

CRS Report for Congress

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The Army's Future Combat System (FCS): Background and Issues for Congress

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Summary

The Future Combat System (FCS) is the U.S. Army's multiyear, multibillion-dollar program at the heart of the Army's transformation efforts. It is to be the Army's major research, development, and acquisition program consisting of 18 manned and unmanned systems tied together by an extensive communications and information network. FCS is intended to replace such current systems as the M-1 Abrams tank and the M-2 Bradley infantry fighting vehicle with advanced, networked combat systems. The FCS program has been characterized by the Army and others as a high-risk venture due to the advanced technologies involved as well as the challenge of networking all of the FCS subsystems together so that FCS-equipped units can function as intended.

The FCS program exists in a dynamic national security environment which could significantly influence the program's outcome. The wars in Iraq and Afghanistan and potential defense budget cuts could play a role in shaping the FCS program. The revised FCS program timeline — including four "Spin-Outs" whereby equipment is to be tested first by a FCS evaluation brigade and then introduced into the current force — has extended the program's timeline by four years and has added additional funding requirements, but it has also served to reduce some of the risk associated with this admittedly high-risk venture.

The overall FCS program budget has risen steadily since the program's inception and because the program is still in its early stages, its full costs are not yet known. The FCS program is managed by a lead systems integrator group consisting of major defense contractors Boeing and Science Applications International Corporation (SAIC). Although widely criticized, the Army adopted this program management approach because it maintains it did not have the required acquisition, scientific, and engineering staff to manage a program of this complexity and scope. The program's recent conversion from an Other Transaction Authority (OTA) agreement to a Federal Acquisition Regulation (FAR) contract — in part due to congressional pressure — raises concerns regarding increasing program costs as well as the Army's ability to take on a larger role in overseeing and executing this highly complex and technologically risky program.

The FCS is experiencing a number of program development issues - with some technologies advancing quicker than anticipated, others progressing along predicted lines, while still others not meeting the Army's expectations. Congress, in its authorization, appropriation, and oversight roles may wish to review the FCS program in terms of its capabilities and program costs. This report will be updated as the situation warrants.

Contents

Issues for Congress	1
Background	2
FCS Program Origins	2
Recent Activities	3
FCS and the National Security Environment	5
Quadrennial Defense Review (QDR) 2006	5
The Wars in Iraq and Afghanistan	6
The FCS Program	8
Program Overview	8
FCS Program Timeline	9
Restructured Program	9
Lack of a Sound “Business Case” for FCS?	11
The FCS Program: A Sound Business Strategy	13
The Army’s View on the FCS Program’s Progress to Date	14
FCS Program Budget	14
FY2007 Defense Authorization Bill Markup	15
FCS Budget Versus FCS Costs	15
Defense Budget Cuts	16
Rising Costs of Military Personnel	17
Program Management and Risk Reduction	18
Lead Systems Integrator (LSI) and Restructured Contract	18
Risk Reduction	20
Program Developmental Issues	22
Joint Tactical Radio System (JTRS)	22
Program Reorganization	22
Reduced Program Scope	23
Warfighter Information Network - Tactical (WIN-T)	23
Manned Ground Vehicles (MGV)	25
MGV Transportability	25
Congressional Action	26
MGV Engines	27
Active Protection System (APS)	27
Safety Concerns	28
Technological and Integration Challenges	28
Unmanned Ground Vehicles (UGV)	28
Issues for Congress	29
What if FCS Proves to be “Less Capable” than Originally Envisioned?	29
System Level Requirements	29
Network Dependency	30
Possible Congressional Interest	31
What if FCS Becomes “Cost-Prohibitive” Late in its Development Cycle?	31

Factor One: FCS Acquisition Strategy	31
Factor Two: Potential Cost Increases	32
Factor Three: Constrained Resources and Competition for Funding ..	32
Options for an Under-Budgeted FCS Program	33
Possible Congressional Interest	33
 Additional Reading	 34
 Appendix A. FCS Subsystems	 35
Manned Ground Vehicles	35
Mounted Combat System (MCS)	35
Infantry Carrier Vehicle (ICV)	35
Non-Line-of-Sight Cannon (NLOS-C)	35
Non-Line-of-Sight Mortar (NLOS-M)	35
Reconnaissance and Surveillance Vehicle (RSV)	35
Command and Control Vehicle (C2V)	36
Medical Vehicle - Evacuation (MV-E) and	
Medical Vehicle - Treatment (MV-T)	36
FCS Recovery and Maintenance Vehicle (FRMV)	36
Unmanned Aerial Vehicles (UAVs)	36
Class I UAVs	36
Class II UAVs	37
Class III UAVs	37
Class IV UAVs	37
Unmanned Ground Vehicles (UGVs)	37
Armed Robotic Vehicle (ARV)	37
Small Unmanned Ground Vehicle (SUGV)	37
Multifunctional Utility/Logistics and Equipment Vehicle (MULE) ..	38
Unattended Ground Sensors (UGS)	38
Tactical UGS	38
Urban UGS	38
Non-Line-of-Sight Launch System (NLOS-LS) and Intelligent	
Munitions System (IMS)	38
The Network	39
System-of-Systems Common Operating Environment (SOSCOE) ...	39
Battle Command (BC) Software	39
Warfighter-Machine Interface Package	40
Communications and Computer (CC) Systems	40
Intelligence, Reconnaissance and Surveillance (ISR) Systems	40
The Soldier	40

List of Tables

Restructured FCS Program Schedule	10
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The Army's Future Combat System (FCS): Background and Issues for Congress

Issues for Congress

The Future Combat System (FCS) is the Army's multiyear, multibillion-dollar program which is considered to be at the heart of the Army's transformation efforts. It is to be the Army's major research, development, and acquisition program for the foreseeable future and is to consist of 18 manned and unmanned systems tied together by an extensive communications and information network. FCS is intended to replace such current systems as the M-1 Abrams tank and the M-2 Bradley infantry fighting vehicle with advanced networked combat systems. The FCS program has been characterized by the Army and others as a high-risk venture due to the advanced technologies involved as well as the challenge of networking all of the FCS subsystems together so that FCS-equipped units can function as intended. The Army's success criteria for FCS is that it should be "as good as or better than" the Army's current force in terms of "lethality, survivability, responsiveness and sustainability."¹

The primary issues presented to Congress are the capabilities and affordability of the FCS program and the likelihood, given a myriad of factors, that the Army will be able to field its first FCS-equipped brigade by 2014 and eventually field up to 15 FCS-equipped brigades. Key oversight questions for consideration include:

- What are the potential FCS capabilities shortfalls given program progress to date and what are the ramifications for the future of the program ?
- What are the Army's plans for FCS, should the program become cost-constrained during the latter stages of development ?

Congress's decisions on these and other related issues could have significant implications for U.S. national security, Army funding requirements, and future congressional oversight activities. This report will address a variety of issues including the program's timeline, budget, program systems and subsystems, as well as current program developmental progress, issues, and challenges.

¹ Government Accountability Office (GAO) Report "Defense Acquisitions: Improved Business Case is Needed for Future Combat System's Successful Outcome," GAO-06-367, March 2006, p. 2.

Background

FCS Program Origins

In October 1999, then Chief of Staff of the Army (CSA) General Eric Shinseki introduced the Army's transformation strategy which was intended to convert all of the Army's divisions (called Legacy Forces) into new organizations called the Objective Force.² General Shinseki's intent was to make the Army lighter, more modular, and — most importantly — more deployable. General Shinseki's deployment goals were to deploy a brigade³ in 4 days, a division in 5 days, and five divisions in 30 days.⁴ As part of this transformation, the Army adopted the Future Combat System (FCS) as a major acquisition program to equip the Objective Force.⁵

This transformation, due to its complexity and uncertainty, was scheduled to take place over the course of three decades, with the first FCS-equipped objective force unit reportedly becoming operational in 2011 and the entire force transformed by 2032.⁶ In order to mitigate the risk associated with the Objective Force and to address the near-term need for more deployable and capable units, the Army's transformation plan called for the development of brigade-sized units called the Interim Force in both the active Army and the Army National Guard. These seven brigade sized units,⁷ known as both Interim Brigade Combat Teams (IBCTs) or

² Many experts consider the Army's 1999 controversial Task Force (TF) Hawk deployment to Kosovo and Albania as the event that triggered the Army's transformation. Reportedly, the Army deployed a unit consisting of units from different divisions that had never trained together commanded by a command and control organization that was unable to conduct joint operations. The most often cited criticism was that it took more than 30 days to deploy TF Hawk, centered on 28 Apache attack helicopters, from bases in Germany to Albania; and, when they finally arrived, they were unable to conduct combat operations due to training and equipment deficiencies. The task force also consisted of mechanized maneuver and support elements competing for limited air lift insertion capabilities.

³ According to Department of the Army Pamphlet 10-1, "Organization of the United States Army," dated June 14, 1994, a brigade consists of approximately 3,000 to 5,000 soldiers and a division consists of approximately 10,000 to 18,000 soldiers.

⁴ Frank Tiboni, "Army's Future Combat Systems at the Heart of Transformation," *Federal Computer Week*, Feb. 9, 2004.

⁵ James Jay Carafano, "The Army Goes Rolling Along: New Service Transformation Agenda Suggests Promise and Problems," *Heritage Foundation*, Feb. 23, 2004, p. 5.

⁶ Bruce R. Nardulli and Thomas L. McNaugher, "The Army: Toward the Objective Force," in Hans Binnendijk, ed. *Transforming America's Military*, (National Defense University Press, 2002), p. 106.

⁷ The Army currently plans to field six active and one National Guard Stryker Brigade Combat Teams.

Stryker Brigade Combat Teams⁸ (SBCTs), are currently being fielded and some have served in Iraq — with the last brigade due to be fielded in 2007.⁹

General Shinseki's vision for the FCS was that it would consist of smaller and lighter ground and air vehicles — manned, unmanned, and robotic — and would employ advanced offensive, defensive, and communications/information systems to “outsmart and outmaneuver heavier enemy forces on the battlefield.”¹⁰ In order to initiate the FCS program, General Shinseki turned to the Defense Advanced Research Projects Agency (DARPA), not only because of their proven ability to manage highly conceptual and scientifically challenging projects, but also because he reportedly felt that he would receive a great deal of opposition from senior Army leaders who advocated heavier and more powerful vehicles such as the M-1 Abrams tank and the M-2 Bradley infantry fighting vehicle. In May 2000, DARPA awarded four contracts to four industry teams to develop FCS designs and in March 2002, the Army chose Boeing and Science Applications International Corporation (SAIC) to serve as the lead systems integrators to oversee the development and eventual production of the FCS' 18 systems. On May 14, 2003, the Defense Acquisition Board¹¹ (DAB) approved the FCS' next acquisition phase and in August 2004 Boeing and SAIC awarded contracts to 21 companies to design and build its various platforms and hardware and software.

Recent Activities

In August 2003, the newly designated CSA, General Peter Schoomaker, changed the Army's transformation plan. General Schoomaker redesignated the Objective Force as the Future Force, emphasizing the fielding of useful FCS program capabilities as soon as they became available instead of waiting a decade or more before they could be integrated into other FCS platforms and technologies under development.¹² Under General Schoomaker's plan, the Army restructured the FCS program to place the emphasis more on the various networks linking Army forces together, as well as with units from the other services, than on the actual FCS platforms themselves.¹³

⁸ The Stryker is the Army's name for the family of wheeled armored vehicles which will constitute most of the brigade's combat and combat support vehicles.

⁹ Annex A (modular Conversion) to Army Campaign Plan, Change 2, September 30, 2005, p. A-1.

¹⁰ The following description of the early stages of the FCS program is taken from Frank Tiboni's *Army's Future Combat Systems at the Heart of Transformation*.

¹¹ The Defense Acquisition Board (DAB) is the Defense Department's senior-level forum for advising the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) on critical decisions concerning DAB-managed programs and special interest programs.

