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Early Lessons Learned from the Army's Future Combat Systems Program (FCS): Developing an Appropriate Contractual Arrangement with Industry, Establishing an Enabling Program Management Structure and Test Organization

30 September 2007

by

Lieutenant General (U.S. Army Retired) Joseph Yakovac, Senior Lecturer

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Prepared for: Naval Postgraduate School, Monterey, California 93943

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Abstract

The Future Combat System (FCS) program is, without a doubt, the most challenging modernization program ever attempted by the Army. The requirement defines the need to develop and field a fully integrated system-of-systems consisting of manned ground vehicles, unmanned ground systems, and unmanned aerial systems—all connected by a complex network. The program is in its fifth year of System Development and Demonstration. Despite two restructures, due to reprioritizations of dollars within the Army and budget cuts imposed by Congress, the program remains on schedule to deliver capability to the current force in 2010 and, by 2017, to field a fully equipped FCS brigade combat team. To date, most articles, studies, and reports on FCS have focused on the complexities of the task of developing and fielding a system-of-systems and on the unique contractual arrangement between the Army and the program's lead system integrator. This paper provides early lessons learned from the FCS program that may be useful to acquisition professionals facing the challenges of managing the complexity inherent in 21st-century Department of Defense programs.

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Acknowledgements

The Future Combat Systems program's early success is the result of a dedicated and professional Army acquisition and requirements-generation workforce. My experience in doing the research for this paper has reinforced my admiration and respect for everyone associated with this monumental effort.

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About the Author

Joseph Yakovac spent the last 16 years of his active duty military career in the Army Acquisition Corps. His last assignment was as the "Military Deputy to the Assistant Secretary of the Army for Acquisition, Logistics, and Technology" in the grade of Lieutenant General.

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Executive Summary

The Army's Future Combat Systems program is generating many lessons learned. This paper attempts to capture three of them: (1) selecting the appropriate contractual arrangement with industry for a complex program, (2) developing an appropriate management relationship, and (3) establishing a truly integrated test organization.

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Introduction

A web search on the FCS program provides over 1.45 million hits. The majority of them focus on the advanced warfighting capabilities enabled by the advanced technologies of the program, though this number also includes numerous papers and reports about the execution of the program and the concept/performance of the Lead Systems Integrator. The search produces very little about the fact that the program is progressing very well and is, after four-plus years, on-cost and within schedule. The program's official June 2007 *Cost Performance Report* shows a cost performance index of 100% and a schedule performance index of 99.2% (FCS, 2007, June 1-June 28). Three recent press releases also support the previous statement. The first two pertain to the family of manned ground combat systems. They announce the decision to build the lead manned combat vehicle system, the Non-line-of-sight Cannon, at Elgin, Oklahoma, beginning in 2010 (Boeing, 2007, August 8), and the successful demonstration of the common hybrid electric drive system for the entire family of vehicles (BAE Systems, 2007, August 15). The third, and probably the most important, sign of progress is the announcement of the successful completion of FCS Experiment 1.1. The experiment was designed to conduct a live-fire exercise with FCS technologies, such as "urban and tactical unattended ground sensors and unmanned vehicles," linked by an advanced network (Army News Service, 2007, February 2). "The future is now," stated MG Charles Cartwright, the FCS Program Manager. "Today's exercise is further confirmation that the FCS program is working as planned" (2007, February 2).

The integration requirements of the FCS program reflect the general movement of 21st-century Department of Defense programs toward a greater degree of complexity. Therefore, the early successes of the FCS program may provide useful lessons learned to other complex programs—either those currently in the research and development phase or those about to get started. This paper focuses on a subset of the many emerging lessons learned from the FCS program, with the

intent of making the information available to current and future program mangers of complex systems so they can benefit from the FCS experience.

Drawn from the researcher's own personal experiences with the program and from discussions with the current program leadership, this paper will highlight three main areas contributing to the early successes of the program: (1) establishment of an appropriate contractual relationship with industry tailored to the requirements of the program, (2) development of a program management structure that enables the successful execution of FCS and (3) establishment of an enabling test structure. The purpose of this paper is to provide lessons learned on how/why these three strategies were developed and to gain some insight into the internal Army processes that led to their development.

Determining the Appropriate Contractual Arrangement for FCS

Background

The most recent Government Accountability Office (GAO) report on the Future Combat Systems (FCS) was directed by Congress to examine "the participation and activities of the Lead Systems Integrator in the Future Combat Systems (FCS) program under the contract of the Army for the Future Combat Systems" (GAO, 2006, sec. a). The GAO report recognizes "that the scope and complexity of the FCS system-of-systems creates a business relationship that is not typical of other weapon system acquisitions" (GAO, 2007, June, p. 4). The purpose of this section of the paper is to provide the true rationale behind the Army's decision to use a Lead Systems Integrator on the FCS program and to explain why it was the right choice. In fact, FCS may prove to be the only program of record in which such a unique contractual arrangement is the correct relationship between the government and industry.

