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Managing risks in mega defense acquisition projects: Performance, policy, and opportunities

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Abstract

This research explores key aspects involved in the process of managing risk associated with acquisition projects within the US Department of Defense (DOD). First, various US Government Accountability Office reports are analyzed to identify the strengths and weaknesses of the DOD's overall program management practices, as well as individual projects. Then, the evolution and progress of United States Army's Future Combat Systems project is examined in detail as a case study to substantiate the argument that insufficient risk management has contributed to project delays and cost overruns significantly.

Poor risk management performance and practices are not unique to the Army, but arises from a system bred into the process of gaining approval to implement projects in the DOD. Incorporating a comprehensive risk management plan in the planning phase and filling key project management positions with personnel trained to recognize sound proposals from contractors would make significant strides toward improving overall project management practices in the DOD.

Keywords: Project management; Risk management; Department of Defense; Cost estimating; Future Combat Systems; Case study

1. Introduction

Adopting and implementing risk management principles, tools, and techniques to manage large defense acquisition programs and projects is one of the most important management decisions for managing government sector's project effectively. However, there have been very limited studies in investigating defense projects in the project management domain [30–33] or exploring the applications of risk management practices for defense acquisition projects (Tables 1 and 2).

The United States Department of Defense (DOD) receives an annual appropriation that topped $439 billion in fiscal year (FY) 2007 [1]. While much of this money is spent on base and incentive pay for military personnel and operations and maintenance of facilities and equipment, a significant portion is also spent on projects. However, the ability of the DOD to effectively implement a plan for project management has been questioned in the fiscally-constrained atmosphere of recent years [2–4]. As the United States Government Accountability Office (GAO) stated in a July 2004 report, "overhauling decades-old financial management and business-related problems of one of the largest and most complex organizations in the world is a daunting challenge" [5].

The purpose of this paper is to identify key aspects involved in the process for managing risks associated with projects within the DOD, and identify areas in which risk management can be emphasized. Particularly, the paper focuses on the management of budget and schedule risks. This will be accomplished primarily by

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Table 1
Changes in JSF program purchase quantities and costs (adopted from GAO report [21]).

	November 1996 (program start)	October 2001 (system development start)	December 2003[a] (reba seine)	December 2005[a] (latest available data)
Expected quantities				
Development quantities	10	14	14	15
Procurement quantities (US only)	2978	2852	2443	2443
Total quantities	2988	2866	2467	2458
Cost estimates (then year $ in billions)				
Development	$24.8	$34.4	$44.8	$44.5
Procurement	Not available	196.6	199.8	231.7
Other	Not available	2.0	0.2	0.2
Total program acquisition	Not available	$233.0	$244.8	$276.5[b]
Unit cost estimates (then year $ in millions}				
Program acquisition	Not available	$81	$100	$112
Average procurement	Not available	69	62	95
Estimated delivery dates				
First operational aircraft delivery	2007	2006	2009	2009
Initial operational capability	2010	2010–2012	2012–2013	2012–2015[c]

Source GAO analysis of DOD data.
[a] The selected acquisition reports are dated December 2009 and 2005 but are not officially released until March or April of the following year.
[b] Numbers may not add due to rounding.
[c] Recent program and President's budget information indicates that initial operational capability for The Navy's carrier variant has been rescheduled from the second quarter of 3013 to the first quarter of 2015.

analyzing GAO reports that document both the strengths and shortcomings of the DOD's overall program management, as well as individual programs and projects themselves.

Additionally, as a case study, this paper will address the evolution of the United States Army's Future Combat Systems (FCS) project, which has been noted by some critics to be the most disastrous effort ever undertaken by the Department of the Army. By utilizing audits performed regularly by the GAO, a characterization will be drawn of the project's performance to the present day. This will substantiate the argument that improper management of risks has contributed significantly to the project's current state and that poor risk management is not unique to the Army or DOD, but arises from a system bred into the process of gaining approval to implement projects in public sectors. The paper will conclude by suggesting a strategy that focuses on rigorous implementation of project risk management processes, principles, and practices from the initiation phase of defense projects.

Table 2
Comparison of original cost estimate and current cost estimate for FCS program (in billions of then-year dollars) (adopted from GAO report [20]).

