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An Analysis of the Future Combat Systems (FCS) Spin Out 1 Low-Rate of Initial Production (LRIP) Contract

24 August 2009

by

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Graduate School of Business & Public Policy

Naval Postgraduate School

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Program managers would like to minimize the risk associated with the acquisition of their system in order to better control costs, schedule, and performance. It is especially important to do so in cutting-edge programs with a history of complexity, difficulty or controversy Deservedly or not, the lead system integrator (LSI) approach used in the Future Combat Systems (FCS) program has been criticized for relying too heavily on private industry to manage this innovative, large scale acquisition program. The objections from Congress center on government's surrender of too much of its responsibility, authority, and budget to private industry. As a result of the concern over the use of LSIs, program managers are understandably interested in minimizing risk to better control costs, schedule, and performance. In order to minimize risk, it is essential that contracts are written well, with appropriate specificity, and include not only the desired goods or services, but also essential information that enables the program manager to track the progress of contract performance and to quickly detect potential problems. This research takes a high-level/macro approach to identifying issues and suggesting items that should be considered when developing the Low-Rate Initial Production (LRIP) contract for Spin Out 1 of the FCS program.

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Abstract

Program managers would like to minimize the risk associated with the acquisition of their system in order to better control costs, schedule, and performance. It is especially important to do so in cutting-edge programs with a history of complexity, difficulty or controversy Deservedly or not, the lead system integrator (LSI) approach used in the Future Combat Systems (FCS) program has been criticized for relying too heavily on private industry to manage this innovative, large scale acquisition program. The objections from Congress center on government's surrender of too much of its responsibility, authority, and budget to private industry. As a result of the concern over the use of LSIs, program managers are understandably interested in minimizing risk to better control costs, schedule, and performance. In order to minimize risk, it is essential that contracts are written well, with appropriate specificity, and include not only the desired goods or services, but also essential information that enables the program manager to track the progress of contract performance and to quickly detect potential problems. This research takes a high-level/macro approach to identifying issues and suggesting items that should be considered when developing the Low-Rate Initial Production (LRIP) contract for Spin Out 1 of the FCS program.

Keywords: Low-Rate Initial Production (LRIP), Future Combat Systems (FCS), Lead Systems Integrator (LSI), Contract

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List of Acronyms

ANSI – American National Standards Institute

AUSA – Association of the United States Army

BMDO – Ballistic Missile Defense Organization

CAIG – Cost Analysis Improvement Group

CDD – Capability Development Document

CLIN – Contract Line Item Number

CPD – Capability Production Document

DARPA – Defense Advanced Research Projects Agency

DAU – Defense Acquisition University

DCMA – Defense Contract Management Agency

DHSIG – Department of Homeland Security Inspector General

DoD – Department of Defense

ERP – Enterprise Resource Planning

EV – Earned Value

EVM – Earned Value Management

EVMS – Earned Value Management System

FCS – Future Combat Systems

GAO – Government Accountability Office

GDLS – General Dynamics Land Systems

GFE – Government Furnished Equipment

IBR – Integrated Baseline Review

ICD – Initial Capabilities Document

ICGS – Integrated Coast Guard Systems

ICS – Integrated Computer System

JTRS – Joint Tactical Radio System

KPP – Key Performance Parameters

LRIP – Low-Rate Initial Production

LSI – Lead Systems Integrator

M&S – Modeling and Simulation

MDA – Milestone Decision Authority

MDAP – Major Defense Acquisition Program

MTBF – Mean Time Between Failures

NGSS – Northrop Grumman Ship Systems

NLOS-C – Non-Line-of-Sight - Cannon

NMD – National Missile Defense

PEO – Program Executive Officer

PM – Program Manager

SAIC – Science Applications International Corporation

SAP – Systems Applications and Products

SDD – System Development and Demonstration

SOSCOE – System of Systems Common Operating Environment

SWaP – Space claim, Weight and Power

UAV – Unmanned Aerial Vehicle

UMDC – United Missile Defense Company

USD(AT&L) – Under Secretary of Defense for Acquisition, Technology, and Logistics

WIN-T – Warfighter Information Network - Tactical

I. Introduction

While all program managers would like to minimize the risk associated with the acquisition of their system, it is especially important to do so in cutting-edge programs with a history of complexity, difficulty or controversy. Significant cost overruns and schedule delays in the Army's Future Combat Systems (FCS) program are testament to the risk involved with the ambitious leap in military capability the FCS is expected to provide. Deservedly or not, the lead system integrator (LSI) approach used in the FCS program has been criticized for relying too heavily on private industry to manage this innovative, large scale acquisition program, which is unprecedented in defense procurement history. The objections from Congress center on government's surrender of too much of its responsibility, authority, and budget to private industry. As a result of the concern over the use of LSIs, program managers are understandably interested in minimizing risk to better control costs, schedule, and performance, in addition to determining the best time to wind down the use of LSIs and bringing the program in-house.

In order to minimize risk, it is essential that contracts are written well, with appropriate specificity, and include not only the desired goods or services but also essential information that enables the program manager to track the progress of contract performance and to quickly detect potential problems.

A. Purpose of Research

The purpose of this research is to take a high-level/macro approach to identifying issues and suggesting items that should be considered when developing the Low-Rate Initial Production (LRIP) contract for Spin Out 1 of the FCS program. Since this research is being performed for the PM Modular Brigade Enhancements, PEO Ground Combat Systems, and they are quite knowledgeable about the FCS program and the associated spin outs (i.e., systems and capabilities provided by each), limited background information will be provided in this report.

B. Limitations

Several significant limitations were encountered in the course of performing this research within the projected time frame. First, attempts to gather specific cost data for analysis were not successful and certain relevant program documents (e.g., the Capability Production Document (CPD)) were not provided. In addition, due to understandable political sensitivities, the researchers were not permitted to conduct personal interviews with top government or private industry officials associated with the initiation and execution of the FCS program and the selection of the LSI approach.

Other difficulties encountered in the research were the uncertainty and relatively frequent changes in the FCS program. Due to budget constraints and technological challenges, a number of requirements have been dropped or scaled back. For example, four of the systems originally planned are no longer required. Another example is that the requirement for the program's vehicles to be transportable by a C-130 has been dropped (Shachtman, 2007). More on this is provided in "C. Background" below.

