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**SOFTWARE ACQUISITION IMPROVEMENT IN THE
AERONAUTICAL SYSTEMS CENTER**

THESIS

William A. Pogorzelski, Capt, USAF

AFIT/GRD/ENV/08-S1

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

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AFIT/GRD/ENV/08-S1

**SOFTWARE ACQUISITION IMPROVEMENT IN THE
AERONAUTICAL SYSTEMS CENTER**

THESIS

Presented to the Faculty

Department of Systems and Engineering 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 Masters of Science in Research and Development Management

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September 2008

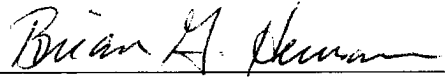
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**SOFTWARE ACQUISITION IMPROVEMENT IN THE
AERONAUTICAL SYSTEMS CENTER**

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15 Aug 2008

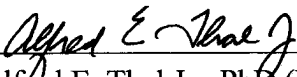
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Abstract

In the past 20 years, over 150 recommendations have been made to improve software systems development by organizations such as the Defense Science Board, National Research Council and the U.S. General Accountability Office. It has been discovered that many of these recommendation have remained unimplemented. This research had the purpose of confirming the application of these previous recommendations to improve software acquisition in the Aeronautical Systems Center. This was accomplished through interviews with 20 software practitioners in the acquisition community and the review of relevant literature. Through the analysis of the interviews and literature, this research was able to confirm that many of the recommendations have been applied in programs throughout ASC.

To My Mom and Dad

Acknowledgements

I would like to express my sincere appreciation to my faculty advisor, Lt Col Brian Hermann, for his guidance and support throughout the course of this thesis effort. The insight and experience was certainly appreciated.

I am also indebted to the many software professionals who spent their valuable time participating in interviews and providing their insight relating to software acquisitions and development.

William A. Pogorzelski

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SOFTWARE ACQUISITION IMPROVEMENT IN THE AERONAUTICAL SYSTEMS CENTER

I. Introduction

Background

United States military operations around the world continue to show the dominance of the weapon systems being developed by the Department of Defense (DoD) (Parcchia: 2004). Though the DoD continues to produce dominant systems, the programs that develop them are continually plagued with cost overruns and unsatisfactory performance (Parcchia: 2004). The dependence of systems on software being developed has continued to increase. This growth of software dependence can be seen when looking at the number of functions performed by software in aircraft over the years (Table 1). In 1960, the F-4 Phantom had only 8% of its functions performed by software. Fifteen years later the F-15 Eagle relied on software for 35% of its functions. This number continues to grow over the years and the Air Force's newest aircraft the F/A-22 Raptor, relies on software for 80% of its functions (GAO: 2000).

Table 1. Increasing Software Functions (GAO: 2000)

Aircraft	Year	% Functions Performed by software
F-4	1960	8
A-7	1964	10
F-111	1970	20
F-15	1975	35
F-16	1982	45
B-2	1990	65
F/A-22	2000	80

The increase in functions controlled by software required a similar increase in Source Lines of Code (SLOC). While the F-15A had only 60 thousand lines of code, as of 2004 the F/A-22 had 2.1 million lines of code and that number was projected to grow (Dobornski: 2005). Though this study focused on aircraft it begins to show how software has continued to grow as an integral part of systems development.

The DoD's growing dependence on software systems has been paralleled by an increase in the number of problems associated with the acquisition of these systems. According to a 1999 study by the Standish Group only 16.2% of large scale government and commercial software systems were completed on budget and schedule (Linberg: 1999). These programs are what the Standish Group considers a "project success," while programs that deliver behind schedule or over budget were considered "project failures" (Linberg: 1999). Of the programs studied by the group, 52.7% were classified project failures with the remaining 31.1% of the projects cancelled before completion (Linberg: 1999).

A 1998 study by Software Productivity Research, Inc. showed that as the amount of software grew in programs, the programs were unlikely to complete within budget and schedule (Jones: 1998). There was even a greater chance of cancellation of the program when the amount of software grew to a size of what was considered major military systems (Jones: 1998). Jones concluded that late delivery, increased budget, or cancellation for military programs often occurred due to lower productivity. This decreased level of productivity in the production of DoD software was primarily due to the increased standards and over regulation (Jones: 1998).

Instead of spending time writing code, developers were spending time completing the paper work required of DoD programs. According to Jones the amount of paperwork required was almost three times that of the commercial market.

Table 2 shows some of the common reasons why both commercial and DoD software programs fail. The reasons are not due to the complexity of software development but due to the management of the processes used. The Defense Science Board in 1987 wrote in a report on military software that, “The task force is convinced that today’s major problems with military software development are not technical problems, but management problems.”

Table 2. Reasons for Project Failure (Charette: 2005)

Unrealistic or unarticulated project goals	Poor communication among developers and users
Inaccurate estimates of resources	Use of immature technology
Badly defined systems requirements	Inability to handle project's complexity
Poor reporting of the project status	Sloppy development practices
Unmanaged risks	Poor project management
Stakeholder politics	Commercial pressure

Independent government organizations such as the Defense Science Board (DSB), Government Accounting Office (GAO), and National Research Council (NRC) have published over 150 recommendations to improve the development and acquisition of military software. Many of the recommendations have remained unimplemented (GAO: 2000). This means that the potential benefits of these recommendations have yet to be seen. Even as recent as September of 2006 the National Defense Industrial Association (NDIA) has raised concerns regarding software development in the military.

Purpose

The purpose of this research is to confirm the application of previous recommendations to improve software acquisition in the Aeronautical Systems Center (ASC) and to investigate any perceived benefits. This study will be accomplished with the review of literature related to the management of software development as well as previous reports by the GAO, DSB, and NRC. The reports have been shown to contain over 150 recommendations to improve software acquisition. A list of these recommendations which can be found in Appendix B will be utilized to formulate a set of interview questions that will be presented to practitioners in the field. The results of the interviews will then be used to make conclusions for the purpose of this study.

Preview

Chapter two of this document will present a detailed summary of the problem, relevant research and past software recommendations. Chapter three will then outline the methodology used to collect and analyze relevant data. Chapter four presents the results of the data collected for this study. Chapter five summarizes the results, present conclusions, and provides recommendations for future related work.

II. Literature Review

Overview

The focus of this research is based on recommendations to improve software development and acquisition made by the DSB, NRC, and GAO. These reports raise issues common to many of today's programs. This chapter will present relevant issues raised by the DSB, NRC, and GAO which affect the DoD. Along with previous reports, this chapter will also discuss relevant literature related to software development.

Problems facing Acquisition Regulation /Process for Software Development

When developing software a developmental model is often used. In the early 1980s the model used by the DoD was the waterfall model, which was mandated by DoD-STD-2167 (DSB: 1987). The waterfall model assumes a non-iterative development process (NRC: 1989) in which development efforts sequentially flow from the first step to the last step and only one step at a time, as shown in Figure 1. The only potential for iteration is with the feedback loops shown in the figure.

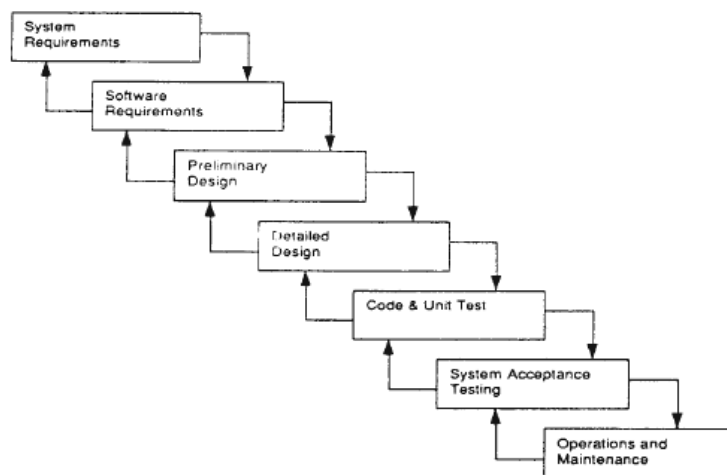


Figure 1. Waterfall Model (Overmyer: 1990)

These feedback loops are often not used due to a large amount of documentation to complete the process (Overmyer: 1990). System requirements were also determined up-front and user/developer interaction occurred only at the beginning of the program (DSB: 1987). According to the NRC, the waterfall model was characterized by unrealistic specifications and was measured by documentation not by demonstrable results (NRC: 1989). This meant that success of the project was not known until completion. To solve these issues it was recommended that the DoD use a more iterative model. The model recommended should have multiple occasions of interactions between the user and developer, evolving requirements, and demonstrable prototypes throughout the process (DSB: 1987, NRC: 1989)

Not only was the waterfall model being imposed on programs, but also other unnecessary standards and specifications (NRC: 1989). In 1983, there was a mandate to use the Ada programming language. The intent was to create a common programming language for DoD systems (Brosgol: 2001). The 1987 DSB report agreed with the push for a standard programming language and recommended more emphasis be placed on the management of the Ada language. In 1983 a mandate was created for the required use of Ada (Brosgol: 2001). This mandate lasted until 1997, when it was realized that the commercial market was not supporting Ada (Brosgol: 2001).

The DoD depended on the commercial market for the development of compiler and tool development for Ada programming (Reifer: 2000). However, the commercial market has been marketing more popular languages such as C and C++ (Brosgol: 2001). With less emphasis on Ada's use and tool development it has been reported that only one in ten defense systems are using Ada for software development (Reifer: 2000).

Mandates such as the use of the waterfall model and Ada language prompted the NRC to recommend that programs be allowed to tailor their processes to the characteristics of their programs. This would encourage program manager to be more innovative and less restricted by standards and specifications (NRC: 1989). The DSB also recommended tailoring of the process based on certain classifications. These classifications included, life cycle model, acquisition strategy, requirement stability, reuse potential, contract support strategy, and evaluation strategy (DSB: 1989). Along with tailoring of systems risk reduction activities should also occur, including prototyping hardware and tracing designs back to user requirements (DSB:1989).

An important aspect of requirements is that they be feasible; unfeasible requirements can negatively impact effectiveness, cost, and schedule (DSB: 1987). To ensure that the requirements are feasible, it was recommended that there be a mutual understanding between the contractor, program office, and user (GAO: 2004a). In order to achieve this understanding, knowledge should be gained from performing systems engineering analysis prior to the start of development (GAO: 2004a). After development has started it is still critical to review changes to requirements.

In 2006 the NDIA recognized that impacts of changes to requirements were still not being consistently addressed by program managers (NDIA: 2006). Like the GAO in 2004, the NDIA in 2006 suggested that an assessment of changed requirements and the impacts be conducted. The trade-off analysis of the requirements should consider the impacts on cost, schedule, and performance (GAO: 2004a). Once a trade-off analysis has been completed, it was recommended that program managers be given the authority to

decide the proper time to begin the development of new or changed requirements (NRC: 1989).

To track progress and ensure that developers are meeting cost, schedule, and performance measures, it was recommended that metrics be provided to the program offices (GAO: 2004a). The metrics should include cost, schedule, size, requirements, test, defects, and quality (GAO: 2004a). The metrics will “portray variances between planned and actual performance” and should provide for early detection of potential problems (Sambur: 2004).

In 2002 the GAO recommended that the Defense Logistics Agency (DLA) implement a software process improvement program due to a lack of a mature software acquisition process (GAO: 2002). The GAO recommended Carnegie Mellon University’s Software Engineering Institute (SEI) Software Acquisition Capability Maturity Model (SA-CMM) (GAO: 2002). This model is used to determine the maturity of software development process in an organization. The model contains five levels in which an organization can be categorized. The first level means that an organization has ad hoc and ill defined processes (GAO: 2002). As the organization progresses to level five, the process become more organized, repeatable and transferable throughout the organization (GAO: 2002). Once an organization reaches level five, processes are institutionalized and the organization can focus on continuous improvement (GAO: 2002).

The GAO found that the DLA was not meeting level two requirements on key process areas and was not at level three on risk management. The GAO recommended that a policy be established stating that the DLA attain at least these SA-CMM levels.

The DoD recognized the need for software process improvement plans and in 2003 these plans were required to be implemented DoD wide by Section 804 of the 2003 National Defense Authorization Act (GAO: 2004a). This section directs the secretary of each military agency to develop programs to improve their software acquisition process (DSB: 2000). The improvement programs are required to have a documented process for planning, requirements development/management, project management/oversight, and risk management (DSB: 2000). The program must also include a plan for producing the appropriate metrics (DSB: 2000). The metrics will be used to measure the performance of the programs and to help in continuous process improvement (DSB: 2000).

Use of Commercial-Off-the-Shelf Products in the Department of Defense

Commercial-of-the-Shelf (COTS) software products have been shown to have both pros and cons in DoD systems development. Since COTS products are available early in the design phase, systems can be designed to incorporate COTS products which can save time and money in systems development (DSB: 1994). Another positive aspect is in the support and operation of COTS products. Many of the products come with documentation and training material along with the availability of already trained personnel from the commercial market (Anderson: 1998). With the commercial market continually advancing technology the DoD can then leverage the commercial market for the most advanced products (Anderson: 1998).

Though the DoD has become more accepting of COTS software products there are still risks associated with their use in defense systems. COTS products offer a variety of security risks including software assurance. Software assurance is concerned with the security risks of the software. The risks can include malicious code that is written into

the COTS products that are developed by foreign countries. The use of foreign developers is at the discretion of program managers (GAO: 2004b). With the threat of malicious code there is an increased need in to test COTS products being used. The NDIA suggest that with the increase of required testing, the DoD should look at reviewing the testing processes to include a reduction in the required documentation and an increase in training of testing personnel to ensure products are safe for use in DoD systems (NDIA: 2006).

Even with the risks associated with COTS products, it has been recommended that the DoD take advantage of commercial products (DSB: 1994). It was suggested that the DoD look to the commercial market to buy tools, methods, environments, and application software, instead of custom-built software (DSB: 1987). These products should only be considered if trade-off studies and analysis of potential reuse of existing COTS products have been accomplished (GAO: 1994). The NDIA in 2006 recommended that these trade-off studies be reviewed at each milestone and major reviews to ensure lifecycle cost are continually being addressed.

Increasing Research and Development of Software Systems

It has been suggested that the commercial market is leading today's information technology (DSB: 2000). However, the commercial market can not cover all the areas needed for unique military systems (DSB: 2000). The technologies needed for the military systems are continually changing due to new operational threats and rapidly changing requirements (NRC: 1989). It was recommended that the DoD fund technology programs to meet the unique demands of DoD systems (NRC: 1989).

Problems facing Software Personnel

In 1987 it was stated that the DoD should assume that it will not be getting any more personnel in the software field and therefore should plan how to best use current personnel (DSB: 1987). In 2006, a similar statement was made by the NDIA which stated that there is an insufficient quantity and quality of software engineers to meet the demands of the government. Reasons given by the NDIA for the lack of software engineers were insufficient career incentives, competition, and inadequate funding (NDIA: 2006). To combat these issues it was recommended that the DoD improve the education and career field of its available personnel (NDIA: 2006, DSB: 1987). This would include prior to program initiation and at appropriate intervals, program managers should receive software-intensive systems training (DSB: 2000). To further educate software personnel it was suggested that a graduate-level program for software engineers be created (DSB: 2000). It was also recommended that government/contractor teams receive team and software refresher training (DSB: 2000). This idea of refresher training along the rotation of government/contractor personnel between the program office and the developing organization was intended to foster team building and sharing of knowledge (DSB: 1994).

III. Methodology

Overview

The purpose of this research is to confirm the application of previous recommendations to improve software acquisition in ASC and to investigate any perceived benefits. To accomplish this study, practitioners in the software acquisition field will be interviewed. The data gained from the interviews will be used to confirm whether the recommendations have been applied within ASC. The first decision in formulating the research methodology is to decide between a qualitative and quantitative study.

Selection of Research Method

Quantitative studies require the use of standard measures so that many perspectives and experiences can fit into predetermined responses (Patton: 2002). There are advantages to a quantitative approach giving the researcher the ability to make statistical generalizations on a larger number of cases (Patton: 2002). While ruling out statistics, qualitative research allows the researcher the ability to gain more depth and detail on a limited number of cases (Patton: 2002). For these reasons a qualitative study was chosen. In order to complete this study a standard set of interview questions was used. However, due to varying experiences and the desire to seek the more in-depth experiences of interviewees questions were left open-ended allowing for a more open study of the research area and the understandings and imaginations of the participants (Mason: 2002).

Patton suggests that qualitative data can be gathered in three ways: in-depth open-ended interviews, direct observations, or through written documents (Patton: 2002). For this research open-ended interviews were selected. This type of data gathering results in “in-depth responses about people’s experiences, perceptions, opinions, feelings, and knowledge” (Patton: 2002). Qualitative studies have also been known to provide benefit in understanding organizational goals, processes, and failures in policies (Skinner: 2000). The type of data collected from this study may lead future research to conduct a quantitative study on the same subject area.

For these reasons, it was determined that opened-ended interviews would be the method used for data collection. Open-ended questions do not limit interviewees to alternatives set by the researcher (Schuman: 1981). Open-ended questions also avoid imparting suggestions or imposing answers that the interviewee has not considered (Shuman: 1981).

Interview Questions Development

The questions were developed with the purpose of confirming whether the programs at the Aeronautical Systems Center had applied the recommendations to improve software acquisition and any perceived benefits to their programs. A list of recommendations was compiled from independent government agencies that have been tasked by the DoD and Congress to investigate software development and acquisition within the DoD.

Among the more than 150 recommendations there were many duplicates and several pertained to programs and organizations that were no longer in existence.

Through research and expert opinion, recommendations that were determined no longer

relevant were omitted from interview questions. For example, recommendations that focused on the use of the Ada programming language were omitted because Ada is no longer mandated by the DoD.

Throughout the review process each recommendation was placed into categories based on the context of the recommendation. The categories were created due to the numerous recommendations and to make them more manageable. Many recommendations may fit into multiple categories; however it was the discretion the researcher to place them into the categories selected. This allowed for a better flow during interview question development. Much iteration took place until the remaining recommendations were categorized as: Policy, Research and Development, Best Practices, Lifecycle, Source Selection, COTS, Project Management, Metrics, Personnel, Test and Evaluation, and Support.

Once placed into the above categories the recommendations were reviewed again. Similar recommendations were restructured and combined into a set of forty-six interview questions. The forty-six interview questions were also aligned in the above categories and used as section headings on the interview form. This gave the interview participant a context for each set of questions. This form can be found in Appendix A.

Selection of Research Subjects

Research subjects were selected based on their knowledge and experience in software development and acquisition in DoD programs. The scope of this study was limited to individuals who work at the Aeronautical Systems Center (ASC), Wright-Paterson Air Force Base so interviews could be conducted in person and also due to lack of funding. To determine if there might be any differences in those individuals who

worked at ASC and other Air Force organizations a four interview participants were selected from the 554th Electronic Systems Group (ELSG), also located at Wright Patterson Air Force Base.

In order to locate individuals at ASC a senior engineering leader within ASC was consulted to provide names of individuals that met the criteria necessary for this study. A list of Chief Engineers from fifteen different wings within ASC was also obtained. Those individuals along with personal contacts of the researcher were contacted and asked to provide names of individuals which fit the criteria. Individuals at the 554th ELSG were identified in a similar fashion. A list of names of potential interview participants was developed and those individuals were contacted via email or phone and asked to participate in the voluntary interview. At the conclusion of each interview the participant was asked to recommend others to participate in this research. These new individuals were then contacted and interviews continued.

For this study seventy-five individuals were contacted. Twenty-six were not considered for the study, but used to gain potential candidates to interview. The remaining forty-nine were considered potential interview participants and were contacted to be interviewed. For various reasons some individuals declined to participant in this study. Many individuals did not return phone calls or e-mails. Others had already moved to different positions or locations. On several occasions many believed they were mistakenly identified by leaders as good candidates since they have not worked with software in at least five years.