	Original estimate	Revised estimate (as of 1/2006)	Percentage Increase (%)
Research, development, testing, and evaluation	$19.6	$30.5	56
Procurement	$71.8	$130.2	81
Total	$91.4	$160.7	76

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

2. Risk management in the Department of Defense

2.1. Project risk management: literature review

There has been a wide range of literatures discussing risk management within the domain of project management since the mid 1990s. Williams [34] recommended using risk register to integrate risk management in project definition, Chapman [35] discussed Project Risk Analysis and Management (PRAM) process developed by Association of Project Managers, and Baldry [36] studied risk management applied in managing public sector capital projects. Benefits and applications of implementing risk management principles, tools, and techniques [37–42], and relationships between project planning and project success [43] have also been studied. More recently, researchers consider risk management from a broader perspective that incorporate opportunity management [44,45] and uncertainty management [46–48] to have better management and stakeholder buy-ins.

2.2. DOD directives

Starting at the largest scope, DOD level, an examination of three core documents will take place; Department of Defense Directive 5000.1: "The Defense Acquisition System" (DODD 5000.1) [6], Department of Defense Instruction 5000.2: "Operation of the Department of Defense Acquisition System" (DODI 5000.2) [7] and Department of Defense Instruction 5000.2-R: "Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information Systems Acquisitions (MAIS) Programs" (DODI 5000.2-R) [8]. GAO's Cost Assessment Guide: Best Practices for Estimating and

Managing Program Costs also has an in-depth discussion on risk management tools, cost risks, and uncertainty [50].

While a myriad of related instructions exist, these documents will provide a sufficient baseline for appreciating the guiding principles governing the process. These documents address a wide range of topics on risk management, including risk planning, assessments, monitoring, and documentation. Based on the documents reviewed, risk management is defined as "a fundamental program management tool for effectively managing future uncertainties associated with system acquisition that encompasses identification, analysis, mitigation planning, mitigation plan implementation, and tracking".

The DOD directives and guideline evolved from the board's 1982 report and emphasize an approach to risk management that establishes a project's technical critical success factors up-front, therefore focusing on assessing the uncertainties and risks to achieving those critical success factors early in the life of the project. The importance of demonstrating a project's tendency toward success before moving to the next phase is stated concisely in DOD Directive 5000.1 [6].

A point should be made here on the focus of meeting key decision points and milestones during the life of a project. The message is clear that the role of the project manager is to demonstrate the viability and sustainability of a project before allowing it to progress into the next stage. Much less focus is given to the importance of identifying key elements of cost estimating and control and early identification of scope creep. While reference is made to these important elements of risk management, they do not seem to be given the same value as factors that influence project performance. This is one area in which risk management in the DOD falls short of risk management in private-sector companies with strong project management. Additionally, the GAO [10] recently determined that of the majority of weapons system acquisition programs in the last 10 years, one third had not achieved design stability by the time they decided to start production. Therefore, with regard to the one part of the triple constraint that is given due attention in the DOD's literature, a significant portion of projects do not follow stated procedures.

Bolles [9] notes that this robust approach to integrating risk management into the DOD's management of major weapons systems acquisitions has not always existed. He identifies the watershed event for risk management in the DOD in 1982, when a Defense Science Board Task Force examined why the DOD continued to experience significant cost overruns and schedule delays on major projects, particularly in weapons systems acquisitions. The board's report identified the Department's lack of a systematic approach to managing technical risk, most notably in a weapon system's design phase, as the primary cause for cost and schedule overruns.

The Sarbanes-Oxley Act (SOX) of 2002 requires submitting an annual report of the effectiveness of internal accounting control of US companies and foreign companies doing business in the US. SOX holds CEO's and CFO's of a publicly traded company that reports to a board of directors and to its investors responsible and accountable for the effectiveness of its project management practices and one can be criminally liable for poor financial management. Therefore, accountability tends to be highly visible, as one individual, or a small team of individuals, guides the company's projects, either to success or failure.