C. Background

> The world situation demands an Army that is strategically responsive. The Army's core competency remains fighting and winning our Nation's wars; however, the Army must also be capable of operating throughout the range of conflict—to include low intensity operations and countering asymmetric threats. It must, therefore, be more versatile, agile, lethal, and survivable. It must be able to provide early entry forces that can operate jointly, without access to fixed forward bases, and still have the power to slug it out and win campaigns decisively. At this point in our march through history, our heavy forces are too heavy and our light forces lack staying power. Heavy forces must be more strategically deployable and more agile with a smaller logistical footprint, and light forces must be more lethal, survivable, and tactically mobile. Achieving this paradigm will require innovative thinking about structure, modernization efforts, and spending.
>
> General Eric Shinseki
> 34th Chief of Staff, United States Army

This statement above was made by newly appointed US Army Chief of Staff General Eric Shinseki at his swearing in ceremony on June 23, 1999, in Washington DC. This was followed by his announcement launching the Future Combat System (FCS) on October 12, 1999. In a speech before the Association of the United States Army (AUSA), General Shinseki presented his vision for transforming and modernizing the Army. The goal was to employ the latest technology and weaponry to enable soldiers to be “light enough to deploy, lethal enough to fight and win, survivable enough to return safely home” (Shinseki, 1999). This was to be achieved by an “off-the-shelf” solution. Originally, the first combat unit was to be fielded by 2010.

To execute this program, a relatively new acquisition approach was selected. Known as Lead Systems Integrator (LSI), this innovative approach to system design and development grants defense contractors broad responsibilities and control of military acquisition programs. This oversight of military acquisition programs is normally the role of acquisition professionals within the Pentagon and military services.

The first use of the LSI concept in major government procurements was the Ballistic Missile Defense Organization (BMDO) in 1999. The United Missile Defense Company (UMDC) was formed as a joint venture equally owned by Lockheed Martin, Raytheon and TRW (DoD, 1998). The UMDC was to design, develop, test, integrate, and potentially deploy and sustain the National Missile Defense (NMD) system. Due to budget constraints and the change in administration, the LSI concept was only used to complete the concept definition of the national ballistic missile system.

Subsequently, on June 25, 2002, the US Coast Guard awarded an LSI contract to Integrated Coast Guard Systems (ICGS)—an industry team led by Lockheed Martin and Northrop Grumman Ship Systems (NGSS) to oversee the Coast Guard’s Deepwater Program. Deepwater refers to a collection of more than a dozen Coast Guard acquisition programs for replacing and modernizing the service’s aging fleet of deepwater-capable ships and aircraft. The management and execution of the Deepwater program was strongly criticized in reports and testimony from the Department of Homeland Security Inspector General (DHSIG), the Government Accountability Office (GAO), the Defense Acquisition University (DAU), and other observers. Also, members of House and Senate oversight committees questioned the management and execution of the program, especially the acquisition of new and modernized cutters and patrol boats. As a result, in 2007 the Coast Guard shifted from an LSI approach to a collection of individual Deepwater acquisition programs. (O'Rourke, 2007) Thus, the LSI approach received its first vote of disapproval.

As a result of reductions in its civilian acquisition and contracting personnel, the Army adopted the LSI concept for the FCS program. On March 7, 2002, the Defense Advanced Research Projects Agency (DARPA) and the Army announced the award of the multi-billion dollar FCS program management contract to the Boeing Company and Science Applications International Corporation (SAIC) team (DoD, 2002). In addition to providing important personnel, the LSI team would provide an important advantage in exploiting the private sector's access to new technology on a more flexible and immediate basis. Especially in electronics and information technology, product lifecycles are measured in months rather than years. Compared to the private sector, traditional federal government procurement takes longer due to the complexity of rules and regulations and the approvals required from Congressional oversight committees and federal budget constraints.

The following year, the LSI team added 15 additional contractors consisting of approximately 70 companies to participate in the $15 billion development effort. Other contractors would be added as the development evolved.

In 2003, the Army estimated that the FCS would cost roughly $92 billion (Shachtman, 2007). In 2007, the Office of the Secretary of Defense's Cost Analysis Improvement Group (CAIG) and the GAO estimated the FCS program's total cost at

$203 billion to $234 billion, including inflation. This far exceeds the Army's own cost estimate of $160 billion (Cole, 2007).

In 2004, the FCS acquisition strategy was revised in an attempt to bring developed technologies to the current Iraq and Afghanistan forces. Spin-Out 1 was the first of four (recently reduced to three) spin-outs to deliver these technologies. As part of this effort and Congressional direction, several of the Non Line of Sight-Cannon (NLOS-C) vehicle's long-lead production items will enter limited production in 2008. However, the Under Secretary of Defense for Acquisition, Technology, and Logistics USD(AT&L) decided to separate the NLOS-C early production from the FCS. In 2009, the USD(AT&L) will decide whether or not to approve NLOS-C production (Francis, 2008b).

Note that the Army's $160 billion cost estimate for FCS is based on a reduction from the original 18 systems to be developed to 14 currently. Thus, the FCS capabilities are likely to decrease. In addition, to stay within space, weight, and power (SWaP) limitations, the Army has made numerous design trade-offs. Gone is the requirement to use the C-130 transport for the program's vehicles (Shachtman, 2007). According to the Army's latest technological assessment in 2008, only 73% of the FCS's critical technologies are mature enough to begin system development (Francis, 2008b). There are significant risks in information network performance and the complex software (now estimated at 95.1 million lines) needed for operation. The required lines of software code have increased as system requirements have been better defined. Future improvements are needed in the Joint Tactical Radio System (JTRS) and the Warfighter Information Network-Tactical (WIN-T) programs to achieve the FCS's objectives as envisioned by General Shinseki.

Clearly, this unprecedented large-scale, high-technology acquisition is among the most challenging defense undertakings in history. The design, development, and integration of new electronics, information networks, unmanned assets, and the warfighter pushes the technological envelope and has strained available resources. Normally, large scale integrations of technology have the advantage of using mature technology such as Enterprise Resource Planning (ERP) systems available from SAP and Oracle vendors. These are off-the-shelf packages of different software systems. Often, the biggest challenge is to engage other firms that actually implement the complex software systems. These are known as “systems integrators” and include Accenture, IBM Global Solutions, and Electronic Data Systems. As mentioned earlier, Boeing and SAIC have been awarded the LSI contract for the FCS program. Their task of performing the LSI function for FCS differs significantly from “normal” large scale integrations of technology because proven technology and software is not currently available. It must be developed as the requirements are better understood. Consequently, the program is much more difficult to execute.

II. Risk Management

Program managers are interested in minimizing the risk associated with their programs. Effectively accomplishing this goal requires an understanding of different types of risk and the methods of controlling and minimizing them. This chapter will briefly discuss risk management and then discuss some risks specific to the FCS Spin Out 1 LRIP contract.