¹² James Jay Carafano, p. 6.

¹³ Ibid.

The FCS program has received a great deal of scrutiny from both governmental and non-governmental organizations and a number of changes to the program have resulted in part from recommendations from these organizations as well as changes initiated by Army and DOD leadership. An April 2004 report by the General Accounting Office (GAO)¹⁴ noted that the FCS was at significant risk for not delivering required capability within budgeted resources, primarily due to the immaturity of a significant number of key FCS technologies.¹⁵ In addition to significant risk, the FCS program was widely criticized for employing an Other Transactions Authority (OTA)¹⁶ arrangement to administer the program. Much of this criticism came from Congress, which was concerned that the OTA did not afford the government the protection that standard contracts provided, gave too much authority to the lead system integrator¹⁷ team of Boeing and Science Applications International Corporation (SAIC), did not provide sufficient opportunities for oversight, and did not have the type of strict cost accountability mechanisms found in traditional contracts.¹⁸

The Army addressed these and other concerns by modifying the FCS program. The Army now plans to “Spin-Out” selected technologies starting in 2008 to an evaluation brigade that will test the technologies and those technologies deemed “ready and relevant” will then be fielded to operational units.¹⁹ The intent is to take the lessons learned from testing and experimentation and roll them back into the FCS

¹⁴ United States General Accounting Office (GAO) (now called the Government Accountability Office), “The Army’s Future Combat Systems’ Features, Risks, and Alternatives,” GAO-04-635-T, April 1, 2004.

¹⁵ *Ibid.*, p. 1.

¹⁶ Other Transactions Authority (OTA) was established by Congress under Section 845 of the National Defense Authorization Act for FY1994 (10 U.S.C. Section 2371) for research, development, and prototyping, and was intended to permit the government to more readily interact with innovative companies who are not part of the traditional defense contracting community. OTA provides the government with the flexibility to negotiate tailored contracts that are not governed by the Federal Acquisition Regulation (FAR). As originally enacted, OTA was intended for companies that may not have the staff or resources to operate under the FAR which has numerous administrative and reporting requirements that may be beyond the capability of smaller companies.

¹⁷ Under Army supervision, Boeing and Science Applications International Corporation (SAIC) operate as the FCS program’s “lead systems integrators” whereby Boeing and SAIC act as the FCS prime contractor and allocate program developmental work through hundreds of subcontracts to both large and small defense contractors.

¹⁸ Jen DiMascio, “Pentagon IG Investigates Acquisition Strategies:McCain Questions FCS Commercial-Item Procurement Strategy,” *Inside the Army*, Vol.17, No.9, March 7, 2005; Renae Merle, “Hearings to Focus on \$100 Billion Army Plan,” *Washington Post*, March 15, 2005; Jonathan Karp and Andy Pasztor, “Army Program Run by Boeing Faces Challenge by Sen.McCain,” *Wall Street Journal*, March 15, 2005; Scott Nance, “McCain Proposes Procurement Study, Possible Reform,” *Defense Today*, Volume 26, Number 51, March 17, 2005; Renae Merle, “McCain, Auditors Question Army Modernization Effort,” *Washington Post*, March 17, 2005.

¹⁹ Scott Nance, “FCS Official: Spin-Outs to Bring Contractors More Work,” *Defense Today*, Volume 26, Number 199, October 18, 2005, pp. 1-3.

program to reduce developmental risk for the entire FCS brigade combat team.²⁰ The Army intends to conduct additional technology spin-outs in 2010, 2012, and 2014.

In 2005, the Army moved the FCS program from the OTA arrangement to Federal Acquisition Regulation (FAR)-based traditional contract that took effect on September 23, 2005.²¹

In August 2005, the FCS program reportedly successfully completed a Systems of Systems Functional Review (SOSFR), an in-house technical review to ensure that the program's design and functional baselines are mature enough for the FCS program to move into the Preliminary Design Phase of the program, currently scheduled to begin in 2008.²² According to reports, the next major program milestone will be the Initial Preliminary Design Review, expected some time in 2006.²³

FCS and the National Security Environment

The FCS, like all other major, multiyear defense programs, is subject to the changing demands of the national security environment. No matter how successful the FCS is on a programmatic level, whether or not the Army eventually achieves its 15-brigade FCS force is highly dependent on the influences of the current and future national security environment.

Quadrennial Defense Review (QDR) 2006. The QDR is the Administration's statement on defense strategy, programs, and spending and is published every four years and submitted to Congress no later than the date on which the President submits the budget for the next fiscal year to Congress. The Defense Authorization Act for FY1997 (P.L. 105-85) established the QDR, but only as a one time requirement. Congress established the QDR as a permanent recurring requirement (10 U.S. Code, 118) in the National Defense Authorization Act of FY2000. The 2006 QDR was released on February 6, 2006, and focused primarily on long-term unconventional warfare, counterterrorism and counterinsurgency, and stabilization and reconstruction operations.

FCS and QDR 2006. The Army and the FCS program emerged from the QDR 2006 process on what was described as a "sound footing" in terms of maintaining momentum with respect to both the FCS program and long-term

²⁰ Ibid.

²¹ Scott Nance, "FCS to Award Active-Protection System Pact," *Defense Today*, Volume 26, Number 191, October 5, 2005, p. 3.

²² "Review: FCS Meets Objectives, Moves Forward," *Defense Today*, August 17, 2005, p. 3.

²³ Ibid.

modernization into a modular force structure.²⁴ QDR 2006 did not recommend any changes to the FCS program and committed DOD to:

Incorporate FCS improvements into the modular force through a spiral development effort that will introduce new technologies as they are developed.²⁵

While Army officials appeared satisfied with the outcome of QDR 2006 — asserting that the program continued “on cost and on schedule” — some Army officials suggested that the “road ahead for FCS is very harsh and that lots of things [developmental efforts] will have to happen very well.”²⁶ Some are concerned, despite improvement in some of the 49 critical FCS technologies, that the risk associated with immature technologies could result in considerable future growth in program costs, which some currently estimate are close to \$160 billion.²⁷

The Wars in Iraq and Afghanistan. In 1999, a peacetime Army introduced the FCS program as the centerpiece of its transformation plan. At that time, the Army reportedly planned on “a few more years of relative tranquility to pay for the FCS”²⁸ Most agree that the wars in Afghanistan and, particularly, Iraq have significantly altered this expectation, resulting in not only a shift of the Army’s focus to dealing with the day-to-day challenges of fighting a multi-front war, but also a total restructuring of the Army’s combat forces, attempting to recruit and retain soldiers, and repair and replace damaged, destroyed, and worn-out equipment.

War “Lessons Learned” and FCS. The wars in Iraq and Afghanistan have provided the Army with a number of “lessons learned” and some suggest that these conflicts will have a significant impact on reshaping how future senior leaders will train and equip the Army.²⁹ Army leadership (1) suggests that operations in Iraq and Afghanistan have reinforced the criticality of unmanned systems to increase soldier survivability; (2) improved mine detection capabilities to counter improvised explosive devices; (3) active protection systems to counter a variety of threats including rocket propelled grenades; (4) reconnaissance at all levels; (5) and an

²⁴ Scott Nance, “Budget Increases Offer Army an Opportunity,” *Defense Today*, Volume 27, Number 28, February 10, 2006, p. 1. Also see CRS Report RL32476, *U.S. Army’s Modular Redesign: Issues for Congress*, for a detailed examination of the Army’s restructuring efforts.

²⁵ Department of Defense, Quadrennial Defense Review Report, February 6, 2006, p. 43.

²⁶ Jen DiMascio, “FCS on Cost and Schedule, But Road Ahead May Be “Harsh,” Official Says,” *Inside Defense*, February 20, 2006.

²⁷ *Ibid.*

²⁸ Megan Scully, Christopher P. Cavas, Laura M. Colarusso, Jason Sherman, “Top Defense Programs: How Secure are they as Pentagon Budgets Tighten?” *Armed Forces Journal*, Dec. 2004, p. 27.

²⁹ Information in this section is from Greg Grant, “Iraq Reshapes U.S. Army Thinking,” *Defense News*, August 29, 2005.

integrated network down to platoon level.³⁰ These capabilities are included as central requirements throughout the FCS program.

According to one defense analyst, operations in Iraq, in particular, have produced “two leading schools of thought within the Army, divided by their visions of the future world.” The first school of thought reportedly believes that the current counterinsurgency campaign in Iraq is not broadly representative of future conflicts and that the Army must remain focused on fighting large, conventional wars and that FCS will be a crucial part of this capability. The second school contends that “large state-on-state conflicts are a thing of the past, and that irregular fighting in Iraq is the future of warfare.” Supporters of this view suggest that it is difficult to find another military “that is building another Republican Guard or major tank army to take on the American Army,” and that terrorism and insurgencies are more likely future scenarios where, they contend, FCS would play a lesser role.

Operation Iraqi Freedom and Hurricane Katrina and the Need for FCS Capabilities. While the Army’s current and future leadership will likely continue to debate the nature of future conflicts, reports suggest that experiences from Operation Iraqi Freedom (OIF) and Hurricane Katrina have demonstrated a need for FCS capabilities. One report from OIF, describing an April 2, 2003, battle between a single 500-man U.S. armor battalion and 8,000 Iraqi troops and 70 tanks and armored personnel carriers, asserts that this sizeable Iraqi force was largely concealed from current U.S. sensors through simple low-technology camouflage techniques.³¹ Analysis of this battle, including interviews with participants, suggests that Army forces on the ground were almost totally unaware of the size, composition, and location of opposing Iraqi forces primarily because the U.S. Army’s speed of advance was so rapid that frontline units “outran” their intelligence. The report further contends that while U.S. commanders in Kuwait had a good picture of the enemy, “good intelligence was virtually non-existent among front-line units.” In order for these units to get an intelligence update on opposing enemy forces, U.S. units would have to stop their advance, set up a number of antennas, and attempt to connect to the Army’s Mobile Subscriber Equipment (MSE) network — a process that could take hours. Furthermore, when units connected to the MSE network, the bit transfer rate was so slow, that it would take additional hours to download data. In addition to network connectivity problems, the report suggested that there were not enough sensors to cover the battle area. Army officials who have studied this battle and its associated reports contend that “FCS is designed to prevent a repeat of that battle and will provide a significantly better information network.”

In the aftermath of Hurricane Katrina, the Army cited the benefits of an FCS-equipped force in disaster recovery operations.³² Army officials suggest that a Katrina-like response mission “would benefit from the increased intelligence, surveillance, and reconnaissance as well as enhanced vertical-lift capabilities that

³⁰ Discussions with Army G-8 Staff, April 13, 2006.

³¹ Greg Grant, “Network Centric Blind Spot,” *Defense News*, September 12, 2005.

³² Information in this section is taken from Scott Nance, “Army Leaders: FCS Will Meet Spectrum of Army Needs,” *Defense Today*, Volume 26, Number 188, September 30, 2005.

FCS platforms will bring.” FCS unmanned vehicles reportedly would be able to enter buildings and negotiate complex urban terrain to locate people and FCS unmanned ground vehicles (UGVs) could also assist in recovery operations, particularly in areas that could present hazards to soldiers.

The FCS Program

Program Overview ³³

The Army describes FCS as a joint (involving the other services) networked “system of systems.” FCS systems are to be connected by means of an advanced network architecture that would permit connectivity with other services, situational awareness and understanding, and synchronized operations that are currently unachievable by Army combat forces. FCS is intended to network with existing forces, systems currently in development, and systems that will be developed in the future. The FCS is to be incorporated into the Army’s brigade-sized modular force structure.