The Interim Defense Acquisition Guidebook (IDAG) [11] integrates risk management into the acquisition process and describes the relationship between risk and various acquisition functions. Again, risks to cost and schedule are not emphasized in this guide. There are significant discussions of how an effective risk management plan can be incorporated into the contract management of an acquisition program. Also, the capability of the industrial base to design, develop, produce, and support a project is addressed. It should be noted that with regard to assessing the capabilities of the industrial base, the anticipated effects on cost and schedule are mentioned:

2.2.1. DODD 5000.1

"Defense Acquisition System exists to manage the nation's investments in technologies, programs, and product support necessary to achieve the National Security Strategy and support the United States Armed Forces. The investment strategy of the Department of Defense shall be postured to support not only today's force, but also the next force, and future forces beyond that" [6]. Within such, an overall responsibility for flexibility, innovation, program manager discipline, and effective management exists. Essentially, DODD 5000.1 establishes the general policy to which projects/programs should be developed. These principles are identical to what is seen across the PM community. Fiscal responsibility, interoperability, adaptability to tailor a given project (e.g., scheduling, development strategies, legal compliance, security based time-sensitivity, etc.) are equally critical to the DOD community as in the private sector.

2.2.2. DODI 5000.2

DODI 5000.2, "establishes a simplified and flexible management framework for translating mission needs and technology opportunities, based on approved mission needs and requirements, into stable, affordable, and well-managed acquisition programs that include weapon systems and automated information systems" [7]. These guiding principles which influence the acquisitions process establish a relationship between mission need and product development. Please see Fig. 1.

When determining the production timeframe for DOD assets (weapons systems or non-weapons systems), a larger scale picture must be weighed to determine project priority based on warfighter need. For example, if you wanted to produce a new Unmanned Aerial Vehicle (UAV), that UAV would be weighed against the multitude of potential

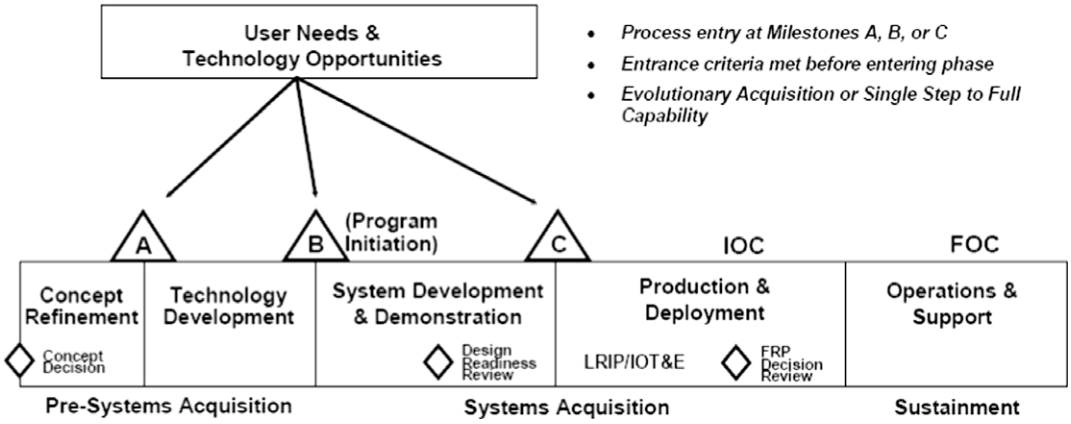

Fig. 1. The defense acquisition management framework (adopted from DODI 500.2 [7]).

DOD projects ranging from weapons systems/platforms to information technology (IT) upgrades and services long before the in-depth planning for product development may occur. After this approval chain is completed, the project must then be weighed against national-level priorities outside the DOD in order to receive appropriated funding.

Furthermore, when considering the development of new programs, a weapons or reconnaissance platform can be greatly impacted by the introduction of innovative technologies. When computer hardware upgrades occur, for example, it can impact the overall project duration by directly effecting hardware utilized on the platform itself. If a cost–benefit analysis takes place, it may be deemed that the project be upgraded, modified or even halted – thus, potentially impacting nodal durations and ultimately the entire project duration. These considerations show the great range of projects that exist under the DOD umbrella; as projects can be lower-cost and locally contracted or high-cost, highly technical and involve immense competition.