Risk can be defined as, "An undesirable event which has both a probability of occurring and a potential negative consequence to program success. Risks are associated with uncertainty" (Wright, 2007). As indicated in the definition, there are two parts to risk: (1) a probability of a risk event occurring, and (2) the negative consequences that will result if it does occur.[1]

Risk management requires assessing risk types, developing risk management options, risk monitoring, and implementing risk mitigation strategies.

A. Types of Risk

From the program manager's perspective, there are five broad categories of risk: (1) technical risk (including supportability), (2) schedule risk, (3) cost/price risk, (4) market risk, and (5) other risks. While each area is discussed separately below, they are interrelated, and they affect each other.

1. Technical risk refers to: (1) the risk inherent in determining and unambiguously specifying all the desired key performance parameters (KPP) in the contract, and (2) the possibility that the KPPs will not be met. Technical risk includes system supportability throughout the lifecycle of the program, as well as operational performance parameters. The language of the specifications or "Statement of Work" can influence the amount of technical risk.

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[1] If an undesirable event with negative consequences is certain to occur, then it is not a risk; it is a certainty.

2. Schedule risk refers to the risk associated with meeting the proposed schedule. The more aggressive the proposed schedule, the higher the risk. Incomplete or ambiguous contracts can also increase schedule risk. Misinterpretations and disagreements about the contract can lead to conflict resolution procedures that could result in delays in contract performance.

3. Cost/price risk refers to unexpected increases in costs. There are a number of possible causes for this. One obvious cause is a poor estimate of the costs involved in successful contract completion. Another possible cause is that the contract is either incomplete or ambiguous. As stated above, this can result in contract delays, which can increase costs. In addition, it may produce poor cost estimates that fail to include all factors required to successfully complete the contract or cost estimates based on misinterpretations of what was intended by the contract.

4. Market risk refers to the risk inherent in acquiring all necessary goods and services to successfully fulfill the contract. For example, scarce materials, components, or a workforce with specialized skills may be difficult to obtain in the desired time frame. Generally, the program manager has little or no control over market risk, but it should be recognized and acknowledged as a factor in program success. If a particular market risk is considered to be significant, the government may choose to provide the required resource of concern to the contractor (i.e., government furnished equipment (GFE)) if it can be obtained more easily by the government.

5. The “Other Risks” category includes a wide variety of factors too numerous to list here. Two common examples are excessive personnel changes by either the government or the contractor, and data accuracy. Excessive personnel changes increase risk because of training or ramp-up time. It takes time for people to become familiar with new tasks and to learn all the implications of different decisions and courses of action. Clearly, this prevents cost reductions and other advantages due to learning curve effects. Potentially more important, though, is that for a professional workforce, the more frequently people transition jobs, the more likely it is that an inexperienced person will be in a job when a significant decision is made and the more likely it is that a less-than-optimal decision will be made. Data accuracy (or more precisely, inaccuracy) is also a risk. Data is continuously collected to provide a sound basis for managerial and technical decisions. Clearly, the less accurate and untimely the data is, the less likely optimal decisions will be made.

As stated above, these five risk areas are interrelated, and problems may first appear as one type of risk when the actual cause is another. For example, a shortage of a necessary good or service (i.e., market risk) may first come to the attention of the program manager as either an unexpected cost increase or a schedule slippage if it cannot be acquired in the marketplace.

B. Risk Management Process

Effective risk management requires a framework within which risk areas are identified, addressed (i.e., assessed, mitigated and planned for), and continuously monitored. There are four steps in the risk management process: (1) risk identification, (2) risk assessment, (3) risk control and mitigation, and (4) risk monitoring.

1. Risk identification refers to clearly stating/describing the risk with respect to key performance parameters (KPP) and program success, as well as their perceived causes. All types of risk discussed above should be considered. All aspects of each risk identified should be included in the description (i.e., what, why, who, where, when, how to detect).

2. Risk assessment refers to prioritizing the risks identified based on their probabilities of occurring and the consequences that will result. By combining the risk causes identified in the risk identification phase with the consequences of the risks in this phase, program managers can develop an understanding of cause and effect in program success.

3. Risk control and mitigation involves determining how each risk will be handled. This means developing strategies to control and reduce the risks that pose the biggest threats to program success and planning appropriate corrective action for high-risk events, should they occur.

4. Risk monitoring involves the tracking and evaluation of each risk. Effective risk management depends on established, meaningful metrics with which to measure progress towards successful contract completion. Measured values of the metrics are compared with planned or expected values to identify variances. The variances are then evaluated to determine the threat they pose to successful contract completion and the appropriate corrective action to be taken, if any.

Risk Management Process[2]

Risk: An undesirable event which has both a probability of occurring and a potential negative consequence to program success. Risks are associated with uncertainties.