FCS would include the following:

- Unattended ground sensors (UGS);
- Non-Line-of-Sight Launch System (NLOS-LS) and Intelligent Munitions System (IMS);
- Four classes of unmanned aerial vehicles (UAVs), which will be organic to platoon, company, battalion,³⁴ and other echelons;
- Three classes of unmanned ground vehicles (UGVs): the Armed Robotic Vehicle (ARV), the Small Unmanned Ground Vehicle (SUGV), and the Multifunctional Utility/Logistics and Equipment Vehicle (MULE);
- Eight types of manned ground vehicles;
- The network; and
- The individual soldier and his personal equipment and weapons.

The FCS is to serve as the core building block of the Army’s Future Force. FCS-equipped brigade combat teams (BCTs) are to consist of:

- Three FCS-equipped Combined Arms battalions (CABs);
- One Non-Line-of-Sight (NLOS) Cannon battalion;

³³ Information in this section is taken from the Army’s official FCS website [<http://www.army.mil/fcs/factfiles/overview.html>].

³⁴ According to Army Pamphlet 10-1, *Organization of the United States Army*, 1994, a battalion/squadron (an equivalent sized cavalry organization) consists of from 300 to 1,000 soldiers and is commanded by a lieutenant colonel, a company, battery (an equivalent sized artillery organization), or troop (an equivalent sized cavalry organization) consists of from 62 to 190 soldiers and is commanded by a captain, and a platoon consists of 16 to 44 soldiers and is led by a lieutenant.

- One Reconnaissance, Surveillance, and Target Acquisition (RSTA) squadron;
- One Forward Support battalion (FSB);
- One Brigade Intelligence and Communications company (BICC); and
- One Headquarters company.

For a more detailed description of FCS subsystems, see **Appendix A**.

FCS Program Timeline

FCS is currently in the System Development and Demonstration (SDD) phase of the Defense Acquisition System Life Cycle. The SDD phase is the third life cycle phase which focuses on reducing integration and manufacturing risk, ensuring operational supportability, and demonstrating the system through prototypes or engineering development models.³⁵ FCS entered the SDD phase in May 2003 despite GAO warnings that the program was entering the phase with “more risk than recommended by best practices or DOD guidance.”³⁶

On July 21, 2004, the Army announced a major restructuring of the FCS program. The primary objectives of the restructuring included

- Fielding FCS technologies to the current force in four discrete “spirals” starting in FY2008;
- Address Congressional language on the Non Line of Sight Cannon (NLOS-C);³⁷
- Field all 18 systems (only 14 were funded under previous program);
- Lengthen schedule by four years; and
- Designate an evaluation brigade to test spiraled FCS capabilities.

Restructured Program. At present, the FCS program is operating under the schedule depicted below:

³⁵ “Glossary of Defense Acquisition Acronyms and Terms,” Defense Acquisition University, Fort Belvoir, Virginia, 11th ed., Sept. 2003, pp. B-136 — B-137.

³⁶ GAO-03-1010R, *Issues Facing the Army’s Future Combat System*, Apr. 2003, p. 39.

³⁷ Section 8109 of Report 108-622, Conference Committee Report, FY2005 Defense Appropriations, July 20, 2004, requires the Army to field the Non Line of Sight Cannon (NLOS-C) and its resupply vehicle by 2010 as well as deliver eight combat operational preproduction NLOS-C systems by the end of CY2008.

Restructured FCS Program Schedule

Event	Date (FY)	Event description
Milestone B Update	May 2005	Milestone B approves entry into System Development and Demonstration Phase (SDD).
Preliminary Design Review	2008	A technical review to evaluate the progress and technical adequacy of each major program item. It also examines compatibility with performance and engineering requirements. (Part of SDD Phase)
Critical Design Review	2010	A technical review to determine if the detailed design satisfies performance and engineering requirements. Also determines compatibility between equipment, computers, and personnel. Assesses producibility and program risk areas. (Part of SDD Phase).
Design Readiness Review	2011	Evaluates design maturity, based on the number of successfully completed system and subsystem design reviews. (Part of SDD Phase).
Milestone C	2012	Milestone C approves the program's entry into the Production and Deployment (P&D) Phase. The P&D Phase consists of two efforts — Low Rate Initial Production (LRIP) and Full Rate Production and Deployment (FRP&D). The purpose of the P&D Phase is to achieve an operational capability that satisfies the mission need.
Initial Operational Capability (IOC)	2015	IOC is defined as the first attainment of the capability to employ the system as intended. (Part of the P&D Phase).
Full Operational Capability	2017	The full attainment of the capability to employ the system, including a fully manned, equipped, trained, and logistically supported force. (Part of the P&D Phase).

Note: Event descriptions in this table are taken from the Defense Acquisition Acronyms and Terms Glossary published by the Defense Acquisition University, Fort Belvoir, Virginia, 11th ed., Sept. 2003.

While GAO acknowledges that the restructured program is an improvement, it still believes that the FCS program is “at significant risk for not delivering planned capability within budgeted resources,” primarily due to the program’s technical challenges and low level of demonstrated knowledge.³⁸ One of GAO’s concerns is that under the current program schedule, the actual performance of the completely integrated FCS will be demonstrated very late in the program and could result a

³⁸ Government Accountability Office, *Future Combat Systems Challenges and Prospects for Success*, GAO-05-442T, Mar. 16, 2005, p. 2.

significant cost increase. According to GAO, the Critical Design Review ideally should occur in the FCS program in 2008 in order to “confirm that the design is stable enough to build production representative prototypes for testing.”³⁹ GAO notes that the FCS Critical Design Review instead occurs in 2010 which is only two years before the Army decides on whether or not to enter into production and that the Army does not expect to conduct a preliminary demonstration of all the elements of FCS until sometime in 2013 — one year after the production decision.⁴⁰ GAO maintains that the Army’s current program schedule makes FCS susceptible to “late cycle churn” whereby problems discovered through testing late in a product’s development cycle result in significant investments in additional time, effort, and funds to overcome the problem — a phenomenon that GAO notes “is a fairly common occurrence” in DOD programs.⁴¹

Lack of a Sound “Business Case” for FCS? In March 2006 testimony to the Senate Armed Service Committee (SASC) Subcommittee on Airland, GAO testified that the FCS program still lacked the following elements of what is described as a “sound business case” needed for FCS program success:

- Firm requirements;
- Mature technologies;
- Knowledge-based acquisition strategy;
- Realistic cost estimate; and
- Sufficient funding.⁴²

Past GAO reports on FCS have also noted these alleged program deficiencies and GAO has been extensively involved with the FCS program from the program’s onset. In particular, GAO suggests that the FCS program needs to address the aforementioned deficiencies in order to be successful.

Firm Requirements.⁴³ GAO acknowledges that the Army has made significant progress in defining some of FCS’s almost 11,500 program-level systems of systems requirements but that, overall, system-level requirements are not yet stabilized and are expected to change. In its report, GAO notes that Army officials

³⁹ Ibid., p. 17.

⁴⁰ Ibid.

⁴¹ Ibid.

⁴² United States Government Accountability Office (GAO), Testimony before the Subcommittee on Airland, Committee on the Armed Services, U.S. Senate, Defense Acquisitions: Business Case and Business Arrangements Key for Future Combat System’s Success, GAO-06-478T, March 1, 2006.

⁴³ Information in this section is taken from GAO Report “Acquisitions: Business Case and Business Arrangements Key for Future Combat System’s Success,” GAO-06-478T, March 1, 2006, p. 5.

say that it is almost certain that some FCS system-level requirements will have to be either modified, reduced, or eliminated and that it would be at least 2008 before the program reaches the point where it should have been at 2003 — when the program started — in terms of stable requirements. GAO's concern is that based on historical evidence, unstable requirements often lead to cost, schedule, and performance shortfalls.

Mature Technologies.⁴⁴ GAO notes that according to an April 2005 technology assessment readiness update by the Office of the Deputy Assistant Secretary of the Army for Research and Technology, that the “Army has not fully matured any of the technologies critical to FCSs’ success.” GAO also contends that several of the Army’s complementary programs - considered crucial in meeting FCS requirements - are experiencing technical difficulties and some are not fully funded. GAO continues to be concerned that some of FCS’s critical technologies may not reach a demonstrated high level of maturity until the start of production which could result in significant cost growth and delays.

Knowledge-Based Acquisition Strategy.⁴⁵ GAO continues to express concern that significant knowledge deficits for both requirements and technologies continue to remain in the FCS program thereby creating an “enormous” challenge to devise an acquisition strategy that can produce a mature design and production process. Even if requirements establishment and technology maturity were at the appropriate level, GAO believes that based on the current FCS program plan — which has a number of late-occurring development and design reviews that are not consistent with a best practices “knowledge-based” approach — that FCS design and production maturity will not be demonstrated until after the production decision is made. Of concern is that if design and production problems due to lack of maturity do occur, production is the most expensive phase of the acquisition process in which to fix these problems.

Realistic Cost Estimate.⁴⁶ GAO now estimates that the total cost for the FCS program is at \$160.7 billion (then year dollars⁴⁷) — up 76% from the Army’s first estimate. This estimate does not include FCS complementary programs needed for FCS technology “Spin- Outs” to the operational force. Taking these costs into consideration, GAO estimates that FCS total costs are more on the order of \$200 billion — with this figure likely to climb due to lack of a knowledge base and its potential associated problems. In the Spring of 2006, the DOD Cost Analysis Improvement Group is reportedly scheduled to release an updated independent estimate of the FCS program costs.

⁴⁴ Ibid.

⁴⁵ Ibid.

⁴⁶ Ibid., p. 8.

⁴⁷ Then Year Dollars are dollars that include the effects of inflation or escalation and/or reflect the price levels expected to prevail during the year at issue.

Sufficient Funding.⁴⁸ Given the lack of a realistic cost estimate and current Federal fiscal imbalances and pressure to decrease spending, GAO is concerned that ultimately, the Army may not have sufficient funds to fully procure 15 FCS equipped combat brigades. Program affordability depends on the FCS program proceeding without exceeding current projected costs; and having sufficient funding to meet FCS procurement in FY2012 and 2013 which are currently beyond the Future Years Defense Plan (FYDP). GAO suggests that if the Army does not have sufficient funds in FY2012 and 2013 to meet FCS procurement requirements, the Army may need to reduce the FCS procurement rate or delaying or reducing “Spin-Out” technologies. If the FCS procurement rate is reduced, FCS unit costs could likely increase and exacerbate an already difficult funding situation.

The FCS Program: A Sound Business Strategy.⁴⁹ According to Army officials the FCS program embodies all the elements of a sound business strategy and is being conducted in accordance with these principles.

Requirements Growth. The Army contends that it has not added significant requirements to the FCS program since the 2003 Operational Requirements Document and has traded off what they term as “unrealistic requirements” to keep the System Development and Demonstration (SDD) phase on cost and on schedule. The Army further asserts that FCS systems-level requirements are planned, on schedule, and will be stable before entering the program’s Initial Preliminary Design Review later this summer.

Technological Maturity. The Army suggests that there is a fundamental disagreement between GAO and DOD on the level of technological maturation required to support a knowledge-based acquisition approach. The Army contends that DOD acquisition policy permits a lower Technology Readiness Level (TRL)⁵⁰ for a program or Milestone B start than GAO recommends. The Army maintains that GAO’s higher TRL benchmark is based on commercial market practices and does not meet DOD operating conditions or operational imperatives. While DOD’s technology maturation approach does carry with it an element of risk, the Army believes that the benefit of this approach is that it can develop a more advanced product quicker and at a lower overall cost.

Cost Growth. The Army maintains that GAO cost estimates are not accurate because they aggregate the costs of other Army modernization programs (so-called

⁴⁸ Ibid.

⁴⁹ Information in this section is from discussions with the Army G-8 Staff on April 13, 2006 and supporting documents provided to CRS.