The GAO report states the rationale for pursuing a Lead Systems Integrator (LSI) in the FCS program was that "The Army determined that with its existing acquisition workforce and organizations, it did not have the agility, capability, or capacity to manage the program without an LSI to assist with certain aspects of program management" (2007, June, p. 6). In addition, the report explains:

> The Army determined it could not meet the challenges of the FCS scope and accelerated schedule with its workforce alone and with traditional management approaches. Army leadership saw its workforce as stovepiped into organizations having areas of expertise that were not a full match for what FCS needed and not large enough with the right skills to staff several separate program offices. (2007, June, p. 7)

Although there was much discussion about the ability of the acquisition workforce to properly manage and deliver FCS, that issue certainly was not the deciding factor in the selection of the LSI arrangement.

Contrary to popular belief, the FCS program did not start with a SDD contract in May of 2003. In 1998, the Army was being pressured to transform into a force more appropriate for the emerging challenges of the 21st Century. The emerging lessons learned from the Balkans (as well as from other circumstances throughout the post-Cold War world) were beginning to influence the thinking of the Army's Training and Doctrine Command about both near-term and future operations and the capabilities the Army would require to fulfill its mission. Simultaneously, the Army entered into an agreement with the Defense Advance Research Projects Agency (DARPA); this agreement served to invite the defense industry to offer its ideas on both the structure of a future Army brigade designed to meet the emerging threats, as well as the technologies necessary to support revolutionary warfighting capabilities—including unmanned ground and aerial systems. This initiative led to contracts with four industry teams. The general timeline envisioned was to provide the new capability by 2015 to 2020. In the meantime, Army transformation for the near-term was defined in October 1999 by the now-established Stryker Brigade Combat Team concept, which was outlined in context of the broader vision of the Army's Objective Force (Objective Force Task Force, 2007). Then, the Bush Administration took office in January 2000 and made military transformation a priority; at that point, pressure was exerted on the Army to move more quickly to define its future.

The vision of a FCS-based unit (to be completed by the end of 2010) was laid out in a speech by the Chief of Staff of the Army in October 2000. This was really a further clarification of the Army's road to the Objective Force. The new concept was to be the next material and unit redesign step beyond the Stryker Brigade Combat Team toward the Army's Objective Force. The FCS program was to leverage the work of the DARPA/Army initiative started in 1998. The work on the program now known as the FCS Brigade Combat Team began immediately after the speech.

The Beginning of the Lead Systems Integrator Concept

Beginning in the late fall of 2000, the Training and Doctrine Command, under the leadership of General John Abrams, began the difficult task of defining the requirement for an FCS Brigade Combat Team. The document would go through many iterations; the first Statement of Required Capabilities was ready in November of 2001 (Schenk, 2001, November 8-9). This document would form the basis of the current FCS requirements document.

Concurrently, in the spring and summer of 2001, the Objective Force Task Force, under the leadership of LTG John Riggs, began to work with the DARPA/Army team toward fielding the initial FCS capabilities as early as 2008. The Army leadership also approached leaders in the defense industry for their ideas.

As a result, the first concept of a Lead Systems Integrator for FCS came in the early summer of 2001 from one of the defense industry companies working under the DARPA/Army FCS contract in the form of an unsolicited briefing—laying out the "why" and the "how" for such an unusual contractual arrangement. The "why" focused on industry's ability to manage the complex integration of required new technologies for manned and unmanned aerial and ground vehicles, as well as the integration of advanced networking capabilities. The "how" suggested the defense company become the program's lead system integrator.

The contractor was directed to make its presentation to the Program Executive Officer for Ground Combat Systems (PEO GCS). The PEO would become responsible for the FCS program upon its transition from the DARPA/Army contract to an Army-only contract tentatively for the Spring of 2003. The Program Executive Officer, the author of this paper, had never heard of such a contractual arrangement. His experience was limited to prime contractor contractual arrangements. Little did he know at the time that the Army leadership had tentatively accepted the concept of a Lead Systems Integrator. In the meantime, he set up a series of meetings with the Missile Defense Agency and the International

Space Station program to understand their contractual relationship with their perspective Lead Systems Integrator. Over the next two years, many of the lessons learned from the Missile Defense Agency and the International Space Station program would be applied to the Army's Lead Systems Integrator concept. The two most important lessons were as follows: ensure the requirement, when finalized, supports the need for such a contractual arrangement and that the associated contractor/management structure is well thought-out—with responsibilities clearly defined in advance of signing the contract.