Ultimately, twenty interviews were conducted in-person at the individual's location and each lasted approximately forty-five minutes. Seventeen individuals representing thirteen different aircraft programs within ASC came from six of the nine aircraft product wings. Fourteen worked on avionics suites and other embedded software systems, which are not stand alone systems but are integrated into an overall system. Two other participants worked on simulator systems and the remaining individual worked with an optical pod. The three interviewed at the 554th ELSG worked on three different business systems.

Experience levels of participants varied for both acquisition and software experience from five to thirty-five years. The years of experience for each interview can be found in Table 3. The interviewees had an average of 19.7 years of acquisition experience. Software experience varied from two to thirty-five years with an average of 15.6 years of experience. At the time of the interview all individuals were working on software portions of Air Force acquisition programs.

Table 3. Years of Experience

Interview	Acquisition	Software
1	25	25
2	18	18
3	23	17
4	9	2
5	8	8
6	25	25
7	17	12
8	34	30
9	32	15
10	20	20
11	5	5
12	18	4
13	7	7
14	10	1.5
15	26	19
16	24	24
17	23	23
18	21	8
19	35	35
20	13	13

Data Analysis Process

Patton recommended that in order to analyze the data collected from interviews, the data should be compiled into a readable narrative, with major themes and identified categories (Patton: 2002). These “themes, patterns, understandings, and insight that emerge from fieldwork and subsequent analysis are the fruit of qualitative research” (Patton: 2002). The purpose of qualitative analysis is to connect, describe and classify the data collected (Dey: 1993). For this study answers were synthesized into a narrative that presents both approving and dissenting opinions of the interviewees.

To accomplish the data analysis, answers given by the interviews were compiled into a spreadsheet to allow for comparison. This spreadsheet can be found in Appendix D of this document. Similar answers were grouped together and themes and patterns were acknowledged and reported in chapter four, which shows the results of the study. The following is an example of how this researcher took the information gathered and identified themes and patterns providing results and conclusions. The questions concerning best practices asked in the questionnaire are, ‘In your experience has the DoD been effective at collecting and disseminating best practices of both the government and industry?’ The other question is “Is there a process to evaluate the usage of best practices?” After conducting the twenty interviews, the researcher created a spreadsheet consolidating the interviewees’ responses and comments about best practices. This allowed for easier analysis. According to the results from the interviews, the majority of respondents thought that the government is effective at collecting, but not necessarily at disseminating best practices.

Also, most said there is no process to evaluate the usage of best practices. Some of the comments which led to this determination were as follows: ‘government tries, but typically there is so much turnover of personnel we are learning lessons over and over again,’ ‘not totally effective in best practice dissemination, it may be there, but [one] is not told where to get it,’ ‘they didn’t really use metrics, but they looked at processes.’ All response to these questions can be found in Appendix D. The results and analysis for best practices is a combination of the answers from the above two questions. Based on these results, the conclusion can be made that the government should create programs to increase the effectiveness of information dissemination of best practices. Chapter four provides the results from all questions and respondents, followed by chapter five, which draws conclusions and recommendations based on the results presented in chapter four, such as the example just described.

IV. Results

Overview

This chapter will provide data gained from the interviews described in chapter three of this document. The individuals interviewed had a variety of experiences in software development and acquisitions. Since interviews were conducted as non-attribution, specifics tying individuals to programs have been omitted for confidentiality reasons. Data was separated into categories corresponding to the questions from each group based on the methodology described in chapter three of the document. The full questionnaire used during interviews can be found in Appendix A.

This research included respondents from both ASC and the 554th ELSG to determine if the questions asked would result in different answers between organizations. No significant differences were observed in the answers given. Therefore the results and conclusions will be discussed with no distinctions made for the different organizations.

Policy

The first question in the policy section focused on a general question whether or not there is a clear set of acquisition policy and more specifically, if this guidance was up-to-date enough to accomplish their program. In both cases, three-fourths of the respondents stated there is an adequate amount of policy and up-to-date guidance to accomplish the program. Rather than a lack of software policy, six subjects suggested that confusion results from excessive policy that cannot easily be located. To further perplexity, the policy and guidance was evolving and constantly changing.

The subjects were also asked if they were familiar with Section 804 of the National Defense Authorization Act, its implementation, and any results from its implementation. Only two individuals had specific knowledge of Section 804 and both agreed it was providing some benefits. All interviewees were asked to read an excerpt of Section 804 supplied to them during the interview. Afterwards, five individuals stated that they were not aware of Section 804, and could not offer more information. The remaining participants had no specific knowledge of the section, but after looking at the excerpt indicated that they had seen some impacts to their program. These impacts were not always a direct result of the Section 804 recommendation; but results of policies that were similar to those directed by Section 804.

Research and Development

The next section of the interview regarded research and development of software technologies. Interviewees agreed with the statement that the commercial market is driving the information technology market. It was suggested that there are areas within the commercial market not covered or should be covered by the DoD. The areas include safety critical systems and security. One reason given to focus on these areas is the DoD has unique requirements in which the commercial market may not be interested. Two individuals also suggested that their programs looked to the commercial market for hardware, but not for software. They indicated that the rest of the DoD should do the same. This impart is due to the unique software applications required by DoD systems. When discussing going to the civilian market for tools, methods, environments, and application software, all participants agreed DoD ought to continue this process. It was suggested it would be too costly to produce and maintain DoD unique software.

Best Practice

It was not widely agreed that both the government and industry have been effective at collecting and disseminating best practices. One suggested the government was effective at collecting the practices, but not necessarily disseminating those practices to other organizations. Another observed that though the government may not be effective, it is getting better than it has been in the past. Most participants were not aware of a process to evaluate the usage of best practices. Those that stated there was a process believed it was the responsibility of external resources. These resources could be from educational sources. One of the sources named was the Air Force Institute of Technology which is a graduate school for the Air Force. Also named was the Air Force Research Laboratory which provides research into technologies to support the warfighter. Finally, the Acquisition Center of Excellence was named. This center provides expert advice to those in the acquisition arena. Non-educational sources could be the ASC engineering home office or through contractors like MITRE. For others it was an internal process, lessons were learned from young developers or by comparing present developments with past developments.

Lifecycle

It was recommended that the DoD should not use the waterfall model and instead use the Evolutionary Acquisition Process (DSB: 1987). All interviewed agreed it is appropriate to use Evolutionary Acquisition for software development. However, not all interviewees agreed it should be the primary model. Some suggested that programs should choose the model that works best for their program; others did not specify programs having the option to choose the appropriate model.

Interviewees were asked if programs should be allowed to tailor the acquisition process based on classifications including: life cycle model, requirements stability, and the use of COTS. All agreed that their programs should be allowed to tailor the acquisition process. What was not agreed upon was the extent and on what classifications the process should be tailored. However, when asked if there is policy or guidance on how to tailor the process a variety of answers were given. A majority responded that there is no guidance. Although some suggested that there was guidance, it was hard for individuals to name a specific document that described how to tailor the process. In fact no specific documents were given at the time of the interviews.

Source Selection

A source selection question about policy requiring the government and/or contractor to reach a particular capability maturity level resulted in many varying answers. Those who agreed there was a policy could not identify a specific policy that required obtaining a precise maturity level. Regardless of whether or not the interviewees thought there was a policy, it was widely suggested that contractors should obtain at least CMMI level 3.

When asked if evaluating competitors on their technical approach rather than cost was feasible, it was agreed it was practical. Technical approach was considered as important as cost and could provide the best value approach. One of the interviewees stated that the technical approach should be considered a trade-off to cost.

Interviewees were asked if the government should perform an analysis of COTS and other contractor products in order to receive a best value solution. Respondents agreed that this recommendation was beneficial and often accomplished in many

programs. This also involved an analysis of contractor past performance in the integration of COTS products. It was suggested that the analysis of the products themselves might be difficult to conduct since requirements might not be established at this phase of the program. This same reason was also given when asked if contractors should demonstrate as much pre-existing functionality. It could be hard to perform since the contractors may not have developed programs which meet the new requirements.

COTS

A specific system could not be identified when asked if there was one to help identify potential COTS products. Respondents indicated COTS systems could be identified through various avenues. These included identification by the contractor and market research to include industry conferences or internet searches. Others may have support contractors such a Gartner Research to aid their program in seeking the appropriate products.

Interviewees agreed that program managers should not assume that software requirements can be met with off-the-shelf products. It was suggested that a thorough analysis must be completed to consider COTS. Modification of COTS products was discussed on several occasions. It can be costly to modify COTS products and therefore they are not always the best solution. This discussion leads into the next question, whether or not the modification of commercial products should be discouraged.

Two-thirds of the interviewees agreed that the modification of COTS products should be discouraged. Once modified, the product can be more costly to continue development and support into sustainment. All of the other interviewees agreed that COTS could be modified to meet the requirements.

Project Management

A common answer for program management was received when asked whether it is beneficial for program managers to manage price, schedule, and functionality but constrain two of the three. The answer was that realistically a program manager must manage all three. A few interviewees thought this is not a realistic approach. However, it was not agreed on which two must be constrained.

Interviewees either stated that one never really knows if requirements are feasible or they described various reviews and documents that can assist in the determination of feasibility. This carried over into the decision to determine if the program office and contractor have the same understanding. It was suggested through meetings, integrated product teams, reviews, and documentation a mutual understanding can be accomplished.

Performing a trade-off analyses for major changes to requirements were widely used by interviewees. Two individuals suggested that the analyses are conducted at the component (hardware/software) level rather than solely at the software level. Not all discussed the level at which the analysis was performed. Another individual stated analysis may not be feasible due to demands by the user representative. The user representative may be willing to assume the risk to push for the product.

It was recommended that program managers be allowed to defer late requirements to future releases (NRC: 1989). Comments on this concept yielded two distinct responses. First, indicating that program managers, in concert with user representatives, should have the authority to defer requirements. Alternatively, some individuals stated that requirements deferral should be the purview of user representatives only.

Software architectures were not widely perceived as beneficial by interviewees. In many cases there was no knowledge of architecture and how it was used. It was said that architectures in place were not complete, fully used or updated and no perceived benefits of improving the software architectures developed.

Incentives specifically for software were not used by most of the subjects' organizations. Those that identified incentives for contracts did not specify if they were for development of the program's software. Interviewees suggested it would be challenging to have incentives for quality, reuse and application of commercial best practices due the difficulty in quantifying contractor efforts in these areas.

Interviewees were asked if their program had a standard cost estimation model. This question resulted with many different cost models identified. Some responded their program used two different models; others only identified one. Some of the common models that were identified were the Constructive Cost Model (Cocomo), Price S, Software Evaluation and Estimation of Resources-Software Estimation Model (SEER/SEM), and the Automated Cost Estimating Integrated Tool (ACEIT.) Most agreed that there should be multiple models to compare results for accuracy.

There was no consensus on tracking software cost throughout the lifecycle of the program. It was suggested that costs were captured but not specific to software and were at a higher level. Other suggested that software cost were tracked but throughout the entire lifecycle. The portion of the lifecycle where costs were tracked was program specific. Others suggested no software costs were captured throughout the lifecycle.

All interviewees stated their program had a risk management plan. However, various answers were given on whether there was policy how to create them.

Interviewees suggested there were some specific policies from the ASC engineering home office, others suggested there was loose policy describing the creation of risk management plans. The level of review for risk management plans varied from bi-weekly to monthly. Depending on the level in the program reviews, it could occur more or less frequently.

Interviewees indicated that they relied on their contractor or the engineering community to help determine program deliverable requirements. Consensus indicated that engineers should help the program managers choose deliverables either using past experience or home office recommendations. The goals of each deliverable are to gain insight into contractor efforts and to deliver useful end-items.

Only one individual stated his program had a Computer Resource Working Group (CRWG). Three others indicated that they had something similar to what this group was originally intended for. However, the remaining subjects stated this group was largely out-dated and was unnecessary to have.

Interviewees were asked if their program had an independent expert review. Nearly all replied that their program had an independent review of one type or another. This review may have been internal or through external sources. Those that did not have an independent review on their current program agreed they still existed and may have occurred on previous programs. It was also suggested that the ASC engineering home office has “Tiger Teams” to provide these types of software reviews.

Metrics

Interviewees we asked a variety of questions on the software metrics provided by the contractor. This resulted in many different metrics provided to the researcher, although they varied program to program. Their use centered on oversight of the contractor. These metrics were used on a monthly basis at lower levels of the program and quarterly at higher levels. Interviewees indicated that there should not be a standard set of metrics, but rather a list of recommended metrics. It would then be up to the program office to choose from the list which metrics to receive. This choice would allow for the correct oversight for each individual program.

Though many different answers were given on how to measure success of programs, two themes arose. The first was that programs are measured via successful achievement of cost, schedule and performance measures. Program failure is the measure of deviation between actual and planned costs, schedule, and performance. The other theme that surfaced was an assessment of whether the system works as defined by the user representative. Finally, it was agreed by all interviewees that contractors should have earned value management (EVM) systems for all but the smallest efforts and those with fixed price contracts.

Personnel

Regarding the number and expertise of program software personnel, half of the participants indicated that their programs had enough engineers and managers with software experience to accomplish their programs. The other half stated their programs lacked the experienced people to complete their program. In order to gain the required

knowledge for their program, participants' organizations relied fairly evenly on either center engineering staff or contract experts.

It was suggested that the DoD reduce in-house software development and limit it to critical functions such as special security-sensitive work (DSB: 1989). This idea was presented during the interviews and it was widely agreed upon by those interviewed that this should happen and in most cases have already occurred. It was stated that the DoD has gotten out of the development business and due to cost it is better for the contractors to do the development and maintenance of the software.

There was no definite common answer to whether or not contractor maturity, design/code reviews and V&V were accomplished using program office "in-house" personnel. This came down to each program being different. Each type of review was done in-house, but no program conducted all these review functions without outside assistance. Most thought it would be beneficial to do these types of measurements in-house. However, responses were split on whether the program required additional personnel to accomplish these tasks. Some programs planned for them while others relied on additional support.

Interviewees also indicated that programs benefit from having software personnel to stay with the program longer. A few numbers were given in the answers that were received; however a common answer was "long enough." This would allow for continuity and the ability to retain corporate knowledge. This also depends on the person as it might be beneficial to the program for those dragging down the program to leave earlier than planned. It was also mentioned that is beneficial for individuals to work multiple programs in order to gain a breadth of knowledge.

It was recommended that personnel should rotate between the program office and the developing contractor (DSB: 1994). Interviewees agreed to the benefit in this recommendation, but that it would be administratively difficult to accomplish. This process would have many costs associated including overhead and lost productivity. Others stated that there might be a benefit, but feared there was a risk that those who rotated would be looked at as an outcast and therefore would not provide much benefit. The advantage of doing this was a better understanding of different points of views and gaining insight into their processes. Insight into each side's processes was also seen as a negative, because those processes should not always be shared.

Early user involvement was viewed as exceptionally important. The user representative should be brought in early to develop requirements and to ensure it is given the correct priority. However, the actual level of user involvement throughout the program varied drastically on each program. Most that the user representative was not as involved as should be and most would definitely like to see involvement escalate beyond participating in major program reviews.

Test and Evaluation

No clear consensus was discovered when participants about what constitutes thorough DT&E. Many suggested the testing of user requirements. Along with testing of requirements, it was suggested the DT&E can be considered thorough through trial and error and the use of experience teams that come to a consensus on the level of maturity of the system.

Two themes arose when participants were asked if software should be directly fielded from test beds. Interviewees thought it possible if the user representative agreed and some evaluation of the test beds operational representativeness could be made. Others believed that it really depended on the application of the software. For some systems especially business systems it didn't matter when they were released. However, when it comes to safety critical systems it may not be the best to release these systems prior to extensive testing.

The question was raised: Were future maintainers being brought in to do V&V during software development? Respondents divided on whether or not maintainers were brought in early in software development. One reply was that on the current program the maintainers were brought in to do the V&V, yet on their previous program this did not occur. The other person had the opposite situation occur.

The final question in regards to test and evaluation was: Who is going to perform the Operational Test & Evaluation on your program and were facilities provided to them? In a majority of the cases the Air Force Operational Test and Evaluation Center (AFOTEC) would conduct the OT&E. If AFOTEC was not conducting the OT&E, it was performed by a MAJCOM testing organization. In all cases facilities were provided or already established.

Support

The questions regarding support focused on who was going to maintain the software and how was the software going to be maintained. It was agreed that software maintenance issues need to be covered early in the life cycle. In many cases a plan was developed to cover software maintenance issues. These plans were developed by the groups responsible for maintaining the systems software. For most, the contractor would maintain the software after development was complete. In order to release new software to get the new software fielded, a variety of different methods were suggested by the interviewees. These included blocks, suites and other tailored processes developed by the contractor. To track and identify problems for fixes to be incorporated into these releases, respondents stated that there were many different formal processes. These could be controlled either by the government or the contractor.

Summary

A variety of answers were received during the interviews due to the use of open-ended interview questions. Throughout the analysis of the conducted interviews many themes and patterns arose in the collected data. This showed that in many cases a majority of the interviewees had similar experiences in software development and acquisitions. The next chapter will provide conclusions and recommendations of the researcher on the data collected and described in chapter 4 of this study.

V. Conclusions & Recommendations

Overview

The purpose of this research was to confirm the application of previous recommendations to improve software acquisition in ASC and to investigate any perceived benefits. This study was accomplished through interviews of practitioners in the software development field and through a review of literature relating to this study. This chapter presents conclusions from this research.

Policy

This study found that acquisition policy related to software intensive systems has continued to grow and evolve. This continual growth and evolution has made it difficult for software practitioners to compile a clear set of policy required for their programs. In order to better serve program managers it is recommended that the DoD assimilate regulations and produce a central source of authoritative policy. This will serve as a “one-stop-shop” for program managers of software intensive systems.

Research and Development

The commercial market is driving technology today and the DoD must stay in close contact with the market in order to leverage state-of-the-art technology. Due to unique and ever changing requirements the DoD cannot always depend on the commercial market to meet their unique needs. Based on the results of this study, the DoD should continue to create research programs in order to obtain the necessary knowledge and products to meet the specific needs.

Best Practice

Recommendations have been made to collect and disseminate both government and industry best practices. Based on the interviews conducted, collection and dissemination of best practices has not been fully implemented. A recommended course of action is to implement a central repository, including a searchable database, for the collection of best practices. All individuals working in the development and acquisitions of software-intensive systems should be aware of this repository. The Defense Acquisition University currently has a website dedicated to sharing acquisition knowledge. One specific community concerned with software acquisition management is located at <https://acc.dau.mil/sam>, intends to share concerns, policies, and practices to assist others in software development. It is recommended that this site or a similar one be expanded and further promoted as an educational tool for DoD software personnel. These websites should be advertised and emphasized at the program office to increase participation. It should also have a panel of software experts that serve as moderators to ensure all questions and suggestions are dealt with appropriately.

Lifecycle

Though it was agreed that Evolutionary Acquisition should be used for software acquisition and development, it is not the only model available for use. Respondents were not clear on policy or guidance describing how to choose or tailor lifecycle process to their program. It is a recommendation that clear guidance and possible recommendations of lifecycles should be developed to allow program office to adequately choose the proper lifecycle to fit their program.

Source Selection

Many of those interviewed discussed government contractors obtaining various maturity levels. The most common answer common answer received was, “CMMI Level 3.” However, it was also not understood how maturity levels should be considered during source selection. It is recommended there be clear guidance established and key parameters developed for using maturity as a criterion in a source selection.