⁵⁰ Technology readiness levels (TRLs) are metrics developed by the National Aeronautics and Space Administration (NASA) and later adopted by DOD as a means of determining if technologies were sufficiently mature to be incorporated into weapons systems. The maturity levels range from Level 1 (paper studies); Level 7 (prototypes tested in a realistic environment); to Level 9 (an actual system proven in mission operations). GAO has found TRLs to be a valuable decision making tool and according to their past experiences, they believe that in order for a DOD program to succeed, that critical technologies should at least be at a TRL 7 before the start of product development.

complementary programs) without considering FCS program reorganization to provide FCS technologies to operational units (Spin-Outs) which the Army contends are the primary sources of cost growth in the program. According to the Army, the GAO estimate of \$200 billion includes these complementary programs that were never in the FCS program baseline budget. The Army further suggests that while these complementary programs have a definite relationship to FCS, that even if the FCS program were to be terminated, that these complementary programs would continue as part of the Army's overall modernization program. Given this relationship, the Army maintains that GAO's \$200 billion figure is an inaccurate depiction, unless one wishes to aggregate most of the Army's modernization programs under the FCS rubric.

The Army's View on the FCS Program's Progress to Date.⁵¹ In their testimony to the Senate, senior Army officials noted that despite all concerns, the FCS program continues to move forward, successfully completing all SOSFRs and beginning the transition into design and prototype development activities. The Army suggested that 2006 was a crucial year for the program with a May 2006 Defense Acquisition Board in-progress review and an August 2006 Interim Preliminary Design Review scheduled. The Army apparently does not share GAO's concern regarding maturity of key technologies and risk. According to the Army:

In terms of critical technologies, 18 of the 49 critical technologies are rated with a Technical Readiness Level (TRL) of 6, one is rated 8. The program is on schedule to have more than 23 rated TRL 6 by December 2006 and it is on schedule to mature the rest by the Preliminary Design Review (PDR) in August 2008. Risk associated with the maturation of technologies was one of the contributing factors in the Army's decision to restructure the FCS (Brigade Combat Team) program and extend it by four years. The current program plan significantly reduces the degree of concurrency and risk through both the spin-out plan and the increased development time between Milestones B and C. The program's maturity approach is consistent with DOD acquisition policy.⁵²

FCS Program Budget

The FCS program budget has risen steadily since 1999 as the program has evolved. According to the Congressional Budget Office (CBO), "Because the FCS program is still in the early stages of development, its full costs are not yet known."⁵³ DOD has asked for \$3.7 billion in FY2007 for FCS Research, Development, Testing and Evaluation (RDT&E) and anticipates \$22.4 billion RDT&E from FY2007-

⁵¹ Information in this section is from the Statement of Claude M. Bolton, Assistant Secretary of the Army for Acquisitions, Logistics, and Technology to the Senate Armed Services Subcommittee on Airland, March 1, 2006.

⁵² Ibid.

⁵³ Congressional Budget Office, *Budget Options*, Feb. 2005, Section 3, National Defense, p. 2.

FY2011 (Future Years Defense Plan - FYDP).⁵⁴ The Army's 2005 reported position was that FCS would cost from about \$122 to \$125 billion in constant dollars through 2025, with about \$27.7 billion for RDT&E and \$94 billion to equip 15 brigades.⁵⁵

FY2007 Defense Authorization Bill Markup. The House Armed Services Committee (HASC), in its markup of H.R. 5122, The FY2007 Defense Authorization Bill, recommended reducing the FCS program by \$325 million — approximately 6%-8% of the President's \$3.7 billion request — for “unjustified program cost increases and excessive management reserve.”⁵⁶ The HASC, while stating its support for FCS, is concerned that spiraling FCS costs could make the FCS program unaffordable and in the markup directed “a Defense Acquisition Board “go/no go” decision after preliminary design review, not later than September 30, 2008.”⁵⁷

The Senate Armed Services Committee (SASC), in its markup up of H.R. 5122, authorized the full budget request for \$3.7 billion, including \$322.7 million for the Non-Line-of-Sight Launch System and \$112.3 million for the Non-Line-of-Sight Cannon.⁵⁸ The SASC markup also includes a legislative proposal requiring DOD to submit an independent cost estimate of the core FCS program, FCS spin-outs, and FCS complementary systems.⁵⁹

FCS Budget Versus FCS Costs. According to GAO, the current total estimated cost for the FCS program is \$160.7 billion (then year dollars) — an increase of 76% over the Army's first estimate.⁶⁰ The Army — currently placing the FCS total estimated cost at \$161.4 billion — notes that this increase from the first estimate is largely the result of restructuring the FCS program to address risk concerns, adding four years to the program, the reintroduction of four FCS systems that had been deferred, and the addition of “Spin-Outs” [previously called “spirals” by the Army] where FCS technologies are evaluated and fielded to the operational Army.⁶¹ In addition, the rate of FCS brigade production will be reduced from two brigade combat teams (BCTs) per year to 1.5 BCTs per year which means that

⁵⁴ FY2007 Department of Defense Budget Briefing, February 6, 2006, p. 6.

⁵⁵ Transcripts from a news conference with Secretary of the Army Harvey and Chief of Staff of the Army General Schoomaker given at the FCS Demo, September 5, 2005 and Gopal Ratnam and Greg Grant, “Cost of DOD's Top 85 Programs Rise \$65 B,” *DefenseNews.com*, November 16, 2005.

⁵⁶ “House Armed Services Committee Approves Fiscal Year 2007 Defense authorization Bill,” House Armed Services Committee Press Release, May 3, 2006, p. 11.

⁵⁷ *Ibid.*, p. 23.

⁵⁸ “FY07 National Defense Authorization Bill Summary,” Senate Armed Services Committee, May 4, 2006, p. 4.

⁵⁹ *Ibid.*

⁶⁰ Government Accountability Office (GAO) Report “Acquisitions: Business Case and Business Arrangements Key for Future Combat System's Success,” GAO-06-478T, March 1, 2006, p. 8.

⁶¹ *Ibid.*, p. 9.

instead of completing all 15 FCS BCTs by 2020, it will take until 2025 to field all 15 BCTs.⁶²

GAO asserts, however, that the \$160.7 billion cost estimate does not include all costs related to the FCS program, in particular

- Costs for the 52 essential complementary programs that are not included in the FCS program, such as the Joint Tactical Radio System (JTRS) Clusters One and Five, which are expected to cost about \$32.6 billion (then year dollars);⁶³
- Some complementary programs such as the Mid-Range Munition and the Javelin Block II missile which are currently not fully funded; and
- Procurement for the four FCS technology “Spin-Outs” to the current Army forces is not yet entirely funded. Procuring these FCS items is estimated to cost about \$19 billion and installation kits needed to support these technology “Spin-Outs” could cost an additional \$4 billion.⁶⁴

Even if the complementary programs are not included, the FCS program, as currently structured, could cost \$ 183.7 billion (\$160.7 billion GAO estimate + \$19 billion for Spin-Out procurement items + \$4 billion for installation kits), which calls into question the Army’s claim that FCS is a \$161 billion program. In addition to reconciling this potential budget shortfall, two other issues that are somewhat outside of the Army’s ability to control, defense budget cuts and rising personnel costs, may have an impact on funds available for FCS in the future.

Defense Budget Cuts. In 2004, The Department of Defense (DOD) was reportedly asked by the Administration, as part of its deficit reduction campaign, to reduce its spending plans over the next six years by \$30 billion.⁶⁵ Under DOD’s Program Budget Decision (PBD) 753 released in December 2004, these cuts fell almost exclusively on Department of Defense, Navy, and Air Force programs procurement programs.⁶⁶ In December 2005, the Pentagon issued PBD 723, cutting about \$ 4 billion from the Army’s budgets between FY2006 and FY2011, with the cuts focusing on reducing the size of the Army’s afloat pre-positioned brigade

⁶² Ibid.

⁶³ For additional information on JTRS see CRS Report RL33161, *The Joint Tactical Radio System (JTRS) and the Army’s Future Combat System (FCS): Issues for Congress*.

⁶⁴ Government Accountability Office (GAO) Report “Acquisitions: Business Case and Business Arrangements Key for Future Combat System’s Success,” GAO-06-478T, March 1, 2006, p. 11.

⁶⁵ Rowan Scarborough, “Pentagon Cost-Cutting Aimed at New Gear,” *Washington Times*, Dec. 20, 2004 and Jason Sherman, “Pentagon Slashes \$30 Billion from Major Navy, Air Force, Missile Defense Programs,” *InsideDefense.com*, Jan. 2, 2005.

⁶⁶ DOD Program Budget Decision 753, December 23, 2004.

equipment sets.⁶⁷ While it is unknown if PBD-based cuts will occur each fiscal year for the duration of the FCS program, it would not be unreasonable to speculate that while FCS has been spared these “11th hour DOD-directed cuts” thus far, that in the future, FCS (particularly FCS-related programs experiencing difficulties) might be targeted for cuts.

Rising Costs of Military Personnel.⁶⁸ A number of reports suggest that the rising costs of military personnel are competing with funds needed for modernization programs, and that DOD and Army leadership reportedly would consider cutting troop strength in order to protect funding for modernization programs. Defense modernization programs “are costing more and taking longer to develop,” according to GAO⁶⁹, making the competition for funds even more acute. Military pay and benefits have reportedly risen 29% above inflation from 2000 and 2004, largely in order to attract new recruits and retain service members.⁷⁰ Some analysts believe that these costs for the Army will climb even higher due to:

- **Enlistment and Re-enlistment Bonuses:** Bonuses are reportedly expected to increase from \$31.3 million to a projected \$ 44.3 million in 2006;
- **Allowances for Housing:** Housing allowances have expanded from \$ 7.3 billion on 2000 to \$12 billion in 2004 and are expected to rise rapidly;
- **Health Care Benefits:** Increasing health care costs are considered a significant contributor to increasing personnel costs. From 2000 to 2004, health care costs rose 69% — a figure that does not reflect expansion of health care benefits for military retirees, reservists, National Guard, and families; and
- **Military Pay:** DOD reportedly plans to increase military pay annually by 3.5% through 2009 and combat zone tax benefits also serve as a significant cost — a reported \$6.4 billion in 2004.⁷¹

⁶⁷ Daniel G. Dupont and Jason Sherman, “Army, Navy Hit with Last Minute Cuts,” *InsideDefense.com*, January 5, 2006.

⁶⁸ William Matthews, “Weapons, Personnel Eat Up U.S. Budget,” *Defense News*, September 12, 2005; David Wood, “Sharply Rising Personnel Costs Force Pentagon Cutbacks,” *Newhouse.com*, November 21, 2005; Jonathan Karp, Andy Pasztor, and Greg Jaffe, “Pentagon Weighs Personnel Cuts to Pay for Weapons,” *Wall Street Journal*, December 5, 2005; and Megan Scully, “Army Poised to Cut Guard Troops to Protect Core Program,” *National Journal’s CongressDaily AM*,” December 6, 2005.

⁶⁹ GAO Report, “Defense Acquisitions: Assessments of Selected Major Weapon Programs,” GAO-05-301, March 2005, p. 5.

⁷⁰ David Wood, “Sharply Rising Personnel Costs Force Pentagon Cutbacks,” *Newhouse.com*, November 21, 2005

⁷¹ *Ibid.*

While scaling back these benefits to the all-volunteer force and their families is highly unlikely — particularly in wartime — DOD’s need to have adequate capital to fund modernization may compel them to attempt to reduce personnel, given the unlikelihood of receiving additional funds for modernization. The Air Force reportedly plans to cut between 30,000 to 40,000 uniformed, civilian, and contractor personnel between 2007 and 2011 — largely to protect funds needed for the next-generation of combat aircraft.⁷² The Army was reportedly considering cutting a number of Army National Guard brigades and slowing active Army growth starting in FY2007 in an effort to prevent cuts to FCS,⁷³ but widespread political opposition from both Congress and governors⁷⁴ might have caused the Army to abandon that strategy. Secretary of the Army Francis Harvey subsequently pledged to fully fund the National Guard to its 333,000-soldier end-strength, despite the Guard finishing FY2005 17,00 soldiers below its end-strength.⁷⁵ Given likely political opposition to future proposed personnel cuts, this course of action — trading force structure and personnel for modernization — may no longer be a viable means to protect FCS funding, suggesting instead that savings will need to be found elsewhere in the Army’s budget.

