You can be assured that the end user's definition of success will be different than the PM's. While the PM's criteria and user's criteria for

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[8] GAO, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 56.

[9] Peter Morris & George Hough, *The Anatomy of Major Projects: A Study of the Reality of Project Management*, 1987, Wiley, 96.

success might have some overlap the end user doesn't care about acquistion cost but wants a functional, reliable piece of equipment that meets his needs and he wants it immediately. The PM has the difficult job of transforming the user's needs into the requirements and attempt to balance those needs with the cost and schedule. The cost, schedule and performance will all be impacted by the choices that are made.

One of the major issues that this project will address is that the services the DoD, Congress and the GAO do not have a definition of success that is agreed upon and used synonymously. If the organizations can not agree on what defines success, then how can it be achieved?

In Introduction of Defense Acquisition Management the author describes success and what it means to the four major players in the PM's environment:

> A successful system acquisition program places a capable and supportable system in the hands of a user when and where it is needed, and does so within the bounds of affordability. The ideal outcome necessary for successful long-term relationships among the participants in defense acquisition is "Win-Win", wherein each participant gains something of value for participating. Depending on your perspective, "success" can take many forms.
>
> - For the PM, success means a system that is delivered on time, within cost and meets the user's requirements.
> - For the Office of the Secretary of Defense (OSD) staff, success means a program that satisfies national security objectives, provides a balanced force structure, and does not attract undue Congressional scrutiny.
> - For industry, success means a program that provides a positive cash flow and a satisfactory return on investment, and preserves the contractor's competitive position in the industry.
> - For the user, success means a system that is effective in combat and easy to operate and maintain.

To a large extent, a person's (or organization's) perspective on what constitutes a successful program depends on position. In other words, where you stand on "success" is largely a function of where you sit.[10]

For every stakeholder in the acquisition process, "success" could have a distinct and different meaning. How can we expect to produce successful programs when we can not even agree on the definition of success? Although it is difficult to define a successful program in a way that would satisfy every stakeholder, it is an important question that must be addressed in order to create a more efficient acquisition process.

D. CRITICAL SUCCESS FACTORS

The theory of "Success Factors" was first developed by D. Ronald Daniel in 1961, but it was not until 1979 that J.F. Rockart of the Harvard Business School published work on a systematic approach to Critical Success Factors (CSF) in "A Primer on Critical Success Factors".[11] His work focused on factors within organizations that if identified and measured can produce successful results. Rockart defined CSF:

> …the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where things must go right for the business to flourish. If results in these areas are not adequate, the organization's efforts for the period will be less than desired.[12]

While Rockart's research focused on identification of CSF at the executive level, Dr. James Dobbins and Dr. Richard Donnelly published research in 1998 regarding CSF within government acquisition programs.[13] Their work published in Acquisition Review Quarterly focused on identification of CSFs within government acquisition programs that can help PMs manage successfully. Dr. Dobbins published several more articles regarding CSFs and their application within the DoD acquisition process and risk management.

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[10] Defense Acquisition University, *Introduction to Defense Acquisition Management,* 1999, 7.

[11] James H. Dobbins & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 62.

[12] James H. Dobbins & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 62.

[13] Ibid.

E. SUMMARY

This chapter has briefly described the organizations and people associated with the DoD acquisition process. It has also demonstrated the external issues that the PM must deal with while managing a weapon system program. Since World War II weapon systems have become more complex and thus more expensive. In order to manage those programs the services assigns a PM to manage the weapon system programs. The PM must deal with three main organizations or groups (Executive, Congress, Industry) throughout the life of the program. There are many factors that affect a program both externally and internally. The subsequent chapters will identify the internal factors that can have a negative affect on weapon system programs. There are many challenges that face the Program Manager of a major weapon system program. He is faced with a system that is extremely complex to produce. He is also faced with a multitude of people and organizations that have input into his system and the PM must try to exert some control over these people and organizations. Unlike the commercial world, PMs within the DoD exert far less control over their programs. The next chapter will focus on the research that has been conducted regarding Critical Success Factors by Dobbins and others and its application to DoD weapon acquisition programs.

III. RESEARCH ON SUCCESS FACTORS

A. DOBBINS' AND DONNELLY'S RESEARCH

In 1998 James Dobbins and Richard Donnelly published research regarding Critical Success Factors and the implications on government acquisition programs. Prior to their work, most research on CSFs was conducted on for profit businesses in the private sector. This research focused on the strategic level, namely executive level managers within specific industries. The basic premise of Dobbins' and Donnelly's work was to determine if it was possible to identify general CSFs that were relevant to most major government acquisition programs. Dobbins and Donnelly sought to answer the following questions, "Are there any general Critical Success Factors for DoD programs?"[14] They surmised that the identification of CSFs that are common to DoD acquisition programs and the identification of metrics to correctly measure the CSFs will help future PMs manage their programs with a higher degree of success.

Dobbins and Donnelly used a survey that was developed based on the CSF categories originally identified by Bullen.[15] The survey asked DoD PMs to identify CSFs in the related categories and the associated metric for the identified CSF. The survey was mailed to two separate groups of PMs. The first group consisted of PMs managing embedded system programs and the second group was PMs managing automated information systems. Dobbins and Donnelly distributed the surveys to both groups including 73 to the embedded system PMs and 57 to the automated information system PMs. They received back 20 completed surveys from the embedded system PMs and 14 from the automated information system PMs. The relatively low percentage of returned surveys, 27% and 25% respectively, is typical for surveys sent to PMs due to the many official and unofficial questionnaires in which PMs are asked to respond.

The results showed 18 CSFs that were common to both groups of PMs. The following three charts show the results for the two groups and the 18 combined CSFs that

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[14] James H. Dobbins & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 61.

[15] Ibid., 63.

were identified. The top four CSFs are highlighted and will be analyzed further in Chapter 4. It is interesting to note is that the program managers specifically mentioned establishing systems engineering expertise within the program office as it related to having a technically competent program staff.[16]

CSF	Times	N = 20 Factor
12	15	Continuous meaningful visibility using measures
4	**9**	**Technically competent program office staff**
2	**9**	**Clearly defined and stable requirements**
1	**8**	**Stable and adequate funding**
3	**5**	**Risk management**
7	5	Schedule management
15	5	Stable, qualified industrial base
17	5	Effective vertical a lateral communication
16	4	Management political influencing agents
6	3	Stable and adequate personnel resources
8	3	Cost management
9	3	User involvement, support and acceptance
10	3	Strong and structured quality control
11	2	Clearly and objectively defined project goals
19	2	Development and execution of program management strategic plan
22	2	Change management
5	1	Configuration management and control
13	1	Other agency support for training and government furnished equipment (GFE)
14	1	Adequate program office resources
18	1	Leadership
20	1	Thorough system documentation
21	1	Test and evaluation master plan (TEMP) approval
23	1	Program office teamwork
24	1	Effective and timely decision making
25	1	Foreign military sales
26	1	Measure and control integrated logistics support performance
27	1	Initiation of new projects

Table 1. CSFs Identified by Embedded Systems Program Managers in Priority Order (From: Summary Research Report on Critical Success Factors in Federal Government Program Management, 1998)

[16] James H. Dobbins & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 68.