2.2.3. DODI 5000.2-R

While its focus extends beyond just the planning and scheduling realm, DOODI 5000.2-R establishes a basic construct in which goals, test and evaluation criteria, life cycle resource estimates and other requirements are outlined. Important themes relevant to the scheduling process noted in this document involve Earned Value Management Systems Guidelines and Mandatory Procedures and Reporting.

While the need to define scheduling requirements is noted throughout the instruction, the overarching focus is on the budgeting process. When the project/program is not one of a time-sensitive nature, concentration is within project cost. The project can be crashed (shortened) when it becomes of greater importance and time-sensitive and the overall concentration is geared towards spending fewer taxpayer dollars. This can bring up discussion within the realm of innovative or technology tradeoff for cost (due to increased project duration), but nevertheless highlights potential production shortfalls when pursuing "lowest bidder" searches and contracts.

2.3. Risk and the industrial base

The industrial base should be given some discussion at this point, as it plays a major role in bringing a project to completion and ultimately has a significant impact on whether a project finishes on time and within the original budget. The IDAG states that the project manager must structure Requests for Proposal (RFPs) and resultant contracts to provide an incentive to the contractor to meet or beat program objectives, including cost, schedule, and performance. Further, "the source selection criteria communicated to industry shall reflect the importance of developing a system that can achieve stated production and total ownership cost objectives within schedule and performance objectives [11]." While incentives are an important component to negotiating an attractive contract for all involved, the incentives do not, by themselves, ensure project success by meeting the triple constraints. This fact is demonstrated no more succinctly than by running through a list of major acquisition projects undertaken by the DOD, virtually all of which contain incentives. This analysis will be discussed later.

The DOD, as responsible stewards of the taxpayers' money, strives to award contracts to companies that have demonstrated the technical knowledge and experience to perform the work and that have quoted a cost consistent with department expectations. In practice, the DOD performs little "bottom-up" cost estimation, essentially relying on the industrial base to submit accurate estimates then validating at a high level by comparing estimates. This process has two net effects: (1) The firm that submits the most-likely cost estimate, which includes thorough cost estimates and the incorporation of a robust risk management plan, will often not be selected, as their estimate will not compare favorably with other lower-priced estimates, and (2) the firm that is selected based on a lower-standard cost estimate will overtax its resources and begin the project in "catch-up" mode with a constant need to rebaseline.

2.4. Project funding

The reason for this trend in major acquisition projects has to do with the way projects are funded. Requesting money from congress for a project halfway complete and with billions already spent is much easier than submitting the request at the project's start. Budget justifications, which are often prepared up to two years in advance, serve as the basis for requesting money to be appropriated from congress. Major acquisition projects generally receive favorable support from the congress, as the members of the industrial base that benefit are hundreds and thousands of constituents, many of whom have considerable influence. However, the program's executive office in the DOD must also be able to demonstrate that they are not wasting taxpayer dollars by accepting an "overblown" or, often more-accurate, proposal. As previously mentioned, this fine line is usually walked by selecting among the lower-priced proposals, then requesting additional funding as the actual costs of the project settle into their realistic and higher levels.

An analysis of the history of major weapons system acquisition projects demonstrates the propensity for the costs of these projects to quickly rise. A GAO report in March 2007 [10] assessed the acquisition programs of 62 weapons systems with a total investment of nearly $1 trillion. Some of the highlights are below and in Fig. 2:

- The Joint Strike Fighter program, the DOD's most expensive aircraft acquisition program, is now estimating that it will spend 32.8% more per unit than expected in 2001. Research and development costs have increased 25% since 2001. The program was also re-baselined in 2004 to reflect upward-spiraling costs [2,21].
- The Aegis Ballistic Missile Defense system was found by the GAO to consist of two critical technologies that have not been reliably demonstrated in a realistic environment. This project has not reached the procurement stage, but its research and development costs have increased over 22% from 2003 to 2006 [10].
- The Expeditionary Fighting Vehicle program was well underway into its Congressional procurement requests. However, in light of the discovery of problems associated with reliability, Congress zeroed out the FY 2007 request and the program was directed to extend its development phase [23]. Between December 2000 and August 2006, the program's research and development costs have increased 59%, total program cost has increased 33.7%, and acquisition cycle time has increased 37% [10].
- The Air Force's Space Based Infrared System has been in development since 1996. In 10 years, research and development costs have increased 112% and the total program cost has increased 147 % [10]. Current direction from the Office of the Secretary of Defense states that if unforeseen difficulties arise during the geosynchronous Earth orbit integration and test sequence, the project is to maintain schedule, even at the sacrifice of performance.