In September 2001, the Secretary of the Army and the Chief of Staff approved, based on recommendations from the Objective Force Task Force, the Army Staff, the Army Secretariat, and the Training and Doctrine Command, the following (Schenk, 2001, August):

1. Accelerate FCS to MSB in April 2003
2. Solicit for a LSI
3. Put an AAC GO in charge

Based on Recommendation 2 above, the Program Executive Officer and his staff had approximately 18 months to follow the progression of the requirement and to work on the management concept. Meanwhile, the newly assigned Brigadier General Program Manager began to work with the DARPA/Army team to transition its program to a Concept Development and Technology phase. This was to be completed under a single contractor or contractor team that could potentially become the Lead Systems Integrator at the Milestone B decision.

A competition was held under DARPA leadership; the Boeing Company was chosen to take the program through the Concept Development and Technology phase. The contract was awarded on the March 14, 2002. Although there were numerous tasks to be performed, the most important for the purposes of this paper is outlined below:

1.2.2	Requirements Development and Documentation	The US Army Training and Doctrine Command (TRADOC) is responsible for requirements determination, development, analysis and documentation. The LSI will provide support to TRADOC as required for the definition of the operational requirements and organizational design for the Unit of Action (UoA) in the UoA O&O plan, establishment of the Operational Architecture within which the FCS-equipped Unit of Action operates, and defining the system of systems elements and their capabilities in the FCS Operational Requirements Document (ORD). The LSI will support TRADOC to develop the System Training Analysis Plan (STRAP), analyze training needs and requirements and provide recommendations for training products and processes. These projects and process will encompass institutional, individual and unit training for soldiers and leaders. TRADOC will provide each published draft version of all requirements documents, in accordance with the Army's Transformation Campaign Plan, to the LSI during the requirements development process to ensure concurrent materiel development and concept/technology demonstration activities are performed IAW user requirements. The LSI, in support of TRADOC, will assist in developing those documents as well as assist in assessment, analysis, war-gaming, and evolution of requirements throughout the program life cycle. This includes support for the alternative analyses of military worth Analysis of Alternatives (AoA). The LSI is responsible for ensuring requirements traceability to the source documents as described in Concept Development above.

Table 1. FCS Contract
(Boeing, 2002, March 14)

Contrary to many reports on the FCS program, the LSI was never responsible for the requirements document. As stated above, the work accomplished by TRADOC, with support from the LSI, was going to be a key factor in determining the continued need for a LSI beyond the Concept Development and Technology phase.

The Requirement, Confirmation of the Need for a Lead Systems Integrator

As previously stated, the initial DARPA/Army competition to select a potential Lead Systems Integrator was supported by a Statement of Required Capabilities (SORC), not an Operational Requirements Document (ORD). Although the SORC sustained the decision by the Army leadership to plan on using a LSI, the final decision would be part of the Milestone B decision. The acquisition professionals now in charge of the development and acquisition of FCS understood the need for the ORD to justify such a departure from the accepted prime/government contractual arrangement. In fact, the newly assigned PM for FCS sent a cautionary note to both the acquisition leadership and the Objective Force Task Force on rushing into a decision on the LSI concept. He stated, "I caution that because the differences between an LSI and a prime with Total Systems Performance Responsibility are vague, it will be difficult to gain consensus on its added value to the effort" (Schenk, 2001, August 25). He further added, "[I]t seems to me that it is incumbent on

TRADOC to deliver the needed pieces of the requirements generation process to allow the programs to proceed to the leadership's desired pace" (2001, August 25).

The TRADOC effort began in earnest in the fall of 2001. The acquisition community strongly supported the entire process. In many instances, community members' input was inserted directly into the emerging ORD. In June of 2002, the commander of TRADOC held a week-long session with all of his leaders. Once again, the acquisition community was well-represented. And once again, its members' input was utilized by the TRADOC team. The results of that week clearly identified the need for a Lead Systems Integrator for the FCS program. The exact nature of the contract would not be evident for approximately 15 months, but its scope was beginning to take shape.

The chart below depicts TRADOC's final ORD:

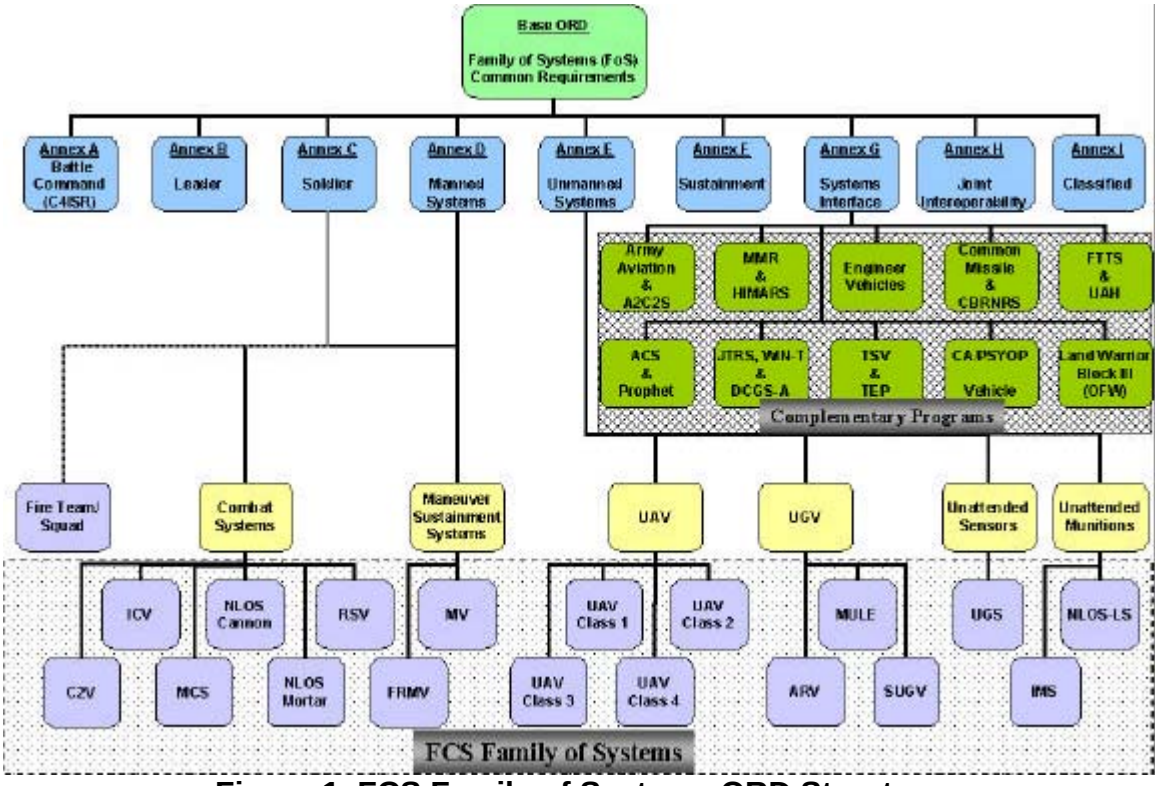

Figure 1. FCS Family of Systems ORD Structure
(United States Army Training and Doctrine Command, 2003, April 14, Figure 1.1-3)

Another way to view the requirement is shown in Figure 2 below.

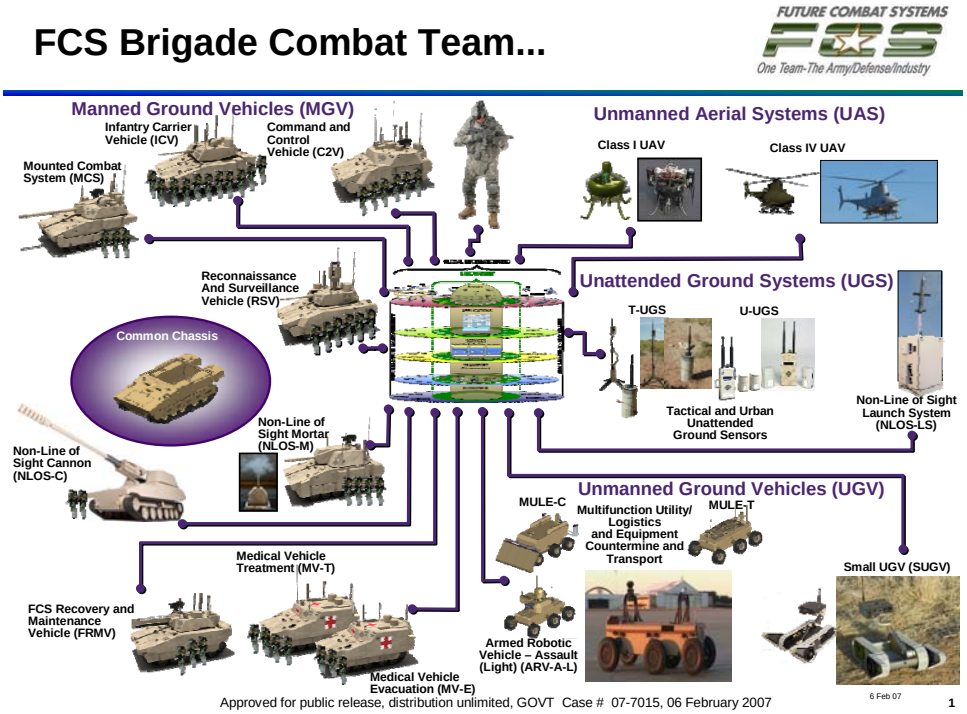

Figure 2. FCS Brigade Combat Team
(FCS, 2007, February 6)

Figure 2 captures the current program's baseline and differs slightly from Figure 1. But, the majority of the requirement has remained unchanged since Milestone B.