CSF	Times	N = 14 Factor
1	**10**	**Stable and adequate budget**
9	9	User involvement and support
12	9	Effective technical performance evaluation
2	**8**	**Detailed requirements analysis**
4	**8**	**Technically competent staff**
19	7	Top management support
17	6	Effective vertical a lateral communication
7	6	Schedule management
10	6	Strong quality control program
6	5	Stable project staff
16	5	Management political influencing agents
13	4	Other agency support for training and government furnished equipment (GFE)
3	**3**	**Risk management**
20	3	Strong knowledge of life cycle management
23	3	Incremental acquisition
8	2	Cost management
22	2	Common Sense
11	2	Clearly defined mission
14	2	Adequate program office resources
21	1	Objective economic analysis
18	1	Leadership
15	1	Stable, qualified industrial base
5	1	Configuration management and control
24	1	On-site team to prevent fraud, waste and abuse

Table 2. CSFs Identified by Automated Info Systems Program Managers in Priority Order (From: Summary Research Report on Critical Success Factors in Federal Government Program Management, 1998)

CSF	Times	N = 34 Factor
12	24	Continuous meaningful visibility using measures
1	**18**	**Stable and adequate funding**
18	2	Leadership
2	**17**	**Clearly defined and stable requirements**
4	**17**	**Technically competent program office staff**
9	12	User involvement, support and acceptance
7	11	Schedule management
17	11	Effective vertical a lateral communication
10	9	Strong and structured quality control
16	9	Management political influencing agents
3	**8**	**Risk management**
6	8	Stable and adequate personnel resources
15	6	Stable, qualified industrial base
13	5	Other agency support for training and government furnished equipment (GFE)
8	5	Cost management
11	4	Clearly and objectively defined project goals
14	3	Adequate program office resources
5	2	Configuration management and control

Table 3. Combined CSFs Identified by Both Groups of Program Managers (From: Summary Research Report on Critical Success Factors in Federal Government Program Management, 1998)

Dobbins and Donnelly concluded that CSFs in DoD acquisition programs were identifiable and published the following findings:

- The CSFs for DOD program management are identifiable, and their explicit identification would clearly assist the program managers in maintaining management focus on the factors most important to program success.
- A significant number of CSFs are common to both groups of program managers.
- The component assumptions and emphasis for a given CSF common to both groups may be slightly different. This difference is largely a function of the difference between the mission of the two groups, the embedded system PMs being more concerned with the complete development of total systems than the automated information system PM.
- The CSFs identified by the PMs as the most significant for program success are not those factors that received the most attention from the oversight activities and agencies.
- The measures identified most often by the program managers as those used or recommended for use, are significantly more oriented toward cost and schedule (which must be briefed to oversight agencies) rather than toward factors identified by the program managers in the field as being most critical to the program success.
- There is no widely recognized and generally used set of measures consistent with the most frequently reported CSFs. This suggests that even though various factors are recognized as critical, they are not usually explicitly identified and the information network required to manage against those critical factors is not well developed.
- A commonly recognized set of CSFs, and a consistent measurement-based information network based on these CSFs, would be of significant benefit to the program managers as well as the oversight agencies. Such a management system would significantly improve the management success potential on programs across the board, and would provide the external groups a consistent method for evaluating and comparing different programs so that recommendations for future improvements could be results-based.
- A CSF-based information network for program management would lend itself to not only increased visibility for the program manager and staff during all life cycle phases, but would provide

the base for the establishment of measures for determining when the underlying assumptions for a given CSF may be changing.

- A CSF-based information network would provide a common framework for productive discussions between the program manager and the external groups, including the development contractors and would greatly support the effectiveness of IPTs.
- A CSF-based information network would significantly reduce the duplicative reporting and diversions the program managers experience under the present conditions.
- A CSF-based analysis process would be significant teaching instrument for educating prospective program managers in strategic thinking in terms of those considerations critical to success.[17]

Other research and studies relating to the DoD have added to the body of knowledge regarding CSFs and their importance to DoD weapon system acquisitions.

B. GAO-06-110 BEST PRACTICES

The GAO published data regarding better support of weapons systems in the best practices series titled "Better Support of Weapon System Program Managers Needed to Improve Outcomes" (GAO-06-110). This GAO report used the case study methodology to identify the best practices and processes used by commercial companies to ensure their programs were successful. The GAO selected companies that produced complex products using program management to conduct research, development and production. The GAO studied three companies; Toyota, Siemens and Motorola, conducting interviews with senior leaders and program managers to identify the processes, practices and metrics that were used by senior management to support program managers and hold them accountable for their program. In addition, the GAO conducted a survey of current PMs of ACAT I and II programs. The survey was sent to 185 PMs of which 128 responded resulting in a 69 percent response rate. The GAO also conducted in-depth interviews with individual PMs and Program Executive Officers as well as PMs from Boeing and

[17] James H. Dobbins & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 77.

Lockheed Martin managing two major weapon systems. They also synthesized information from previous GAO work regarding best practices in product development.[18]

The GAO found many differences between the programs being run by successful companies and DoD acquisition programs. The following topics were discussed as major differences between commercial companies studied by the GAO and the DoD acquisition process.

1. Funding

One of the key issues noted in the GAO report was the competition for funding. While the DoD is very good at developing long-term strategic plans, those plans do not appear to lead to a long-term realistic investment strategy including weapon development. Instead, there is severe competition because more programs are started than can be funded, this in turn, leads to increased competition and overly optimistic estimates regarding cost, schedule and performance of the competing programs. The GAO has continually identified problems with the DoD budget process including this assessment in 2003:

> Since the mid-1980s, we have reported that the DoD employs overly optimistic planning assumptions in its budget formulation. As a result, DoD has too many programs for the available dollars, which often leads to program instability, costly program stretchouts, and program termination. In 2000, we reported that because the fiscal year 2001 program's projected cost was $16 billion more than the cost projected for the same elements in fiscal year 2000 program, DoD could not implement its operation and maintenance and procurement programs as planned. Over the past few years, the mismatch between programs and budgets has continued, especially in the area of weapon systems acquisition.[19]

The problems identified by the GAO have also been identified by DoD program managers. These comments were taken directly from program managers interviewed by the GAO:

[18] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 20.