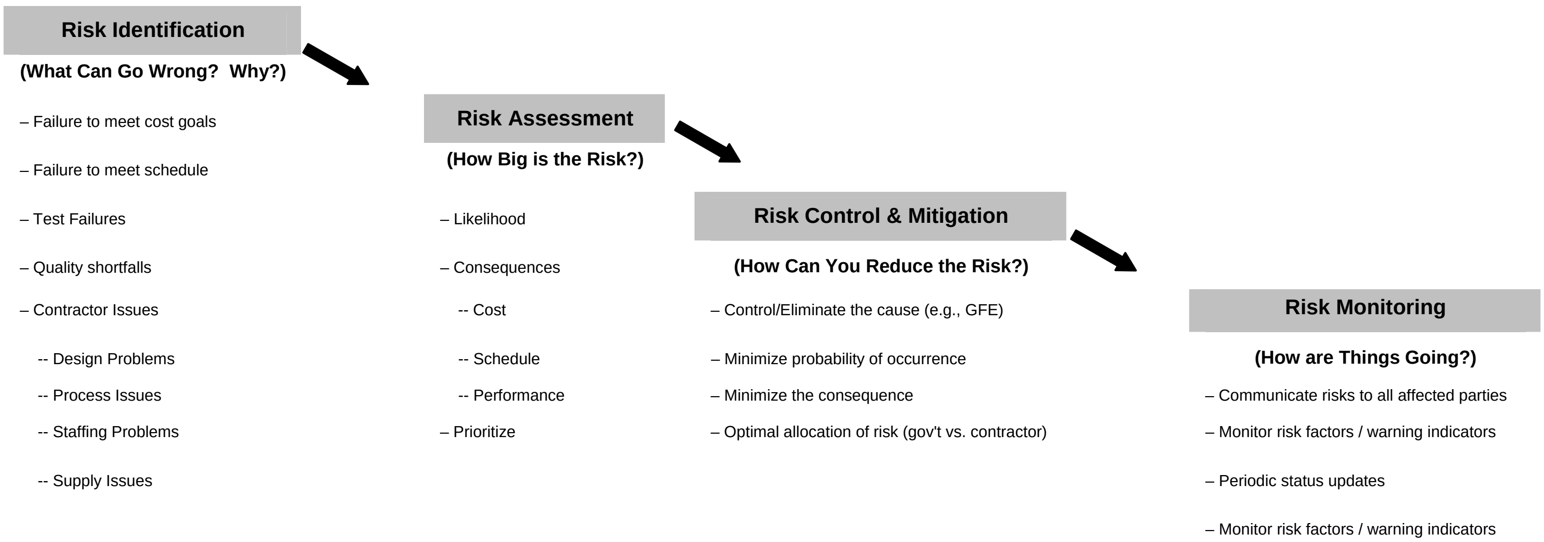

Figure 1. Risk Management Process
(Wright, 2007)

C. Methods of Handling Risk

There are four generally recognized methods of handling risk: (1) risk avoidance, (2) risk transfer, (3) risk assumption, and (4) risk control (Wright, 2007).

1. Risk avoidance eliminates the risk by either eliminating the requirement with which the risk is associated or eliminating the cause of the risk. For example, the government may eliminate a KPP or make it less stringent. Alternatively, it may require the contract winner to have strong finances to essentially eliminate the risk that it will go out business before fulfilling the contract. There are generally costs associated with avoiding risk. Costs can take the form of increased financial costs, decreased performance specifications, or longer delivery schedules.

2. Risk transfer shifts the risk from one party to another or reapportions the risk among the parties. Using a fixed-price contract rather than a cost-plus contract is an example of risk transfer.

3. Risk assumption means that the government accepts the risk associated with a risk event. This would be appropriate if the probability of a risk event occurring were low and the consequences of the risk event were small. If the government assumes the risk for higher probability or higher consequence events, it needs to carefully monitor the events that could cause the risk event to occur and develop risk mitigation plans and corrective action procedures.

4. Risk control attempts to reduce the probability that a risk event will occur and/or reduce the potential consequences if the risk event does occur. Contract terms and conditions and defined program KPPs are the main methods of controlling risk. Defining non-negotiable program and contractual requirements along with the judicious use of incentives and disincentives are effective ways to control contractor behavior and risk. In addition, contracts can require additional standards and certifications, such as Six Sigma certification or compliance with American National Standards Institute (ANSI) standards, as a means of ensuring at least a minimum level of competence. (Wright, 2007)

In conclusion, in order to minimize the risk associated with their programs, program managers must exercise appropriate foresight in identifying potential risk events, developing a risk management plan that addresses risks by specifying how each will be controlled and monitored, and developing contracts that incorporate the risk management plan by specifying the actions to be taken in each event.

D. LSI vs. Army Program Management for the Spin Out 1 LRIP Contract

Not surprisingly, the LSI approach to complex, large-scale systems acquisition has received a significant amount of criticism. Consequently, from a political perspective alone, it is expected that a program manager would be interested in determining the best time to phase out the use of an LSI and have the government assume all acquisition management responsibilities. For several reasons, the LRIP phase of the acquisition process seems like a suitable time to take such action.

There are two broad categories of risk involved in LRIP contract performance: (1) risk involved in accomplishing the objectives of LRIP (i.e., deliverables and capabilities), and (2) risks involved with administering the LRIP contract.

Since Milestone C approval is necessary prior to issuing an LRIP contract, it is assumed that all systems being acquired in Spin Out 1 are determined to have:[3]

1. acceptable performance in development, test and evaluation, and operational assessment,
2. mature software capability,
3. acceptable interoperability,
4. acceptable operational supportability,
5. an approved CPD,
6. no significant manufacturing risks, and
7. acceptable affordability throughout the lifecycle.

Therefore, this assumes that much of the risk associated with the systems included in Spin Out 1 has been resolved. As a result, it is commonly felt that it is probably a good point to reduce the role of the LSI for the Spin Out 1 systems and for the Army to assume more of the acquisition management functions for these systems. Therefore, the Army should strongly consider issuing the LRIP contract(s) for these systems to the individual manufacturers/suppliers of these systems rather than to the LSI. However, there are factors that should be considered before making the final decision. One of them is whether the reasons that lead the Army to use the LSI approach in the first place are still valid.

The principal reasons the Army used the LSI approach at the outset of the FCS program were to take advantage of private industry's flexibility with respect to its (1) human resource capabilities (i.e., speed and ease of recruiting and hiring

[3] According to *DoDI 5000.2*, these seven characteristics are among those required before a program can receive Milestone C approval.

people with specialized skills), and (2) subcontract management practices (Flood & Richard, 2006). Specifically at that time, the Army's acquisition workforce lacked enough people with the expertise to execute the systems engineering function in the timeframe and at the level required for the FCS program. The LSI was intended to provide the systems engineering and management oversight throughout the development phases of the program. At this point, the systems engineering function should be complete (or very close to being complete) for the Spin Out 1 systems. Consequently, the LSI concept's two biggest advantages—its ability to fill the personnel gap and its subcontract management—may no longer be needed for the Spin Out 1 systems. If the Army still thinks its acquisition workforce cannot handle all the necessary functions, it may be able to take advantage of the Defense Contract Management Agency (DCMA) to perform contract management services. The DCMA can assist in developing and monitoring the LRIP contract. Chapter III mentions some of the services DCMA offers.

Another potential reason to continue using the LSI through the LRIP contract might be that the total cost to the government (i.e., contract costs plus contract administration costs) of LSI implementation of LRIP for all Spin Out 1 systems is less than the total cost of the government implementing several LRIP contracts (i.e., one for each system).

A third potential reason to continue using the LSI is to ensure communication/cooperation between the LSI and Spin Out 1 system suppliers continues, especially with regard to the System of Systems Common Operating Environment (SOSCOE). This will probably not be a problem, but it is a concern that should be considered. If LRIP contracts are awarded to the system suppliers, care should be taken to ensure the incentives (or lack thereof) provided in the contracts do not encourage behavior that is inconsistent with overall FCS success. Since normal behavior for business is to hoard information and FCS success depends on information sharing by producers of the various systems, contracts should be constructed to reward cooperation and information sharing.