COTS

To better leverage the commercial market in the development of DoD systems, a stronger emphasis has been placed on the use of COTS software products. These products pose both pros and cons with their use in DoD systems. Recommendations involving COTS products were made based on this emphasis and suggested that COTS products be looked at to meet software requirements.

COTS products are not without risks; program managers should not assume that requirements can be met with COTS products. Rather, COTS or modified COTS should only be considered if they meet the necessary requirements and if justified through a life-cycle analysis. Difficulty finding COTS products to meet program requirements was also discovered. Many different ways to discover COTS products were discussed.

Recommended actions include drafting a policy requiring the use of life-cycle analysis to evaluate COTS products and creating a database of potential COTS products. This database should include recommendations of other programs that may have considered the use of a particular product.

Program Management

It was determined that respondents do not understand software architectures or the perceived benefit of them. Most were not aware of an architecture in their program.

Those that were aware stated that it was not at the software level. It was not clear if those interviewed even felt there was a benefit to having a software architecture. This study recommends that software practitioners be educated on the development and use of software architectures.

Metrics

It was common for programs to use a variety of metrics to track progress in their programs, from the program level to the software level. To most this was beneficial and practical. However, cost data was not shown to be tracked at the software level. Software costs were even shown not to be covered for the entire lifecycle. This level of tracking could provide benefit to programs. The benefit received is unknown. Therefore, it is a recommendation to conduct a study and determine the level of cost data required to benefit software acquisition programs.

Personnel

It could not be concluded if there is a lack of personnel with software expertise. The opinions of those interviewed varied; some interviewees thought they had adequate personnel for their programs, while others stated the opposite. There is great disparity in what is adequate staffing for individual software programs. It is recommended to further study the number of personnel required for each program. This study should include not only the number of personnel, but also the type of expertise.

Support

In questions concerning Test & Evaluation and support, it was discovered that software maintenance issues are important and need to be addressed early in the program. The majority of respondents indicated that their programs have elected to have contractors maintain their software. It was a common answer that the DoD does not have organic support. However, beside opinions, it was not clear if there was a precise reason that programs choose contractor support over organic support. Decision criteria should be developed and benefits should be weighed in the determination of contractor or organic support in software development.

Application of Recommendations

The analysis described in chapter four confirms many of recommendations investigated in this study have been applied in programs at ASC. The recommendations may have not been applied in their entirety or as originally intended and in some case they have been updated due to the age of the recommendation. Updating the recommendations was required due to change in policy, technology and the business environment over the past years since the recommendations were originally made. It cannot be confirmed that the use of these recommendations benefit all programs. Perceived benefit varied from program to program; some saw no benefit to the use of the recommendations.

It is therefore an overall recommendation of this study to consider these recommendations not as policy, but as best practices. The recommendations should not be forced on an organization, but made available as options to improve their development and acquisition of software. Specific recommendations do not provide an overall benefit

to every program. This further justifies allowing each program to choose what best benefits the program.

Limitations of Study

This study was conducted mostly at ASC with limited input from the 554th ELSG. Though no significant difference was recognized between the organizations only a small number of individuals were interviewed. The lack of differences between these two organizations may begin to indicate that the results may be consistent across the Air Force. Interviewing a larger number of practitioners from several organizations may provide different results or more consistent results across the Air Force.

To reduce the scope of this study, only recommendations by the DSB, NRC, and GAO were considered. These organizations are commonly tasked by Congress to conduct studies of DoD programs. There are many different organizations producing recommendations to improve software development, too numerous to be considered in the scope of this research.

The large number of recommendations considered resulted in a larger number of interview questions. This translated into a longer interview. It was an observation of the researcher that as the interview time increased participants' responses became shorter. Therefore, interviewees became less involved in the interview. As a result, it was more difficult to draw conclusive results from the later portion of the responses.

Future Research

To further investigate the findings found in this study it is recommended that a follow-on quantitative study be undertaken. Using the data in chapter four, survey questions can be developed and delivered to a larger sample of DoD software personnel.

This sample could include the entire DoD or specific services. If a quantitative study is developed, future research can add generalizations to the entire DoD or specific services on the application and perceived benefits to recommendations considered in this study.

It is also recommended that future research evaluate recommendations from other government agencies, professional organizations, and industry. This will allow for different points of view on ways to improve software development. However, with the large number of recommendations future research should be reduced in scope to focus on specific areas of software acquisition and development.

Summary

The purpose of this research was to confirm the application of previous recommendations to improve software development in ASC and to investigate any perceived benefits. This research found that previous recommendations were applied in numerous programs at ASC. It was also concluded that recommendations were not universally applied to all programs since there was not a perceived benefit in all programs. In conclusion, this research found that some of the same problems facing software development in the 1980s -1990s are still relevant today. Though the issues are still relevant, the recommended solutions of the past may not be the universal solution to correct the problems of today. It is therefore recommended that the issues on software development be continually evaluated and that best practices be applied to improve the software acquisition and development environment within ASC.

Appendix A. Interview Questionnaire

Software Acquisition and Development

Policy

1. Is there a clear set of Acquisition Policy for software development?
 - a) Is there enough up-to-date guidance for accomplishing your program?
2. Have you seen impacts from Section 804?

R&D

3. It has been suggested that the commercial market, not the DoD, is clearly driving today's information technology. DoD, however, must stay abreast of the most current technology, and are there areas that are imperative to the success of DoD which are not being cover by the commercial market?
4. In addition to looking at COTS products should we continue to be looking for opportunities to buy, in the civilian market, tools, methods, environments, and application software?

Best Practices

5. In your experience has the DoD been effective at collecting and disseminating best practices of both the government and industry?
6. Is there a process to evaluate the usage of best practices?

Lifecycle

7. Is it appropriate to use Evolutionary Acquisition, including simulation and prototyping, for software development?
 - a) Should it be the primary model?

8. Should the Software Acquisition Process be standardized or tailored for each system?
 - a) Based on classifications such as: Life cycle Model, Requirement Stability, Reuse potential, Contract and Support Strategy, and % of new development, COTS, Modified COTS, or Custom?
 - b) Should programs be tailored based on amount of user involvement?
 - c) Is there policy/guidance on how this should be done?

Source Selection

9. Is there a policy requiring government and/or contractor software-intensive acquisition projects to reach a particular capability maturity level or equivalent?
 - a) Is this policy helping improve the development of these programs?
10. Is evaluating competitors on their technical approach rather than cost, feasible?
11. Is requiring the Government, prior to RFP, to perform an Independent Market Analysis of Off-the-Shelf and contractor products to assure a “Best Value” solution beneficial to the acquisition of software?
12. When considering offers in source selection process should the offerors be encouraged to demonstrate as much pre-existing functionality as possible?
 - a) How was experience with COTS usage considered in source selection?

COTS

13. Do you have a system to help identify potential COTS products to meet systems requirements?
14. Should Program Managers assume that system software requirements can be met with off-the-shelf subsystems and components until it is proved that they are unique?
15. Should the modification of commercial components be discouraged and allowed only if justified by a thorough analysis of life-cycle costs and benefits?

Project Management

16. Is it beneficial to have program managers manage price, schedule, and functionality but only constrain 2 of the 3?
 - a) Is this a realistic approach?
17. How do you know your software requirements are feasible?
 - a) How do you know you and your contractor have the same understanding of the requirements?
 - b) Was a trade-off analyses performed, supported by systems engineering analysis, considering performance, cost, and schedule impacts of major changes to software requirements?
18. Who should have the authority to defer requirements?
19. What is the role of software architectures in your program?
 - a) Has it improved your software development?
20. Do you use incentives on contract for the contractor to build better software?
 - a) Should there be incentives for quality, reuses, and application of commercial best practices?
21. Is there a standard cost estimation model used for your program?
22. Does your program track actual software cost throughout the entire lifecycle?
23. Do you have an established Risk Management Plan?
 - a) Is there policy on how a RMP should be created?
 - b) When are program risks reviewed?
24. How do/did you decide what software engineering deliverables to require?
25. Does your program have a CRWG or similar IPT?
 - a) How is the performance of that group evaluated?
26. Have you had an Independent Expert Review (IER)?

Metrics

27. What metrics are provided to you by the contractor?
- a) How do you use them?
 - b) How often are they used?
 - c) Would it be better to get them more often?
 - d) Would it benefit you to get metrics related to cost, schedule, size, requirements, tests, defects, and quality to program offices on a monthly basis and before program milestones?
28. Would the use of standardized Software maturity metrics be beneficial in the development of software?
29. How do you measure success in your program?
30. Should the DoD ensure that contractors have an earned value management system that reports cost and schedule information at a level of work that provides information specific to software development?

Personnel

31. Do you have the appropriate number of software personnel with the right skills for your program?
32. Do you have enough in-house (within SPO) software expertise or do you rely on center engineering staff or contract out for software expertise?
33. Should the DoD reduce in-house software construction, extension, and maintenance, limiting such to critical functions at operational bases, adaptation of existing software to local needs, and special security-sensitive work?
34. Which of the following tasks is done in-house: Contractor maturity measurement, design/code reviews, and V&V?
- a) Was it beneficial to do them in-house?
 - b) Did it require additional resources?
35. Would it be beneficial for program office personnel to stay with the program longer?
36. Would the rotation of government and contractor personnel between the PM and the developing organization be beneficial to software development?

37. How important is early user involvement in software development programs and what is the nature of the relationship in your program?

a) How involved are they?

Test and Evaluation

38. How do you know what constitutes thorough DT&E?

39. Should software be directly fielded from test beds if given user consent?

40. Where future maintainers of your software product brought in to do V&V during software development?

41. Who is/will be performing the Operational Test and Evaluation?

a) Have facilities been provided for the completion of this testing?

Support

42. Do software maintenance issues need to be covered earlier in the lifecycle?

43. Who is going to maintain your software system?

a) How do you evaluate the efficiency/benefits of in-house software support versus contractor software support?

44. Was a plan developed for software maintenance?

45. Do you have a designed process for release of software that is ready to be fielded, block increments, or improvements?

a) Has it helped reduce cycle time in development and release of the software?

46. Do you have a formal process to identify, track, and assign problems in your software development?

--- Backup Material ---

National Defense Authorization Act of 2003 -SECT.804

A. Establishment of Program

- (1) The Secretary of each military department shall establish a program to improve the software acquisition processes of that military department.
- (2) The head of each Defense Agency that manages a major defense acquisition program with a substantial software component shall establish a program to improve the software acquisition processes of that Defense Agency.
- (3) The programs required by this subsection shall be established not later than 120 days after the date of the enactment of this Act.

B. Program Requirements.—a program to improve software acquisition processes under this section shall, at a minimum, include the following:

- (1) A documented process for software acquisition planning, requirements development and management, project management and oversight, and risk management.
- (2) Efforts to develop appropriate metrics for performance measurement and continual process improvement.
- (3) A process to ensure that key program personnel have an appropriate level of experience or training in software acquisition.
- (4) A process to ensure that each military department and Defense Agency implements and adheres to established processes and requirements relating to the acquisition of software.

Appendix B. Recommendations

Recommendation	Source	Reason for Exclusion	
1	All the methodological efforts, especially STARS, should look to see how commercially available software tools can be selected and standardized for DoD needs	DSB 1987	
2	DoD should examine and revise regulations to approach modern commercial practices insofar as practicable and appropriate.	DSB 1987	
3	Direct STARS to choose several real programs early in development and augment their funding to ensure the use of existing practices and tools.	DSB 1987	
4	Use evolutionary acquisition, including simulation and prototyping, as discussed elsewhere in this report, to reduce risk.	DSB 1987	
5	The Undersecretary of Defense (Acquisition) should update DoD Directive 5000.29, "Management of Computer Resources in Major Defense Systems", so that it mandates the iterative setting of specifications, and rapid prototyping of specified systems and, incremental development.	DSB 1987	
6	DoD STD 2167 should be further revised to remove any remaining dependence upon the assumption of the "waterfall" model and institutionalize rapid prototyping and incremental development.	DSB 1987	
7	Each service should provide its software Product Development Division with the ability to do rapid prototyping in conjunction with users.	DSB 1987	
8	The Undersecretary of Defense (Acquisition) should adopt a four category classification as a bias for acquisition policy: Standard, Extended, Embedded, and Advanced.	DSB 1987	
9	The Undersecretary of Defense (Acquisition) should develop acquisition policy, procedures, and guidance for each category (Follow on to above recommendation)	DSB 1987	
10	The Undersecretary of Defense (Acquisition) and the Assistant Secretary of Defense (Comptroller) should direct Program Managers to assume that systems software requirements can be met with off-the-shelf subsystems and components until it is proven that they are unique.	DSB 1987	

11	The Undersecretary of Defense (Acquisitions) and the Assistant Secretary of Defense (Comptroller) should by directive spell out the role of Using Commands in the evolutionary and incremental development of software systems.	DSB 1987	
12	DoD should devise increased profit incentives on software quality.	DSB 1987	
13	The Undersecretary of Defense (Acquisition) and the Assistant Secretary of Defense (Comptroller) should direct Program Managers to identify in their programs those subsystems, components and perhaps even modules, that may be expected to be acquired rather than built; and to reward such acquisition in the RFP's.	DSB 1987	
14	The Undersecretary of Defense (Acquisition) should develop economic incentives, to be incorporated into standard contracts, to allow contractors to profit from offering modules for reuse, even though built with DoD funds.	DSB 1987	
15	The Undersecretary of Defense (Acquisition) should develop economic incentives, to be incorporated into all cost-plus standard contracts, to encourage contractors to buy modules and use them rather than building new ones.	DSB 1987	
16	DoD should devise increased productivity incentives for custom-built software contracts, and make such incentives contracts the standard practice.	DSB 1987	
17	Directive 5000.29 and STD 2167 should be revised or superseded by policy mandate risk management techniques in software acquisition, as recommended in 1983 USAF/SAB Study.	DSB 1987	
18	DoD should develop metrics and measuring techniques for software quality and completeness, incorporate these routinely in contracts.	DSB 1987	
19	Focus a critical mass of software research effort on software needs that are unique to SDI objectives.	DSB 1987	
20	Task the new STARS director to define a new set of program goals together with an implementation plan; emphasis should be on visible, early milestones that have demonstratable results	DSB 1987	
21	DoD should develop metrics to measure implementation progress.	DSB 1987	
22	Each service should provide its software Using Commands with facilities to do comprehensive operational testing and life-cycle evaluation of extensions and changes.	DSB 1987	

23	Task the STARS Office, the Ada JPO, and SEI, the SDI software methodology program element, and DARPA Strategic Computing Program to produce a one-time joint plan to demonstrate a coordinated Software Technology program.	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
24	Commit DoD management to serious and determined push to Ada	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
25	Move the Ada JPO into the same organization as STARS and the SEI.	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
26	Keep the AJPO as the technical staff support agent for the DoD's executive agent.	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
27	DoD policy should continue to forbid subsetting of Ada language.	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
28	The DoD should increase investments in Ada practices education and training, for both technical and management people.	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
29	Allow fourth-generation languages to be used where the full life-cycle cost-effectiveness of using the language measures more than tenfold over the using a general-purpose language.	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved

30	The Software Engineering Institute should establish a prototype module market, focused on Ada modules and tools for Ada, with the objective of spinning it off when commercially viable	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
31	The Software Engineering Institute, in consultation with the Ada JPO, should establish standards of Description for Ada modules to be offered through the Software Module Market.	DSB 1987	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
32	DoD should follow the concepts of the proposed FAR 27.4 for data rights for military software, rather than those of the proposed DoD Supplement 27.4 , or it should adopt a new "Rights in Software" see appendix A6	DSB 1987	FAR 27.4 currently used includes regulations on data rights
33	Move STARS and Rebuild it.	DSB 1987	STARS is no longer a program
34	SS-311 Establish clear Acquisition Policy for Software	DSB 1989	
35	SS-316 Enhance Interaction between Activities	DSB 1989	
36	SS-315 Develop a Computer Resource Data Base	DSB 1989	
37	SS-114 Evaluate Software Life Cycle Models	DSB 1989	
38	SS-133 Tailor Software Acquisition Process to Systems	DSB 1989	
39	SS-134 Develop a Consistent Contracting Approach	DSB 1989	
40	SS-112 Develop an Approach to Software Reuse	DSB 1989	
41	SS-123 Establish mechanism for Reverse Engineering	DSB 1989	
42	SS-411 Enforce Standard Software Cost Model	DSB 1989	
43	SS-413 Identify and Capture Actual Software Costs	DSB 1989	
44	SS-326 Provide Software Maturity Management	DSB 1989	
45	SS-113 Develop and Evaluate Software Metrics	DSB 1989	
46	SS-111 Implement an Effective Software R&D Strategy	DSB 1989	
47	SS-131 Develop a Strategy for Technology Insertion	DSB 1989	
48	SS-431 Develop Software Engineering Career Program	DSB 1989	
49	SS-223 Organize to Grow Software Engineers	DSB 1989	

50	SS-232 Develop Operational Software Literacy Program	DSB 1989	
51	SS-432 Improve Incentives For Military Software Experts	DSB 1989	
52	SS-433 Establish Career Subprogram Management	DSB 1989	
53	SS-434 Provide Job Challenge for Software Engineers	DSB 1989	
54	SS-221 Provide One-Stop Support for Program Managers	DSB 1989	
55	SS-423 Conduct Contracting Out Study	DSB 1989	
56	SS-421 Provide Efficient front End Loading	DSB 1989	
57	SS-132 Conduct Integrated Software Planning	DSB 1989	
58	SS-424 Measure Efficiency of Current LCSE Centers	DSB 1989	
59	SS-313 Provide for Management of Software Change	DSB 1989	
60	SS-422 Consider Alternative Support Options	DSB 1989	
61	SS-324 Address Software as part of a Materiel Release	DSB 1989	
62	SS-325 Develop Responsive Distribution Processes	DSB 1989	
63	SS-314 Establish Internal Controls and Feedback	DSB 1989	
64	SS-321 Integrate Software Quality into Process	DSB 1989	
65	SS-312 Clarify Funding Policy for Software Support	DSB 1989	Funding issue is largely OBE
66	SS-122 Manage the introduction of Ada into the Army	DSB 1989	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
67	SS-231 Develop Pilot Software Awareness Program	DSB 1989	
68	SS-224 Eliminate Confusion in Training Device Support	DSB 1989	Specific to AMC, not an issue for USAF
69	SS-225 Provide Virtual Collocation with TRADOC Centers	DSB 1989	No longer relevant, e-mail, video conferencing, electronic blackboards commonly used
70	SS-211 Organize Army to Manage Acquisition Process	DSB 1989	Specific to AMC
71	SS-212 Improve PM/PEO Computer Resource Management	DSB 1989	Specific to AMC

72	SS-213 Establish Clear Organizational Responsibilities	DSB 1989	Specific to AMC
73	SS-214 Strengthen AMC'S software Management Role	DSB 1989	Specific to AMC
74	SS-222 Build an Army Software Technology Center	DSB 1989	Specific to AMC
75	SS-233 Find Army Software Advocates	DSB 1989	Specific to AMC
76	SS-121 Establish Controls on Software Environments	DSB 1989	DoD no longer drives development technology
77	SS-322 Improve Software Configuration Management	DSB 1989	Best Practices and DoD no longer driving technology
78	SS-323 Implement Effective Interoperability Control	DSB 1989	Basic requirements issue -- the JCIDS process drives us toward interoperability -- not just software
79	SS-412 Improve Interface into PPBS for Software	DSB 1989	Funding issue is largely OBE
80	Emphasize Technology Transfer (External and Internal) - Fund technology transfer programs - Initiate demonstration program (e.g., ATDs) to facilitate software technology insertion into systems. Examples of candidate criteria: - Open Standards, Use of COTS and GOTS, Frequent releases to include numbers of users, multiple platforms, and stratifies commercial standards and interoperability standards across DoD organization	DSB 1994	
81	Increase tech base funding for security audit tools for systems employing COTS	DSB 1994	
82	Establish acquisition focus on functionality and consistency with "commercial best practices"	DSB 1994	
83	Minimize DoD regulations for review and documentation that are different than "commercial best practices"	DSB 1994	
84	Provide expertise and resource to ensure coordinated DoD participation in commercial/international standards and users groups	DSB 1994	
85	Provide for evolution of the DoD Software Technology Strategy to align with the emerging commercial technology and practices	DSB 1994	
86	Apply Evolutionary Development with rapid deployment of initial functional capability	DSB 1994	