[19] GAO, *Major Management Challenges and Program Risks*, GAO-03-98, 2003, 11.

- OSD staff has reduced funding without any understanding or appreciation for program impacts. It appears that the staff makes arbitrary cuts.
- OSD has a very near-term execution year focus, resulting in great instability. In reality, it should provide much more strategic vectors for the Department instead of short-term adjustments to fix more tactical-level funding needs.
- My experience is that the service and OSD typically cut programs to pay top down bills.
- There is no such thing as funding stability in DoD. Funding reductions and programs stretchouts are the norm due to top down fiscal bills that occur during the execution year. The pentagon must pay the bills, therefore it takes funds from the programs, thereby contributing to program stretchout, cost increases, inefficiencies, etc.
- Unstable funding results in pressure to do aggressive things in order to minimize the impact of budget cuts on schedule and performance. I believe this has been a major factor in recent…program execution problems.
- Our product is considered a support function. When funding gets tight, we have been considered a bill payer for others, even if it has "broken" our program. [20]

The next chart depicts the results when the GAO asked DoD program managers about the obstacles they faced.

[20] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 40.

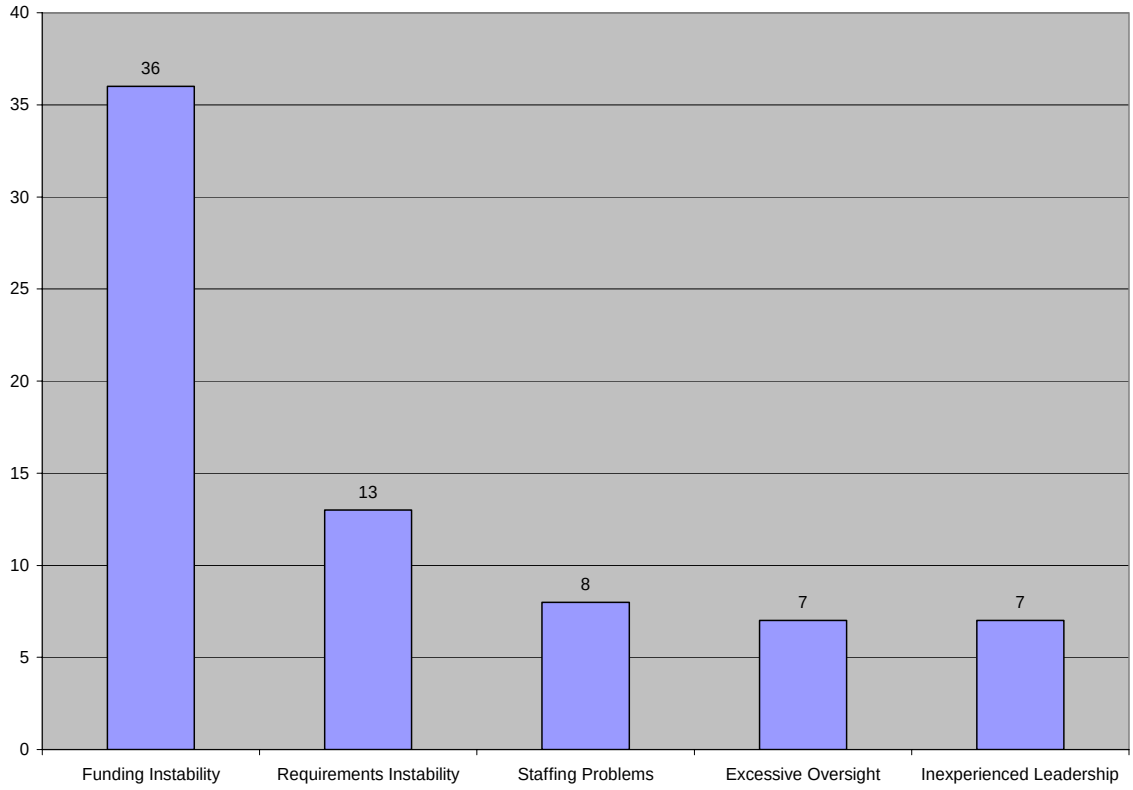

Figure 5. How Program Managers Responded to an Open-ended Question on What Were the Biggest Obstacles They Faced (From: GAO, GAO-06-110, 2006)

In contrast, key leaders within the companies the GAO researched, ensured that the projects undertaken supported the investment strategy of the company. This process gives the assigned program manager confidence that the leadership is committed to the program and there is a clear understanding of funding priorities. It is interesting to note that the GAO found in their research that not one program manager, from any of the companies, ever mentioned funding as a problem during the program, funding was a given once senior leaders had committed to their project.[21]

2. Requirements

The companies the GAO visited achieved there overall investment strategy by matching requirements to the available resources. All the key resources needed, including

[21] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 25.

time, money, technology and people, were available before the program began. The companies had already conducted extensive research and all requirements were clearly defined prior to initiation and commitment to the program. Previous research conducted by the GAO in the best practices series had consistently found that matching requirements and resources prior to initiating a new program to be a hallmark for successful companies. While research on DoD programs noted that requirements were often not fully defined at the onset of a program, and many also pointed out that users and stakeholders often did not adhere to the agreements made when programs were launched, especially if technologies did not mature as planned.[22]

3. Staffing

The GAO report 06-110 identified staffing issues as an important concern of both program managers and program executive officers within the DoD. They pointed to critical shortages of staff in the areas of program management, systems engineering, cost estimating and software development.[23] The GAO also identified practices within successful companies that produced highly qualified program managers. The companies placed a high value on strong leadership qualities including, decision making skills, diplomacy, communication skills and the ability to motivate others. The program managers interviewed by the GAO had a combination of formal training and informal mentorship by senior executives. The companies that were visited also had formal process for developing and deploying experts to assist the program manager. The program managers had a high degree of confidence in their support staff.

C. DELANO'S RESEARCH

Further research was published in the winter 1998 issue of *Acquisition Review Quarterly* (now *Acquisition Review Journal*) that supported the idea of Critical Success Factors. Major Kenneth Delano's research concluded that there were factors in DoD acquisition programs that could be identified as being key to the success of programs. Delano's research was conducted using survey questions and a literature review. Of the 32 surveys sent to PMs, 18 were returned. This resulted in a 56 percent rate of return

[22] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 42.