Program Management and Risk Reduction

Lead Systems Integrator (LSI) and Restructured Contract. The Army, in recognition that it does not have the resources or expertise to manage the FCS program, continues to employ the Lead Systems Integrator (LSI) management approach whereby defense contractors Boeing and Science Applications International Corporation (SAIC) serve as “prime contractors with increased responsibilities such as involvement in development design and source selection of major system and subsystem contractors.”⁷⁶ Boeing’s role, in particular, involves systems engineering functions, competitive selection of defense companies to develop initial systems, and integrating and testing these systems. Boeing is also responsible for developing two crucial technologies for the FCS network — the System-of-Systems Common Operating Environment (SOSCOE) and the Warfighter-Machine Interface (WMI) — as well as Cluster One of the Joint Tactical Radio System (JTRS).⁷⁷ There is concern, however, about Boeing being the LSI and also administering and overseeing

⁷² Jonathan Karp, Andy Pasztor, and Greg Jaffe, “Pentagon Weighs Personnel Cuts to Pay for Weapons,” *Wall Street Journal*, December 5, 2005.

⁷³ Jonathan Karp, Andy Pasztor, and Greg Jaffe, “Pentagon Weighs Personnel Cuts to Pay for Weapons,” *Wall Street Journal*, December 5, 2005; Megan Scully, “Army Poised to Cut Guard Troops to Protect Core Program,” *National Journal’s CongressDailyAM*, December 6, 2005; Greg Jaffe, “Army Weighs Slower Troop Growth to Keep Modernization on Track,” *Wall Street Journal*, December 7, 2005.

⁷⁴ Megan Scully, “Senators, Governors Rally Against National Guard Cuts,” *GovExec.com*, January 20, 2006.

⁷⁵ *Ibid.*

⁷⁶ Government Accountability Office (GAO) Report “Acquisitions: Business Case and Business Arrangements Key for Future Combat System’s Success,” GAO-06-478T, March 1, 2006, p. 12.

⁷⁷ *Ibid.*

SOSCOE, WMI, and JTRS — also Boeing-run programs. One study suggests that this situation creates an “inherent tension” regarding Boeing’s roles that could lead to conflicts of interest.⁷⁸ GAO notes, however, that “thus far, the Army has been very involved in the management of the program and in overseeing the LSI.”⁷⁹ Other analysts suggest that Boeing has done an “amazing job of managing the development of FCS”⁸⁰ and the Army contends that by managing the FCS program with a LSI-Army “one team” approach, that:

- There is one integrated management team versus 19 separate program teams;
- There is a 30% reduction in the estimated development to fielding timeline;
- A 37% cost savings now due to collaborative large-scale, systems of systems integration of FCS elements; and
- Reduced life cycle costs in excess of 50%, largely due to cross systems commonality that would be difficult to achieve with 19 separate programs.⁸¹

Since September 2005, the FCS program has been operating under a standard Federal Acquisition Regulation (FAR) contract which the Army hopes to finalize in March 2006.⁸² This new contract is expected to include standard FAR clauses such as Truth in Negotiations, procurement integrity, and cost accounting standards and the Army reportedly expects that the program content, such as the statement of work, will remain unchanged and that “cost, schedule, and performance of the overall development effort’ will not change materially.”⁸³

The new FAR-based contract will reportedly revise the LSI’s management fee plan, aligning it more closely to management performance.⁸⁴ Under the OTA

⁷⁸ Stan Crock and Stanley Holmes, “The Right Stuff of the Future: The Army’s \$125 Billion Future Combat Systems Comes Under Sharp Scrutiny,” *Business Week*, August 15, 2005.

⁷⁹ Government Accountability Office (GAO) Report “Acquisitions: Business Case and Business Arrangements Key for Future Combat System’s Success,” GAO-06-478T, March 1, 2006, p. 13.

⁸⁰ Scott Nance, “Analyst: FCS Good News, Bad News: Boeing Role “Amazing” But Vehicle Weight a Problem,” *Defense Today*, Volume 26, Number 194, October 11, 2005, p. 1.

⁸¹ “FCS 2006” FCS Program Office, September 2005, p. 29.

⁸² Government Accountability Office (GAO) Report “Defense Acquisitions: Improved Business Case is Needed for Future Combat System’s Successful Outcome,” GAO-06-367, March 2006, p. 7.

⁸³ *Ibid.*, p. 8.

⁸⁴ Stan Crock and Stanley Holmes, “The Right Stuff for GIs of the Future,” *Business Week*, August 15, 2005; “Boeing, Army Revise Fee Plan,” *Bloomberg News*, July 13, 2005; Tim (continued...)

agreement, Boeing's reported base fee was 10% of the \$21 billion FCS management contract and a 5% incentive bonus. Under the new FAR-based contract, Boeing is scheduled to receive a 3% base fee and a 12% incentive bonus — which some contend will make Boeing more accountable for program performance. Others, however, note that DOD has historically “paid billions in award and incentive fees regardless of acquisition outcomes,”⁸⁵ and doubt that such a proposed fee restructuring will have discernable impact on improving accountability and performance.

There are additional concerns about this new contract and fee structure — both of which reportedly have not yet been finalized. While the Army suggests that the cost of changing to a FAR-based contract would be minimal, reports suggest that the costs of changing the contract could range from \$25 million to \$75 million and, while not a substantial amount in a \$160 billion-plus contract, could raise further concerns about the program's overall affordability.⁸⁶ There might also be additional costs that have yet to be determined, as one Pentagon official has suggested that the Army did “little or no analysis before deciding to restructure the contract.”⁸⁷ Under the new FAR-based contract, the Army will reportedly exercise more oversight and will assume more of the system management functions previously assigned to Boeing. Some analysts, however, question how the Army will manage more aspects of the FCS program when the original rationale used for selecting the LSI approach was that the Army did not have the resources or expertise to manage such a complex program.⁸⁸ One defense expert suggests that “the government is not competent to manage a program of this complexity,”⁸⁹ which could lead to a potential situation where the new FAR-based contract and increased Army participation in the program management process could result in a less efficient and perhaps more costly program than under the original OTA and management arrangement.

Risk Reduction. The Army has taken a number of initiatives to reduce the overall risk associated with the FCS program. Two particular initiatives are “spinning-out” technologies to operational forces and the establishment of an experimental unit to test those technologies.

“Spin-Outs”. The Army's FCS program consists of four “spin-outs”, formerly known as spirals, that will introduce FCS technologies and systems to the current

⁸⁴ (...continued)

McLaughlin, “Army Will Cut Boeing's Digital Force Fee,” *St. Louis Post-Dispatch*, July 13, 2005.

⁸⁵ GAO Report, “Defense Acquisitions: DOD Has Paid Billions in Award and Incentive Fees Regardless of Acquisition Outcomes,” GAO-06-66, December 2005.

⁸⁶ Jonathan Karp and Andy Pasztor, “About-Face: Army's Decision on Boeing Changes Philosophy,” *Wall Street Journal*, April 6, 2004; Tom Bowman, “Cost Climbs on Army's Contract with Boeing,” *Baltimore Sun*, April 30, 2005.

⁸⁷ *Ibid.*

⁸⁸ Jonathan Karp and Andy Pasztor, “About-Face: Army's Decision on Boeing Changes Philosophy,” *Wall Street Journal*, April 6, 2004.

⁸⁹ *Ibid.*

force. These fielding spin-outs are slated to occur in 2008, 2010, 2012, and 2014 to an experimental brigade and then two years later to the rest of the Army. The first spin-out of FCS technology in 2008 is to emphasize improved munitions and sensors connected in an initial version of the FCS Network. These network capabilities are thought to include Joint Tactical Radio System (JTRS) Clusters One and Five and the Wideband Networking Waveform. In Spin-Out One, JTRS Clusters One and Five would be used in conjunction with other FCS systems such as Unattended Ground Sensors (UGS), the Intelligent Munitions System (IMS), and the pre-production model of the Non-Line of Sight Cannon (NLOS-C). Details for Spin-Outs Two through Four are less well-defined. Reportedly, if Spin-Out One is successful, the Army will add additional sensors and unmanned aerial vehicles (UAVs) to the current force.⁹⁰ Spin-Out Three, scheduled for 2012, would add the manned ground vehicles (MGVs) to the current force and 2014's Spin-Out Four would deploy the FCS Network to the force.⁹¹

The Army's goals for the spin-outs are to address the recommendations of a number of reviews, such as GAO's, to reduce overall developmental risk and also to "get more capabilities into the hands of the warfighters sooner."⁹² Of concern, however is that procurements needed to equip the Spin-Outs are not entirely funded.⁹³ These unfunded requirements would likely have to compete with other unfunded programs in an increasingly fiscally-constrained environment.

Experimentation. The Army is reportedly in the midst of its first major field test of FCS technologies. Referred to as Experiment 1.1, the Army was to have first conducted a field exercise in October 2005, using modified High Mobility Multi-Purpose Wheeled Vehicles (Humvees) as surrogates for yet-to-be developed FCS manned ground vehicles.⁹⁴ These surrogate vehicles would be used to test early versions of the Joint Tactical Radio System (JTRS), System-of-Systems Common Operating Environment (SOSCOE) and elements of battle command software. The Army reportedly also planned to test early prototypes of the Unattended Ground Sensor (UGS), an early prototype launch system for the Intelligent Munitions System (IMS) and possible early versions of selected unmanned ground and aerial vehicles. These 2005 field tests were then to be followed by a series of experiments in 2006 to be conducted in the program's systems of systems integration lab. Little is publically known about the exact scope of Experiment 1.1 or its results to date but analysts suggest that lessons learned and the results of Experiment 1.1 could prove to be valuable tools not only for risk mitigation but also in terms of judging the feasibility of the FCS network's intended capabilities.

⁹⁰ Scott Nance, "FCS Official: "Spin-Outs" to Bring Contractors More Work," *Defense Today*, Volume 26, Number 199, October 18, 2005, p. 3.

⁹¹ *Ibid.*

⁹² *Ibid.*

⁹³ Government Accountability Office (GAO) Report "Defense Acquisitions: Improved Business Case is Needed for Future Combat System's Successful Outcome," GAO-06-367, March 2006, p. 31.

⁹⁴ Information in this section is from Ann Roosevelt, "First Major Field Test for FCS Network Begins This Year," *C4I News*, July 7, 2005.

The Army has designated a combat unit to test FCS “spin-out” technologies before they are fielded to operational forces.⁹⁵ The Evaluation Brigade Combat Team (EBCT) is scheduled to begin forming at Fort Bliss, Texas in March 2007 and is expected to grow from 819 to 3,500 soldiers by 2008 when Spin-Out One equipment is expected to arrive at the unit for testing. The Army plans on using the EBCT to test FCS equipment until 2016 and then the brigade will transition to the Army’s first fully FCS-equipped brigade combat team. Test results and user feedback from the EBCT are expected to be used to further develop FCS equipment.

Program Developmental Issues

The FCS program is comprised of a myriad of programs, each progressing in its own unique manner. Some programs are exceeding or meeting expectation, while others are experiencing significant difficulties. Some of the more notable ongoing programs are examined in the following sections.