87	Establish mechanism to allow both current ability to perform as well as past performance key factors in source selection -Require source selection evaluation of development contractors through a formal software process capability evaluation	DSB 1994	
88	Encourage competition of technical approach vs. cost	DSB 1994	
89	Prior to RFP, Government should perform Independent Market Analysis of off-the-shelf and contractor products to assure "Best Value"	DSB 1994	
90	Require trade studies and analysis of the use of COTS in DoD's software acquisition process where effective Use of COTS appropriate when: - Defining Requirements - Rapid prototyping situations - Not required to tailor COTS source code to application - Not required to be error-free - COTS software is "Close Enough" to tailor requirements	DSB 1994	
91	Define successful performance on contracts as delivering solution (with predictable Price, Schedule, and Functionality) not adherence to Government processes, procedure and specifications	DSB 1994	
92	Encourage offers to demonstrate as much functionality as possible as part of bid without eliminating domain knowledgeable competition	DSB 1994	
93	Establish "Customer Friendly" application-specific information technology "Component Stores" - Generic Architectures for Specific domains - Rapid requirements definition process and prototyping - Reusable, prequalified components - Assemble systems rather than develop them - Reduce lead time - Security is not paramount	DSB 1994	
94	Capitalize on Innovative Cost-Effective techniques for acquiring and using COTS software products - Such as use of enterprise licenses	DSB 1994	
95	Have Program Managers manage 3 of 3 (Price/Schedule/Functionality) but only constrain 2	DSB 1994	
96	Define software architecture to enable rapid changes and reuse	DSB 1994	
97	To achieve the benefits of using standards-based architectures, DoD must manage programs using: -Early systems engineering - Interactive Development -Proactive participation in development of these standards	DSB 1994	

98	Emphasize use of software architecture - Establish model and context for architecture section - Standards-based with emphasis on "unimplemented" - Require vendors to propose, manage, and control architecture - Require delivery of software architecture definition as first step in any software acquisition - Foster migration strategies at architecture level	DSB 1994	
99	Provide government funded vehicle in contracts to incentives development of reusable software	DSB 1994	
100	Provide incentives and guidelines to encourage software reuse (architecture-based reuse)	DSB 1994	
101	Promote Development/Use Community-wide Metrics and Models (e.g., SEI's Capability Maturity Model)	DSB 1994	
102	Upgrade educational requirements for personnel assigned to acquisition, management, development, and oversight of software intensive programs	DSB 1994	
103	Establish DoD-Wide software program management education and training initiative	DSB 1994	
104	Change DSMC and IRMC courses for PMs to reflect best commercial practices and other recommendations of this Task Force and provide for changes to reflect the dynamics of the software industry	DSB 1994	
105	Develop and provide interactive training tools for senior managers to perfect software management skills	DSB 1994	
106	Incorporate software management principles in senior management education and seminars (including senior service colleges)	DSB 1994	
107	Provide mechanisms for keeping software expertise current in the workplace	DSB 1994	
108	Establish norms for the number of software experts on program offices	DSB 1994	
109	Develop Acquisition Managers with software program management expertise - Integrate software-qualified personnel into senior acquisition staff	DSB 1994	
110	Develop expertise in analysis of domain software design - Promote software reuse in the design	DSB 1994	
111	Have program managers stay with programs at least through Beta testing to maintain continuity of understanding of original nuances of requirements	DSB 1994	
112	Rotate government and contractor personnel between the PM and development organization to build understanding and trust; encourage use of IPA's form industry	DSB 1994	

113	Require early interaction between user, acquisition, agent and developer; identify and get early user involvement	DSB 1994	
114	Revise procedures encouraging interaction between user and developer and achieving early functionality	DSB 1994	
115	Tailor operational testing to develop DoD "Beta Test" philosophy -Allow fielding of software direct form test beds with user consent	DSB 1994	
116	Revise Milestones for Software-Intensive Development -Address the need for software first philosophy -Provide for a layered software/hardware standards based architecture	DSB 1994	
117	Require planning for maintenance at beginning of development process	DSB 1994	
118	Reduce documentation and review requirements for "mature" companies (i.e. Companies determined to be "mature" through evaluation mechanisms)	DSB 1994	
119	Assign responsibility within Government for domain analysis and product line developments	DSB 1994	
120	Do not require C-level specifications for software projects developed in Ada	DSB 1994	Due to decreasing support by industry and academia the mandate for the required use of Ada removed and the Ada JPO was dissolved
121	Review all existing military standards and military specification pertaining to software development and documentation, for continued applicability, such as DOD-STD 2167	DSB 1994	New Policies, Standards, and Directives have been implemented
122	Strengthen technology base	DSB 2000	
123	Collect, disseminate, and employ best practices	DSB 2000	
124	Stress software past performance and process maturity	DSB 2000	
125	Restructure contract incentives	DSB 2000	
126	Initiate Independent Expert Reviews (IERs)	DSB 2000	
127	Improve software skills of acquisition and program management	DSB 2000	

128	To strengthen DLA, Marine Corps, and the Navy software systems development, acquisition, an engineering processes, we recommend that the secretary of Defense direct the Director DLA, the Commandant of the Marine Corps, and the Secretary of the Navy to establish SPI programs where this report shows none currently exist. In doing so, these officials should consider following the best practices embodied in the SEI IDEAL model and drawing from experiences of the Army, Air Force, DFAS, and some Navy units	GAO-01-116	
129	To strengthen DoD-wide SPI, we recommend that the Secretary of Defense direct the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence, in collaboration with the Under Secretary of defense for Acquisition, Technology, and Logistics, to (1) issue a policy requiring DoD components that are responsible for systems/software development, acquisition, or engineering to implement SPI programs, and (2) develop and issues SPI guidance and, in doing so, consider basing this guidance on the SEI IDEAL model and the positive examples of SPI within the Army, Air Force, DFAS, and some Navy units cited in this report	GAO-01-116	
130	The Secretary of Defense should direct the Assistant Secretary for Command, Control, Communications, and Intelligence to (1) annually determine the components' compliance with the SPI policy and (2) establish and promote a means for sharing SPI lessons learned and best practices knowledge throughout DoD	GAO-01-116	
131	To ensure that DLA has in place the necessary process controls to acquire quality software consistently on future acquisition projects, we recommend that the Secretary also direct DLA to: issues a policy requiring that (1) DLA software-intensive acquisition projects satisfy all applicable SEI SA-CMM level-2 key processes areas and the level-3 risk management key process maturity levels; and direct the Chief Information Officer (CIO) to establish and sustain a software process improvement program, including (1) developing and implementing a software process improvement plan that specifies measurable goals and milestones, (2) prohibiting adequate resources to the program, (3) reporting to the Director every 6 months on progress against plans	GAO-02-9	

132	To reduce the software acquisition risks associated with its two ongoing acquisition projects, we recommend that the Secretary of Defense direct the Director of DLA to immediately correct each BSM and FAS software acquisition-practice weakness identified in this report	GAO-02-9	Specific to DLA
133	These practices should be included and enforced with controls and incentives in DoD's acquisition policy, software acquisition improvement plans and development contracts	GAO-04-393	
134	To assure DoD appropriately sets and manages requirements, we recommend that DoD document that software requirements are achievable based on knowledge obtained from systems engineering prior to beginning development and that DoD and the contractor have a mutual understanding of the software requirements. Furthermore, we recommend that trade-off analyses be performed, supported by systems engineering analysis, considering performance, cost, and schedule impacts of major changes to software requirements	GAO-04-393	
135	The ensure DoD acquisitions are managed to disciplines process, acquires should develop a list of systems engineering deliverable (including software), tailored to the program characteristics, and based on the results of systems engineering activities that software developers are required to provide at the appropriate stages of the systems development phases of requirements, design, fabrication, coding, integration, and testing	GAO-04-393	
136	To ensure DoD has the knowledge it needs to oversee software-intensive acquisitions, we recommend that acquires require software contractors to collect and report metrics related to cost, schedule, size, requirements, tests, defects, and quality to program offices on a monthly basis and before program milestones and that acquirers should ensure contractors have an earned value management system that reports cost and schedule information at a level of work that provides information specific to software development	GAO-04-393	
137	Develop and implement an explicit plan for incorporating onto the 5000 series the best practices and associated activities currently missing from the series. We recommend that the plan specify tasks to be performed, resources needed and assigned, and milestones for completing tasks.	GAO-04-722	

138	To ensure that the best practices provided for in DoD acquisition policies and guidance are appropriately followed, we also recommend that the above recommended plan incorporate steps to include in DoD's acquisition policies a provision for measurement and verification of best practices.	GAO-04-722	
139	Investment decisions throughout a system's life cycle are based on a continuous set of tradeoffs among capabilities available in commercial components (current and future), the architecture environment in which the system is to operate, defined systems requirements, and existing cost/schedule constraints	GAO-04-722	
140	Evaluation criteria are established for selecting among commercial component options that include both defined system requirements and vendor/commercial product characteristics	GAO-04-722	
141	Systems integration contractors are explicitly evaluated on their ability to implement commercial components	GAO-04-722	
142	Modification of commercial components is discouraged dandy allowed only if justified by a thorough analysis of life-cycle costs and benefits	GAO-04-722	
143	Acquisition plans provide for preparing users for the impact that the business processes embedded in the commercial components will have on their respective roles and responsibilities	GAO-04-722	
144	Product line requirements-rather than just the requirements for the systems being acquired-are an explicit consideration in each acquisition	GAO-04-722	
145	Acquisition reviews include the status of identified risks	GAO-04-722	
146	Acquisition project managers activities are communicated to all stakeholders	GAO-04-722	
147	Modification or upgrades to deployed versions of systems components are based on deliberate and thorough research, analysis, and evaluation of the components interdependencies	GAO-04-722	
148	Changes affecting how users will be expected to use the system to execute their jobs are actively managed	GAO-04-722	
149	AFSC, with the Joint Logistics Commanders, should expedite preparation and distribution of the 2168 guide book and support maintained of this and other software guidebooks over time	NRC 1989	

150	For key technologies in systems and application areas where operational threats or requirements change rapidly, AFSC should fund parallel technology programs at the systems level to foster a ready industrial base from which to compete single phase systems acquisition	NRC 1989	
151	AFSC should increase its technology base investment in software engineering technology, which is currently running at less than \$8 million per year. This increase should include Air Force laboratories more broadly and directly than in the past decade. As a way to improve software technology transfer, and in line with its usual strategy, AFSC should select programs for application and demonstration of advances in software engineering technology, and provide separate 6.3 funding to support demonstrations	NRC 1989	
152	AFSC should consider funding a program to evaluate candidate SEEs and where applicable, stand-alone tools, for consideration as acceptable environments and tool sets	NRC 1989	
153	AFSC should require the use of commercial off-the-shelf software test technology in systems and software development, make it a part of the technology and software process research and development programs to further advance the area, and apply it throughout the software life cycle	NRC 1989	
154	AFSC should create and fund a project to provide support for the software systems engineering advisory team(s) of recommendation 8, in particular to capture the knowledge gained and used by the team members for use via knowledge-based tools. This could be a valuable lead project for later use of similar tools, more broadly in AFSC systems and software acquisition management	NRC 1989	
155	AFSC should select an appropriate program (or programs) through which to implement incremental acquisition, using it (or them) to articulate to the Office of Management and Budget and the Congress the need for and special benefits of an evolutionary, incremental, acquisition process	NRC 1989	
156	AFSC should take steps to increase the motivation for innovative acquisition tailoring. AFSC should issue policy a statement, conduct workshops, and distribute guidebooks	NRC 1989	

157	AFSC should direct its product division to tailor the contract form for each specific programs needs; in particular, AFSC should avoid using firm fixed price contracts for unprecedented programs (This will require management follow-up, consistency, and the support of higher authority)	NRC 1989	
158	Product divisions should be directed to specify use of an SEE for each program having, as an example, a software staff of more than 12 people, and to require proof of its existence and the contractor's knowledge of its effective use, in order to qualify	NRC 1989	
159	When a program manager is faced with late identification of software requirements that can be deferred to a later time or capability block, AFSC management guidance should encourage and support this deferral and accept the consequences of doing so.	NRC 1989	
160	AFSC should ensure adequate software risk reduction for unprecedented systems during a full-scale development. For unprecedented systems, AFSC should provide policy guidance for competitive two-phased procurements, such that software risks are reduced to a practical minimum before proposal are prepared.	NRC 1989	
161	Each program involving software should be required to carry out early identification of critical software issues and to develop and maintain a Software Risk Management Plan.	NRC 1989	
162	AFSC, with AFLC and the using commands, should sponsor a fresh look are actual maintainer documentation needs. This review should consider the growing automation of documentation by contractors, and how that might be used to reduce the cost or improve utility of data	NRC 1989	
163	Product divisions or Headquarters AFSC should regularly monitor computer resources working group performance. Explicit evaluations should be solicited from using commands and AFLC	NRC 1989	
164	AFSC should select key programs that have high concerns for reliability, maintainability, re-usability, and interoperability for demonstration and evaluation of this prototype product quality assessment scheme. AFSC should invest funds to merge product and process quality measurement schemes to get increased benefits and to keep the measurement technology updated to the needs of future life cycle models	NRC 1989	

165	AFSC should initiate a program in the style of MANTECH (the manufacturing technology program) to transfer software development process technologies into actual minor systems and software development programs	NRC 1989	
166	AFSC special management of software skills should include a software systems engineering advisory team and special career tailoring for selected officers and civilians	NRC 1989	
167	AFSC, in collaboration with others, should make available to officers and civilians a mid-career systems engineering and software engineering graduate program and appropriate short course	NRC 1989	
168	AFSC should broaden the base of its personnel skilled in acquisition of software-intensive systems; prepare, use, and maintain, current guide books; and exercise special management of skilled personnel	NRC 1989	
169	User involvement should be tailored for each program, varying from cases requiring very limited involvement to ones in which user will assume lead role	NRC 1989	
170	The Air Force should consider revision of AFR 800-14 paragraph 5-3, Test Planning , and all derived directives, to require demonstration of testing of every instruction within the software prior to completion of development, test, and evaluation (DT&E). Implementation needs, costs, and expected benefits should be analyzed by experts prior to implementing revisions	NRC 1989	
171	Each program should consider using the designated software "maintainer" (operational phase) as the independent validation and verification agent during software development	NRC 1989	
172	AFSC, working with the Joint Logistics Commanders organization, should ensure that development models and accompanying rational alternatives to the waterfall model, based on risk reduction concepts, are included in forthcoming Handbook 287 for DoD-STD-2167A, with supporting direction in AFR 800-2 and 800-14	NRC 1989	
173	AFSC must strongly encourage AFLC and the using commands toward collected support for software in integrated systems, rather than complex reprogramming without adequate resources in the field	NRC 1989	Specific to AFSC

174	When software development contracts are granted to design groups that are organizationally or geographically separated , near-term management criteria in source selection should emphasize use of modern telecommunications and division of tasks to reduce requirements for interface among separate locations or organizations.	NRC 1989	OBE- Technology today exists to accomplish this task
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Appendix C. Question Traceability

Question Number	Question	Recommendation	Source
1	Is there a clear set of Acquisition Policy for software development? A. Is there enough up-to-date guidance for accomplishing your program?	SS-311 Establish clear Acquisition Policy for Software	DSB 1989
1		AFSC, with the Joint Logistics Commanders, should expedite preparation and distribution of the 2168 guide book and support maintained of this and other software guidebooks over time	NRC 1989
2	Have you seen impacts from Section 804?	To strengthen DLA, Marine Corps, and the Navy software systems development, acquisition, an engineering processes, we recommend that the secretary of Defense direct the Director DLA, the Commandant of the Marine Corps, and the Secretary of the Navy to establish SPI programs where this report shows none currently exist. In doing so, these officials should consider following the best practices embodied in the SEI IDEAL model and drawing from experiences of the Army, Air Force, DFAS, and some Navy units	GAO- 01-116
2		SS-316 Enhance Interaction between Activities	DSB 1989

Question Number	Question	Recommendation	Source
2		The Secretary of Defense should direct the Assistant Secretary for Command, Control, Communications, and Intelligence to (1) annually determine the components' compliance with the SPI policy and (2) establish and promote a means for sharing SPI lessons learned and best practices knowledge throughout DoD	GAO-01-116
2		To strengthen DoD-wide SPI, we recommend that the Secretary of Defense direct the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence, in collaboration with the Under Secretary of defense for Acquisition, Technology, and Logistics, to (1) issue a policy requiring DoD components that are responsible for systems/software development, acquisition, or engineering to implement SPI programs, and (2) develop and issues SPI guidance and, in doing so, consider basing this guidance on the SEI IDEAL model and the positive examples of SPI within the Army, Air Force, DFAS, and some Navy units cited in this report	GAO-01-116

Question Number	Question	Recommendation	Source
3	It has been suggested that the commercial market, not the DoD, is clearly driving today's information technology. DoD, however, must stay abreast of the most current technology, and are there areas that are imperative to the success of DoD which are not being cover by the commercial market?	Emphasize Technology Transfer (External and Internal) - Fund technology transfer programs - Initiate demonstration program (e.g., ATDs) to facilitate software technology insertion into systems. Examples of candidate criteria: - Open Standards, Use of COTS and GOTS, Frequent releases to include numbers of users, multiple platforms, and stratifies commercial standards and interoperability standards across DoD organization	DSB 1994
3		For key technologies in systems and application areas where operational threats or requirements change rapidly, AFSC should fund parallel technology programs at the systems level to foster a ready industrial base from which to compete single phase systems acquisition	NRC 1989
3		Strengthen technology base	DSB 2000
4	In addition to looking at COTS products should we continue to be looking for opportunities to buy, in the civilian market, tools, methods, environments, and application software?	AFSC should consider funding a program to evaluate candidate SEEs and where applicable, stand-alone tools, for consideration as acceptable environments and tool sets	NRC 1989
4		All the methodological efforts, especially STARS, should look to see how commercially available software tools can be selected and standardized for DoD needs	DSB 1987

Question Number	Question	Recommendation	Source
4		AFSC should require the use of commercial off-the-shelf software test technology in systems and software development, make it a part of the technology and software process research and development programs to further advance the area, and apply it throughout the software life cycle	NRC 1989
4		Increase tech base funding for security audit tools for systems employing COTS	DSB 1994
5	In your experience has the DoD been effective at collecting and disseminating best practices of both the government and industry?	Collect, disseminate, and employ best practices	DSB 2000
5		AFSC should create and fund a project to provide support for the software systems engineering advisory team(s) of recommendation 8, in particular to capture the knowledge gained and used by the team members for use via knowledge-based tools. This could be a valuable lead project for later use of similar tools, more broadly in AFSC systems and software acquisition management	NRC 1989
5		DoD should examine and revise regulations to approach modern commercial practices insofar as practicable and appropriate.	DSB 1987
5		Establish acquisition focus on functionality and consistency with "commercial best practices"	DSB 1994
5		Minimize DoD regulations for review and documentation that are different than "commercial best practices"	DSB 1994