[23] Ibid, 44-45.

which was sufficient to validate the survey results. The next table depicts the results of the survey. The highlighted areas within the tables will be analyzed further in Chapter 4.

Average Score	Program Success Factor
4.42	Program Manager's ability to communicate
4.25	**Type and quality of people associated with the program**
4.25	Program managers ability to lead
4.25	Good relationship with user organization
4.17	**Resources: people, facilities, money**
4.08	**Product requirements and design stability**
3.91	**Funding stability**
3.83	Good relationship with prime contractor
3.58	Program's acquisition strategy
3.58	Program manager's acquisition experience
3.25	Program personnel continuity
3.00	Program manager continuity
3.00	**High degree of technical difficulty**
2.92	Program managers field experience
2.67	Program managers technical ability
2.33	Total quality management program
2.25	Low degree of technical difficulty

5 = Critical Factor 3 = Important Factor 1 = Not Very Important Factor
4 = Very Important Factor 2 = Somewhat Important Factor

Table 4. Delano's Program Success Factors Rank by Importance (From: Identifying Factors That Contribute to Program Success, 1998)

Delano's literature review consisted of researching 19 articles, documents and books. He then categorized key factors into two groups; Acquisition Factors and Resource Factors. These categories were then measured as to the number of times the factor was mentioned in an article and he concluded through his calculations, that factors with a correlation higher than 32 percent were considered the most significant.[24] While the factors that Delano used do not exactly mirror the factors Dobbins used there are many correlations and enough data to compare the two. The results of Delano's literature review are shown in the following chart.

[24] Kenneth J. Delano, *Identifying Factors That Contribute to Program Success*, Acquisition Review Quarterly Winter-1998, 1998, 42.

Factor	Source																			Total	%
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S		
Well defined requirements	X		X	X	X		X	X			X		X	X						9	47
Acquisition strategy	X	X		X	X			X	X		X					X		X		9	47
Works well when fielded	X							X	X		X					X		X		6	32
Stability	X		X	X	X			X								X				6	32
Good relations with contractor	X				X		X								X					4	21
TQM program								X									X		X	3	16
Meets performance objectives	X			X																2	11
Meets cost objective				X																1	5
Meets IOC date																				0	0

Table 5. Delano's Acquisition Factor Analysis (From: Identifying Factors That Contribute to Program Success, 1998)

Factor	Source																			Total	%
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S		
Quality people	X		X	X	X			X					X	X	X			X		9	47
PM responsibility & authority	X		X	X	X		X					X		X		X				8	42
Total team concept	X				X		X				X	X		X	X					7	37
PM skills	X			X	X			X				X	X	X						7	37
Congressional involvement				X	X									X						3	16
User involvement							X					X								2	10
Adequate resources			X					X												2	10
Adequate staffing															X					1	5

Factor	Source																		Total	%
Spt agency involvement							X												1	5
Higher Cmd involvement							X												1	5
PM technical ability	X																		1	5
GAO involvement																			0	0

Table 6. Delano's Resource Factor Analysis (From: Identifying Factors That Contribute to Program Success, 1998)

A	Baumgartner, Brown and Kelly
B	Beltramo
C	Clay
D	Gansler
E	Gregory
F	Heberling and Graham
G	Hicks, Rich, Wertheim and Meyer
H	Hirsch and Waelchli
I	Kish
J	Lesser
K	Nelson
L	Price and Valentine
M	"RX for Ailing Procurement System"
N	Sammet and Green
O	Settlmeyer
P	Snoderly and Acker
Q	Total Quality Management Master Plan
R	Weiss
S	Zairi

Table 7. Correspondence Between Codes and Sources (From: Identifying Factors That Contribute to Program Success, 1998)

Delano's research concluded that the following factors were ranked high both in the literature review and the PM survey and considered key to the success of DoD acquisition programs.

- Well defined requirements
- Acquisition strategy
- Actual weapon system performance

- Program stability
- Quality people
- PM authority
- Total team concept
- PM skills[25]

While the data that is presented in Delano's paper has distinct differences there are many similarities to the research done by Dobbins and Donnelly. Some of the differences in the survey results could be explained by the questionnaire format and focus of the surveys, but the main point of Delano's research is the same as Dobbins' and Donnelly's, that there are factors common to most programs that if they are managed and controlled will lead to a successful program.

D. RAND STUDY

In 1996, Robert Johnson and John Birkler published "Three Programs and Ten Criteria" which was sponsored by the Office of the Secretary of Defense (OSD) and addressed issues within DoD acquisition management. The authors used their observations combined with lessons learned from past programs, as well as their knowledge of DoD acquisition management to develop a structured list of "key factors" to be considered in successfully managing a major defense acquisition program. The following is a list of factors that Johnson and Birkler identified as critical to the success of a weapons system program:

- Lines of authority have been established and are clear. Defense Management Review issues and/or problems must not cause confusion, bickering, or a diminution of Program Manager responsibility and accountability.

- Communication is open (no secrets-all information is divulged; using all media and avenues, e.g., email, written, verbal) and continuous at and between all levels of authority.

[25] Kenneth J. Delano, *Identifying Factors That Contribute to Program Success*, Acquisition Review Quarterly Winter-1998, 1998, 43.

- Cost/Schedule Control System (CS2), cost performance measurement (CPM), and other management reports are used as indicators of trends in program progress and for reporting program status.

- Risk-management techniques have been implemented.

- Program stability has been achieved through control of requirements.

- A strong Government-industry support team (Program Office, functional support, Defense Plant Representative Offices) is present and has explicit mechanisms for coordinating responsibilities.

- Incentives for the Program Manager are adequate and positive.

- Funding is stable and adequate.

- Selection of best-qualified personnel for key acquisition management positions is objective and regulated.

- Security requirements do not restrict adequate and sufficient management.[26]

The author used this list of factors to form a baseline for a well managed program and see the above factors as critical to managing a successful acquisition program. The author's main points listed above focus on the same areas as research conducted by Dobbins and Donnelly as well as Delano and find that areas such as requirements, funding, risk management and staffing are critical to the success of DoD acquisition programs.

E. LESSONS LEARNED FROM THE F/A-22 AND F/A-18E/F DEVELOPMENT PROGRAMS

At the behest of the Air Force the Rand Corporation conducted a review of the F/A-22 and F/A-18E/F programs in order to identify lessons learned that could be applied to future programs. The results were published in 2005 and provide useful information to

[26] Robert V. Johnson and John Birkler, *Three Programs and Ten Criteria-Evaluating and Improving Acquisition Program Management and Oversight Processes Within the DoD,* 1996 Rand, 7-8.

future program managers regarding critical factors and their impact on the outcome of DoD acquisition program. The Rand study identified the following lessons learned:

- Early, realistic cost and schedule estimates set the program on the right path for the rest of the development program.