It is interesting to consider the reaction of its stockholders if the Department of Defense were a publicly traded

Program		Initial estimate	Initial quantity	Latest estimate	Latest quantity	Percentage of unit cost increase
Joint Strike Fighter		$196. 5 billion	2,866 aircraft	$223.3 billion	2,458 aircraft	32.8
Future Combat Systems		$85.5 billion	15 systems	$131.7 billion	15 systems	54.1
V-22 Joint Services Advanced Vertical Lift Aircraft		$36.9 billion	913 aircraft	$50.0 billion	458 aircraft	170.2
Evolved Expendable Launch Vehicle		$16.0 billion	181 vehicles	$28.6 billion	138 vehicles	134.7
Space Based Infrared System High		$4.2 billion	5 satellites	$10.4 billion	3 satellites	311.6
Expeditionary Fighting Vehicle		$8.4 billion	1,025 vehicles	$11.3 billion	1,025 vehicles	33.7

Source: GAO analysis of DOD data. Images sourced in their respective order: JSF Program Office; Program Manager, Future Combat Systems (BCT); V-22 Joint Program Office; (Left) © 2005 ILS/Lockheed Martin, (right) © 2003 The Boeing Company; Lockheed Martin Space Systems Company; General Dynamics Land Systems.

Fig. 2. Examples of reduced buying power (adopted from GAO Report [10]).

company. Considering the above examples from its project portfolio, the company would surely be the focus of intense scrutiny on Wall Street and would most likely be considering bankruptcy protection. The GAO's findings state that "*DOD does not have an environment that facilitates effective program management. For example, key personnel are rotated too frequently. Further, DOD is increasingly relying on contractors to perform key management functions raising questions about the capacity of DOD to manage new weapons systems programs*" [11].

To summarize, risk management in the DOD is not generally sensitive to effective cost estimation, as this activity is carried out beyond the purview of the Department. Additionally, the congress considers the weapons systems acquisition programs that comprise the bulk of the DOD's procurement accounts to be too important to cancel midstream. Essentially, the identified need will be met regardless of risk, therefore effective risk management is not required to bring a project to completion.

3. Case study: Future Combat Systems

Major issues drawn from a big-picture analysis of risk management in the DOD should be reachable with a more in-depth study of a specific program. As one of the largest weapon system acquisition projects ever undertaken by the Department, the US Army's Future Combat Systems (FCS) project presents a unique opportunity to further explore the role of risk management in the DOD [22].

3.1. FCS project overview

The earliest stages of FCS can be traced to 1999, with full funding to R&D and procurement realized in early-2003. FCS is the result of the Army's recognition that its combat forces must evolve in the post-cold war environment. The requirement for heavy forces that could deliver the necessary firepower to defeat large armies has been reduced in favor of lighter, faster forces that can quickly deploy anywhere in the world in a matter of hours or days. Versatility and technological advancement with people, platforms, weapons, and sensors seamlessly linked together in a sustainable land operation is the goal of the Army's Future Force concept. Boeing is the prime contractor for developing the system, which as a whole is anticipated to deliver 46 critical technologies and eight manned and unmanned ground vehicles, air vehicles, sensors and munitions linked by an information network [12]. Fig. 3 summarizes the Future Combat System.