Question Number	Question	Recommendation	Source
5		Provide expertise and resource to ensure coordinated DoD participation in commercial/international standards and users groups	DSB 1994
5		Provide for evolution of the DoD Software Technology Strategy to align with the emerging commercial technology and practices	DSB 1994
5		Develop and implement an explicit plan for incorporating onto the 5000 series the best practices and associated activities currently missing from the series. We recommend that the plan specify tasks to be performed, resources needed and assigned, and milestones for completing tasks.	GAO-04-722
5		Direct STARS to choose several real programs early in development and augment their funding to ensure the use of existing practices and tools.	DSB 1987
5		SS-315 Develop a Computer Resource Data Base	DSB 1989
5		These practices should be included and enforced with controls and incentives in DoD's acquisition policy, software acquisition improvement plans and development contracts	GAO-04-393
6	Is there a process to evaluate the usage of best practices?	To ensure that the best practices provided for in DoD acquisition policies and guidance are appropriately followed, we also recommend that the above recommended plan incorporate steps to include in DoD's acquisition policies a provision for measurement and verification of best practices.	GAO-04-722

Question Number	Question	Recommendation	Source
7	Is it appropriate to use Evolutionary Acquisition, including simulation and prototyping, for software development? Should it be the primary model?	Use evolutionary acquisition, including simulation and prototyping, as discussed elsewhere in this report, to reduce risk.	DSB 1987
7		Apply Evolutionary Development with rapid deployment of initial functional capability	DSB 1994
7		AFSC should select an appropriate program (or programs) through which to implement incremental acquisition, using it (or them) to articulate to the Office of Management and Budget and the Congress the need for and special benefits of an evolutionary, incremental, acquisition process	NRC 1989
7		The Undersecretary of Defense (Acquisition) should update DoD Directive 5000.29, "Management of Computer Resources in Major Defense Systems", so that it mandates the iterative setting of specifications, and rapid prototyping of specified systems and, incremental development.	DSB 1987
7		DoD STD 2167 should be further revised to remove any remaining dependence upon the assumption of the "waterfall" model and institutionalize rapid prototyping and incremental development.	DSB 1987
7		SS-114 Evaluate Software Life Cycle Models	DSB 1989
7		Each service should provide its software Product Development Division with the ability to do rapid prototyping in conjunction with users.	DSB 1987

Question Number	Question	Recommendation	Source
7		AFSC, working with the Joint Logistics Commanders organization, should ensure that development models and accompanying rational alternatives to the waterfall model, based on risk reduction concepts, are included in forthcoming Handbook 287 for DoD-STD-2167A, with supporting direction in AFR 800-2 and 800-14	NRC 1989
8	Should the Software Acquisition Process be standardized or tailored for each system?	AFSC should take steps to increase the motivation for innovative acquisition tailoring. AFSC should issue policy a statement, conduct workshops, and distribute guidebooks	NRC 1989
8	A. Based on classifications such as: Life cycle Model, Requirement Stability, Reuse potential, Contract and Support Strategy, and % of new development, COTS, Modified COTS, or Custom?	SS-133 Tailor Software Acquisition Process to Systems	DSB 1989
8	B. Should programs be tailored based on amount of user involvement?	The Undersecretary of Defense (Acquisition) should adopt a four category classification as a bias for acquisition policy: Standard, Extended, Embedded, and Advanced.	DSB 1987
8	C. Is there policy/guidance on how this should be done?	The Undersecretary of Defense (Acquisition) should develop acquisition policy, procedures, and guidance for each category (Follow on to above recommendation)	DSB 1987

Question Number	Question	Recommendation	Source
8		AFSC should direct its product division to tailor the contract form for each specific programs needs; in particular, AFSC should avoid using firm fixed price contracts for unprecedented programs (This will require management follow-up, consistency, and the support of higher authority)	NRC 1989
9		To ensure that DLA has in place the necessary process controls to acquire quality software consistently on future acquisition projects, we recommend that the Secretary also direct DLA to: issues a policy requiring that (1) DLA software-intensive acquisition projects satisfy all applicable SEI SA-CMM level-2 key processes areas and the level-3 risk management key process maturity levels; and direct the Chief Information Officer (CIO) to establish and sustain a software process improvement program, including (1) developing and implementing a software process improvement plan that specifies measurable goals and milestones, (2) prohibiting adequate resources to the program, (3) reporting to the Director every 6 months on progress against plans	GAO-02-9
9		Establish mechanism to allow both current ability to perform as well as past performance key factors in source selection -Require source selection evaluation of development contractors through a formal software process capability evaluation	DSB 1994

Question Number	Question	Recommendation	Source
9		SS-134 Develop a Consistent Contracting Approach	DSB 1989
9		Product divisions should be directed to specify use of an SEE for each program having, as an example, a software staff of more than 12 people, and to require proof of its existence and the contractor's knowledge of its effective use, in order to qualify	NRC 1989
9		Reduce documentation and review requirements for "mature" companies (i.e. Companies determined to be "mature" through evaluation mechanisms)	DSB 1994
10	Is evaluating competitors on their technical approach rather than cost, feasible?	Encourage competition of technical approach vs. cost	DSB 1994
11	Is requiring the Government, prior to RFP, to perform an Independent Market Analysis of Off-the-Shelf and contractor products to assure a "Best Value" solution beneficial to the acquisition of software?	Prior to RFP, Government should perform Independent Market Analysis of off-the-shelf and contractor products to assure "Best Value"	DSB 1994
11		Require trade studies and analysis of the use of COTS in DoD's software acquisition process where effective Use of COTS appropriate when: - Defining Requirements - Rapid prototyping situations - Not required to tailor COTS source code to application - Not required to be error-free - COTS software is "Close Enough" to tailor requirements	DSB 1994

Question Number	Question	Recommendation	Source
11		Investment decisions throughout a system's life cycle are based on a continuous set of tradeoffs among capabilities available in commercial components (current and future), the architecture environment in which the system is to operate, defined systems requirements, and existing cost/schedule constraints	GAO-04-722
11		Evaluation criteria are established for selecting among commercial component options that include both defined system requirements and vendor/commercial product characteristics	GAO-04-722
11		Define successful performance on contracts as delivering solution (with predictable Price, Schedule, and Functionality) not adherence to Government processes, procedure and specifications	DSB 1994
12	When considering offers in source selection process should the offers be encouraged to demonstrate as much functionality as possible?	Encourage offers to demonstrate as much functionality as possible as part of bid without eliminating domain knowledgeable competition	DSB 1994
12	How was experience with COTS usage considered in source selection?	Stress software past performance and process maturity	DSB 2000
12		Systems integration contractors are explicitly evaluated on their ability to implement commercial components	GAO-04-722
13	Do you have a system to help identify potential COTS products to meet systems requirements?	SS-112 Develop an Approach to Software Reuse	DSB 1989

Question Number	Question	Recommendation	Source
13		<p>Establish "Customer Friendly" application-specific information technology "Component Stores"</p> <ul style="list-style-type: none"> - Generic Architectures for Specific domains - Rapid requirements definition process and prototyping - Reusable, prequalified components - Assemble systems rather than develop them - Reduce lead time - Security is not paramount 	DSB 1994
14	Should Program Managers assume that system software requirements can be met with off-the-shelf subsystems and components until it is proved that they are unique?	The Undersecretary of Defense (Acquisition) and the Assistant Secretary of Defense (Comptroller) should direct Program Managers to assume that systems software requirements can be met with off-the-shelf subsystems and components until it is proven that they are unique.	DSB 1987
14		<p>Capitalize on Innovative Cost-Effective techniques for acquiring and using COTS software products</p> <ul style="list-style-type: none"> - Such as use of enterprise licenses 	DSB 1994
15	Should the modification of commercial components be discouraged and allowed only if justified by a thorough analysis of life-cycle costs and benefits?	Modification of commercial components is discouraged and only allowed only if justified by a thorough analysis of life-cycle costs and benefits	GAO-04-722
15		Acquisition plans provide for preparing users for the impact that the business processes embedded in the commercial components will have on their respective roles and responsibilities	GAO-04-722

Question Number	Question	Recommendation	Source
16	Is it beneficial to have program managers manage 3 of 3 (Price/Schedule/Functionality) but only constrain 2 of 3? Is this a realistic approach?	Have Program Managers manage 3 of 3 (Price/Schedule/Functionality) but only constrain 2 of 3	DSB 1994
17	How do you know your software requirements are feasible? How do you know you and your contractor have the same understanding of the requirements?	To assure DoD appropriately sets and manages requirements, we recommend that DoD document that software requirements are achievable based on knowledge obtained from systems engineering prior to beginning development and that DoD and the contractor have a mutual understanding of the software requirements. Furthermore, we recommend that trade-off analyses be performed, supported by systems engineering analysis, considering performance, cost, and schedule impacts of major changes to software requirements	GAO-04-393
17	Was a trade-off analyses performed, supported by systems engineering analysis, considering performance, cost, and schedule impacts of major changes to software requirements?	Product line requirements-rather than just the requirements for the systems being acquired-are an explicit consideration in each acquisition	GAO-04-722
17		SS-123 Establish mechanism for Reverse Engineering	DSB 1989
18	Who should have the authority to defer requirements?	When a program manager is faced with late identification of software requirements that can be deferred to a later time or capability block, AFSC management guidance should encourage and support this deferral and accept the consequences of doing so.	NRC 1989

Question Number	Question	Recommendation	Source
18		The Undersecretary of Defense (Acquisitions) and the Assistant Secretary of Defense (Comptroller) should by directive spell out the role of Using Commands in the evolutionary and incremental development of software systems.	DSB 1987
19	What is the role of a software architecture in your program? Has it improved your software development?	Define software architecture to enable rapid changes and reuse	DSB 1994
19		To achieve the benefits of using standards-based architectures, DoD must manage programs using: -Early systems engineering - Interactive Development -Proactive participation in development of these standards	DSB 1994
19		Emphasize use of software architecture - Establish model and context for architecture section - Standards-based with emphasis on "unimplemented" - Require vendors to propose, manage, and control architecture - Require delivery of software architecture definition as first step in any software acquisition -Foster migration strategies at architecture level	DSB 1994
20	Do you use incentives on contract for the contractor to build better software? Should there be incentives for quality, reuses, and application of commercial best practices?	DoD should devise increased profit incentives on software quality.	DSB 1987

Question Number	Question	Recommendation	Source
20		The Undersecretary of Defense (Acquisition) and the Assistant Secretary of Defense (Comptroller) should direct Program Managers to identify in their programs those subsystems, components and perhaps even modules, that may be expected to be acquired rather than built; and to reward such acquisition in the RFP's.	DSB 1987
20		Restructure contract incentives	DSB 2000
20		The Undersecretary of Defense (Acquisition) should develop economic incentives, to be incorporated into standard contracts, to allow contractors to profit from offering modules for reuse, even though built with DoD funds.	DSB 1987
20		The Undersecretary of Defense (Acquisition) should develop economic incentives, to be incorporated into all cost-plus standard contracts, to encourage contractors to buy modules and use them rather than building new ones.	DSB 1987
20		DoD should devise increased productivity incentives for custom-built software contracts, and make such incentives contracts the standard practice.	DSB 1987
20		Provide government funded vehicle in contracts to incentives development of reusable software	DSB 1994
20		Provide incentives and guidelines to encourage software reuse (architecture-based reuse)	DSB 1994
20		SS-321 Integrate Software Quality into Process	DSB 1989

Question Number	Question	Recommendation	Source
21	Is there a standard cost estimation model used for your program?	SS-411 Enforce Standard Software Cost Model	DSB 1989
22	Does your program track actual software cost throughout the entire lifecycle?	SS-413 Identify and Capture Actual Software Costs	DSB 1989
23	Do you have an established Risk Management Plan? Is there policy on how a RMP should be created? When are program risks reviewed?	AFSC should ensure adequate software risk reduction for unprecedented systems during a full-scale development. For unprecedented systems, AFSC should provide policy guidance for competitive two-phased procurements, such that software risks are reduced to a practical minimum before proposal are prepared.	NRC 1989
23		Directive 5000.29 and STD 2167 should be revised or superseded by policy mandate risk management techniques in software acquisition, as recommended in 1983 USAF/SAB Study.	DSB 1987
23		Each program involving software should be required to carry out early identification of critical software issues and to develop and maintain a Software Risk Management Plan.	NRC 1989
23		Acquisition reviews include the status of identified risks	GAO-04-722

Question Number	Question	Recommendation	Source
24	How do/did you decide what software engineering deliverables to require?	The ensure DoD acquisitions are managed to disciplines process, acquires should develop a list of systems engineering deliverable (including software), tailored to the program characteristics, and based on the results of systems engineering activities that software developers are required to provide at the appropriate stages of the systems development phases of requirements, design, fabrication. coding, integration, and testing	GAO-04-393
24		AFSC, with AFLC and the using commands, should sponsor a fresh look are actual maintainer documentation needs. This review should consider the growing automation of documentation by contractors, and how that might be used to reduce the cost or improve utility of data	NRC 1989
25	Does your program have a CRWG or similar IPT? How is the performance of that group evaluated?	Product divisions or Headquarters AFSC should regularly monitor computer resources working group performance. Explicit evaluations should be solicited from using commands and AFLC	NRC 1989
26	Have you had an Independent Expert Review (IER)?	Initiate Independent Expert Reviews (IERs)	DSB 2000
27		DoD should develop metrics and measuring techniques for software quality and completeness, incorporate these routinely in contracts.	DSB 1987
27		SS-326 Provide Software Maturity Management	DSB 1989

Question Number	Question	Recommendation	Source
27		AFSC should select key programs that have high concerns for reliability, maintainability, re-usability, and interoperability for demonstration and evaluation of this prototype product quality assessment scheme. AFSC should invest funds to merge product and process quality measurement schemes to get increased benefits and to keep the measurement technology updated to the needs of future life cycle models	NRC 1989
28	Would the use of standardized Software maturity metrics be beneficial in the development of software?	SS-113 Develop and Evaluate Software Metrics	DSB 1989
28		Promote Development/Use Community-wide Metrics and Models (e.g., SEI's Capability Maturity Model)	DSB 1994
28		SS-111 Implement an Effective Software R&D Strategy	DSB 1989
28		SS-131 Develop a Strategy for Technology Insertion	DSB 1989
28		Focus a critical mass of software research effort on software needs that are unique to SDI objectives.	DSB 1987
28		AFSC should initiate a program in the style of MANTECH (the manufacturing technology program) to transfer software development process technologies into actual minor systems and software development programs	NRC 1989
28		Task the new STARS director to define a new set of program goals together with an implementation plan; emphasis should be on visible, early milestones that have demonstratable results	DSB 1987

Question Number	Question	Recommendation	Source
29	How do you measure success in your program?	DoD should develop metrics to measure implementation progress.	DSB 1987
30	Should the DoD ensure that contractors have an earned value management system that reports cost and schedule information at a level of work that provides information specific to software development?	To ensure DoD has the knowledge it needs to oversee software-intensive acquisitions, we recommend that acquirers require software contractors to collect and report metrics related to cost, schedule, size, requirements, tests, defects, and quality to program offices on a monthly basis and before program milestones and that acquirers should ensure contractors have an earned value management system that reports cost and schedule information at a level of work that provides information specific to software development	GAO-04-393
31	Do you have the appropriate number of software personnel with the right skills for your program?	SS-431 Develop Software Engineering Career Program	DSB 1989
31		SS-223 Organize to Grow Software Engineers	DSB 1989
31		SS-232 Develop Operational Software Literacy Program	DSB 1989
31		SS-432 Improve Incentives For Military Software Experts	DSB 1989
31		SS-433 Establish Career Subprogram Management	DSB 1989
31		SS-434 Provide Job Challenge for Software Engineers	DSB 1989
31		Upgrade educational requirements for personnel assigned to acquisition, management, development, and oversight of software intensive programs	DSB 1994

Question Number	Question	Recommendation	Source
31		AFSC special management of software skills should include a software systems engineering advisory team and special career tailoring for selected officers and civilians	NRC 1989
31		AFSC, in collaboration with others, should make available to officers and civilians a mid-career systems engineering and software engineering graduate program and appropriate short course	NRC 1989
31		Establish DoD-Wide software program management education and training initiative	DSB 1994
31		Change DSMC and IRMC courses for PMs to reflect best commercial practices and other recommendations of this Task Force and provide for changes to reflect the dynamics of the software industry	DSB 1994
31		Develop and provide interactive training tools for senior managers to perfect software management skills	DSB 1994
31		Incorporate software management principles in senior management education and seminars (including senior service colleges)	DSB 1994
31		Provide mechanisms for keeping software expertise current in the workplace	DSB 1994
31	Do you have the appropriate number of software personnel with the right skills for your program?	Establish norms for the number of software experts on program offices	DSB 1994

Question Number	Question	Recommendation	Source
31		Develop Acquisition Managers with software program management expertise - Integrate software-qualified personnel into senior acquisition staff	DSB 1994
31		Develop expertise in analysis of domain software design - Promote software reuse in the design	DSB 1994
31		AFSC should broaden the base of its personnel skilled in acquisition of software-intensive systems; prepare, use, and maintain, current guide books; and exercise special management of skilled personnel	NRC 1989
32	Do you have enough in-house (within SPO) software expertise or do you rely on center engineering staff or contract out for software expertise?	Improve software skills of acquisition and program management	DSB 2000
32		SS-221 Provide One-Stop Support for Program Managers	DSB 1989
33	Should the DOD sharply reduce in-house software construction, extension, and maintenance, limiting such to critical functions at operational bases, adaptation of existing software to local needs, and special security-sensitive work?	SS-423 Conduct Contracting Out Study	DSB 1989
34	Which of the following tasks be done in-house: Contractor maturity measurement, design/code reviews, and V&V? If so, was it beneficial to do them in-house? Did it require additional resources?	SS-421 Provide Efficient front End Loading	DSB 1989

Question Number	Question	Recommendation	Source
35	Would it be beneficial for program office personnel to stay with the program longer?	Have program managers stay with programs at least through Beta testing to maintain continuity of understanding of original nuances of requirements	DSB 1994
36	Would the rotation of government and contractor personnel between the PM and the developing organization be beneficial to software development?	Rotate government and contractor personnel between the PM and development organization to build understanding and trust; encourage use of IPA's form industry	DSB 1994
37	How important is early user involvement in software development programs and what is the nature of the relationship in your program? How involved are they?	Require early interaction between user, acquisition, agent and developer; identify and get early user involvement	DSB 1994
37		User involvement should be tailored for each program, varying from cases requiring very limited involvement to ones in which user will assume lead role	NRC 1989
37		Acquisition project managers activities are communicated to all stakeholders	GAO-04-722
37		Revise procedures encouraging interaction between user and developer and achieving early functionality	DSB 1994
38	How do you know what constitutes thorough DT&E?	The Air Force should consider revision of AFR 800-14 paragraph 5-3, Test Planning , and all derived directives, to require demonstration of testing of every instruction within the software prior to completion of development, test, and evaluation (DT&E). Implementation needs, costs, and expected benefits should be analyzed by experts prior to implementing revisions	NRC 1989

Question Number	Question	Recommendation	Source
39	Should software be directly be fielded from test beds if given user consent?	Tailor operational testing to develop DoD "Beta Test" philosophy -Allow fielding of software direct form test beds with user consent	DSB 1994
40	Where future maintainers your software product brought in to do V&V during software development?	Each program should consider using the designated software "maintainer" (operational phase) as the independent validation and verification agent during software development	NRC 1989
41	Who is/will be performing the Operational Test and Evaluation? Have Facilities been provide for the completion of this testing?	Each service should provide its software Using Commands with facilities to do comprehensive operational testing and life-cycle evaluation of extensions and changes.	DSB 1987
42	Do software issue need to be covered earlier in the lifecycle?	Revise Milestones for Software-Intensive Development -Address the need for software first philosophy -Provide for a layered software/hardware standards based architecture	DSB 1994
42		SS-132 Conduct Integrated Software Planning	DSB 1989
43	Who is going to maintain your software? How do you evaluate the efficiency/benefits of in-house software support over contractor software support?	SS-424 Measure Efficiency of Current LCSE Centers	DSB 1989
44	Was a plan developed for software maintenance?	SS-313 Provide for Management of Software Change	DSB 1989
44	Who is going to maintain the your software system?	SS-422 Consider Alternative Support Options	DSB 1989