In summary, the LRIP phase of the acquisition process may be the best time to phase out the use of the LSI in the FCS program and revert to conventional acquisition practices. The risk is relatively low, it is likely to be less expensive than continuing to use the LSI, and it is the politically expedient alternative.

III. Issues to Address in the LRIP Contract

Contract terms and conditions and defined program key performance parameters are the main methods of controlling risk. Therefore, in addition to preparing for Full-Rate Production, the terms and conditions of the LRIP contract should—to the maximum extent possible—address all issues and potential problems that could arise from the beginning of contract execution through the integration of the materiel delivered into the force and contract termination. This means that in addition to requiring the production and delivery of the desired goods, services, or systems, the contract should also require the provision of information necessary to enable the program manager to effectively monitor the progress of contract performance, detect and identify potential problems early, and manage contract execution. This chapter mentions items and discusses issues that should be considered when determining what to include in the LRIP contract.

There are two parts to the following discussion based on the two broad categories of deliverables that should be included in the LRIP contract. The first category of deliverables relates to the goods, services, and systems being acquired and all specifications and performance parameters related to them. The second category includes all managerial data and information provided to the program manager to assist in monitoring and controlling contract execution. These two categories will be discussed separately below.

A. Information to Be Included and Issues to Consider for Materiel Delivered

When considering performance parameters to include in the contract, there are two broad categories of parameters to consider. The first type of parameter has a pass/fail metric in which the deliverable either satisfies or does not satisfy the requirement. The second type of parameter has a metric with a range of acceptable values in which there might be a minimum acceptable performance level (which might be zero), but a higher score indicates the deliverable does a better job of satisfying the requirement than a lower score (or vice versa). For example, a gun that can shoot 500 rounds per minute may be the minimum acceptable level of performance, but it would be better if it could shoot 600 rounds per minute and better still if it could shoot 700 rounds per minute. Conversely, the maximum acceptable weight for a piece of equipment that must be carried by a soldier might be 20 pounds, but it would be better if it weighed 15 pounds and better still if it weighed 10 pounds. When developing metrics to be included in a contract, the appropriate type of metric should be used for each KPP. Additionally, appropriate incentives and disincentives should be offered for the KPPs with ranges of acceptability. For more on this, see "4. Incentives (Awards) and Disincentives (Penalties)" below.

For each good, service, and system being acquired, the following information should be considered for inclusion in the LRIP contract. For each issue listed, some specific information is mentioned. In general, the list of specific information is not exhaustive. It is meant to be a starting point and is intended to stimulate thinking about the issue and the problems that could arise if all aspects of the issue are not addressed. A number of the issues will not be relevant and, therefore, should not be addressed. However, the contract should address all relevant issues. Otherwise, situations could arise which lead to misunderstandings, disagreements, legal action, cost increases and schedule delays.

1. Materiel Deliverables

a. Name and detailed description of items to be produced or provided. This should unambiguously identify the good, service, or system to be produced/provided and delivered.

b. Cost per unit or total cost of items to be produced or provided.

c. Quantity to be produced and delivered.

d. Schedule of deliveries.

(1) Number of units to be delivered each month.

(2) If the delivery/installation of a good requires the removal of an operational piece of equipment from service (e.g., the

installation of a B-Kit on a Bradley), how long will the equipment be inoperable or unavailable?

(3) Who installs the delivered equipment?

e. Duration of services (e.g., training, maintenance, warrantees, etc.) being provided.

(1) Time period the service will be provided.

(2) Limitations of when the service will be available (e.g., 24/7, including Christmas and New Year's; 8 hours per day, Monday through Friday; etc.).

f. Specific site where the items need to be shipped/delivered, including who pays for the shipping.

(1) Will the government pick up the items at the manufacturing facility?

(2) Should the items be shipped/delivered to a government facility (e.g., operational unit, depot, storage facility, etc.)?

(3) Should the items be shipped/delivered to the LSI or another subcontractor's facility?

(4) If the item requires installation (e.g., A-Kits, B-Kits):

(a) Who will install the item (manufacturer, government, another LSI subcontractor, other)?

(b) Where will it be installed (manufacturer's facility, government depot, operational unit, another LSI subcontractor's facility, other)?

g. Specifications and quality/performance metrics of deliverables.

This includes all technical specifications and key performance parameters of all deliverables. These were likely identified in the Capability Development Document (CDD). Examples of specifications and quality metrics to be considered are:

(1) Speed of operation.

(2) SWaP (Space claim, Weight, and Power).

(3) Survivability.

(4) Mean Time Between Failures (MTBF).

(5) Safety mechanisms.

(6) Power consumption.

(7) Range of effectiveness.

(8) Environmental effects.

h. Specifications and quality/performance metrics of the production process being developed for Full-Rate Production.

This includes all technical specifications and key performance parameters of the production process. These were likely identified in the Capability Production Document (CPD), but if not, the LRIP contract is an opportunity to correct the omission. Examples of specifications and quality metrics to be considered are:

(1) Compliance with a specified organization's (e.g., ANSI, ISO, etc.) standards or certifications.

(2) Six sigma.

(3) Critical manufacturing processes.

i. Supportability requirements. Examples may be:

(1) Power requirements.

(2) Ease of software upgrades.

(3) Ease of maintenance.

(4) Methods of transport.

(5) Logistics requirements.

j. Spares.

(1) Cost per unit or total cost.

(2) Shelf life.

(3) Where spares will be delivered and stored.

(4) Who will provide and pay for storage.

(5) Special packaging and storage instructions.

(6) Acceptance conditions.

k. Data Rights.

Contracts can be grouped into two categories: transaction-based contracts and relationship-based contracts. Transaction-based contracts are short-term or one-time agreements between the parties. Changing suppliers in subsequent procurements does not reduce the likelihood of satisfying the requirement. An example is the purchase of off-the-shelf items like office equipment. Relationship-based contracts are agreements in which it is in the best interests of the government to enter into a long-term relationship with the supplier.

FCS contracts should clearly be relationship-based contracts. However, while it is in everyone’s best interest to maintain a positive and productive relationship with the contractor, the program manager cannot ignore the possibility that events sometime occur that cause the termination of the relationship. Therefore, it may be in the government’s interest to purchase the necessary data rights that will enable it to re-compete the production contract in the future. In addition, certain data rights may be required for future iterations in an evolutionary acquisition program.

l. Required Testing and Equipment Acceptance Conditions.

(1) Types of testing the deliverable should undergo before being accepted by the government.

(2) Who tests the delivered equipment?