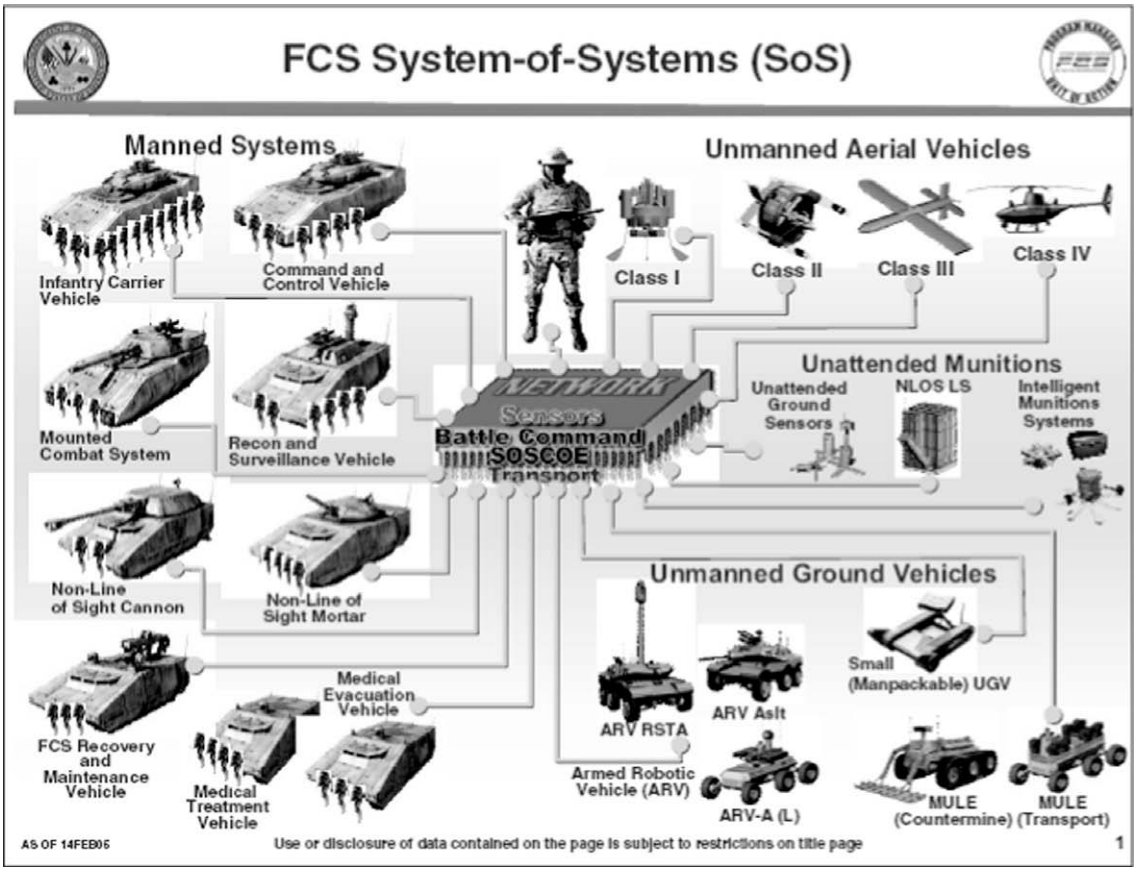

Fig. 3. Future Combat System (adopted from GAO report [12]).

The FCS network allows a Family-of-Systems (FoS) to operate as a system-of-systems, essentially making the whole greater than the sum of its parts. The FCS network is noted by the Army as the key to the system's technological superiority [13]. The network will enable senior commanders at various locations throughout the world to interact with officers and enlisted personnel in theater, who in turn can unleash the full potential of a new array of technologically-advanced weaponry systems.

3.2. FCS risk management

FCS continues to be highly visible to many both in and outside of the DOD. Unfortunately for the program, the visibility is often linked to underperformance and scrutiny due to rising costs rather than to its accomplishments or superior project management. One recent example of this is found in a report that accompanied the House of Representatives' version of the 2007 Defense Authorization Bill in which the FCS was cited as an example of the Armed Services Committee's opinion that the Army is not properly balancing technical risk with its desire to develop improved capabilities [14]. The program's 2007 budget request of $3.7 billion was reduced by over $300 million amidst increasingly frequent investigations into the oversight controls in place among high-ranking Army and Defense personnel.