Question Number	Question	Recommendation	Source
44	Was a plan developed for software maintenance?	Require planning for maintenance at beginning of development process	DSB 1994
45	Do you have a designed process for release of software that is ready to be fielded, block increments, or improvements? If so, has it helped reduce cycle time in development and release of the software?	SS-324 Address Software as part of a Materiel Release	DSB 1989
45		Modification or upgrades to deployed versions of systems components are based on deliberate and thorough research, analysis, and evaluation of the components interdependencies	GAO-04-722
45		Changes affecting how users will be expected to use the system to execute their jobs are actively managed	GAO-04-722
45		SS-325 Develop Responsive Distribution Processes	DSB 1989
46	Do you have a formal process to identify, track, and assign problems in your software development?	SS-314 Establish Internal Controls and Feedback	DSB 1989

27/30	<p>What metrics are provided to you by the contractor?</p> <p>a) How do you use them?</p> <p>b) How often are they used?</p> <p>c) Would it be better to get them more often?</p> <p>d) Would it benefit you to get metrics related to cost, schedule, size, requirements, tests, defects, and quality to program offices on a monthly basis and before program milestones?</p>	<p>To ensure DoD has the knowledge it needs to oversee software-intensive acquisitions, we recommend that acquires require software contractors to collect and report metrics related to cost, schedule, size, requirements, tests, defects, and quality to program offices on a monthly basis and before program milestones and that acquirers should ensure contractors have an earned value management system that reports cost and schedule information at a level of work that provides information specific to software development</p>	GAO-04-393
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Appendix D. Interview Responses

Question 1

1	Yes through ASC A. Yes I think so	11	I'm sure there is but hard to say
2	Have not seen a clear policy in a long time, since the acquisition reform nothing has come out in a while A. No I would say not	12	Yes there is A. IT Lean supposed to fix the 5000 series problem, ability to react to small spirals in 5000 is lacking
3	Yes, tons of policy...too much policy and policy often conflicts A. Sure plenty of guidance	13	No, very confusing A. No
4	Policies are more directed towards reporting and manning , EVM and Risk Management are in ASC policies. (Management of Software is basically the same as hardware) A. Sure....yeah	14	Yes- probably too many A. It radically changes. Lots of research or ask the ACE. There probably is a database, but not easily accessible. No probably not, need to consolidate current policy and make consistent with each other.
5	Yes A. As an ACTD don't adhere to all of it, but yes there is though	15	Yes A. Yes
6	I don't know, hard to say, program is stable, there is a ton of policy A. Yes	16	Yeah there is, but not updated for a while A. Mostly common sense
7	Yes A. Yes, but not necessarily agree with it...it's not accurate. Problem is with estimation. During	17	Yes, EN has some , plus AF A. Yes in general we do
8	Clearer- but still evolving, but that is not a bad thing...need agile practices A. Yeah reasonably well, with the Perry reform we got ride of mil stds., but pendulum may have swung to far	18	No, it's getting there A. No
9	Yes A. Yes, AF Deskbook or contact EN Home office	19	In written form, too specific at times, others not specific enough A. Generally speaking, some up-to-date, but constantly changing
10	No clear acquisition policy, obviously they are out there, but not clear A. Don't use policy/guidance....we use best practices and performance based specs.	20	Yes A. Yes

Question 2

1	Don't know what it is, have seen impacts though	11	Not Familiar with it
2	Not sure	12	Not aware of it-so its like a lot of the NDAA cert stuff or is it talking about making sure people are qualified; if so yes but to a lesser degree
3	Yes and have been good things, then there are things not in 804 that are driving things...things not attributed to the act, but because more people understand software	13	Not aware of it...well yes and no...it is what we are doing right now, it's what we ask the contractor to put in the software development plan
4	Yeah in a way (then referred to comments in question one)	14	We pretty much do that (she was responsible for this in her area, but said most PMs would not be aware of it)
5	Have not seen impacts, but it looks good	15	Not aware of it
6	Don't know what it is.....we have documented process for many of the sections, may not be attributed to 804 though....just saw recent guidance on software development	16	Not familiar with it, Software letter came out of Sambur's office, but it didn't really say anything new
7	Yes, have seen impacts. We are doing a better job at planning of programs. Better job at collecting the right metrics.	17	Seen it from Mr. Nicols
8	Not aware of it	18	Have IT Lean, getting there on software (SAM courses at DAU)
9	Haven't really seen it (Section 804), - Once program has started it's too late, - If starting a program now, it might be more beneficial, that's when you see where the policy is at, at that time	19	Have not heard of it, but have seen impacts, makes it more difficult are working level
10	Yeah have seen some impacts...we do have a program, not sure if it is specifically intended to improve software acquisition	20	N/A

Question 3

1	Have not encountered any yet A. Following guidance from EN Directorate and Center specific	11	Don't see any areas – Contractors make their own standards anyways
2	I would think so, commercial market seems to be more current and has better practices	12	Multi level security was killing us- commercial market probably working on it
3	Not suggested...would affirm that...commercial market drives everything. DOD takes to long to develop things...by then they are out dated	13	Yeah we need to stay abreast of most current technology but try to stay away from military standards, it may not give the contractor to much flexibility
4	Commercial is hardware side of the program, Unique parts of DOD is software, so it's all unique	14	Defiantly agree, but it is really tough to stay up with current technology. 1101-63X –Specific Training Programs. Select the leaders of the pack or use Gardner Research (independent research company) (http://www.gartner.com/). This is accomplished in the labs (AFRL)
5	No that I'm aware of	15	Yes-absolutely
6	Hardware is way behind the commercial market...software is using a lot more commercial tools, but we are moving away from contrator proprietary development tools	16	Can't think of areas that the commercial market is not covering, at least not in aeronautical
7	We use COTS and stay close to industry processes (CMMI, ISO 9000)...we are pretty close	17	True, almost mandated by leadership, but we are getting away from standards like Ada
8	Small market so will be tough to do, More (AFRL) labs like Rome, NY or SEI, Defiantly collaboration, in past we went our way and now we can't support in the commercial market (mentioned Ada), -Whether they do what you ask them to do is tough, because we are such a small market (1-2%)	18	Not that I know of, were looking at meta data, and incorporating them , so much larger than the commercial market
9	We are staying abreast of the current technology.	19	Mostly agree, commercial market is driving technology, but not true for requirements for secure systems....DoD drives this.
10	Focus on safety critical, a lot of our processes come from the auto environment	20	No

Question 4

1	Previous programs have done it	11	Yes Absolutely, commercial market is surpassing what the labs (AFRL) and government centers are doing. So we (Govt.) need stuff to leverage from and “it’s about how flexible you are in changing software”
2	Yes, some are actually really good products, but sometimes it's not all ways ruggedized/militarized	12	If option is to build it or use commercial application...use civilian application, the challenge is mindset, if necessary have the commercial market modify it.
3	Yes, absolutely. Tools today are far superior to anything before	13	Yes, but can’t completely depend on COTS products, want to go that way but no clear guidance
4	Yeah but the software of the aircraft is very unique. In transitioning parts and pieces to COTS	14	Yeah anytime we can leverage what is existing. Have to an understanding of the requirements, and a clear understanding of the tool to make sure the tool and requirements match. Yes they make suggestions all the time, but don’t drive what the contractor uses
5	Yes, based on requirements and what you need to do the job	15	Yes, take advantage of their market share.....cheaper, faster, don't reinvent
6	Yeah, its too expensive to maintain proprietary software; too unique and hard to upgrade	16	Need to rely on commercial tools that are available and build only when necessary. Rely on contractor unless we direct them otherwise
7	Always be open to what industry has to offer, but be careful	17	Tools, Methods, and Environments – Yes. However COTS is overblown, if you change one line of code then lots more testing is required
8	Defiantly otherwise support tools are not there, They become obsolete pretty quickly so constantly changing, Will not hesitate to tell us	18	Yes
9	We should be looking for these products in some areas to be compatible with and to evaluate the contractors...it really depends who is doing the development, use the same as the contractor, but it is a very small segment where we are doing the development.	19	Yes, absolutely. DoD is not in the business of developing tools, methods, etc.
10	Yeah, the less we have to develop from scratch the better off we are...except for safety critical	20	Yes

Question 5

1	Not totally effective in best practices dissemination, it may be there, but not told where to get it	11	Yes, but hard to transfer to other programs
2	Even though they send it out most people really don't look at it	12	No
3	DOD has a real desire to collect best practices, the people who try do the best they can...have been effective at collecting but not disseminating	13	Don't see it happening
4	Government tries, but typically there is so much turn over of personnel we are learning lessons over and over again	14	They try to disseminate it, but so much out there it is hard to keep up with it. There probably is a tool out there, but not aware of a specific one (just too much information out there)
5	Not to sure, could be better	15	Effective in the government perspective, not necessarily industry ...industry varies widely
6	Not as effective as it could be, past 5-6 years we have been doing better than in the past...there are plenty of people with knowledge, seek them out...not sure if it should be a requirement of someone be in charge of the collection...we have a best practice website, but there are no incentives to contribute to it	16	I think we have been good at collecting, but not necessarily disseminating. Yes. None that I am aware of, but it's up to the contractor to use them
7	Starting to do it smarter now, we used to have databases now we try to build them into the program	17	ASC has and experienced people also help
8	We do it but not very well, More R&D for more agile acquisition, AFIT could be used, studies like this could get them out	18	No... not aware of tools, can use COPs but those are going away
9	Would say so, yes, AF Deskbook is pretty effective or Knowledge Now	19	Do a fair job at it
10	Nah, its out there, just have to go out and look for it	20	Yes

Question 6

1	N/A	11	Don't know, "It's a nice to have", a role for maybe the ACE, AFIT or Labs
2	No Process	12	Can use someone like MITRE to evaluate, but there is no real process
3	If there is I don't know. What or who would it be? What is the best way, you can have multiple perspectives?	13	Not aware of one
4	We have Suites (releases) so we look from Suite to Suite on how to improve	14	Don't think there is – we look at what industry does and it works for them , but not us (DoD) and this can get us in trouble
5	Not at my level	15	Yes, always look for lessons learned, but not always done, industry encourages it more than government
6	Don't know	16	No process that I'm aware of...ad hoc surveys maybe the best thing though
7	Yes	17	Didn't really use metrics, but looked at processes
8	Treated kind of whimsically	18	Use Gartner processes
9	Too some extent the EN home office is involved in initial stages of program or if program is in trouble a review team may look at things	19	Depends on who is doing the software development, younger developers may bring it with them
10	Not that I know of...just talk to others	20	Yes

Question 7

1	Yes A. I think so, it has worked on other programs	11	Yes Definitely
2	Yes A. It would be nice	12	Absolutely, gives you the ability to pop something out and let them play with it and then fix it in the next spiral...small spirals are defiantly the way to go
3	SCRUM might be better A. In some respect, in aircraft software development it might be the only model	13	Yes, especially with our current funding issue
4	Sure it can be used, but on a development program, we are more into modifications	14	Yes we should use it A. Not primary but should be looked at more and more, N/A- Legacy system , Usually driven by data that is available, Contractor would not help decide
5	Yes it is appropriate A. Depends, base on speed, need and complexity	15	Absolutely, its essential to be able to do simulation and prototyping, to get customer buy in A. Don't know
6	Yes, they are so complex, you can't wait till the end to see if it works, there is no way around it...have to do this in small increments A. I guess so	16	Yeah or spiral...what ever the buzz word is
7	Absolutely...risk reduction A. Depends on what you are trying to do...early in the phase, then move to spiral.	17	For safety critical systems it's not appropriate, it can put out partial systems, for others systems it may work A. See Above Answer
8	Yes, roll product out in pieces, usually due to funding A. Yes in a way, mainly due to funding. -Funding use spiral. Technological use Evolutionary	18	Yes A. Yes technology is changing too quickly can't do big bang..to costly
9	Yeah, it depends on time frame and maybe not on small programs, yeah.	19	Yes A. No depends on application
10	Yes, we use model and sim extensively A. Sure	20	Yes

Question 8

1	<p>Tailored</p> <p>A. N/A</p> <p>B. N/A</p> <p>C. Don't think so</p>	11	<p>Should be standardized</p> <p>A. Maybe tailor for Requirement Stability and % new development</p> <p>B. It depends, but it goes back to requirement stability and % of new development</p> <p>Type of user involvement, but not amount</p>
2	<p>Things change so fast</p> <p>A. Yeah, I guess you can</p> <p>B. Yes</p> <p>C. No</p>	12	<p>Yes tailor programs, but requirements process should remain standardized</p> <p>A. N/A</p> <p>B. Absolutely</p> <p>C. Looking to a milestone B type thing (talked about who makes program decisions), should tailor who is make the decisions especially for small programs</p>
3	<p>Tailored for each contractor, so yes for each system</p> <p>A. Yeah these are appropriate inputs on how to tailor</p> <p>B. Yeah</p> <p>C. Policy/Guidance doesn't follow what really works</p>	13	<p>If there is a standard process, do we have enough resources to do it, we need clear guidance from top level on what to do in software development</p> <p>B. Yeah give some flexibility</p>
4	<p>It would be hard to standardize across each program</p> <p>B. You have to have them through out, upfront so they tell you what they want and then through out development and testing</p>	14	<p>Yes Tailor, each program is not one size fits all</p> <p>A. Yes same as above</p> <p>B. Yes to keep customer involved</p> <p>C. Very limited ESC has a checklist for SE processes that helps</p>
5	<p>Should be tailored</p> <p>A. Good things to look at</p> <p>B. Yes absolutely user involvement is good</p> <p>C. No policy or guidance, it's a grey area</p>	15	<p>Yes, has to be tailored</p> <p>A. Process should be address all methods</p> <p>B. Don't tailor by it, but you defiantly want it</p> <p>C. No, not aware of a policy for tailoring</p>
6	<p>Tailored assumes you are going off a standard to start with</p> <p>A. These really determine how you do the acquisition and development</p> <p>B. I don't think in any significant way</p> <p>C. Not that I know of</p>	16	<p>Tailor for each system. Small systems don't need all the artifacts and reviews. Still need requirements etc. but not all the specifications</p> <p>A. Can't say universally a way to tailor, there is no cookie cutter approach, look at by a case-by-case basis</p>
7	<p>Tailored for each system</p> <p>A. Yes</p> <p>B. Have to be involved</p> <p>C. Informal guidance</p>	17	<p>Safety critical – No there are lots of things that are required...waterfall maybe the best model</p> <p>B. They need to be involved to ensure requirements are met</p> <p>C. No, most things I read tell you to tailor, but</p>
8	<p>A. N/A</p> <p>B. Technological use Evolutionary</p> <p>C. Have policies, but not always executed to them</p>	18	<p>Yes, standardized and tailored</p> <p>A. Yes tailor for those, not sure about contract and sport strategy. Most of what we are looking at is COTS</p> <p>B. Yes if based on above</p> <p>C. Not yet. Getting there quickly</p>
9	<p>Should be tailored</p> <p>A. Yeah could be tailored based on these</p> <p>B. Yeah defiantly, it can very quite a bit</p> <p>C. Not in depth, no real specific guidance</p>	19	<p>Should have flexibility, do it the best way to what you are trying to accomplish</p> <p>A. Have to be</p> <p>B. No we don't involve the user enough</p> <p>C. Don't think so</p>
10	<p>Tailor...technology and laguages are different</p> <p>A. Yeah</p> <p>B. Yeah, I would say so</p> <p>C. No guidance out there</p>	20	<p>Yes when possible</p> <p>A. N/A</p> <p>B. Yes</p> <p>C. No</p>

Question 9

1	No sure if it is a policy, but have used a maturity modelASC version of CMMI	11	Don't Know....CMMI model is an indication but the model may show one part a CMMI 5 , but not all divisions are at the same level so it may be misleading
2	Yes A. Yes I think so, in most cases	12	No requirement, something that can be looked at though A. Have seen level 5 program kick out crap, while a CMMI level 1 program kick out great stuff -It's just tool to help
3	People think there is, but there is none. Contractors think there is one too A. Great set of recommendations, but not sure if it is really helping	13	Heard about a policy, but have not seen anything written (mentioned CMMI Level 3) A. Doubtful...how do they really get to level 3? Don't depend on it but can be useful
4	Yeah the basic standards....occurs in the proposal	14	Policy for dealing with companies not for government. Just cause contractor can do it (process) doesn't mean its repeatable A. It's debatable.
5	Yes there is a policy, with TRLs there is a right time to go to production A. Yes	15	Yeah, you set requirements for it before you proceed into milestones A. No, we do what's smart...if not mature enough you don't go forward
6	Has been proposed before, we at ASC are not proponents of maturity levels, they do not guarantee good products A. there are other things at ASC that are more effective	16	I believe there is, most are CMMI level 3 A. Not necessarily, they will be at a level 5 but not following the process in place
7	CMMI level 3...unofficially, but if an organization is big, all parts of organization might not be at the same level A. Yes, it reduces the fighting for information	17	I think, we do....level 3 CMMI....can't remember AFI A. Can't remember any program that comes near cost and schedule
8	Yes A. Just cause one part of the company is highly certified another part of the company may not be	18	There is but people are not following it they don't understand TRLs A. If used yes, but not being used
9	More organizations need to have a maturity level, but have not looked at guidance recently, but a few years ago there was some debate A. No visibility into this, but it gives a false sense of security, because in a big company one division may have reached a certain level, but others division that you are working directly with may not have	19	Yes I think so, depends on the application, if doing business applications yes, imbedded systems are a little tougher
10	It is desired, but not necessarily required....its a factor maybe a policy out there that says have to CMMI level 3 A. I don't know, certainly hasn't helped ours	20	Did not apply to their program

Question 10

1	Yes on technical	11	Absolutely, we focus on the schedule and cost that are in a bid
2	Yeah it would be nice to do technical, but technical knowledge of the government is not always there to do this	12	Depends on when you want to go with it, from a life cycle perspective it is feasible
3	I think it is, but hard to do	13	Should be a balance of all of them
4	We are IDIQ (Indefinite Delivery/Indefinite Quantity) so same contractor for the next 15 years or more	14	We focused on technical approach; it had a heavier rating in source selection
5	Yeah depends on what you are working on (requirements, missions)	15	No it's a trade off
6	Yeah, we have do that in source selections, it's the best value source selection theory...most bang for your buck	16	It is feasible, and should be done, but probably won't
7	Yeah, I would rather overbid than underbid and overrun	17	Yes, may not play a role in who is selected...lots of political influence
8	Yes, classified programs often look at technical merit rather than cost	18	Yes, it's the best value approach
9	Defiantly, technical approach is at least as important as cost in many projects	19	Yes you have to do it, have been on a source selection where too much focus was on cost, not enough technical
10	Yes, better technical approach it maybe costly upfront but save in the end	20	Did not apply to their program

Question 11

1	No expensive	11	Yeah good idea
2	Yeah I would like to see it	12	Yes, it's market research
3	Hard to due since major requirements might not be there	13	Yes, if you have time to do independent market analysis
4	Yeah if it is not core software	14	Yes A. The team worked with an independent contractor to walk through the process of determining best value
5	Yes	15	It could be beneficial if there is something already out there and meets the requirement we should use it
6	Yes before you write any RFP, you find out what is avilbe our can actually be done	16	It is feasible, and should be done, but probably won't
7	Yes Absolutely	17	Yes, but with flight controls hard to reuse
8	Yes we have been doing market analysis, Look at ours for similar programs and some gut feeling because no two programs are identical	18	Good to do, should do it any how
9	Could be beneficial, but we should have policy on what does... Yes, Quantitative trade off analysis	19	N/A
10	It dosen't hurt to do it	20	Did not apply to their program