(3) If each delivered item will not be tested:

(a) What sampling technique will be used to select the items that will be tested?

(b) Who implements the sampling technique to select the items to be tested?

m. Information needed to continue into Full-Rate Production.

(1) Cost of first unit.

(2) Learning curve.

n. What the government shall provide.

(1) Manpower (e.g., to provide or receive training, maintenance, expertise, etc.).

(2) Equipment (e.g., Bradleys, HMMWVs, manufacturing tools/equipment, etc.).

(3) Information.

(4) Funding.

o. Applicable regulatory requirements. Examples may be:

(1) Small business requirements.

(2) Minority owned business requirements.

p. Option Clauses.

Optional contract clauses which may be exercised at the government's discretion may be desirable.

(1) Increase in number produced due to excessive deliverable failures or the production process does not demonstrate readiness to proceed to full-rate production.

(2) Acquire production equipment or facilities if it becomes necessary to re-compete production contracts in the future. See the discussion in section "k. Data Rights" above.

q. Contract Termination Conditions.

(1) Production line capabilities at the end of the LRIP contract.

(2) Logistics systems and capabilities.

2. Warranty/Guarantee

What happens if a deliverable (i.e., part, entire unit) becomes inoperable? Issues that should be addressed in the contract are below.

a. Types of problems covered by the warranty and their causes.

(1) Defective parts.

(2) Poor construction.

(3) Poor design.

(4) Poor/incomplete training.

(5) User error.

(6) Damage to other equipment caused by failure of warranted item.

b. Handling of inoperable parts/units.

(1) Will the deliverable be repaired/refurbished or replaced?

(2) Where will the repair work be performed (e.g., the factory, a depot, or the operational unit)?

(3) Within what time period should repair parts be shipped from the repair location?

(4) Within what time period should repair parts be received by the receiving location?

(5) Within what time period should the equipment be repaired, tested, fully operational and back in the force?

c. Transport/shipping of inoperable parts/equipment and associated TDY costs.

(1) To repair the inoperable parts/equipment, who pays for its transport/shipping from the operational units (i.e., location where problem is discovered) to the depot or manufacturer (i.e., repair location)?

(2) After repair, who pays for the transport/shipping of inoperable parts/equipment from the repair location back to where it should be (e.g., the operational unit, depot, storage facility, LSI or other contractor)?

(3) Who pays for TDY costs associated with repairs? TDY costs include the transport of people and diagnostic and repair equipment/tools?

d. Labor & materials.

(1) Who supplies the labor, materials, diagnostic equipment, and repair tools/equipment?

(2) Who pays for the labor, materials, diagnostic equipment, and repair tools/equipment?

e. Duration of warranty.

(1) How long will the warranty/guarantee be in effect?

(2) Conditions/occurrences that could increase the duration of the warranty (e.g., excessive number of failures)?

3. Training

a. Number and type of personnel needing training (e.g., operators, maintenance personnel, active duty, civilians).

(1) Operators.

(2) Maintenance personnel.

(3) Active duty.

(4) Civilians.

b. Types of training required for each type of trainee listed in "a. Number and type of personnel needing training" above.

(1) In operational environment.

(2) In developmental lab.

(3) M&S.

(a) Full-size mock-up.

(b) Computer-based.

(4) Combination (e.g., M&S and operational).

c. Who will perform the training?

(1) Will contractor personnel train all government personnel?

(2) Will contractor personnel train a cadre of government personnel who will then train all other personnel?

(3) Will government personnel perform all training?

d. Location of training.

(1) Supplier's facility.

(2) LSI facility.

(3) Government facility or operational unit.

e. Schedule of training (total time for training all soldiers).

(1) Beginning and end dates of training.

(a) Date training for the first soldier will begin.

(b) Date training for the last soldier will end.

(2) Number of soldiers completing training in each month.

(a) Example: Sep 09—10 soldiers, Oct 09—15 soldiers, etc.

f. Duration of training (per soldier).

(1) Length of training course (e.g., 4 weeks).

(2) Number of man-hours and schedule of training.

(a) Example: Training Course will require 40 hours, 20 hours in week 1, 10 hours in week 2, and 5 hours each in weeks 3 and 4.

g. Training materials to be used and format of training.

(1) Written materials (e.g., training books, posters, etc.).

(2) Modeling and Simulation (M&S)—full-size mock-up.

(3) Modeling and Simulation (M&S)—computer-based models.

h. Training materials & infrastructure to be delivered.

(1) Written materials (e.g., training books, posters, etc.).

(2) Training facility (e.g., M&S facility).

(3) Exercises and procedures.

i. Metrics to measure levels of training/competence and/or to ascertain when training is completed.

(1) Written exam—multiple choice, short answer, essay, True/False, etc.

(2) Oral exam—single tester, committee/group questioning, etc.

(3) Operational exam.

(4) Objective vs. subjective grading.

(5) What score is considered passing?

4. Incentives (Awards) and Disincentives (Penalties)

Depending on the type of contract issued (e.g., Fixed-Price Award-Fee, Cost-Plus Incentive-Fee, etc.), the government may have a series of incentives/awards for outstanding performance and disincentives/penalties for unsatisfactory performance.

As mentioned earlier, there are two broad categories of performance metrics: (1) pass/fail, in which the deliverable either satisfies or does not satisfy the requirement, and (2) range of acceptability, in which there might be a minimum acceptable performance level (which might be zero), but a higher score does a better job of satisfying the requirement than a lower score (or vice versa). It is appropriate to use awards and penalties for a contractor's performance on "range of acceptability" metrics. For pass/fail performance parameters, using awards is not appropriate. However, if the deliverable does not pass a KPP, then the contractor has not satisfied the contract and, therefore, penalties might be appropriate.

a. Schedule acceleration or schedule slippages.

(1) Deliveries.

(2) Training.

b. Quality shortfalls.

(1) Type of failure, including metrics determining type of failure (e.g., partial vs. catastrophic).

(2) Frequency of failures (Mean Time Between Failures (MTBF)).

c. Cost management if a Cost-Plus contract.

5. Forms of Compensation

Clearly, government compensation to contractors will be in some form of cash. Payments made by the contractor to the government, however, may take different forms. The form of payment should be considered and addressed in the contract.

a. Cash or discount for future contract performance.

b. Extension of warranty/guarantee or some other aspect of the contract.

6. “Order of Precedence” Clauses

An “order of precedence” clause defines the order of the individual contract documents. It states which document’s provisions will take precedence in the event of contract ambiguities. These may be used to resolve problems or omissions in previous FCS contracts, as well as to prevent confusion over interpretation of the LRIP contract. Of course, precedence clauses will only work if the previous omission or ambiguity is clarified in the LRIP contract.