For those readers not familiar with traditional ORDs, the structure of FCS is very unique. It describes the requirement (refer to Figure 1) for a system-of-systems whose parts are subservient to the requirements identified in Annexes A (Battle Command C4ISR) through I (Classified). The system-of-system annexes had approximately 535 specified requirements; these were meant to flow down to the piece parts (such as Combat Systems, shown in the blue boxes). The other major distinguishing feature is its Complimentary Systems (identified in the entire green, shaded area). For the first time, other systems being developed outside of the program were now tied directly to FCS. It was now obvious to the majority of

acquisition leaders that an unique contractual arrangement with an industry partner would be necessary to deliver the warfighting capability described in the FCS Family-of-systems ORD Structure. Immediately after the discussion week in June, plans began to take shape in earnest to structure a very distinctive contractual arrangement with the DARPA/Army-chosen LSI. As a side note, the LSI approach also required program leadership to think through the roles of government in this unique relationship and determine how the government could maintain both strong management and oversight functions. The final two sections of the paper will continue to discuss those roles.

Lessons Learned

(1) The complexity and costs associated with most major acquisition programs in the Department of Defense require a close working relationship between the requirements and acquisition communities from day one. Every day the program proceeds without it will eventually lead to cost and schedule delays and will potentially negatively influence overall expected system performance.

(2) Complexity also requires a tailored approach to the type of contractual arrangement between government and industry. The contract must be structured to meet the requirements of the program as articulated in the requirements document. Classic, prime relationships will normally be sufficient, but management should never close the door to other types of relationships—including the use of a Lead Systems Integrator. The FCS requirement demanded such a "tailored" LSI approach. No other consideration (such as the competency of the government workforce) should influence the approach selected. The nature of the requirement should be *the only* factor considered in the decision process. As will be discussed later, the roles of government and industry can then be defined.

(3) It is incumbent upon the acquisition community to leverage lessons learned from similar programs already in existence at the very startup of a new program. It is the author's experience that acquisition professionals are somewhat reluctant to talk amongst themselves. Maybe this is because we have historically worked with programs which did not require integration across functional areas, or that we saw low-tech Army ground programs having

little or nothing in common with Air Force, Navy, or large DoD programs. In most major programs, those days of low-tech are over. The lessons passed on by the Missile Defense Agency and the International Space Station leaders were invaluable to the acquisition leaders of FCS.

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Establishing an Enabling Program Management Structure

The second element in Section 115 of the *John Warner National Defense Authorization Act of Fiscal Year 2007* directs the Comptroller General to provide: "a description and assessment of the responsibilities of the Army in managing the Future Combat Systems program, including oversight of the activities of the Lead Systems Integrator and the decisions made by the Lead Systems Integrator" (The Defense Advanced Research Project Agency Senate Armed Services Committee, 2006, para. (b)(2)). Although the report responding to Section 115 includes concerns about the management arrangement (primarily regarding potential conflicts between the partnering of the Army with the LSI and the Army's oversight function), it makes no recommendations to alter the relationship (GAO, 2007, June, p. 27). The purpose of this section of the paper is to provide information on the early steps taken by the government and contractor to lay the foundation for an effective program-management structure and partnering relationship.

As stated earlier, the competition for the original selection of the FCS Lead Systems Integrator was held by the DARPA/ARMY program. There was active participation by the Army—both in the Request for Proposal preparation and the source-selection process. However, once the contract was drafted, two things had to occur simultaneously to make the Milestone B date of April 2003. First of all, the chosen contractor team of Boeing and its subcontractor, SAIC, had to satisfy the terms and conditions of the Concept and Technology Development-phase contract with DARPA. Secondly, the team had to concurrently begin working with the designated Army PEO/PM team that would take over at Milestone B. The Department has historically struggled with transitioning much less challenging programs from the technology base to the program-management world, let alone a program based on a unique system-of-systems requirement and with a relatively

unusual Lead Systems Integrator relationship vice a classic prime contractor. This was, indeed, a challenging situation.

The PEO/PM team began to meet in the summer of 2002 to think through how it would build an appropriate government/LSI management structure to meet the cost, schedule, and performance parameters of the FCS System-of-systems program. By August of that summer, the team was prepared to make its first decision briefing to the Army Acquisition Executive on its proposed approach and the issues associated with it. The briefing covered not only the proposed framework of the PM shop and its responsibilities, but the recommended role of all Army PEOs, the Defense Contract Management Agency, the Army's Test and Evaluation Command, the Army Material Command's Research and Development Command, TRADOC and, finally, DARPA—the organization then currently in charge of the program. With minor exceptions, the majority of the plan was approved. Now the hard work of deciphering the duties and responsibilities of the LSI could begin.