Question 12

1	Yes it was helpful, contractor had a prototype A. It was not considered, not a driver	11	Yeah they ought to be able too A. But often there are new things that might not be out there, so it's completely new development
2	It would be nice, things done in the past really show what they can do A. It's been good	12	It's a whole different acquisition strategy, may not be the best....well it depends A. You look at technical approach and how they are going to use it - Some use COTS and then build their own interface
3	I think so, good idea A. Have not been in a source selection	13	Yes A. Yes it was considered
4	N/A	14	We are always looking for COTS solutions and will tailor around that
5	Yes it would be beneficial A. The weight was not as high as other aspects	15	Yes, otherwise you don't know the level of maturity otherwise A. Should be considered, past performance in using COTS , Need to know the pitfalls of COTS
6	Heck Yeah, more reuse the better A. N/A	16	Doesn't matter A. Still need to do requirements and integration, so not really saving anything
7	Yeah A. Make sure it's COTS or Reuse, but if they make major changes I don't consider it COTS or Reuse...has to be truly COTS to be beneficial	17	For ground based stuff yeah
8	Definitely A. See a lot more of it now	18	Yes, did it a lot in the 90s, get technical value added
9	Might go to far...in general re-use can be over optimistic on how much is going to be reused A. Look at developing organization if proposing COTS	19	Yes, if they can they should demo
10	Yeah, w are in the demonstration world today, we like to see things work A. Considered a lot in cost, schedule, time and level of effort	20	Did not apply to their program

Question 13

1	No	11	No
2	No	12	No, Engineer and Market Research, Gartner Research is often used
3	Never seen one, might exist	13	Don't have one
4	We only have once piece of COTS on the whole aircraft	14	Do fly offs were competitors come in a demonstrate also went out to industry to seek solutions
5	Contractor determines based on requirements	15	Lists are available with vendors
6	No	16	Not really...just Google search or other ad-hoc searches
7	No we don't	17	Had a database a while ago, or at NATCOM (conferences), now we rely on contractors to do this more
8	Talk to others in the organization and industry...basically word of mouth	18	Through market research, small businesses, put word out, and Industry days
9	Though knowledge of what's out there and web searches	19	Not directly, since embedded systems, other areas no system but the internet
10	We did early on, don't so much any more	20	Yes

Question 14

1	Don't think so, it depends on the application	11	Kind of agree...puts risk on contractor, they are maybe responsible for a part (of the system) that they might not have created, and they now have to maintain it. Depends on level of maturity
2	No	12	Yes, push back to ensure do diligence is incorporated into acquisition strategy
3	In this day and age might be a good idea in the past opposite	13	The reality is in the (program masked) we assume so
4	No, if you are buying a desktop PC sure, but not for pieces for the aircraft	14	Almost have to...to communicate beyond small programs and to get them AF wide. Also it will help alleviate stove piping
5	No	15	Where COTS is the potential should always look at them...If a support trail is established it will be cheaper
6	Very dangerous assumption...almost everything we deal with we modify...the software is not usually developed for the hardware we use	16	No, if all COTS, most don't schedule enough time and budget then if you have to modify you end up in trouble
7	No, but consider them	17	Should not assume, only through analysis
8	Contentions due to money issues, Dual-use – if COTS are available and are qualified to use them	18	Not a good assumption, have to do some analysis to know where you stand
9	PM should assume there is going to be unique improvements, Anytime it can meet the requirements	19	No, should assume can't do it with COTS
10	I would say no, I would not make that assumption...have to look at safety criticality...have a unique system	20	Yes

Question 15

1	No real experience with this, but it should be the last resort to modify commercial compenents	11	Depends... were COTS products developed with a robust set of documentation and mastery of development
2	No, shouldn't be discouraged	12	Ideally don't want to modify, but may have to modify interfaces, can be costly and hard when new (COTS) software updates are pushed out
3	Would not want to discourage modification. In the past told not to modify, but today not so much	13	Yes I think so
4	When you do a market survey, you do some, but this might be too much	14	Should be encouraged more than it is now
5	Yes for legal issues in modifying COTS, better to build from scratch	15	Yes, difficult once modified, you lose the support trail (because it is now a unique system), You can always tailor it to be backwards compatible
6	Not enough of this, usually only looking t short term savings	16	Anything you do should be justified
7	It should be discouraged, because when you modify... you are now a development program.	17	Yes, modification requires a lot more testing....if you modify it is it still COTS?
8	Defiantly, if we don't have to change them then don't	18	Yes, some cost analysis to see if cheaper to change COTS or business processes
9	Yes discourage in general	19	Defiantly yes, also need a demo to prove it
10	No shouldn't be discouraged	20	No

Question 16

1	Yes it is beneficial, happened on the previous program. A. Yes	11	You have to make trade-offs can not constrain all three A. Yes
2	It's a common practice A. Yes	12	Can't realistically constrain 2 of the 3, A. No, all 3 have to be fulfilled, but there is some trade space
3	Don't know if we can constrain two of three. Price always constrained A. That is what we do	13	This happened price and schedule were constrained ...functionality not so much, A. It is a realistic approach
4	Depends on the program goals A. Nothing wrong with this though, could constrain only one	14	We don't constrain all of them A. Reality is that you get beat up if you don't meet all of them, Depends on the political environment
5	Need all three, all the time	15	Have to manage all three, A. Not realistic
6	Everything tends to be connected A. Usually not, constrained on all three	16	Don't really know if it is beneficial A. Yes probably realistic but not today
7	Program dependant, depends on understanding of requirements and/or the contractor being used	17	Yes something has to float supposed to use CAIV A. I don't like constraining schedule
8	Yes A. Tough on PM, their career can depend on it	18	Not sure... usually constrained with all three
9	N/A	19	Schedule and Price/funding hard to manage A. Its real life, not realistic to manage all three
10	You have to balance all three can't constrain only two	20	No, not realistic, price is usually constrained. Schedule and functionality impact each other.

Question 17

1	Have a dialogue with contractor and review the proposal A. N/A B. Do a trade off analysis	11	Through validation and systems engineering A. Validating requirement and understanding trade-offs of Price, Schedule and Functionality
2	You never really know. You go over and over them again and again A. N/A B. Yes	12	Working expectations, also system requirements reviews, functional requirement reviews, etc. A. All of the above plus user involvement, B. When hit a critical junction (PDR, CDR) then go through them with user
3	No one knows at beginning if they are feasible. But after time what is infeasible becomes obvious A. By look and feel. Each side will look at them in different ways	13	Very difficult, done through peer review (program office, contractor and user), Peer review and face-to-face meetings, A. Peer review B. Yes done at system level, maybe not all cases (software level)
4	Go through requirements with contractor, program office and user A. Same B. N/A	14	Through IPT's, Developed IPT to discuss these items, No it should be unique to the program A. Through the IPT B. Yes always, we are pretty good at doing all, that
5	Design reuse and some prototyping A. Software design documents B. Typically yes, absolutely should be done	15	Systems engineering approach and evaluate, A. Documentation- all software design documents and requirements must be frozen Also, design review, PDR, CDR, etc. and always invite user, B. Analyze cost and schedule impacts, you don't want to change requirements, but if you do you must do an RFP along with a Systems Engineering analysis
6	Contractor does analysis and determines if it will work A. Meetings with contractor and pilots, have sims B. Haven't had any major changes	16	Experience, Engineering judgment and do analysis A. You never do, but can sit down with user, developer and program office B. Sometimes a trade-off is accomplished and
7	Yes, have seen impacts. We are doing a better job at planning of programs. Better jobs a collecting the right metrics A. Bring in the user and do requirements reviews; contractors can do internal peer reviews B. Yes already do those....do them upfront for risk reduction	17	Testable, traceable ---all the ilities A. Through the review process contractor has analysis tools B. Not done in general
8	Contractor will tell us, well it depends on the contractor. B. Not always at Software level, usually at systems level	18	Functional review boards that take functional requirements to systems requirements A- Industry days and build demo's with them B- No
9	By knowing the state of the art and what can be done with commercial products A. In-depth discussion and in-depth document review B. Yes there is a process	19	N/A A. When they deliver the product, in development process and demos should show you are talking about the same thing B. Yes do it constantly
10	Don't always know until implement and test them out....through discussion A. Through discussion B. Always, eventually software becomes the fix because hardware is too expensive	20	A. Weekly IPT meetings, mature software processes B. Yes

Question 18

1	Acquisition Community and User	11	PM
2	Customer	12	PM in conjunction with the User, a- Needs to be at appropriate level (PM or PEO or MDA), b- Depends on program size – really should be at appropriate MDA
3	User	13	Program Manager and User, yes
4	PM and User. PM tells user what they can do and user makes decision	14	Customer and PM, Yes defiantly, small programs have more flexibility, To make an exception for one you have to make an exception for all (requirements) A PM can justify anything
5	Program office and User	15	User and PM
6	Program Manager has authority, mostly because they know the impacts	16	PM once requirements are established
7	If they are customer requirements then the development office with input from customer	17	User
8	User A. Depends more on the environment, who the product is for, how import is the system B. PM often decides, then goes to the user and asks for forgiveness	18	User with inputs from acquisition community
9	PM with the sponsor, should go to who ever has authority and who has review purposes, shouldn't matter if higher authority is comfortable	19	Only the user
10	Program director	20	ACC/USER

Question 19

1	Havent really done anything yet. Could in the future with net-centricity	11	Don't really get involved
2	Yes it's an excellent tool A. Yes it helps	12	Has its own challenges, but not necessarily improved it
3	Integrate into the program A. Not really improved, it is what it is	13	No answer
4	Yes we have one and when we make a change to one piece we use to look at what else is effective A. N/A	14	Critical Role, but if others can't us it you don't gain anything A. In the long run it would have to
5	Have poor software architecture, working on implementing an architecture A. Should make it cheaper and help with growth	15	It's a huge role, directly determines complexity of software design, gives you lots of choices on how you set up your software A. Yes, always look at and re-evaluate to make sure it sill fits
6	N/A	16	They are usually at the system level A. Don't know
7	They are very important...gives you insight into requirements and sustainment feasibility A. Minimal...if there is a risk of breaking, then we make a change	17	Absolutely... mapping software to hardware keeps stuff manageable
8	Commercial market has been using them for a while, we are starting to use them A. Improved integrity, but some times its a hindrance	18	N/A
9	N/A	19	Continuous problem in last 10 years more emphasis not universally applied A. It can improve
10	Built system first then did architecture... did it in reverse A. It is extermely difficult to now draw an exact usefull architecture... It hasn't improved development	20	Constantly analyze A. Yes

Question 20

1	No incentives	11	Don't really build a lot of SW...So no
2	Just on this program A. N/A	12	They are a good thing and should be considered in Acquisition. Strategies...need to ask what behaviors you are trying to incentivize? A. In some cases yes incentivize these, but in some case like legacy systems incentivize other things... like up time (availability)
3	Yes A. It is hard to measure	13	It's better to have it, but takes to much time to collect feedback and to many resources needed to give out fee...in reality bypass it
4	Award fee, but we are looking at incentive fee A. Don't really care about these. Want to incentivise schedule and getting capabilities within that schedule	14	Award Fee – use Firm Fixed Price A. Tough to measure any of these, Program was cancelled, Brought in someone from ACE to help
5	No specific incentives for software	15	Not for software, but for total program...there should be incentives for software though A. Yes for quality, but it depends on what your building
6	Cost plus incentive fee, incentive to spend less money, award fee used in past- worked well A. Yes, if you can make the program. In the past it was beneficial	16	Not really sure, some maybe on maintenance side A. Yes
7	Award fee A. During source selection yeah	17	They get awards, but nothing specific to software A. Yes
8	Yes, sometimes but amount not much and can be a morale booster A. Hard to quantify	18	Not that I know of....good idea though
9	Not really used at software level A. For quality it makes sense, but for reuse it can be a trap if program needs lots of changes	19	Yes award fee A. Yes
10	Yes have a specific award fee A. Yes covers all of it	20	Yes A. Yes depends on the software fix

Question 21

1	N/A	11	Yes not common across all , beneficial to have different ones to costly to create a standard.
2	No, haven't used one. FM says they have one	12	Yes there is...ACID used by ESC
3	Have a couple, COCOMO and SEER/SEM	13	C-SAM- used by engineers and Price-S used by FM, Better not to have it, use two to check each other
4	Been with same contractor for so long it is hard to change	14	Yes, done in the FM community, Would be very useful, but (models) are not always accurate, good for estimating, but will need to do some additional analysis
5	No	15	Yes, SCCM and Price-S, Yes there should be, find one that works well, Don't know them well enough to say which one though
6	Contractor has this own. We have our own, calibrated to past performance	16	Yes we use ? Pro- everyone works with same model Con- if flaw everyone has flaw
7	Yes SEER/SEM	17	Prices-S A. I think so plus use independent people
8	Lost art, rely on several models A. No standard in industry, but should use what they use	18	Yes there is
9	Price-S and SEER were both used, You don't want one standard model need to compare with two or three models	19	NG and CRC as their standard. It would be beneficial if we could get everyone to agree
10	Yes we have a standard model	20	No, historical data

Question 22

1	No, we don't track software costs	11	No
2	Someone in FM may do that	12	Yes
3	Yes we do	13	Don't track software costs, we track cost for all acquisition (cost by WBS)
4	Yes we do but life cycle restarts when you field it	14	Did not get that far- program cancelled
5	No, things get pushed or taken away. Very dynamic program hard to track	15	Yeah, software metrics tracks Estimate to complete until fielded
6	No	16	Don't think so... track through SDD to deployment
7	Through out development and then through sustainment and by two different groups	17	Should have a database to do this
8	Not very well, should probably do it...but it is hard to keep track of	18	Not that I know of
9	Yes they are defiantly tracked, Maybe good to get an independent look at risks...otherwise new risks may not get identified	19	Yes we do
10	We do and review it at lower levels monthly, higher levels quarterly	20	Yes

Question 23

1	Yes A. Follow ASC policy B. Annual/Semi-annual	11	Yes, used one from contractor and tailored A. Yeah EN had guidance B. Quarterly, but more often when big ones jumped up
2	Yes A. Yes B. Design review or PMR	12	Yes, A. Yeah informal policy, B. Not enough, at a minimum should be looked at major events (milestones) and at monthly PMRs
3	Yes A. Yes B. Quarterly high level, biweekly lower level	13	Yes, it was built in to system engineering plan also we have a SPO plan and a contractor plan, a- Don't know about it, b- Monthly- Risk Working Group (SPO and Contractor)
4	Yes jointly with contractor A. Sure there is B. Monthly	14	Yes had one A. Yes there was, but can not quote exact policy B. Briefed at monthly PMR and discussed often in the Program office
5	Yes A. ASC policy B. Monthly	15	Yes, it is essential to have, A. Required to have them, but don't know if there is policy on how to create it Always had one, just change it to make improvements B. At least monthly, at higher levels quarterly, and lowest levels weekly
6	We do them, but may not updated often A. We have some B. Weekly risk meetings- day to day risks... then at quarterly PMRs	16	Yes A. Yes there is a policy B. Monthly
7	Yes A. Yes EN provides guidance	17	Yes, don't think there is
8	Yes A. Yes tracked under systems engineering...PM made it mandatory B. Quarterly and at bi-monthly PMRs	18	A. Yes DoD policy B. At least at PMR quarterly, at lower level Monthly
9	Yes we have one A. Yeah there was standard policy B. Every other week	19	Yes A. Yes B. Almost weekly, quarterly comprehensive review
10	Yes A. Yes B. Lower Monthly sometimes more often...higher quarterly	20	Yes, but nothing documented

Question 24

1	Few deliverables	11	Part of the original proposals
2	Decided early in the program, kind of a set standard and cross off what they don't want and also work with the contractor	12	No answer
3	We don't decide	13	Guidelines from ASC/EN posted on EN website which gives required documents by milestones
4	EN community decides what they want unless too costly	14	Never got that far
5	What's in it?, What bugs are there?, Requirements, Specs, software descriptions	15	Base it on what you need to get approval of a document, use the sparingly CDRLs are expensive
6	Been around for so long, have a standard list. Add new one every now and then	16	What has been delivered before, there is a standard set, most people get same stuff
7	What ever gives you insight into what's being developed	17	Need proper documentation if going to recomplete
8	N/A	18	Engineers decide, some guidance with SEP and IT Lean
9	There are some things you have to have others depend on the size of the program	19	Did you ask for enough or too much...it depends on what you are doing and how much risk is involved....if risky then more
10	Don't have any on program...all performance based specs and contractor sets them	20	Based on historical need

Question 25

1	No	11	No A. N/A
2	No, havent seen it done in a long time	12	Does not apply here
3	Yes A. Don't know.	13	Haven't had one for quite awhile have an action to make it come back,
4	No offical group, but people keep an eye on it A. N/A	14	Don't know
5	No	15	It has one, but neglected for a while, now being reestablished A. If doing their job there will be no unexpected surprises and through the readiness of the labs
6	No, we are stable in what we do and how we do it	16	No trying to re-established one
7	Government lead?....No	17	I think CRWGs are dead, most have IPTs
8	Not anymore	18	Not sure, may have something
9	We had a software working group A. Not really evaluated	19	Have something similar A. Self-evaluation
10	We don't have CRWG we have block managers that do something similar	20	Yes A. Based on end product

Question 26

1	Have not had an IER	11	No not specific but the contractor has
2	Nt on this project, still exists, EN home office does this (tiger teams)	12	An independent V&V contractor was used on other programs
3	Yes, a couple	13	Yes, it depends...when a problem occurs
4	They are pulling together a team to look at the program	14	Didn't get that far, did use a SEP (Systems engineering process) which will track a requirement through entire process
5	Yes	15	No well maybe, we have Independent Review Teams (IRT) and Executive Review Team (ERT)
6	Sure, had 2 or 3...had an unexecutable program at one time	16	No we have not on software
7	Yes had several....good to get a different set of eyes on the program	17	Have safety review for first flight and independent teams
8	Only when a problem arises or GAO/UCI visits	18	Not that I know of
9	Yes, we did have an independent review	19	No
10	Yes	20	Yes