Joint Tactical Radio System (JTRS)⁹⁶

JTRS radios are software-defined radios that are to be used to provide voice, video, and data communications to ground and aerial vehicles. One of the primary benefits of JTRS is that it is being designed so that it can operate on multiple radio frequencies, permitting it to talk to certain non-JTRS radios that are expected to stay in the Army’s inventory. JTRS is a joint program and therefore not considered part of the FCS program by the Army but it is to form the “backbone” of the FCS Network and therefore it never the less is of critical importance to the program’s success. Two JTRS sub-programs managed by the Army — Cluster One and Cluster Five — have experienced developmental difficulties, delays, and cost overruns which called into question their viability. The Cluster One radio is intended for ground vehicles and helicopters and is being developed by Boeing, and the Cluster Five variant, includes handheld, manpack, and smaller versions for use in missiles, sensors, and unmanned vehicles, is being developed by General Dynamics.⁹⁷

Program Reorganization. The Department of Defense is reportedly in the process of reorganizing the JTRS program by eliminating the previous system of

⁹⁵ Information in this section is from Sergeant Sara Wood, “Army to Test Future Combat Systems at Fort Bliss,” *American Forces Information Service*, January 30, 2006.

⁹⁶ For additional information see CRS Report RL33161, *The Joint Tactical Radio System (JTRS) and the Army’s Future Combat System (FCS): Issues for Congress*.

⁹⁷ Boeing (Anaheim, California) is the prime contractor for JTRS Cluster One. Other team members include Northrop Grumman Mission Systems (Carson, California); Rockwell Collins (Cedar Rapids, Iowa); BAE Systems (Wayne, New Jersey); and Harris Communications (Rochester, New York). General Dynamics (Scottsdale, Arizona) is the prime contractor for JTRS Cluster Five. Other team members include Rockwell Collins (Cedar Rapids, Iowa); BAE Systems (Wayne, New Jersey); and Thales Communication (Clarksburg, Maryland).

“clusters” and splitting future funding equally among the Services.⁹⁸ Under this plan, Clusters One and Five will be combined into the “JTRS Ground Services Domain” with Cluster One now being referred to as the “Ground Mobile Radio” and Cluster Five the “Handheld/Manpack/Small Form Fit (HMS) Radio - with the aerial version of Cluster One being replaced by the JTRS Air Maritime Fixed (AMF) radio which suggests that Boeing will no longer be involved in developing an airborne version of the former Cluster One radio. In addition, DOD reportedly plans to establish a Joint Waveform Program Office to manage and oversee the JTRS waveform program.⁹⁹

Reduced Program Scope. It also appears that the scope, and perhaps the functionality of JTRS, might be reduced as a result of this program reorganization. The new program will refocus on developing an “increment one” radio combining the successful aspects of Boeing’s and General Dynamic’s previous work.¹⁰⁰ Under this plan, Boeing will focus developmental efforts on the Wideband Networking Waveform and General Dynamics plans to focus on the Soldier Waveform, with each contractor also ensuring that their respective radios are compatible with the Army’s older SINCGARS and EPLRS radios.¹⁰¹ In addition, the Ground Mobile Radio (formerly Cluster One) will only develop 6 or 7 waveforms as opposed to 32 waveforms under the old program.¹⁰² Also reduced in scope are the number of channels for this radio — down to four channels from the original six to eight channels envisioned by Army planners.¹⁰³ While a reduced scope may be beneficial to a struggling program that, in addition to technical difficulties, has also reportedly suffered from additional requirements levied from DOD for functionality and shorter timelines, some question what capabilities are being “given up” under this newly-reorganized program and how this will affect the overall FCS program.

Warfighter Information Network - Tactical (WIN-T)

WIN-T is described as the Army’s “communications network of the future consisting of a three-tiered architecture of orbital, airborne, and ground links that will

⁹⁸ Information in this section is from Jen DiMascio, “New Plan for JTRS Scraps Clusters, Divides Funding Among Services,” *InsideDefense.com*, February 27, 2006; Rebecca Christie, “Army Weapons Buyer Sees “Shakedown” for Troubled Radios,” *Wall Street Journal*, January 19, 2006; and Rebecca Christie, “DOD to Scale Back \$34 Billion Radio System, Trim Program Scope,” *Wall Street Journal*, December 5, 2005.

⁹⁹ Waveforms are defined as software applications that determine the functionality of the radio.

¹⁰⁰ Rebecca Christie, “Army Weapons Buyer Sees “Shakedown” for Troubled Radios,” *Wall Street Journal*, January 19, 2006.

¹⁰¹ Ibid. The Army’s current tactical internet is made up of primarily the Single Channel Ground and Airborne Radio System (SINCGARS). The vehicle-mounted wideband radio used for data distribution is the Enhanced Position Location Reporting System (ELPRS).

¹⁰² Jen DiMascio, “Joint Staff Memo to Outline Incremental Approach to JTRS Requirements,” *InsideDefense.com*, March 13, 2006.

¹⁰³ Ibid.

provide connectivity to a dispersed and highly mobile force.”¹⁰⁴ Reports suggest that developmental work on WIN-T has been relatively successful to date. Testing in November 2005 of the current WIN-T network “proved that WIN-T can provide high capacity, wireless voice and data network access to commanders at all levels of the force despite a very dynamic operating environment.”¹⁰⁵ The Army reportedly was so pleased with the WIN-T test results that it plans to begin deploying WIN-T to operational forces starting in 2007, far in advance of other FCS network technologies.¹⁰⁶ Even with overall program success, there are a number of significant technological challenges associated with WIN-T, such as developing multi-functional antennas.¹⁰⁷ WIN-T, a program potentially worth \$10 billion, is being developed jointly by General Dynamics and Lockheed Martin, both of whom were originally competitors for the WIN-T contract.

While WIN-T development is apparently exceeding expectations, the program may potentially be rebaselined¹⁰⁸, delayed, or even terminated, in part because the WIN-T program overlaps with a similar program which is now being procured and fielded to operational units.¹⁰⁹ The other program, the Joint Network Node (JNN) built by General Dynamics, was “rushed” to Army ground forces in 2004 to improve tactical communications.¹¹⁰ JNN has improved satellite communications links, with quicker network access and more bandwidth but is not mobile — something that the Army hopes to achieve with the introduction of WIN-T and JTRS.¹¹¹ The Army is reportedly considering a variety of programmatic options including merging JNN and WIN-T ahead of schedule, continue fielding JNN, or spiraling in WIN-T into the operational force over time. Of concern are the high costs of both programs, the Army could possibly spend up to \$700 million from FY2006 - 2009 in procurement dollars for WIN-T. JNN procurement funds (\$ 854 million in the FY2006 supplemental, \$340 million in the President’s FY2007 Budget Request, and \$161.3 million in the FY2006 bridge supplemental) could also be spent at the same time WIN-T is being procured.¹¹² Some critics suggest that the Army may be paying twice for essentially the same capabilities.

¹⁰⁴ Scott Nance, “Analyst: Advanced Networks to be Rumsfeld Legacy,” *Defense Today*, Volume 26, Number 233, p. 3.

¹⁰⁵ *Ibid.*

¹⁰⁶ *Ibid.*

¹⁰⁷ Jen DiMascio, “Army to Sole-Source Next Buy of Joint Network Node Equipment to GD,” *InsideDefense.com*, March 20, 2006.

¹⁰⁸ According to GAO, a baseline is a detailed estimate of acquisition and ownership costs normally required for high level decisions. This estimate is performed early in the program and serves as the base point for all subsequent tracking and auditing purposes.

¹⁰⁹ Jen DiMascio, “Army Defends WIN-T Program Against Possible Milestone B Rescission,” *InsideDefense.com*, February 6, 2006.

¹¹⁰ Jen DiMascio, “Army to Sole-Source Next Buy of Joint Network Node Equipment to GD,” *InsideDefense.com*, March 20, 2006.

¹¹¹ *Ibid.*

¹¹² *Ibid.*

Manned Ground Vehicles (MGV)

MGV Transportability. The MGV program is currently facing a major technological challenge concerning its air transportability. It has been widely reported that one of the Army's seven key performance parameters (KPP)¹¹³ for MGVs is that they be transportable by the Air Force's C-130 transport aircraft.¹¹⁴ This is not the case, however, as the Army notes that the MGV C-130 transport issue is not a KPP but instead a Critical Operational Issue and Criteria (COIC) which is a far less stringent requirement.¹¹⁵ That said, the MGV program continues to face significant issues regarding C-130 transportability. In general, in order to meet this criteria, the MGVs must weigh 19 tons or less (in accordance with the FCS Operational Requirements Document) and be capable of driving into and fitting inside the C-130 to meet Air Force safety requirements, all while not exceeding C-130 operational limits.¹¹⁶

Reports suggest that, to date, the best that industry has been to do in terms of MGV weight is more than 24 tons.¹¹⁷ In order to meet the C-130 weight limit, this vehicle would need to be "stripped down" and it would require four to six hours per vehicle to reconfigure them with fuel, ammunition, and other supplies — which is significantly longer than the operational requirement that MGVs be converted to its combat configuration no more than 30 minutes after rolling off a C-130.¹¹⁸ In addition, a second C-130 aircraft would be required for each MGV to carry the components and ammunition that had been stripped off the MGV so that it could meet the 20 ton limit.¹¹⁹ According to one Army official, this would "add hours to intra-theater deployment times and tax the service's logistics tail because it would significantly increase the number of sorties to move the force."¹²⁰ If, instead, the Air

¹¹³ According to the Defense Acquisition Acronyms and Terms Glossary published by the Defense Acquisition University, Fort Belvoir, Virginia, Eleventh Edition, Sept. 2003, a key performance parameter (KPP) is "Those minimum attributes or characteristics considered most essential for an effective military capability." KPPs are generally considered "absolutes" in system design and are therefore, rarely modified or disregarded.

¹¹⁴ Megan Scully, "U.S. Army May Tinker with FCS C-130 Need," *Defense News*, Nov. 15, 2004.

¹¹⁵ Conversation with the Army's System of System/FCS Department of the Army Systems Coordinator Office, Apr. 8, 2005.

¹¹⁶ Information in this section is from discussions with the Army G-8 Staff on April 13, 2006 and supporting documents provided to CRS.

¹¹⁷ Megan Scully, "Army May Not Require FCS Vehicles to Fit C-130," *Army Times*, Feb. 7, 2005.

¹¹⁸ Megan Scully, "U.S. Army May Tinker with FCS C-130 Need," *Defense News*, Nov. 15, 2004.

¹¹⁹ Ashley Roque, "Band Track Used on Both Models: Transportability of Manned FCS Ground Vehicle Remains a Challenge," *Inside the Army*, vol. 17, no. 7, Feb. 21, 2005.

¹²⁰ Megan Scully, "Army May Not Require FCS Vehicles to Fit C-130," *Army Times*, Feb. 7, 2005.

Force's C-17 transport is used for MGV transport, this process of "stripping" MGVs would not be required.¹²¹

In 2005, the Army reportedly adopted a "24-ton design to weight requirement" whereby the goal for the basic vehicle design was 19 tons, but allowed for the addition of additional elements to the vehicles upon landing.¹²² The Pentagon's Director of Operational Testing and Evaluation (DOT&E)¹²³ in his 2005 Annual Report on DOD Programs recommended that the Army:

Review the relevance of key requirements, particularly transportability of manned ground vehicles. Design trades necessary to meet this requirement are significant and have consequences in terms of operational effectiveness, lethality, survivability, tactical mobility, and sustainability.¹²⁴

Recently the Army has suggested that there has "been an evolution in thinking in the Army on transportability," moving away from the C-130 instead to the C-17 as the preferred means of air transport for MGVs.¹²⁵ The Secretary of the Army, Francis Harvey, instead sees the C-130 as a design template, intended to "discipline engineers and prime contractors to "think light" and "think mobile."¹²⁶ The Secretary of the Army reportedly stated that the "real requirement is three FCS vehicles in a C-17."¹²⁷

Congressional Action. In the Conference Report to the FY2006 National Defense Authorization Act (P.L. 109-163), Congress called for the Secretary of Defense to complete an independent analysis for congressional defense committees on FCS key performance transportability requirements for manned ground vehicles.¹²⁸

¹²¹ Information in this section is from discussions with the Army G-8 Staff on April 13, 2006 and supporting documents provided to CRS.