One immediate concern regarding the use of a risk management plan for FCS is the timing of the formulation of the plan. In testimony before the House Armed Services Committee Subcommittee on Tactical Air and Land Forces, the Military Deputy to the Assistant Secretary of the Army (Acquisition, Logistics and Technology), Lieutenant General Joseph Yakovac, Jr. stated "*Risk Mitigation Plans have been developed, or are in the process of being developed, that address both technology maturation risk and system/system-of-systems integration risks into the FCS Family-of-Systems and the greater Unit of Action at the system-of-systems level. Where applicable, these RMPs contain technology 'off ramps' or 'tollgates' – specific decision points and criteria where decisions would potentially be made to use alternate, less risky (and potentially less capable) technologies and technology development*" [15].

The above testimony was given on April 1, 2004, roughly 5 years after the earliest stages of the program. The fact that risk mitigation plans were still being drawn up this late in the project is an indication of the role the plans play in the program as a whole. This fact alone is unsettling, however, considering the sheer size of the undertaking and the vast amount of new technology required to be developed and tested, the start of the program (including billions of dollars spent on R&D and procurement) without a clear, comprehensive risk management plan could be characterized as downright careless.

Kendrick [16] notes that technical project risk assessment is part of the earliest phases of project work. He offers tools that provide insight into project risk, even in the beginning stages, each of which starts with the same question: "How much experience do you have with the work the project will require?" The size of the FCS program and the relative immaturity of most of its technology do not necessarily categorize it as a program that should not have been undertaken by the Army; indeed, such a program is an opportunity for the Army to excel in demonstrating superb project management and to set an example for the rest of the DOD. These factors do immediately make the program extremely risky, however, and the Army's failure to incorporate a robust risk management plan prior to spending billions has certainly not set the program on the right track.

3.3. Scope and schedule risks

The lack of a comprehensive risk management plan in the planning phases of the FCS has resulted in substantial scope increases and schedule delays which have in turn led to increasing cost estimates. 2007 GAO report to Congress on FCS [17] found that "the Army has far less knowledge about FCS and its potential for success than is needed to fulfill the basic elements of a business case." The report goes on to note that FCS technologies that should have been matured in 2003 are still immature and that while production is still currently scheduled to begin in 2013, key testing to demonstrate performance will not begin until after that date. This disconnect between demonstration of performance and the commencement of production is indicative either of a disconnect within the overall program schedule or a tacit assumption that performance criteria will be achieved by 2013 and the demonstration phase will be a mere formality. Either case is clearly at odds with the policy outlined in DOD Directive 5000.1 and should give rise to renewed concerns about the ability of the FCS program to deliver its objectives.

The GAO reporting on the FCS program has grown to be more frequent, and the commentary more alarming over the years. Over 60 GAO reports since 2002 have included discussion of the FCS, and most of those reports have made FCS the main focus. The number of reports undertaken over this time is not the most interesting point of GAO investigations into FCS. The most telling facet of the GAO reports is the language and sternness of voice. Early reports document the Army's need for an evolved fighting force that is smaller, faster, and more technologically advanced [18,19]. As the reporting period progresses, however, the GAO notes increasing scope growth, serious delays in schedule, and significant cost overruns due to a lack of understanding of required technologies [12,17]. Current estimates on the total cost of the program now fall upwards of $200 billion, well in excess of the Army's original estimate of $99 billion [20] as shown in Fig. 4.