- A stable development team structure, proper team expertise, clear lines of responsibility and authority and a lead contractor responsible for overall program progress are critical to program success.

- An experienced management team and contractors with prior business relationships help eliminate early management problems.

- Concurrent development of new technology for the airframe, avionics and propulsion adds significant risk.

- Reducing the cost and risk of avionics should be a key focus of the concept development phase. Avionics is a considerable cost driver of modern weapon systems, and new concepts should be demonstrated along with new airframe designs.

- Preplanned, evolutionary modernization of high-risk avionics can reduce risk and help control cost and schedule.

- Careful monitoring of airframe weight is important. Airframe weight instability is an early indicator of problems.

- Earned Value Management (EVM) data should be used to monitor and manage program costs at the level of integrated product teams (IPTs). [27]

F. GAO REPORTS

Several GAO reports are also relevant to the research on Critical Success Factors within DoD Acquisition programs. While the data provided in these reports does not

[27] Obaid Younossi , David E. Stern, Mark Lorell, Frances M. Lussier, Lessons Learned from F/A-22 and F/A-18 E/F Development Programs, 2005, Rand, 57.

specifically address Critical Success Factors these GAO reports present separate issues that programs have encountered during their development that are closely tied to Critical Success Factor Theory.

1. GAO-06-585T Defense Acquisitions-Actions Needed to Get Better Results on Weapon Systems Investments

This document outlines the major issues with DoD acquisitions from the GAO's perspective and then provides solutions that it believes will address the problems that the DoD faces. Several of the problems they identify and solutions they suggest are similar to those that are addressed by the Critical Success Factors. The first issue, is the problem of well defined and stable requirements. Regarding requirements, the GAO stated:

> …DoD has exacerbated their problems by not clearly defining and stabilizing requirements before programs are started. At times, in fact, it has allowed new requirements to be added well into the acquisition cycle-significantly stretching technology and creating design challenges, and exacerbating budget overruns. For example, in the F-22A program, the Air Force added a requirement for air-to-ground attack capability. In its Global Hawk program, the Air Force added both signal intelligence and imagery intelligence requirements.[28]

In order to address the problem the GAO recommends that system requirements are agreed by the service acquisition executives and the warfighters and that no additional requirements are added during execution unless they are fully funded.

Another issue that the GAO addresses is funding of weapons systems. The GAO report states:

> DoD starts more weapons programs than it can afford and sustain, creating a competition for funding that encourages low cost estimating, optimistic scheduling, over promising and suppressing of bad news. Programs focus on advocacy at the expense of realism and sound judgment. Invariably, with too many programs in its portfolio, DoD and the Congress are forced to continually shift funds to and from programs.[29]

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[28] Government Accountability Office, *Defense Acquisition-Actions Needed to get Better Results on Weapons Systems Investments*, GAO-06-585T, 2006, 6.

[29] Government Accountability Office, *Defense Acquisition-Actions Needed to get Better Results on Weapons Systems Investments*, GAO-06-585T, 2006, 6.

Their solution is to enforce funding for priorities annually and measure success against the original plan. The GAO report addresses many other issues outside the scope of this research which is not pertinent to the discussion on Critical Success Factors.

2. GAO-03-98 Major Management Challenges and Program Risks

This report was written as part of a series on performance and accountability and identifies systemic and specific problems with management processes. While this report does not address Critical Success Factors directly, some of the systemic issues the GAO found within the DoD have implications with regard to CSFs. Specifically, The GAO findings regarding technical risk and critical technology maturity. The GAO report stated, "…we have found major weapon systems at risk of not being able to meet program objectives because critical technologies were immature and software development was not effectively managed."[30] The systems that are at risk because of immature technology include the Joint Strike Fighter, the Airborne Laser and the Space-based Infrared System. The report focuses on several management challenges but the main point regarding Critical Success Factors is that risk management and specifically technological risk is a major concern for weapon system programs.

3. GAO-04-393 Defense Acquisitions-Stronger Management Practice are Needed to Improve DoD's Software-Intensive Weapon Acquisitions

This GAO report focused on problems related to DoD's management of software and software development within weapon systems. The GAO visited three leading commercial software developers to identify procedures that could improve DoD's software development processes. While many issues are addressed in this report, the section regarding requirements is relevant to the discussion of Critical Success Factors. The GAO found:

> Senior managers at software development and acquisition companies we visited expect requirements to be managed and controlled before design work begins and virtually all lower-level design elements to be adequately defined before the start of coding. Without adequate definition and validation of requirements and design, software engineers could be coding

[30] Government Accountability Office, *Major Management Challenges and Program Risks*, GAO-03-98, 2003, 54.

> to an incorrect design, resulting in missing functionality or errors. Motorola CSG, a communications company, and Teradata, a division of NCR that specializes in database technology, estimate that 95 percent of their requirements are set by the end of the requirements phase and 98 percent by the end of the design phase. Officials view managing requirements as the most critical development task to ensure successful software outcomes.[31]

The report found that stable and defined requirements are critical to the success of any software development process. As weapon systems become more complex and dependent on software the ability to stabilize and clearly define requirements becomes even more crucial for the successful acquisition of weapons.

4. GAO-03-55 Acquisition Workforce - Status of Agency Efforts to Address Future Needs

This report focuses on problems regarding the size and quality of the workforce within Government organizations. The GAO identifies the work the DoD has done on human capitol strategy as a model for other organizations to follow. The GAO acknowledges that the DoD has room for improvement but is farther along than most organizations and stated the following, "DOD has been working for several years to strengthen its civilian acquisition workforce. The acquisition workforce comprises a large proportion of the overall workforce, and DOD views the acquisition workforce as critical to accomplishing its mission."[32]

Improving the quality of the DoD workforce has been part of the strategy within the DoD for many years and incorporates guidance from the Defense Acquisition Workforce Improvement Act (DAWIA), the Clinger-Cohen Act and other policies to ensure the acquisition workforce has the necessary skills that are required to assist in the successful acquisition of weapon systems. While the DoD has identified the need for a professional workforce the downsizing of the same workforce has caused several problems, including the following reported by the GAO:

> During the past decade, DOD has downsized its civilian acquisition workforce by half. It now faces what it considers to be serious imbalances in the skills and experience of its remaining workforce and the potential loss of highly specialized knowledge if many of its acquisition specialists

[31] Government Accountability Office, *Defense Acquisitions-Stronger Management Practices are Needed to Improve DoD's Software-Intensive Weapon Acquisitions*, GAO-04-393, 2004, 14.