¹²² Jen DiMascio, "Pentagon's Chief Tester Blasts FCS Transportability Requirements," *InsideDefense.com*, January 23, 2006.

¹²³ The Director, Operational Test & Evaluation (DOT&E) is the principal staff assistant and senior advisor to the Secretary of Defense on operational test and evaluation (OT&E) in DOD. DOT&E is responsible for issuing DOD OT&E policy and procedures; reviewing and analyzing the results of OT&E conducted for each major DOD acquisition program; providing independent assessments to Secretary of Defense, the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)), and Congress making budgetary and financial recommendations to the Secretary of Defense regarding OT&E; and oversight to ensure OT&E for major DOD acquisition programs is adequate to confirm operational effectiveness and suitability of the defense system in combat use.

¹²⁴ Director, Operational Test & Evaluation (DOT&E) 2005 Annual Report on DOD Programs, January 2006, p. 59.

¹²⁵ Scott Nance, "Analyst: FCS Good News, Bad News: Boeing Role "Amazing" But Vehicle Weight a Problem," *Defense Today*, Volume 26, Number 194, October 11, 2005, p. 2.

¹²⁶ *Ibid.*

¹²⁷ *Ibid.*

¹²⁸ National Defense Authorization Act for Fiscal Year 2006 Conference Report to (continued...)

The Committee further decided to “limit funds available” for manned ground vehicle system development and demonstration (SDD) phase activities until the independent report on MGCV transportability was submitted to the defense committees. According to Senate Armed Service Committee (SASC) staff, as of April 19, 2006 this report, which was due to Congress by February 1, 2006, has not yet been provided by the Army.

MGV Engines. In December 2004, the contract for the MGV engine was delayed, marking the fourth contract delay since requests for proposals (RFPs) were first issued in October 2003.¹²⁹ The decision to delay the contract was reportedly based on the Army’s desire to increase engine power from a 410 kilowatt power rating to a 440 kilowatt power rating in order to power heavier vehicles.¹³⁰ In August 2005, the Army awarded Detroit Diesel a reported \$47 million SDD phase contract to develop diesel engines for FCS MGVs.¹³¹ This contract calls for delivering 12 5L890 engines beginning in mid-2006 with an option for 35 additional engines. The 5L890 reportedly can operate at the Army’s required 440 kilowatts and could “easily” propel a 20 to 25 ton vehicle, however anything heavier would require an upgraded engine.

Active Protection System (APS).¹³² In March 2006, the FCS LSI Team of Boeing and SAIC reportedly awarded a contract potentially worth \$70 million to Raytheon to develop an Active Protection System (APS) for FCS as well as the Army’s current fleet of vehicles. The APS, divided into a short-range system for dealing with urban-type threats such as rocket-propelled grenades and a long-range system for dealing with anti-tank guided missiles, has been compared to a “mini anti-ballistic missile system.” For both systems, a suite of sensors is intended to detect an incoming threat and then hit the incoming projectile with projectile of its own.

Raytheon was reportedly given 90 days under its contract to conduct trade studies and then present the results to the Army and LSI, who will then decide on an APS architecture for the current force and evaluate proposals for the direction of the system destined for use on FCS vehicles. Initial work is expected to focus on the short-range

¹²⁸ (...continued)

Accompany H.R. 1815, December 18, 2005, p. 613.

¹²⁹ Jen DiMascio, “Army Looks at Propulsion System as a Whole: Award for FCS Manned Ground Vehicle Engine is Delayed Indefinitely,” *Inside the Army*, Dec. 20, 2004.

¹³⁰ Jen DiMascio, “Army Asks if Power Output Could Increase,” *Inside the Army*, vol. 16, no. 46, Nov. 15, 2004.

¹³¹ Information in this section is from Ashley Roque, “Army Selects Diesel Engine to Power FCS Manned Ground Vehicles,” *Inside the Army*, Volume 17, Number 34, August 29, 2005, pp. 1-10.

¹³² Information in this section, unless otherwise noted, is taken from Jen DiMascio, “Raytheon Wins \$70 Million Contract to Develop Active Protection System,” *InsideDefense.com*, March 13, 2006; Scott Nance, “Army Active Protection Pact Due Soon,” *Defense Today*, Volume 27, Number 34, February 21, 2006; Scott Nance, “FCS to Award Active-Protection System Pact,” *Defense Today*, Volume 26, Number 191, October 5, 2005; and Scott Nance, “Official: FCS to Be “Far More Survivable” Than Current Platforms,” *Defense Today*, Volume 26, Number 165, August 29, 2005.

threat as technology is further along than it is for the longer-ranged threats. The Army and LSI will reportedly decide on the APS architecture for FCS vehicles in early 2007. The \$70 million contract is broken into three parts: \$10 million over the course of the contract (2006 to 2011); a \$30 million option for Raytheon to find current force applications; and \$30 million to provide APS to FCS. An early version of the short-range APS is expected in 2007.

Safety Concerns. There are a number of concerns about APS - with safety to friendly troops being at the forefront. As currently envisioned, APS will fire some yet to be determined projectile in response to a sensor detecting an incoming threat projectile, with the response time being almost instantaneous in some cases. There are concerns that dismounted U.S. forces, allied forces, and possibly civilians, in the proximity of the APS could be killed or wounded. Another potential issue is that the APS's sensor arrays and kill mechanisms could put unacceptable power requirements on current Army vehicles as well as FCS platforms.

Technological and Integration Challenges. GAO suggests that there are technological and integration challenges facing the APS program, asserting that:

- It may not be technologically possible to have a single, integrated active protection system that protects against all threats;
- The Threat Warning System, a proposed system that will detect and track incoming threats at extended ranges, will not mature to TRL 6 standards until FY2009;
- The part of the system intended to defeat kinetic energy threats will require a significant effort from the scientific and engineering community; and
- Protection technology may have limited utility in urban environments due to collateral effects.¹³³

Unmanned Ground Vehicles (UGV)

In August 2005, BAE Systems was reportedly awarded a \$122.3 million contract modification to develop two armed robotic vehicle (ARV) variants for the FCS program.¹³⁴ This modification raises the value of BAE's previous system development and demonstration (SDD) contract from \$189 million to \$311.3 million and an additional \$9.2 million could possibly be added to the contract if additional task orders are authorized. Under this modification ARV prototype development will be accelerated, with the first prototypes to be fielded in 2010 and with production models scheduled to be fielded to FCS-equipped brigade combat teams in the 2012-2014 time

¹³³ Government Accountability Office (GAO) Report "Defense Acquisitions: Improved Business Case is Needed for Future Combat System's Successful Outcome," GAO-06-367, March 2006, p. 20.

¹³⁴ Information in this section is from Scott Nance, "BAE Systems Wins \$122.3 Million FCS Pact," *Defense Today*, Volume 26, Number 156, August 16, 2005, pp. 1-2.

frame. The ARVs are intended to be the size of a large pick up truck and also highly deployable — either two at a time on a C-130 aircraft or one on a CH-47 helicopter. BAE Systems is also working with General Dynamics under a SDD contract to lead the MGV developmental effort.

Additional funding has also reportedly been provided to iRobot Corporation (Burlington, Massachusetts) to develop the Small Unmanned Ground Vehicle (SUGV).¹³⁵ The new funding — now \$51.4 million up from a previous \$37.3 million — is intended to expedite the development of the FCS SUGV. The FCS SUGV will likely be a more compact version of iRobot's PackBot - a man portable reconnaissance and tactical robot which U.S. forces have used extensively in Afghanistan and Iraq.

Issues for Congress

What if FCS Proves to be “Less Capable” than Originally Envisioned?

The FCS program ultimately hopes to produce a futuristic combat unit of unmatched capability in terms of lethality and survivability. But approximately one-third of the way through the program, there is growing concern that FCS could be significantly less capable than envisioned by the Army, which raises the question if FCS will meet the Army's “as good as or better than” criteria for the FCS program.

System Level Requirements.¹³⁶ In a recent report on the FCS, GAO states that “the Army anticipates that there could be roughly 90,000 systems-level requirements for FCS.”¹³⁷ According to GAO, the Army plans to “trade off systems requirements to offset technical risks and costs,” but that there is limited flexibility to this approach in order to meet program success criteria.¹³⁸ While many systems requirements are likely achievable, GAO suggests that would be “technical risk in the full achievement of some system-level requirements including;”

- Mine detection;
- Automatic target recognition for terminal weapon guidance;
- Real-time battle damage assessment;

¹³⁵ Information in this section is from Scott Nance, “Funds Climb for FCS Robot Maker,” *Defense Today*, Volume 26, Number 102, May 31, 2005, p. 3.

¹³⁶ Information in this section, unless otherwise noted is from Government Accountability Office (GAO) Report “Defense Acquisitions: Improved Business Case is Needed for Future Combat System's Successful Outcome,” GAO-06-367, March 2006.

¹³⁷ *Ibid.*, p. 12.

¹³⁸ *Ibid.*, p. 2.

- Chemical and radiation detection;
- Weapon self-loading for some unmanned ground vehicles;
- Manned ground vehicle countermine capabilities;
- Safe operation of unmanned ground vehicles;
- Network latency, quality of service, and intrusion detection;
- Improvised explosive device detection and suppression;
- Reliability, availability, maintainability, and testing;
- Unmanned aerial vehicle size and weight; and
- Sensor data fusion.¹³⁹

An examination of these potential capability shortfalls reveals that they are not focused in one specific area of the program but, instead, run the gamut of capabilities. In particular, manned ground vehicle survivability is called into question in terms of potential “mine detection,” “countermine capabilities,” and improvised explosive device (IED) detection and suppression” capability shortfalls. While analysts suggest that survivability, even among current armored fighting vehicles, is a significant challenge — with opponents such as in Iraq constantly devising new ways to defeat armored vehicles with mines and IEDs — these potential survivability shortfalls for the weight-constrained FCS manned ground vehicles could mean a much lower survival threshold for these vehicles than anticipated.

Network Dependency.¹⁴⁰ In its report GAO notes the criticality of the FCS Network in achieving many of FCS’s requirements, suggesting that there is “hardly any aspect of FCS functionality that is not predicated on the network.”¹⁴¹ While some developmental aspects of the FCS network appear to be progressing in good order, others are said to be experiencing difficulties. In particular, the JTRS program has raised concerns as it appears to some to be in an almost constant state of reorganization or on the verge of cancellation. Early JTRS versions delivered for experimentation are reported to be able to accommodate fewer waveforms than anticipated and can operate on fewer channels than ordinally envisioned. These and other difficulties have led to the adoption of legacy radio systems - particularly for the Army’s helicopter fleet.

¹³⁹ Ibid., p. 13

¹⁴⁰ Information in this section, unless otherwise noted is from Government Accountability Office (GAO) Report “Defense Acquisitions: Improved Business Case is Needed for Future Combat System’s Successful Outcome,” GAO-06-367, March 2006, p. 7.

¹⁴¹ Ibid., p. 13.

With many more parts of the FCS Network still in varying stages of development with a variety of possible outcomes in terms of success, partial success, or failure, there appears to be a growing concern that the overall FCS Network - which will not be fully-developed until almost the end of the FCS development cycle - may also be less capable than originally envisioned. One possible scenario which could have significant implications would be a “17 Go and 1 No-Go “ scenario whereby 17 of the FCS core systems are judged by the Army to meet its success criteria for development and deployment but 1 core system - the FCS Network - falls significantly short of its requirements, perhaps prompting the Army to accept a far less capable system. Given the FCS Networks “central nervous system” - role in FCS, such an outcome could result in 17 state of the art combat systems not being employed to their full technological and warfighting potential because the FCS Network cannot provide them with the requisite command and control, communications, intelligence, sensory data, tracking, and planning capabilities.