A meeting was scheduled through the DARPA/Army project manager between the PEO GCS and representatives of the LSI management team. The only guidance to them was to present what they thought their scope as the Army's LSI would be, as well as what management and oversight they anticipated would come from the government. Unfortunately, to the government representatives, it was obvious that the LSI envisioned its role as a very large prime contractor. The meeting ended with both sides knowing that some guidance needed to be established; only then could the leaders of both parties give some direction to the perspective personnel to guide them both in structuring the roles of the LSI and the System Development and Design phase, as well as in laying the foundation for the role of both after Milestone C.

After that first meeting, the leaders of both organizations decided that a group of guiding principles (or program tenets) were necessary to provide the basis upon which the workforces could build a contractual relationship and management

structure. The tenets below are the fruits of that decision. Early in its reply to the Section 115, the GAO states:

> The Army established a number of key tenets that it wanted to achieve on the FCS program, in partnership with the LSI. They include:
>
> - create opportunity for best of industry to participate;
> - leverage government technology base to maximum extent;
> - associate ongoing enabling efforts with LSI-led activity;
> - maintain a collaborative environment from design through life-cycle;
> - as a minimum, achieve commonality at subsystem/component level;
> - design/plan for technology integration and insertion;
> - maintain and shape the industrial base for the future;
> - retain competition throughout future force acquisition;
> - have appropriate government involvement in procurement processes;
> - achieve consistent and continuous definition of requirements;
> - maintain and shape government acquisition community;
> - achieve program affordability—balance performance and sustainment; and
> - have a "one team" operating with partnership and teamwork. (2007, June, p. 5)

Unfortunately, the GAO failed to do more than mention the tenets in its report; yet, these tenets became the foundation for the contract as well as the management relationships that exist today between the all government players and the Lead Systems Integrator.

Their importance to the program has been evident since they were established. For example, as a result of the tenet, "create opportunity for the best of industry to participate," all major subcontractors on the program were competitively

selected by a combined LSI/government team, with the Army's Acquisition Executive as the final approval authority. This is one major area that separates a LSI from a prime contract. The LSI members build/provide little, if anything, for the program unless it is competitively awarded. (Footnote: There is one exception to this tenet that was awarded under the DARPA/Army contract with concurrence of the Army.) Another example of the critical nature of the above-listed tenets was the noncompetitive selection of General Dynamics and United Defense as the manned ground vehicle integrating team as a result of the tenet to "maintain and shape the industrial base of the future." As these corporations were the providers of all the Army's current inventory of manned combat platforms, government management made the decision to maintain that portion of the base. Yet, it demanded competition at the manned ground vehicle major subsystem level to bring new, high-tech suppliers into the business.

The above tenets are alive and well in the program today. In a recent interview with the Army and LSI program managers, they stated that the tenets established at the outset of the government and LSI relationship are the baseline that government and LSI leaders still follow today. The tenets focus the leadership on management of the program, not the contract (Cartwright & Muilenburg, 2007, August 21). These managers further state that the successful and timely restructurings of the program since 2003 (due to the Army's changing priorities, the impact of the war on Army near-term requirements, and Congressional cuts) would not have been possible without the partnering relationship that exists between the Army and the LSI. The above tenets set the foundation for both (2007, August 21).

Lessons Learned

(1) The leaders of the FCS program office realized from the time they were given the acquisition lead that program success was only possible with the support of the entire acquisition community. From day one, the planning for Milestone B and beyond was effected in collaboration with strategic partners—including all Army PEOs, the Army's Test and Evaluation Command, the

Defense Contract Management Agency, the Army's Research and Development Command and the Army's Training and Doctrine Command. The initial decision briefing to the Army Acquisition Executive was truly a team effort. Along the way, additional team members were added to include representatives from the OSD staff, DOTE, the Cost Analysis Improvement Group, and, yes, even the Government Accountability Office. Sometimes, acquisition professionals forget that the building and executing of programs are team sports. The early successes of the FCS program are proof of the value of teaming early in the process.

(2) Rather than rushing into a contractual and management relationship with a defense contractor, acquisition community members should spend significant time determining together what both sides consider to be important for program success. As the FCS program team learned from visiting the Missile Defense Agency and the International Space Station, a lack of upfront understanding between the program's participants as to the role of the government in a Lead Systems Integrator relationship resulted in duplication of effort and, eventually, major contractual and program issues. The FCS program attempted to mitigate the confusion of program participants' roles and responsibilities by first establishing agreed-to tenets that both sides decided were important for program success. Although the FCS program has a LSI, this lesson applies to all types of contractual relationships.