[32] Government Accountability Office, *Acquisition Workforce-Status of Agency Effort to Address Future Need*, GAO-03-55, 2003, 16.

> retire. DOD created the Acquisition 2005 Task Force to study this problem and develop a strategy to replenish personnel losses. The task force's first recommendation was to develop and implement a human capital strategic plan for the civilian acquisition workforce.[33]

The report identified the need to have a well-trained, professional and certified workforce that has the right mix of skills and is sustainable in order to assist their organizations to be effective.

G. CONCLUSION

This chapter presented data related to Critical Success Factors from a variety of sources including the Government Accountability Office, Rand Corporation and several authors. The next chapter will illustrate that Critical Success Factors are relevant to DoD acquisition programs and can be used to successfully manage programs. Furthermore, it will show the relationship between the variety of research that has been done by the different authors and organizations.

[33]Government Accountability Office, *Acquisition Workforce-Status of Agency Effort to Address Future Need*, GAO-03-55, 2003, 17.

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IV. ANALYSIS OF CRITICAL SUCCESS FACTORS

There is significant data regarding the failure of DoD acquisition programs and what steps the DoD and services should take to "fix" the problems with the acquisition system. For example, the GAO has complete series of reports dedicated to improving DoD acquisition, such as the Best Practices Series which identifies industry leaders and applies there best practices to government applications. The data in chapter three is an attempt by professionals and government organizations to identify issues that lead to the failure of a program and identify corrective actions in order to create a more favorable outcome with future DoD programs. The data gathered comes from many sources including, lessons learned from past programs, this includes reports such as Three Programs and Ten Criteria[34], interviews with program managers, such as those conducted by the GAO for the report GAO-06-110[35], interviews and studies of program managers and programs in the civilian sector as well as professional experience, such as the Rand report Lessons Learned from the F/A-22 and F/A-18 E/F Development Programs.[36] The following factors have been identified by several authors or publications as critical to the success of programs and support Dobbins conclusions that there are Critical Success Factors common to most, if not all DoD acquisition programs. Dobbins' and Donnelly's research found 18 CSFs that they considered critical to successful programs and relevant to all DoD programs. While most other data does not find the exact results that Dobbins and Donnelly did, other research has found elements with key similarities. For example, Dobbins and Donnelly use the category of "Risk Management" for one of their Critical Success Factors, while Delano divides risk management into several categories including "High degree of technical difficulty" and "Program's acquisition strategy". These categories are not identical but are similar when they are applied to acquisition programs.

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[34] Robert V. Johnson and John Birkler, *Three Programs and Ten Criteria-Evaluating and Improving Acquisition Program Management and Oversight Processes Within the DoD,* 1996 Rand.

[35] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006.

[36] Obaid Younossi , David E. Stern, Mark Lorell, Frances M. Lussier, Lessons Learned from F/A-22 and F/A-18 E/F Development Programs, 2005, Rand.

A. STABLE AND ADEQUATE FUNDING

In Dobbins and Donnelly's research among DoD Program Managers stable and adequate funding is the number one Critical Success Factor identified by both the Embedded System PMs and the Automated Information Systems PMs.[37] The GAO found the same results when interviewing PMs, and Figure 4 clearly illustrates that PMs identify funding instability as the number one issue when addressing DoD acquisition management.[38] Delano's research as well as Johnson and Birkler's also found that stable funding was critical to the success of acquisition programs. With regard to funding stability the Johnson and Birkler stated, "Budget instability plagues all three programs (F/A-18EF, F-22, RAH-66) and causes the greatest concern for acquisition-management officials. Failure to meet this criterion was the most seriously detrimental aspect we found during our research on the three programs."[39] The GAO found that among PMs in the private sector stable funding was not a serious concern during the life of a program. The private sector PM must worry about the cost of his program and ensure that the cost is within a narrow band of the cost estimates but once a strategic decision is made for a new product, the PM has the support and understands that the senior leaders are fully committed to the program.

B. CLEARLY DEFINED AND STABLE REQUIREMENTS

As presented in the previous chapter, Dobbins' and Donnelly's research found that stable requirements was ranked second among CSFs and was mentioned 17 times in the returned surveys.[40] Their research found that clear and stable requirements were critical to the success of acquisition programs.

Further research by the GAO and others has also shown that requirements are critical to the success of programs. The GAO report 06-110 found that DoD program

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[37] James H. Dobbins & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 69-70.

[38] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 44.

[39] Robert V. Johnson and John Birkler, *Three Programs and Ten Criteria-Evaluating and Improving Acquisition Program Management and Oversight Processes Within the DoD,* 1996 Rand, 55.

[40] James H. Dobbins & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 71.

managers saw requirements instability as a major obstacle to their program. Program managers interviewed by the GAO made the following comments: "…that requirements were often not fully defined at the onset of the program and stakeholders often did not stick to the agreements they made when programs were launched, especially if technologies did not mature as planned."[41] When DoD program managers were asked to respond to the open-ended question regarding the biggest obstacle to their program, requirements instability was mentioned often and only less than funding instability as a major concern.[42] The Report also showed that, in companies that the GAO reviewed, requirements were clearly identified and the senior leadership ensured that the company had the resources to meet the requirements set out in the program. The companies will only fund programs with clearly defined and stable requirements. While the GAO reported the following regarding DoD programs, "…program managers commented that requirements continue to be added as the program progresses and funding instability continues throughout. These two factors alone cause the greatest disruption to programs, according to program managers."[43]

Major Delano's research also concluded that product requirements and design stability was considered very important among the respondents to his survey. As the tables in the previous chapter showed, Product Requirements and Design Stability (4.08 out of 5.00) was considered very important in the success of a program. Delano's literature review also had requirements ranked high among the books, articles and journals he examined. In his analysis of acquisition factors Delano found that "well defined requirements" was mentioned 47 percent of the time. He found this to be significant and determined that it is critical to the success of a program. From the data presented in the previous chapter, there appears to be a correlation between successful weapon systems programs and clearly defined and stable requirements.

While it seems simple to say that DoD programs need clearly defined and stable requirements, in practice, it is difficult to achieve. DoD programs often experience

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[41] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 42.

[42] Ibid, 44.

[43] Ibid, 45.

changes to requirements due to several factors including; length of the program, emerging technologies, changes in mission or changes in funding. Frequently the need for a weapon no longer exists but the services do not want to cancel the program because extensive time and money has gone into the program, so instead of treating the program as a sunk cost and cancelling it the services develop a weapon system that is not needed.