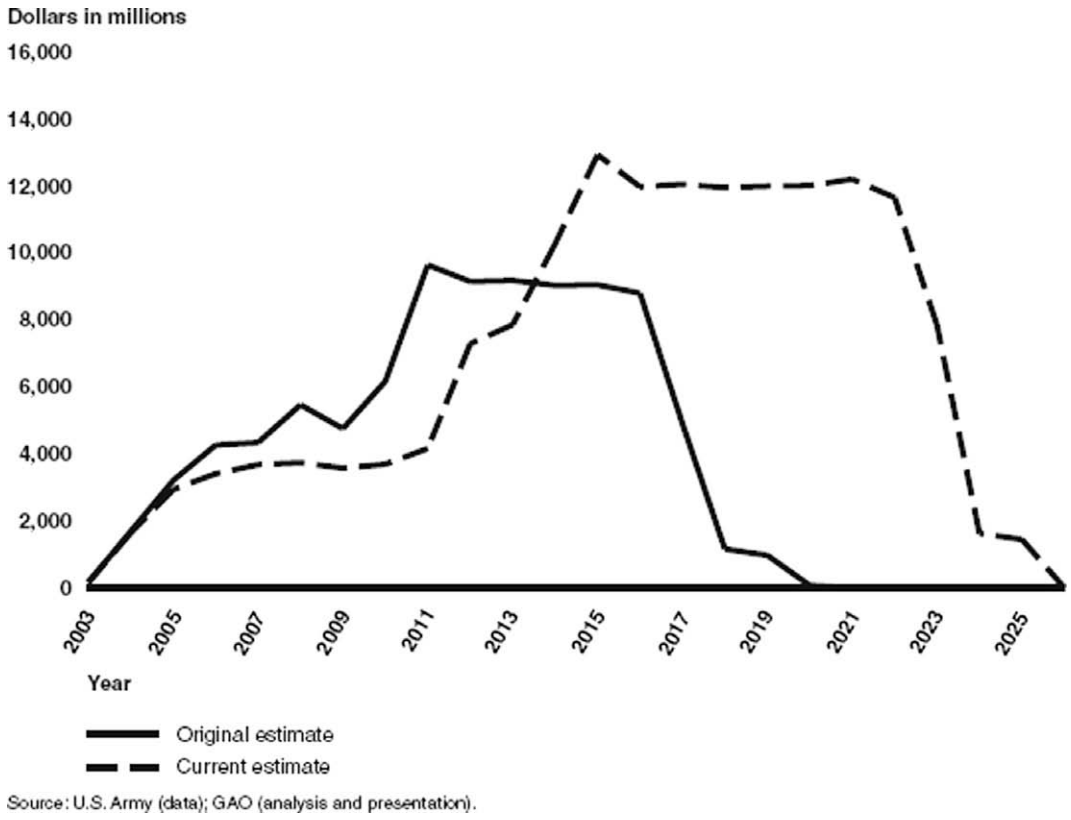

Fig. 4. Comparison of original cost estimate and current cost estimate for FCS program between fiscal years 2003 and 2026 (in million of then-year dollars) (adopted from GAO report [20]).

4. Conclusions and recommendations

The apparent problem with the ability of the Department of Defense to deliver its biggest weapons acquisition programs in accordance with original schedule and cost estimates does not stem solely from a lack of guidance on incorporating risk management plans into overall project plans. In fact, lengthy directives and supplemental documents to those directives do indeed guide the DOD project manager, even if the content of the information, particularly in the areas of planning for risk to cost and schedule, could be improved. There does, however, appear to be inconsistent application of the DOD directives, which has contributed to the underwhelming benchmarks achieved by the Department.

The greatest obstacle to incorporating and monitoring a comprehensive risk management plan is the lack of accountability held by DOD officials who openly place accountability in the hands of contractors, thereby relieving themselves of the pressures of performing to plan. Furthermore, an underlying assumption or a corporate conspiracy of optimism exists that the largest projects, either public or private, will not be canceled despite poor project performance [49].

While the solution to these problems would require a significant overhaul to the system in which DOD projects are delivered (e.g., requests for funding, contract administration), one area that could be improved with little additional effort on the part of DOD personnel is the solicitation of RFPs. Personnel at the highest levels who ultimately decide on awarding contracts should be trained to recognize sound, credible proposals early in the project that are accompanied by an extensive and executable project management plan [24,26]. Furthermore, the climate that funnels preference toward low-cost estimates should be changed to recognize that those estimates are most often fraught with inadequate planning and assumptions (i.e., greater risk) that will usually result in higher costs, schedule slips, and questionable performance over the life of the project [25].

The concept of risk management applied to project and organization has only been recent. Mega projects often result in cost overrun, schedule delays, and sudden project terminations because risks are poorly identified and under estimated [49]. Given the complexity and dynamics of the defense projects that involve technical, legal, and political risks, all the stakeholders who are involved in defense projects should have an strategy [27–29] and knowledge of applying risk management processes, procedures, and policies and to implement them rigorously from the initial stage of the project. Future study will focus on further analyzing DOD's risk management practice and process by investigating specific case in-depth and identifying specific aspects of DOD's risk management process that needs to

be improved and examine its overall impact toward project performance.

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