B. Management Information to Be Provided to the Government

1. Requirement for an Earned Value Management System (EVMS)

In order to effectively manage the acquisition contract, it is necessary to monitor contract performance and implement appropriate risk mitigation strategies. One effective tool used by the DoD and defense contractors to assist program managers in monitoring contract performance is an Earned-Value Management System (EVMS). DoD policy requires Earned-Value Management (EVM) implementation (although not a formally validated EVMS) on all cost or incentive contracts and subcontracts valued at $20 million or more. It requires a formally validated and accepted EVMS on all cost or incentive contracts and subcontracts valued at $50 million or more (DCMA, 2006).

Since the specific information collected to implement an EVM system depends on the individual contract and its work breakdown structure (WBS), it is not reasonable in this paper to address the specific managerial information that should be collected to effectively manage the Spin Out 1 LRIP contract(s). However, the Defense Contract Management Agency (DCMA) can be quite helpful in ensuring that an effective EVMS is employed, including receiving periodic progress reports and having online access to contractor earned value data.

The DCMA is the DoD’s Executive Agent responsible for verifying initial and ongoing supplier compliance with EVM guidelines. It has already validated many defense contractor manufacturing facilities’ EVMS or determined that they are compliant with DoD requirements.[4] In addition to validating EVM systems, the DCMA can perform other acquisition functions for program managers, as well. The DCMA provides various services:

Before contract award:

- Contract structure and content formulation
- Pre-contractual advice and consultation
- Source selection activities
- Supplier capability assessment
- Cost/schedule risk assessments

After contract award:

- Compliance evaluations of suppliers' EVM systems
- Assistance with identified deficiency reviews
- EVMS surveillance to ensure data integrity
- Integrated Baseline Review (IBR) support
- Ongoing program surveillance

The DCMA is already being used by some FCS program offices, so they are already familiar with the program.

[4] EVMS validation is awarded to a manufacturing facility, not a defense contractor as a whole. Therefore, if a defense contractor has five manufacturing facilities, each of the five facilities' EVMSs must be validated. Among the defense contractors who have a number of manufacturing facilities that have received EVMS validation are BAE Systems and General Dynamics Land Systems, two main contractors for Spin Out 1 systems.

2. EVM Explained[5]

While this paper cannot provide in-depth coverage of Earned Value Management, a brief explanation of the information provided by an EVM system is provided to show its importance in managing a program.

Earned Value (EV) is a management technique that uses cost, schedule, and progress to determine variances from planned profiles. EVM tracks and monitors cost and schedule. As the program progresses, managers can use it to determine if the program is on schedule and on budget. Program managers can also use it to obtain objective cost and schedule trends to predict, with some degree of confidence, actual cost and schedule at project/contract completion.

EV does not measure or quantify performance objectives such as quality. Therefore, other standards must be developed to measure quality. For this reason, contracts also require the KPPs outlined in the CDD and discussed in section "A. Information to Be Included and Issues to Consider for Materiel Delivered" above.

As stated earlier, an EVMS collects and monitors data on the budgeted cost (i.e., value) of work performed (BCWP) from the beginning of contract execution to a certain date, the actual cost of work performed (ACWP) over the same period, and the budgeted cost of work scheduled (BCWS).

Through a series of formulas and ratios, EV compares planned budget expenditures and work schedules to actual expenditures and work completed to determine whether the program is ahead of schedule, on schedule, or behind schedule.

For example, if the program schedule states the work scheduled to be completed by a certain date was budgeted to cost $40, then the budgeted cost of work scheduled (BCWS) is $40. If the program has actually spent $55 for the work

[5] For a more detailed discussion of EVM in the context of government acquisition programs and government requirements for an EVMS, see DCMA's *Earned Value Management Implementation Guide* and *EVMS Standard Surveillance Operating Manual*, and Garrett and Rendon, chapter 8.

performed to date, then the actual cost of work performed (ACWP) is $55. It appears that the program has a cost overrun of $15. But that is a simplistic way to view the program’s status because all it considers is cost. It does not consider the amount of work completed. Now assume that the program had budgeted $50 for the work that has actually been completed. Therefore, the budgeted cost of work performed (BCWP) is $50. As shown in Figure 2 below, by applying some basic EVM formulas, the program manager can determine that the program is ahead of schedule, which is one of the reasons the program has incurred higher expenses than planned/budgeted at this point. He/She can also see that, for the work already performed, the program is over budget, but only by $5, not the $15 originally thought. Figure 3 is a graphical representation of the cost variance and schedule variance described in this example.