C. RISK MANAGEMENT

Dobbins' and Donnelly's research concluded that risk management was a Critical Success Factor within DoD acquisition programs. Risk Management encompasses all aspects of risk within a program to include technological risk as well as funding and schedule risk. In 2002 Dobbins described the process of risk management:

> The fundamental notion is that we identify risk, we assess their probability of occurrence, and we assess the consequence of occurrence. Then we put a risk management plan in place that is designed to alleviate the impact of the serious event. Every risk is necessarily a future event, and only when the risk event actually happens is the risk transformed into a problem. The better we are at identifying risks and understanding the underlying basis of our risks, the better we can manage the risks.[44]

The DoD Guide to Risk Management defines risk and risk management in the following manner, "Risk is a measure of the potential inability to achieve overall program objectives within defined cost, schedule, and technical constraints and has two components: (1) the *probability/likelihood* of failing to achieve a particular outcome, and (2) the *consequences/impacts* of failing to achieve that outcome." It goes on to define the process of risk management as:

> Risk management is the act or practice of dealing with risk. It includes planning for risk, assessing (identifying and analyzing) risk areas, developing risk-handling options, monitoring risks to determine how risks have changed, and documenting the overall risk management program.[45]

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[44] James Dobbins, *Critical Success Factor Analysis for DoD Risk Management*, Program Management Journal, May 2002, 40.

[45] Risk Management Guide for DoD Acquisitions (5th ed.), 2003, 7.

Dobbins and Donnelly describe risk management in broad terms and use the overarching concept of risk management as one of their Critical Success Factors. As Dobbins and Donnelly use the term "risk management", all aspects of a program can be considered part of the risk management process, from funding stability which causes budget risk to technical immaturity which is one aspect of technical risk. Other research has also identified risk management as critical to the success of a program but many researchers have defined the elements of risk management.[46] For example, Delano uses several categories to describe risk including "Program's acquisition strategy", and "High degree of technical difficulty". While neither of these categories mentions risk management, both are strategies to reduce budget, schedule and technical risk and are part of an overarching risk management plan. It is clear that Delano also sees risk management as critical to the success of DoD acquisition programs.

The GAO has also found issues with technical risk with many of the weapon systems being developed by the DoD. The GAO notes that many weapons are developed with immature technology that is key to the system. This usually creates unacceptable risk for most programs. When technologies are not mature and the system must have that capability to perform properly, the program runs the risk of going over budget, or over schedule, or both because the key technology did not mature fast enough. The GAO commented:

> Our most recent annual assessment of major weapon systems programs, showed that only 15 percent of the programs we reviewed began development having demonstrated that all of their technologies were mature. More often than not, programs had to worry about maturing technologies well into system development, when they should have focused on maturing system design and preparing for production. These assessments also show that programs that started development with mature technologies experienced lower development and unit cost increases than those programs that started with immature technologies.[47]

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[46] Kenneth J. Delano, *Identifying Factors That Contribute to Program Success*, Acquisition Review Quarterly Winter-1998, 1998, 39.

[47] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 41.

As the GAO points out, immature technologies often exacerbate budget and schedule problems because it takes longer and costs more than if the technology was already at a readiness level that was useful to the program. This is a theme that is seen in repeated in several GAO reports, including GAO-06-585T, where the GAO found:

> …DoD commits to its programs before it obtains assurance that the capabilities it is pursuing can be achieved within the available resources and time constraints. Funding processes encourage this approach, since acquisition programs attract more dollars than efforts concentrating solely on proving out technologies. Nevertheless, when DoD chooses to extend technology invention into acquisition, programs experience technical problems that have reverberating effects and require large amounts of time and money to fix.[48]

From the data that was presented in Chapter three it is clear that risk management is a Critical Success Factor and researchers, professionals and the GAO agree that risk management must be carefully addressed in order to develop successful weapon system acquisition programs. This is difficult to do within the DoD because of the need to develop weapons with greater capability and survivability. Most program managers would want to include any technology if they thought it would save a service-members life in a combat environment. The trade-off between cost and performance is a tough choice to make when it involves someone life. While trade-offs must be made it clear that program managers must manage risk in order to develop a successful program.

D. TECHNICALLY COMPETENT PROGRAM OFFICE STAFF

Dobbins and Donnelly identified a technically competent program staff as the fourth most identified Critical Success Factor mentioned by both Embedded Systems Program Managers and the Automated Information Systems Program Managers. As was pointed out in Chapter III, program managers specifically mentioned expertise in systems engineering as part of a technically competent staff. Further research by others identified

[48] Government Accountability Office, *Defense Acquisition-Actions Needed to get Better Results on Weapons Systems Investments*, GAO-06-585T, 2006, 6.

the same staffing/personnel problems, including the program managers interviews and literature review that was conducted by Delano, and interviews and case studies completed by the GAO. [49]

Delano's research also identified a technically competent staff as a key factor within acquisition programs. His reference to "type and quality of people associated with the program" and "resources: people" are comparable to Dobbins' and Donnelly's "technically competent staff." Delano's literature review also found that attribute "quality people" was considered critical and was mentioned in 47 percent of the literature that he researched.

Program managers interviewed by the GAO, also identified staffing problems as a major obstacle to successful programs. Specifically, the GAO stated, "…program managers comments and interviews with program executive officers pointed to critical shortages for staff that support them-including program management, systems engineering, cost estimating and software development."[50]

Further research conducted by the GAO and the DoD have also revealed that technically competent and professional staff are a key component of the acquisition process. The GAO has done several studies on the Government workforce and one of these reports was presented in Chapter Three as data regarding the importance of a technically competent workforce within the DoD and specifically, competent program staff within DoD acquisition programs.[51] The DoD also has identified the need to educate and train the acquisition workforce to ensure they are technically competent regarding the acquisition process. The Defense Acquisition Workforce Improvement Act certification was the system that answered the question, "how does the DoD ensure they have a technically competent and qualified workforce?" The DAU website states, "The DAU

[49] Kenneth J. Delano, *Identifying Factors That Contribute to Program Success*, Acquisition Review Quarterly Winter-1998, 1998, 38.

[50] Government Accountability Office, *Best Practices-Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110, 2006, 44-45.