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Establishing an Enabling Test Organization

> The latest GAO report states:
>
> > The LSI has a lead role in developmental testing and verification of technical requirements throughout FCS development. For the FCS program, testing and evaluation of system prototypes will be managed through a combined test organization co-led by the LSI and the Army and made of up representatives of the LSI, Army Test and Evaluation Command and the Army's FCS program management office. (GAO, 2007, June, p. 14)

The truth is, the LSI has a major role in testing (as does any prime contractor), yet the organization responsible for testing is the FCS program's Combined Test Organization (CTO). For the Army, the CTO is a unique organization. It was organized during the DARPA/ARMY CDT phase of the program to formulate the entire test strategy (including hardware and software) from early developmental through operational testing. The charter for the CTO states:

> The CTO will have the authority and responsibility for management of all FCS system level combined DT/OT Tests. The CTO will integrate, coordinate, and plan (on a broad scope) combined developmental and operational testing in accordance with the FCS acquisition strategy and the Test and Evaluation Master Plan (TEMP). The CTO will act as the single integration team for system level testing. System tests under CTO cognizance include: Production Qualification Tests (PQTs), Production Verification Tests (PVTs), Live Fire Test & Evaluation (LFT&E), and some Specialty Tests. The LSI and its subcontractors will execute a portion of the developmental testing and support operational testing in accordance with the terms of the contracts, Army regulations, and the terms of this charter. (Director CTO, p. 1)

Similar to the contractual arrangement and the management structure, the concept of an organization, rather than a traditional test directorate, was once again dictated by the requirements document. Historically, single-system testing is difficult enough, but the added complexity of system-of-systems requirements (including the network, etc.) forced the acquisition and test community leaders to think creatively.

The task of creating a test program was made somewhat easier because of the planning and execution for the Army's Stryker program. The Stryker program

was the Army's first attempt at developing and fielding a family of combat systems to support the concept of an infantry-centric mobile brigade combat team. It did not have the complexity of FCS because the basic vehicle was military off-the-shelf, and most of the major subsystems were already integrated on other Army platforms. In addition, Stryker integrated the tactical network already in use by the Army—except the Stryker Brigade required a more robust version.

As stated earlier, the PEO GCS was given the responsibility for the FCS program. The PEO GCS was also responsible for the development and fielding of the Stryker. The experience the PEO organization gained in establishing the Stryker test program was critical to the success of FCS. The other enabler of the development of the FCS's test strategy and test organization was the relationship between the Army's Test and Evaluation Command and the PEO GCS. Stryker was truly a collaborative effort from day one, and it was obvious to all involved that FCS presented an even greater challenge. Thus, the relationship between tester and material developer had to be taken to the next level.

Early in the summer of 2002, a meeting of program officials and leaders of the test community met—both to discuss the lessons learned from on-going Stryker testing and to put in motion the foundation for FCS testing. That session catalyzed the idea for a Combined Test Organization to be organized within the PM FCS program office but located at the Army's major test center, Aberdeen, Maryland. This forum also made the decision to place a seasoned, senior executive service from the test community in charge of the organization. The current organizational structure is shown below.