Question 27

1	No metrics	11	Cost, man hours A. Track obligation and expenditures B. Every couple of months C. Monthly so no D. Depends on size of program small programs would be burden
2	A. Information only B. Monthly C. Sometimes that can really help others, if not its just good info, but not really useful D. We get these and its helpful	12	Test, funding, manning, Earned Value, Help desk, deficiency, B. Sometimes daily, depends on what you are doing -if in a test...test metrics used daily others like Earned Value maybe monthly C. Depends on the metric D. Depends on the metric
3	Worm charts based on IMS A. Plan vs actual B. Review once a month C. Yes but costs more in lost productivity and not feasible D. Already get them	13	Guidelines about metrics in 2006 letter (EN letter) B. Frequently...when we have time too. Bit they are updated every two weeks C. Probably not...too costly. Every two weeks is good enough
4	SLOC, testing, problem reports, EVM, IMS A. N/A B. Monthly C. N/A D. Get all these	14	Some schedule, didn't really get any typical cost, schedule performance metrics, Didn't really use metrics, program was well established and only focused on integration of established programs
5	Cost, schedule, nothing software specific A. EVM B. Program quarterly, lower biweekly C. No D. Yes if used appropriately definitely on slower predictable programs, maybe not on dynamic programs	15	Software metrics, schedule, IMS, EVM, a-To determine of on track (cost and schedule), b- Bi-weekly to monthly it depends on the metric, c- Not necessarily, have to accomplish enough (between receipt of metric),
6	Memory through put and EVM are the biggest ones A. Monitor program B. EVM monthly C. No D. No, cost and schedule already get monthly	16	We get them
7	Requirements, Software Trouble Reports, Prioritizations, Integrated Master Schedule, People (enough to do the job?) A. Track and predict health of effort B. Weekly C. No	17	A. Management used them more B. Some policy makes recommendations D. Yes it would benefit them but hard to determine measurements
8	Use DCMA along with program office people to evaluate how contractor is doing D. PM probably gets them, I don't see them but some of my engineers probably see them	18	N/A D. Yeah closer of open item
9	There is difficulty in getting and applying metrics....not very efficient and not used effectively A. It might help if there was an agreement on how metrics were going to be used D. Yes it would be a benefit to get those	19	EVM A. Whole group monitors B. Monthly C. Yes often enough D. Yes its beneficial
10	Defect, SLOC, memory through put A. Manage progress and look for concerns B. All the time C. No but keep on top of them D. Get them already	20	Cost, Schedule, content data A. To determine future costs, evaluate performance, cost B. Monthly C. No D. We do get this

Question 28

1	Yes, it was	11	Yeah
2	Don't see it	12	Perhaps some standard metrics, but each programs have their own vocabulary so maybe not really standard
3	Yes	13	Have metrics specific to each phase of the program, for example test metrics. Yes very beneficial to predict or detect deficiency
4	We really don't do development... just do mods	14	Didn't deal with it, All ready established programs, Yes familiar with it, most PMs are probably not
5	Yes, but the contractor must be able to do it without getting in the way of development	15	Don't think you can develop specific standard metrics, Yeah, but don't know how you would determine it
6	I think there was policy suggesting this, most people are doing this anyways with CMM level 3	16	Could be a list and you pick
7	Shy away from standard metrics...otherwise you get metrics for the sake of getting metrics	17	Theoretically yes, but how do you measure?
8	I think so B. Yes I herd of it	18	Yes they would be
9	Number of defects remaining would be beneficial	19	Use AF standard metrics as required and policy
10	I would say no, not easily measured, not useful	20	Yes they are

Question 29

1	Meeting requirements	11	Not driving schedule impacts and are they able to integrate our products
2	Turn it on it works, doesn't have issue later	12	Cost, Schedule, Performance A. All ready graded on these (Cost, Schedule, and Performance)
3	How delighted the user is. Not a quantitative measure	13	Flight test and integration for program as a whole for software only measure by metrics
4	Cost and schedule	14	Don't get cancelled, Tough to standardize
5	On key events, for example first flight test	15	Deliver on time and budget along with user satisfaction, Cost, schedule and performance are met (TPNs and KPPs are met)
6	EVM	16	Was I able to take people's money and look at EVM, tech review, and schedule
7	You do what you say you are going to do	17	Something that meets requirements
8	In the test bed, the program does what it is supposed to do and also by schedule	18	Meeting delivery date and do they have any outstanding items
9	Quality of products, maintaining cost and schedule	19	When you fly does it work as its supposed to
10	Achieve our schedule	20	Wing, ACC, customer feedback

Question 30

1	Yes, has been very helpful. Can track where they are	11	Depends on size of program
2	Yes, it would be nice	12	Not necessarily- if firm fixed price don't need it
3	Yes they should and we do	13	Yes we have it...have monthly EVM report
4	Yes I like EVM and it has been pretty successful	14	Depends on the contract vehicle- if you have a firm fixed price can't really measure it
5	Yes, should but not if contractor cannot support it	15	Yes, it measures ability, but doesn't address if you are getting for money being spent
6	Yes, have to make sure they are planning at that level	16	Most contactors have an implemented EVM system
7	Yeah, but more for management not engineering	17	Yes
8	Use it religiously –used to determine award fee	18	Yes
9	Yeah defiantly	19	It depends on what your doing and magnitude- small project may not benefit
10	Yeah we do	20	Not under PBL, not in our case

Question 31

1	For the program? Yes previous job was the same	11	Yeah but we don't have big software component right now
2	Yes, got more than we need in the program office	12	No, Engineers that understand Software , PM that really understands it, needs depth (a good PM that gets the process), Some people have to work harder...get over worked or buy ANAS support, People are over worked
3	No we don't	13	Right skills yes, could use more though, Need to work hand in hand with developer and need competent software engineer
4	They have got way too much	14	Had no resources...but across the board no, we hire the wrong engineers, Nave a back ground in software development, maybe a computer science engineer
5	No	15	We do now, just ramped up the number of people
6	Yes	16	We do here in the program office, debatable whether the contractors have enough
7	No	17	Yes, but cutting a lot of personnel
8	Yes A. Electrical Engineers and some Aero Engineers	18	No, need more management and software management have too many coders
9	Yes, but at one time it was not true in a certain area of development didn't have enough personnel, this resulted in a schedule slip A. Need specific language, Overtime there has been limited people and there is only so much you can do, Need people experienced with interface work or schedule slips	19	No high level and low level (program level or lower)
10	Yes	20	Yes

Question 32

1	Never gone outside of Wing	11	You rely on center and contract out
2	We don't have any SPO expertise, most program office people are managers	12	N/A
3	Don't have enough. Everyone is short on people not just software. Had to use center and contractor in the past	13	Work with contractor as a team and have good communication
4	We have a couple of key people. EN will backfill	14	Do a lot of contracting out, TITAN
5	No	15	Yes from software perspective
6	No	16	Got enough in-house for management
7	No have to contract out for software expertise	17	Overall running low on software expertise
8	No home office support	18	No, contracting it out
9	At certain times we rely on engineering staff as a supplement, but not day to day activities ... we have enough and we do some contracting out	19	Have 1 govt and 1 contractor, yes you have to contract out
10	We do not with the SPO and don't contract out either	20	No, rely on organic software expertise

Question 33

1	We really don't do in-house construction	11	Don't really do software in-house, contractor should do the work we should set requirements and manage
2	Yes, reduce it or get out of the business	12	As much as possible, don't need to do in-house coding
3	Don't know	13	Don't think so, especially with more and more software intensive programs,
4	They should not be developing software, they should only be fixing. There are benefits to having contractor doing it	14	Pretty much done only at Gunter (Maxwell AFB)
5	Depends, can see good both ways	15	Yes... put govt. in critical path
6	No, ALC do software development, do it well and cheaply, good or better report w/user	16	No if you have done software the better you are at managing software
7	Don't do in-house, ALCs do this type of stuff	17	EN policy doesn't allow for organic support, not sure anybody does in-house
8	Very expensive, can't get anymore of these people because they were capped by regulation	18	Yeah they should, we are contracting it out
9	No should not reduce, keep at current level	19	All ready happened, being forced to go to contractors
10	We don't do a lot of coding, Navy is more organic...our contractor will continue to have maintenance responsibility	20	No

Question 34

1	Yes to both A. Yes B. Had a separate group that just did a V&V	11	Don't do these
2	None A. No B. It would	12	Try to do it in-house B. Beg borrow and steal for additional resources
3	None in-house. Too much software code to do in-house A. N/A B. It would	13	Did a lot in-house, lots of document review A. Yes B. Yes
4	Partial coding, normal PM overhead activities	14	Done in house, (Government) contractor oversees it
5	None A. It would be B. It would be	15	Do Design and V&V A. Yes B. No...going to staff appropriately
6	Do in-house, don't do V & V, don't do A. Design and reviews, yes B. No	16	We participated, had insight, influence, and control A. Very beneficial to have influence and control B. Yeah
7	CMM- informally, Design/Code reviews- Yes A. Yes B. Yes brought in help.	17	Yes A. Yes there is benefit and encourage it B. Yes
8	Don't do V&V anymore...rely in contractor to do their thing and send our engineers for oversight	18	Not sure
9	Design/code reviews, and V&V were done in-house, we also did code sampling A. Yes it was beneficial B. Yes at certain times it did require additional people	19	CMM- No Design/Code Reviews- Kind of, V&V have in-house tester A. Would not B. Yes it would and that's why don't we do it
10	Do CMM & design/code reviews... don't do V&V but have oversight A. N/A B. No	20	Code reviews and V&V A. Yes B. Yes

Question 35

1	Yes it would be beneficial to stay with the program through critical phase. No... turn over during critical phase though	11	Yeah, 3 yrs is about right
2	No, not any more. It helps though, but can also become more complacent. Good for people to get good experience	12	Need to show growth, so changing jobs a good thing for the military folks, civilian folks can stay with the program longer
3	Absolutely	13	Yes, I think so...need experience people that know every nut and bolt
4	Yes, the longer you are around the smarter you are, but there comes a point when its time to leave	14	Depends on the person
5	Don't know, depends on who you are	15	Continuity it is very important... leaving after 1 or 2 years is not good
6	Beneficial to the program, but not to the person	16	Optimal is 3-4 years... enough for continuity and then should move to broaden their view
7	Yes, 5 years is probably long enough though	17	Yes
8	Should move to get new perspectives	18	Yes good for any program, relatively long enough but not too long
9	Yes it is defiantly beneficial	19	Defiantly, loss of institutional knowledge
10	It is always benifical to keep corporate knolwedge there	20	Yes

Question 36

1	Don't really know about that	11	It would be, gets other sides point of view...a simple requirement change on one side is not so simple on the other
2	It could be good or bad, depends on the people	12	Would be very inefficient, different cultures and would take a while to catch on, EWI- is a fantastic program
3	I think so, worked in the past	13	Cost involved ...can't afford it
4	Yeah, it wouldn't hurt. But can end up an outcast	14	Tough to do... contractor personnel even tougher to do...can sit in IPT, but not into an organization (no real benefit to it)
5	It would be counter productive, in a large organization maybe	15	No not for all software development, need good communication
6	Probably not a whole lot, we both understand how each side works, EWI	16	Don't think so, too much overhead, not past requirement phase
7	Yes, but in small doses...maybe 2 weeks at a time	17	No, must be familiar with each side of process
8	Yes it would a little A. EWI (Education with Industry)	18	It would be beneficial, but not necessary
9	No real significant benefit, we are all doing a lot of different things so it may be hard to do	19	It would be beneficial, but not sure if you really can do it
10	Yeah, I would say so	20	Yes in some cases

Question 37

1	Very important, its critical, need them from day one till fielding	11	Extremely important especially in requirement definition and changing requirements A. They are pretty involved
2	Its good to get the users involved	12	Absolutely critical
3	Incredibly important A. Not as involved as should be	13	Very important. Lesson learned and it's proven. Need to keep in requirements definition
4	You help get them involved	14	Involved early on A. Drove a lot of things they shouldn't have...were involved in early meetings, - Personality driven, - need to find were it (user involvement) fits into your program
5	Yes, absolutely important A. Involvement increasing	15	Defiantly important, ensure requirements meet user expectations and understanding A. Participate all reviews
6	User provides requirements in priority and input, estimate concept of operations. Without user there would be more problems A. Formal meetings and a lot of informal exchanges	16	Extremely critical... need to get their expectations and their understanding of requirements A. Not as involved as we would like them to be
7	Very important A. All major reviews	17	Always have user involved, they develop the requirements A. They are involved
8	Very important A. Very Involved	18	Very important, have to be involved up front for requirements definition
9	Defiantly important A. They should have been more involved, they were only moderately involved	19	Vital early and continuously (ACC is intimately involved)
10	Extremely important A. They are very involved	20	Critical A. Adequately....determined by training and mission

Question 38

1	Used a matrix that defines all requirements and it defined DT&E plus requirements tracable all the way back to ORD.	11	N/A
2	You never do	12	Exercise all required functionality, all interfaces, load test, and make sure data is going through correct, Killing yourself by doing that
3	Don't know	13	If we have a successful FOQ&T. and satisfied test cases, If we have a successful FOQ&T. and satisfied test cases
4	Rely on test community. Great test plan and Test Readiness Review	14	No answer – didn't get that far
5	Requirements are met, user is okay with it	15	Have requirements correlation matrix... as long as every requirements can be tested
6	No specific criteria	16	Have consensus on the govt. team, get ITT together and look at test cases
7	Flight test	17	Experience
8	1. Ground test, 2. flight test, get user participation in both. The sooner the user is involved A. It would be ideal, but not enough time, money, or people	18	Requirements traceability, if requirements can be shown they were tested
9	When you know you requirements are thoroughly checked out, Contractor should exercise each module extensively, but in DT&E not realistic to test every instruction	19	Don't know depends on application
10	Trial and error, comes through experience and knowledge of the system	20	Minimum problems that make it to the field

Question 39

1	Not so sure, I need to have some operational testing to be fieldable	11	Risk management decision
2	Yes if the customers want it	12	No, if you do that you have to be sure you are getting the right data out, really need thorough tests
3	Only time you want to do that is if test guys are constrained to production	13	It depends, if software that could affect life then yes, but if not mission critical then yes
4	N/A	14	No answer – didn't get that far
5	Absolutely	15	No OT is a different way of looking at it, could be sometimes... if it transparent to users
6	Disaster waiting to happen. Small limited cases, but in general no	16	Yeah if user has reviews it, but probably not a good idea
7	No	17	No... not safety critical stuff, but in some cases yes
8	Yes and No depends on level of testing	18	Yes provided its been given some kind of OA
9	Don't see a problem if there is a pressing need and risks are understood	19	Depends on application - Business systems yes - embedded systems no
10	No	20	Depends on software

Question 40

1	Yes, the maintainers are the contractors. Yes they were involved	11	Don't know
2	No, in some cases they bring in, but sometimes not. It would be good to though	12	Software goes back to the contractor, so not really relevant here
3	Future maintainers are doing development	13	N/A
4	Yes- (Base Masked)	14	No answer – didn't get that far
5	No	15	No
6	No	16	No, they are off doing their own software maintenance and don't have time or people
7	Yes on this program, my previous program no	17	Not done very much
8	On F-16 they were, but here not so much	18	Not sure
9	Yes they were the same one who developed the software	19	Not sure
10	No	20	Yes

Question 41

1	Locations Masked A. Yes they have their own	11	Doesn't apply but kind of by implementing on aircraft A. Yes
2	A. Yes	12	AFOTEC delegated it to (masked) A. Yes they were provided
3	AFOTEC A. Yes	13	Main operating base (masked) A. Yes
4	Doing FDE at (masked) A. Yes	14	No answer – didn't get that far
5	AFOTEC A. Yes	15	Command squadron A. Yes
6	OT & E, AFOTEC A. Yes	16	(Masked) A. Yes
7	Customer/AFOTEC A. Yes	17	Flight controls.... (Masked) A. Yes
8	AFOTEC	18	User conducts OT&E, Customer Acceptance Testing A. As required
9	AFOTEC A. There was no real need for a dedicated facility, but arrangements were made	19	AFOTEC A. Yes
10	Intergrated test force A. Yes	20	(Masked)

Question 42

1	Yes, we try to have them involved from the beginning	11	Yes absolutely - need flexible software
2	Yes, we try to have them involved from the beginning	12	Yes, plan for it in your Acquisition Strategy
3	Yes	13	Yes
4	Yes we are trying to do that with this suite	14	No answer – didn't get that far
5	Absolutely	15	Yes have to
6	Not given a high enough priority early in development	16	Depends if you have a robust well documented software architecture
7	Yes	17	Yes
8	Defiantly	18	Yes if you have a plan to resolve them
9	They are addressed early and sometimes software maintenance issues are forced on you. They decision you make early maybe arbitrarily reversed later though	19	Yes its an area often over looked
10	Yes, we deal with the maintenacne issue in our releases	20	Yes

Question 43

1	Contractor who maintains it.. It's NDI, buying software, not developing it	11	Contractor
2	Contractor	12	Contractor, A. Acq. Strategy
3	Contractor for now, but want to move to depot	13	Prime contractor A. Don't evaluate it anymore, contractor maintained
4	Contractor, we usually don't do maintained, we just wait till next release, unless its a critical failure	14	No answer – didn't get that far
5	Contractor	15	Contractor, we don't do organics... its only CLS
6	(Masked) A. Source of repair analysis determined (masked) cheaper than the contractor.... extensive study	16	Contractor, we can't hire the people to do it in-house
7	Contractor A. With a complicated system lean toward contractor...they have insight	17	Contractor , we can't do in house anymore....not feasible... don't have enough people
8	CLS – Contractor Logistic Support	18	Contractor
9	Contractor maintained A. Does the government have the facilities and manpower? It may come down to a cost trade-off.	19	Weapon system support center in (masked), both govt and contractor do to security reasons
10	Contractor A. Don't have a choice use contractor support, but you could do a cost befit analysis	20	Contractors and organic engineers A. Based on product

Question 44

1	Contractor maintenance plan	11	Preliminary, but now on front end of development and they are scrambling
2	No comment	12	Contractor will do plan
3	Yes	13	Yes, open software every 2 years to do maintenance
4	Yes, normal DR process	14	No answer – didn't get that far
5	There is a process for it	15	Use same plan that exists
6	No, might have one but very old and not used, had a transition plan	16	Not really... Software maintenance planning has been ad-hoc
7	Yes	17	Normally included in software development plan
8	Yes	18	Most contracts have some kind of sustainment planning, built in as a deliverable , but govt didn't come up with plan
9	It wasn't a detailed plan, since it was going to be maintained by the contractor	19	Yes its been followed for the last 20 years
10	No it was not	20	Yes

Question 45

1	Yes, OSS&E process A. We have a small cycle time pretty quick, no 2 yr long cycle	11	Based on contractor processes
2	Yes A. Yes	12	Absolutely designed process, Also depends on decision authority for reviews. A- On small programs, on large ones can have trouble with scheduling PEO review
3	Yes A. Hard to say but know what we want to do	13	N/A
4	Use suites	14	No answer – didn't get that far
5	We are getting the process to mature A. No it is counter productive coming of an ACTD... it's a learning curve.	15	Yes defiantly sustainment block process A. No doesn't have anything to do with software development
6	Yes A. Have modified process to reduce time to get fielded	16	Have a sustainment block process, but not on development side
7	Yes, that's how we do it A. Yes	17	Its in life-cycle, spirals A. You can spend more time doing models... it can but tend not to
8	Yes A. No, vary from contractor to contractor	18	IT lean process EA and Spiral A. Yes
9	Yes and No, tailored to the organization	19	Block increments, very formal process A. was not important to do things quickly, but you have to do it
10	Yes, block release, flight test updates A. Yes it has	20	Yes A. Yes

Question 46

1	Have a DR (deficiency report), standard AF program	11	Based on contractor processes
2	Yes	12	Absolutely- also grade severity, Varies by program
3	Yes	13	Yes, contractor has deficiency report and procedures
4	Yes we do, contractor tracks all problems	14	No answer – didn't get that far
5	Yes, the SOW system process, MIP review board handles DRs.	15	Absolutely - defined by discrepancy reports
6	Yes A. A few processes...DR and WIT	16	Not sure what the contractor process is
7	Yes, software trouble reports and anyone can write one including the user	17	Most programs do, whether or not is a different thing
8	Yes we use our own process	18	Yes, but not in software processes
9	There was a formal process	19	Yes very formal process occurring at all levels
10	Yeah system problem reports, problem reporting system	20	Yes

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Vita

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His first assignment was at Peterson AFB where he was assigned to Detachment 5 of the Electronic Systems Center (ESC). While assigned to Detachment 5 ESC he served as Test Lead for space systems within the Combatant Commanders Integrated Command and Control System (CCIC2S). In August 2005, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology where he will receive his Masters of Science in Research and Development Management. Upon graduation he will be assigned to the Air Force Security Assistance Center, Wright-Patterson AFB.

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