[51] Government Accountability Office, *Acquisition Workforce-Status of Agency Effort to Address Future Need*, GAO-03-55, 2003, 17.

provides a highly structured sequence of courses needed to meet the mandatory and desired training standards established in DoD 5000.52-M, "Career Development Program for Acquisition Personnel."[52]

The DoD continues to face challenges to its workforce. The DoD must provide adequately trained and educated staff to support the complex weapon system programs that are developed and produced by the DoD. Over the past decade the DoD has reduced the acquisition workforce by half, while still trying to maintain qualified personnel to assist program managers, the loss of many experienced people has reduced the overall effectiveness of the acquisition system.[53] Furthermore, it is imperative that acquisition professionals receive both education and training. DAWIA certification is a excellent training tool but must be coupled with education in a specific discipline such as systems engineering, program management, operational research etc. While the challenge to train and educate staff is critical it is also critical to have the right people in sufficient numbers at the right place to effectively staff a program office. It is clear from the data presented in Chapter III that program managers and other program professionals as well as the GAO have identified a technically competent staff as a critical component of a DoD programs.

E. SUMMARY

There have been a number of documents written on Critical Success Factors and their application to the DoD acquisition process and there has also been work on issues that continue to plague DoD acquisition programs. While much of the research does not acknowledge the existence of Critical Success Factors as it applies to DoD acquisition many authors are attempting to find a set of criteria that can be identified in most programs that will be predictive in nature, and allow program managers and program executives to use the criteria to assess the probability of a positive outcome for the program. The analysis that has been done in this chapter shows that there is a correlation between the Critical Success Factors researched and the success of the program.

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[52] http://www.dau.mil/plm/plm.asp, DAU Website, 2006.

[53] Government Accountability Office, Acquisition Workforce-Status of Agency Efforts to Address Future Needs, GAO-03-55, 2002, 17.

The research of Dobbins and Donnelly, Delano, The Rand Corp and The Government Accountability Office make it clear that the DoD can benefit from a systematic approach to identifying factors that lead to the successful completion of programs. While not all programs will benefit from a set of criteria, it is imperative that Critical Success Factors are identified and measured for most programs in order to have a repeatable process for predicting the success of future DoD acquisition programs. Critical Success Factors will help to eliminate some of the variability in the acquisition process and provide a more stable acquisition environment.

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V. RECOMMENDATIONS AND CONCLUSIONS

A. CONCLUSIONS

The DoD is continuing to buy more complex and sophisticated weapons that cost more money to develop and produce, and has lead to a higher per unit price tag and the purchase of smaller, inefficient quantities. The DoD continues to face Congressional scrutiny of its acquisition programs because of recurring problems with weapon system acquisition.[54] The DoD must develop an approach to weapon system development and acquisition that produces superior weapons while maintaining the defense industrial base and keeping the trust and confidence of the U.S. taxpayer. The use of Critical Success Factors can help toward accomplishing this goal.

From the data that was gathered regarding Critical Success Factors it is clear that while program management by definition is a one time undertaking that produces a unique and specific product, the systems engineering process that program management is based on has enough structure to allow the use of Critical Success Factors to identify possible problems within a program.

The goal of this research was to answer the question:

- What are the Critical Success Factors (CSF) that influence the successful acquisition of DOD weapon system programs?

From the data that was collected and the analysis that was done, it is clear that there are several Critical Success Factors that can help determine the success of DoD weapon system acquisition programs. These four factors are:

- Stable and Adequate Funding
- Clearly Defined and Stable Requirements
- Risk Management
- Technically Competent Program Staff

While there are many factors that can affect a program positively it is clear that these four factors listed above are seen by program managers, acquisition professionals and the

[54] www.govexec.com/dailyfed/0705.htm, McCain Amendment Would Increase Defense Acquisition Oversight, 06 December 2006.

Government Accountability Office as the key elements to a successful acquisition program. Dobbins' and Donnelly's research identified 18 Critical Success Factors related to DoD acquisition programs.[55] Many were not addressed in any detail by other authors or the GAO. The four Critical Success Factors that are mentioned above have been identified extensively in books, journals and government documents detailed in Chapter III and there is extensive information on why these four CSFs are key to the success of DoD acquisition programs. There was insufficient data to conduct analysis on the other 14 Critical Success Factors identified by Dobbins and Donnelly.

To help answer the primary research question the following secondary questions were also asked, and answered:

- How do we define the success of an acquisition program?

As stated in Chapter III, the way an organization defines success often depends on where that organization is in the acquisition process. For example, the user's definition of success does not necessarily coincide with the contractor's definition and vice versa.[56] It is also apparent that each organization uses its own definition of success and from the research done there has not been one definition of success that is accepted by all the stakeholders.

B. RECOMMENDATIONS

- The DoD must recognize that Critical Success Factors exist and are the primary reason why programs succeed. The DoD must formally identify the Critical Success Factors that apply to DoD acquisition programs and implement a program to analyze and measure these factors in order to improve the success of future programs.
- The DoD must institutionalize the lessons on Critical Success Factors and ensure that future program managers understand the process and can

[55] James H. Dobbins. & Richard G. Donnelly, *Summary Research Report on Critical Success Factors in Federal Government Program Management,* Acquisition Review Quarterly Winter-98, 1998, 62.

[56] Defense Acquisition University, *Introduction to Defense Acquisition Management,* 1999, 7.

successfully implement the program. This requires "buy in" from senior acquisition executives that support and understand the importance of Critical Success Factors.

- The formal education and training of program managers through the Defense Acquisition University must include the process of identifying Critical Success Factors and implementing the measures to ensure successful programs. It is not enough to understand what critical factors are, there must be a systematic process for identifying and measuring factors that are key to the success of the acquisition program.
- The DoD, the Congress, the user and the acquisition community must agree to the definition of what a successful program is. Until the major stakeholders can agree to what success means and share a common vision then future programs will continue to have major problems.

C. AREAS OF FURTHER RESEARCH

There are two areas that further research should explore. First, it is clear that more research must be done in the area of Critical Success Factors. There must be a concerted effort to identify and measure the effects of Critical Success Factors on DoD acquisition programs. There is not enough data to validate the next 14 Critical Success Factors that were identified by Dobbins and Donnelly, so more research need to be done in this particular area. Further research should focus on documenting the effect that the 14 Critical Success Factors have had on past programs and possible predictions on future programs.

The second area that needs to be explored is the relationship between internal and external factors and the impacts that the two have on programs. This research focused on internal factors that, for the most part, could be controlled within DoD, future research needs to focus on the relationship between outside factors and program success, to include the budget process and how it creates instability within programs.

The DoD acquisition process produces the most technically advanced and lethal weapon systems in the world, and our military is unmatched in its capability to project lethal forces around the world. This reality must be tempered with the understanding that

defense budgets are coming under greater scrutiny and control and as our weapon systems become more complex we buy fewer of them. The DoD must become better at producing weapons in a cost and time constrained environment. If the DoD can adopt a basic guideline for using Critical Success Factors to guide a program to completion it will streamline the process and create a more efficient process for weapon systems acquisition.

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