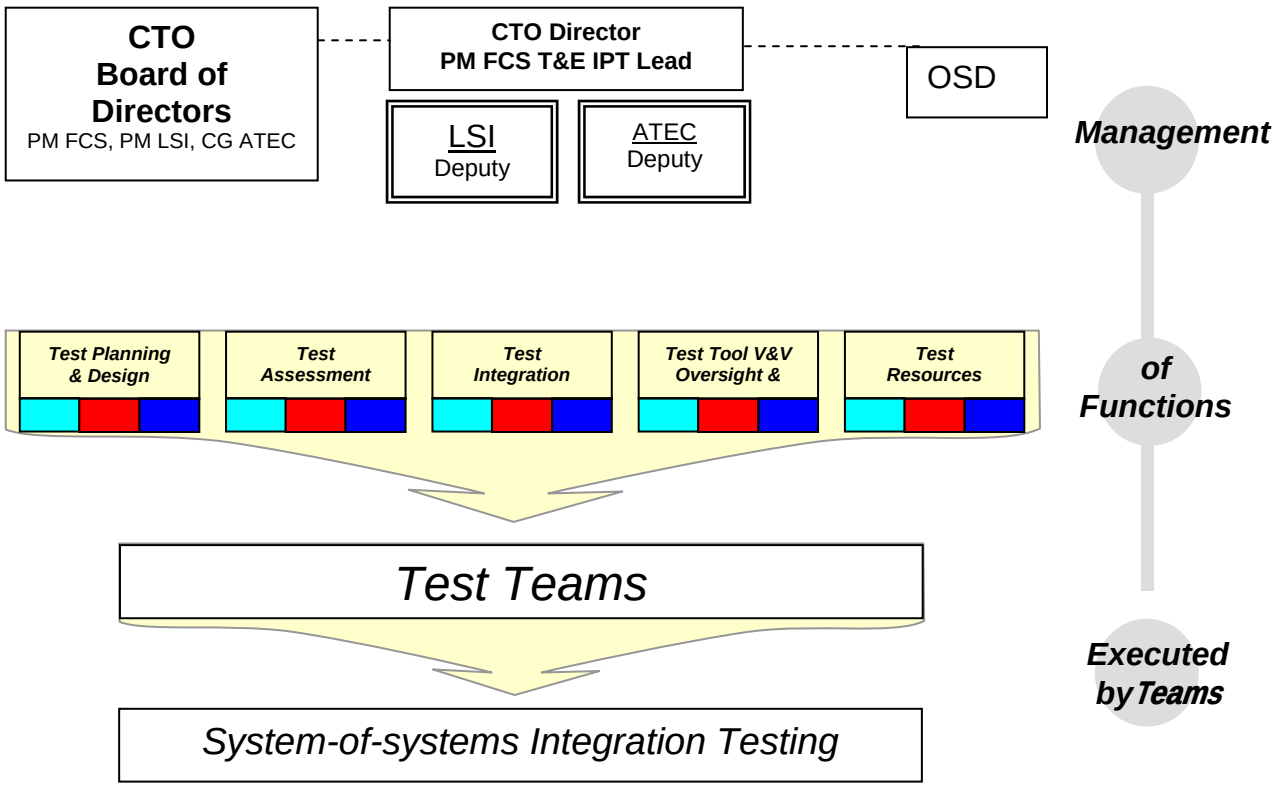

Figure 3. Combined Test Organization
(Combined Test Organization, 2006)

As the organizational chart depicts, the FCS CTO represents all of the stakeholders of the program, including a supporting relationship with Director, Operational Test and Evaluation.

From day one of the FCS test program, the challenge was not only how to effectively and economically test the piece parts, but more importantly, how to fulfill the system-of-systems requirements. The CTO, through its organizational structure and its collaborative development of a detailed Test and Evaluation Master Plan (TEMP) (over 1500 pages in length), has allowed the FCS program to execute its test strategy of "'Plan Together, Test Once, and Share the Data' by executing collaboratively across the government, the Lead Systems Integrator (LSI), and industry partners" (Combined Test Organization, 2006, April 7, pp. 2-5).

To date, testing throughout the entire FCS program is very successful. For example, the restructuring of the program (which began in 2004) to bring FCS technologies into the current force by 2010 is on track. In just a little over two years (at Fort Bliss, Texas), the program successfully conducted the first experiment to determine the readiness of the technologies and the applicability of the capabilities to the current force. Since the experiment was a live-fire exercise, the CTO had to ensure and certify that over 5 million lines of code integrated into several prototype systems were safe for use and also that instrumentation and trained personnel were in place to do the evaluation (Army News Service, 2007, February 2). The upfront focus on testing by the leaders of the FCS program, both government and LSI, and their strategic partners of the Army's Test and Evaluation Command and the Training and Doctrine Command will continue to pay dividends throughout the entire life of the program. Testing is truly a team sport!

Lessons Learned

(1) As with all other acquisition processes, testing of complex 21st-century programs requires a much higher level of collaboration among all stakeholders than did those systems developed in the 20th Century. Systems are more complex because of the combination of advanced electronics and millions of lines of software code. Additionally, they are expected to operate in an integrated network environment. The only solution to testing effectively and economically is to ensure a much higher degree of teaming between developers (both government and contractor) and testers.

(2) There is no cookie-cutter approach to testing. The test strategy needs to be tailored to the program's requirements and to be implemented by an integrated organization dedicated to the test mission.

(3) **Finally, test strategy and test planning require as much attention early in the program as the development of program requirements and costs. It is the author's experience that many program managers leave testing to the quality and assurance directorate within the program shop. Testing is a leader's responsibility.**

Conclusion

The days are over when commanders are willing to make things work "on the fly." Twenty-first-century warfighting capabilities are required to be joint, integrated throughout the battle space, and seamlessly networked. These requirements bring a great degree of complexity to the development and fielding of those capabilities. Acquisition leaders need to be innovative and adaptive when constructing programs that can deliver within cost, schedule, and provide required performance. Cookie-cutter approaches to everything from contractual arrangements through logistics support will not work.

The FCS requirement challenged Army acquisition professionals to think outside of the box; yet, they were forced to use the tools available to them to create an acquisition and management strategy to deliver a highly integrated system-of-systems. By leveraging lessons learned and working closely with the warfighting community, the acquisition leaders of FCS initiated a unique contractual arrangement with a Lead Systems Integrator, a program management organization based on tenets developed by all parties, and a test organization designed to validate the performance of individual components, systems, and, ultimately, the system-of-systems.

Understandably, the focus on FCS (to date) has been on program complexity, overall cost, and the concept of having a LSI. Why? It is different and more challenging than any other acquisition program. However, the early successes within the program and the agility it has demonstrated by staying on course through two restructures and significant Congressional decrements within 4 years should cause all to ask, "What is right about FCS?"

This paper attempted to shed light on certain aspects of the program that are proving themselves every day. It is now time to understand why FCS, although

different, is on cost, on schedule, and, validated by early testing, on track to provide 21st-century warfighting capabilities.

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