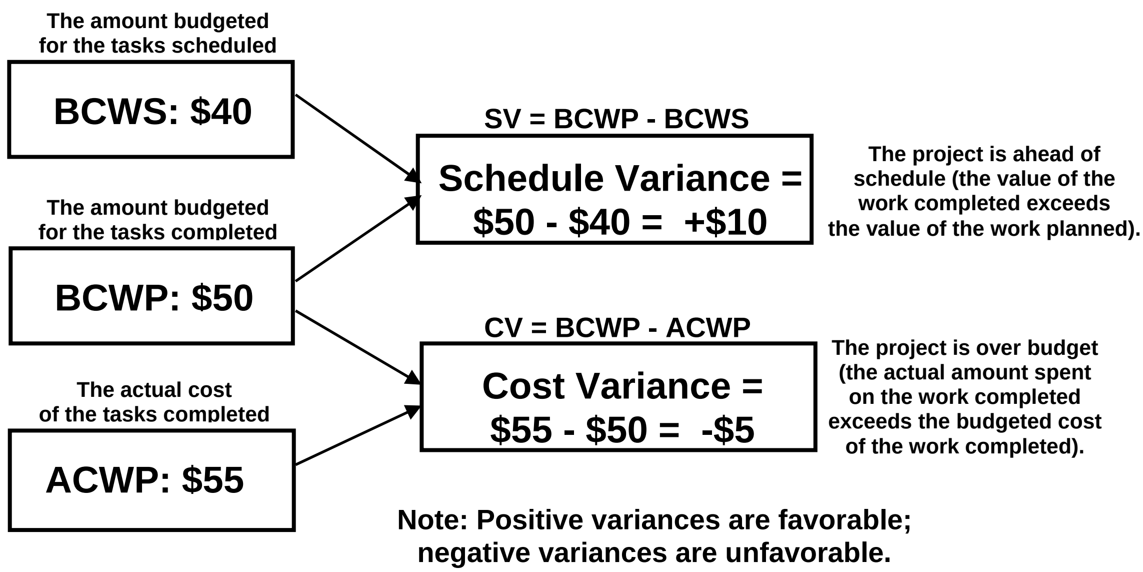

Figure 2. Earned Value Management Example—Equations

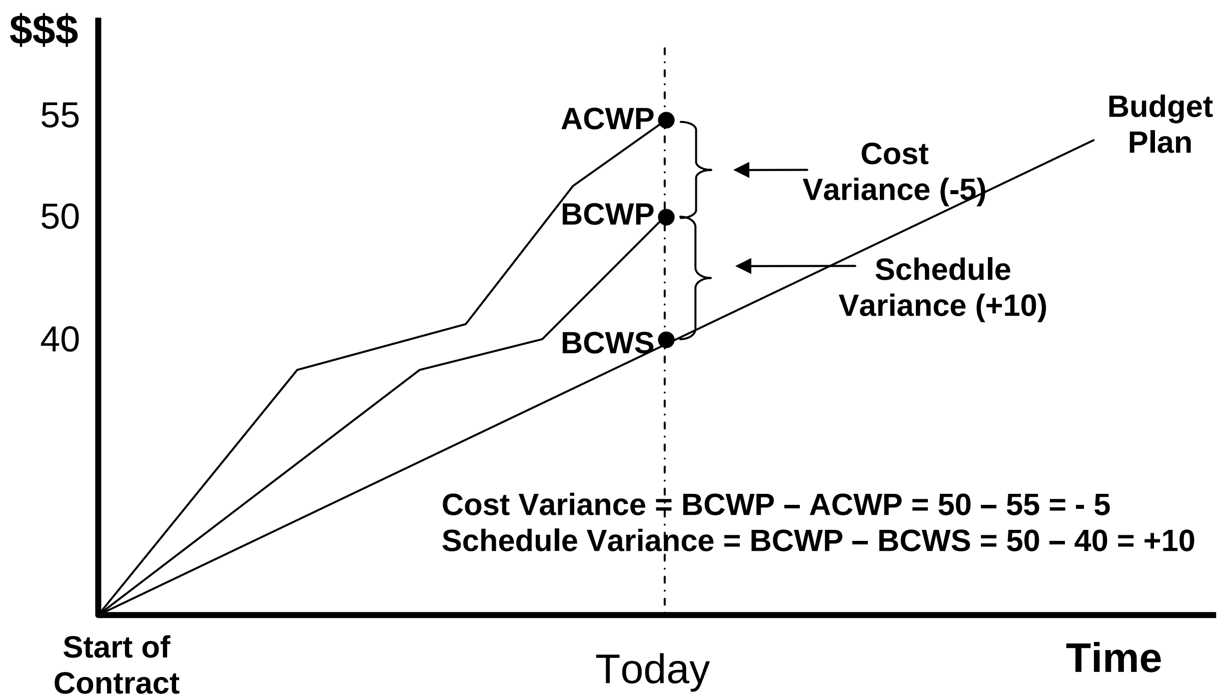

Figure 3. Earned Value Management Example—Graph

Earned Value can also be used to determine how efficient the contractor is with respect to cost and schedule. The Cost Performance Index (CPI) measures contractor cost efficiency.

$$\frac{Value\_of\_Work\_Performed}{Actual\_Cost\_of\_Work\_Performed} = \frac{BCWP}{ACWP} = \frac{50}{55} = 0.91$$

The Schedule Performance Index (SPI) measures contractor schedule efficiency.

$$\frac{Value\_of\_Work\_Performed}{Value\_of\_Work\_Scheduled} = \frac{BCWP}{BCWS} = \frac{50}{40} = 1.25$$

Indexes (CPI and SPI) less than 1 are unfavorable (i.e., cost overrun or behind schedule). Indexes greater than 1 are favorable (i.e., cost savings or ahead of schedule).

The above information is only a sample of the information program managers can obtain from an EVMS. EVM uses additional data and many other formulas to provide program managers useful information concerning program status. Clearly, EVM is potentially a valuable tool for program managers. If designed properly, an EVMS can provide cost and schedule insights not otherwise readily available.

IV. Conclusion and Recommendations

Contract terms and conditions and defined program key performance parameters are the main methods of controlling risk. Therefore, in addition to preparing for Full-Rate Production, the terms and conditions of the LRIP contract should, to the maximum extent possible, address all issues and potential problems that could arise from the beginning of contract execution through the integration of the materiel delivered into the force and contract termination. This means that in addition to requiring the production and delivery of the desired goods, services, or systems, the contract should also require an Earned Value Management system that provides the information necessary to effectively monitor the progress of contract performance, detect and identify potential problems early, and manage contract execution.

The LSI approach to complex, large-scale systems acquisition has received a significant amount of criticism. Consequently, from a political perspective alone, it is reasonable that a program manager would be interested in determining the best time to phase out the use of an LSI and have the government assume all acquisition management responsibilities. For several reasons, the LRIP phase of the acquisition process seems like a suitable time to do so.

Since Milestone C approval is necessary prior to issuing an LRIP contract, it is assumed that all systems being acquired in Spin Out 1 are determined to have:

1. acceptable performance in development, test and evaluation, and operational assessment,
2. mature software capability,
3. acceptable interoperability,
4. acceptable operational supportability,
5. an approved CPD,
6. no significant manufacturing risks, and

7. acceptable affordability throughout the lifecycle.

Therefore, much of the risk associated with the systems included in Spin Out 1 has been resolved. As a result, this is probably a good point to reduce the role of the LSI for the Spin Out 1 systems and for the Army to assume more of the acquisition management functions for these systems. However, if the reasons that lead the Army to use the LSI approach in the first place are still valid,[6] then it might be prudent to continue using the LSI through LRIP.

Alternatively, if the Army still believes its acquisition workforce cannot handle all the necessary functions, it may be able to take advantage of the Defense Contract Management Agency to assist with the acquisition functions for which the Army thinks it can use assistance or to provide additional manpower or expertise. The DCMA offers many services from pre-contract award functions to post-contract award functions, including assisting with contract development, validating EVM systems to assist program managers in tracking contract execution progress and identifying potential problems early, and monitoring contracts.

[6] The principal reasons the Army used the LSI approach at the outset of the FCS program were to take advantage of private industry's flexibility with respect to its (1) human resource capabilities (i.e., speed and ease of recruiting and hiring people with specialized skills), and (2) subcontract management practices. (Flood & Richard, 2006)

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