Possible Congressional Interest. Congress may decide to examine, in concert with the Department of Defense and the Army, the possibility that FCS may develop into a less capable system than originally envisioned. Although still in the development phase, progress in some areas has been characterized as less than satisfactory and the Army has reportedly acknowledged that it would “trade off systems requirements to offset technical risks and costs.” Congress might choose to explore with the Pentagon which systems requirements are falling short of expectations as well as what systems requirements would be “traded off” by the Army for risk and or cost considerations.

What if FCS Becomes “Cost-Prohibitive” Late in its Development Cycle?¹⁴²

The potential convergence of three factors in the later stages of the FCS program could place the FCS program in a “cost-prohibitive” status, potentially forcing the Army, the Department of Defense, and ultimately Congress into making some crucial decisions about the future of the FCS program.

Factor One: FCS Acquisition Strategy. GAO has repeatedly warned that the FCS acquisition strategy lacks an adequate knowledge base, relies too heavily on concurrent development, and does not demonstrate a sound business case. As previously discussed, of critical concern is that under the current program schedule, the actual performance of the completely integrated FCS will be demonstrated very late in the program and could result a significant cost increase. This situation, referred to as “late-cycle churn” — a common occurrence in DOD programs — occurs when significant problems are discovered late in a product’s development, resulting in additional and unanticipated costs, time, and effort. GAO suggests that “the late accumulation of design and production knowledge called for by the FCS acquisition strategy increases the likelihood that problems will be discovered in late development

¹⁴² Information in this section, unless otherwise noted is from Government Accountability Office (GAO) Report “Defense Acquisitions: Improved Business Case is Needed for Future Combat System’s Successful Outcome,” GAO-06-367, March 2006

and early production.”¹⁴³ In the event that the FCS program does fall victim to “late cycle churn” GAO speculates that DOD might be hard pressed to accommodate this situation “given the magnitude of its cost in an increasingly competitive environment for investment funds.”¹⁴⁴

Factor Two: Potential Cost Increases. Apart from unanticipated costs as a result of late cycle churn, there are other potential additional costs which could push the price tag for FCS higher than the current estimated \$160 billion or \$200 billion if essential complementary programs are factored in. As previously discussed, GAO believes that the Army does not have sufficient funds in FY2012 and 2013 to meet FCS procurement requirements and that there are also a number of program requirements, including spiraling, that are not fully funded. As the program progresses and becomes further defined, other additional costs will likely be identified. Examples of potential additional costs are lightweight armor, vehicle survivability technologies, and additional unmanned vehicles.

Lightweight Armor and Survivability Technologies. In order to meet weight requirements for manned ground vehicles, the Army is considering the use of advanced, lightweight materials, such as ceramics which could be significantly more costly than current armor protection. Meeting manned ground vehicle survivability requirements could also prove to be more costly than anticipated as each vehicle will need to be equipped for “detection avoidance, target acquisition avoidance, hit avoidance, ballistic protection, and kill avoidance,” as well as sensors to “detect, classify, recognize, identify, and locate enemy combatants.”¹⁴⁵

Additional Unmanned Vehicles. The FCS as depicted by the Army, will depend to a large extent on unmanned ground and aerial vehicles (UGVs and UAVs) to enhance the FCS brigade combat team’s survivability. It is expected that a large number of these systems will be destroyed by enemy fire and will therefore need to be replaced or risk the loss of even more costly manned ground vehicles. With 200 UAVs planned for each of the 15 brigades, UAV replacement costs alone could be considerable.

Factor Three: Constrained Resources and Competition for Funding. Constrained resources and competition for funding, given the first two factors, could potentially push the FCS into the “cost-prohibitive” category. The current budgetary environment has been characterized by some as austere as the United States is facing a large and growing deficit. Recent Pentagon Program Budget Decisions levying Service-wide cuts may continue in future years and could have implications for future FCS funding. Within the Army itself, competition between rising personnel costs, as well as increasing costs to repair and replace damaged or destroyed equipment, and growing funding requirements for the Army’s modular force transformation, could put the FCS program, even if it manages to hold down costs, into a cost-prohibitive status. Unknown factors such as future major Global War on Terror operations, potential

¹⁴³ Ibid., p. 3.

¹⁴⁴ Ibid., p. 28.

¹⁴⁵ Ibid., p. 14.

regional conflicts, and possible disaster recovery expenses could further impact on funds available for the FCS program.

Options for an Under-Budgeted FCS Program. It is not inconceivable that the FCS program could emerge from its development phase and face substantial cost challenges from late-identified developmental problems as well as additional costs accrued in developing systems that meet the Army's lethality, transportability, and survivability criteria. Historically, in similar cases when only a single system was involved, the Services could opt to extend the development timeline or reduce the number of ships, aircraft, or tanks procured. Such courses of action may not be viable for FCS due to its system interdependencies. There might be some cost savings associated with extending timelines or reducing the procurement from 15 brigades to some lesser number of brigades, but there could be economy of scale costs or costs associated with delaying procurement which could make the overall program even more expensive. In such a case, there may be little recourse other than paying whatever the costs are to procure FCS. However, given the current and potential budgetary challenges, this could have a detrimental impact on other Army or DOD programs if DOD decides to fully fund FCS procurement at a higher than anticipated cost.

Possible Congressional Interest. Congress might opt to examine how DOD and the Army would respond to a situation where FCS program costs become prohibitive late in its development cycle, assuming that significant additional funds are not available to cover increased program costs. Would the Army opt to delay the program or cancel a system or a family of systems in order to outfit 15 brigade combat teams with remaining FCS technologies or instead field fewer than the 15 brigades presently planned? All courses of action carry operational considerations and trade offs which could be of interest to Congress. If these courses of action are not economically or operationally sound and assuming that additional funds for FCS are not forthcoming, what Army and/or DOD programs might be candidates for budget reductions in order to fully fund FCS procurement?

Additional Reading

CRS Report RL32476, *U.S. Army's Modular Redesign: Issues for Congress*, by Andrew Feickert.

CRS Report RL33161: *The Joint Tactical Radio System (JTRS) and the Army's Future Combat System (FCS): Issues for Congress*, by Andrew Feickert.

CRS Report RS21754, *Military Forces: What is the Appropriate Size for the United States?*, by Ed Bruner.

CRS Report RS21195, *Evolutionary Acquisition and Spiral Development in DOD Programs: Policy Issues for Congress*, by Gary J. Pagliano and Ronald O'Rourke.

Appendix A. FCS Subsystems

Manned Ground Vehicles

FCS manned ground vehicles (MGVs) are a family of eight different combat vehicles — with some having more than one variation — that are based on a common platform and are being designed to be air transportable by the U.S. Air Force. They are to be equipped with a variety of passive and active protection systems and sensors that the Army hopes will offer them the same survivability as the current heavy armor force. In addition the Army intends for its MGVs to be highly reliable, require low maintenance, and have fuel-efficient engines. The following are brief descriptions of MGV types and variants. All are intended to have a range of 750 kilometers and a top speed of 90 kilometers per hour (kph) — 55 miles per hour:¹⁴⁶

Mounted Combat System (MCS). As envisioned, the MCS provides direct and beyond-line-of-sight (BLOS) fires, is capable of providing direct fire support to dismounted infantry, and can attack targets with BLOS fires out to a range of 8 kilometers. The MCS is intended to replace the current M-1 Abrams tank. The MCS is to have a crew of two and might also be able to accommodate two passengers. The MCS is to be armed with a 120 mm main gun, a .50 caliber machine gun, and a 40 mm automatic grenade launcher.

Infantry Carrier Vehicle (ICV). As planned, the ICV consists of four versions: the Company Commander version, the Platoon Leader version, the Rifle Squad version, and the Weapons Squad version. All four versions appear to be identical from the exterior to prevent the targeting of a specific carrier version. The Rifle Squad version is to have a two man crew and is to be able to transport a nine man infantry squad and dismount them so that they can conduct combat operations on foot. The ICV is to mount a 30 or 40 mm cannon.

Non-Line-of-Sight Cannon (NLOS-C). The NLOS-C is to provide networked, extended-range targeting and precision attack of both point and area targets with a wide variety of munitions. Its primary purpose will be to provide responsive fires to FCS Combined Arms Battalions and their subordinate units. The NLOS is to have a two man crew and a fully automated handling, loading, and firing capability.

Non-Line-of-Sight Mortar (NLOS-M). The NLOS-M is intended to provide indirect fires in support of FCS companies and platoons. The NLOS-M is to have a four man crew, mount a 120mm mortar, and also carry an 81 mm mortar for dismounted operations away from the carrier.

Reconnaissance and Surveillance Vehicle (RSV). As planned, the RSV will feature advanced sensors to detect, locate, track, and identify targets from long ranges under all climatic conditions, both day and night. The RSV is to have a mast-mounted long-range, electro-optical infra-red sensor, sensors for radio frequency (RF)

¹⁴⁶ Information for these descriptions are taken from two Army sources: The Army's *FCS 18+1+1 White Paper*, dated Oct. 15, 2004 and the *FCS 2005 Flipbook*, dated Aug. 26, 2004.

intercept and direction finding as well as a remote chemical warfare agent detector. RSVs are to also carry four dismounted scouts, unattended ground sensors (UGS), a Small Unmanned Ground Vehicle (SUGV) with various payloads, and two Unmanned Aerial Vehicles (UAVs). In addition to the four scouts, the RSV is to have a two man crew and a defensive weapons system.

Command and Control Vehicle (C2V). The C2V is intended to serve as the “hub” for battlefield command and control. It is to provide information management for the integrated network of communications and sensors for the FCS brigade combat teams. The C2V is to have a crew of two and carry four staff officers and also be capable of employing UAVs.

Medical Vehicle - Evacuation (MV-E) and Medical Vehicle - Treatment (MV-T). There are to be two versions of the MV: the MV-E and MV-T. The MV-E would permit combat trauma specialists to be closer to the casualty’s point of injury as it is to move with combat forces and evacuate casualties to other treatment facilities. The MV-T is to enhance the ability to provide Advanced Trauma Management/Advanced Trauma Life Support forward in the battle area and both MV-E and MV-T would be capable of conducting medical procedures and treatments using telemedicine systems. Both would have four man crews and the capability to carry four patients.

FCS Recovery and Maintenance Vehicle (FRMV). The FRMV would be the FCS Brigade Combat Team’s recovery and maintenance system. The FRMV is to have a crew of three, plus additional space for up to three recovered crew members.

Unmanned Aerial Vehicles (UAVs)¹⁴⁷

Each FCS-equipped brigade is to have almost 200 UAVs ranging from small, platoon-level vehicles to larger, higher endurance aircraft.¹⁴⁸ While these UAVs are to provide a variety of capabilities to forces on the ground, some experts note that they could also present an air space management challenge to not only manned Army aviation assets, but also to Navy, Marine Corps, Air Force, and other nation’s aircraft that might be providing support to Army ground operations. The following are brief descriptions of the Army’s four classes of UAVs:

Class I UAVs. Class I UAVs are intended to provide Reconnaissance, Surveillance, and Target Acquisition (RSTA) at the platoon level. Weighing less than 15 pounds each, these Class I UAVs are intended to operate in urban and jungle terrain and have a vertical takeoff and landing capability. They are to be used to observe routes and targets and can provide limited communications transmissions relay. The Class I UAV are to be controlled by dismounted soldiers and can also be controlled by selected FCS ground platforms, and have an endurance of 50 minutes over an 8 kilometer area, and a 10,500 foot maximum ceiling.

¹⁴⁷ Unless otherwise noted, UAV information for these descriptions are taken from two Army sources: The Army’s *FCS 18+1+1 White Paper*, dated Oct. 15, 2004 and the *FCS 2005 Flipbook*, dated Aug. 26, 2004.

¹⁴⁸ Sandra I. Erwin, “Army to Field Four Classes of UAVs,” *National Defense*, Apr. 2003.

Class II UAVs. Class II UAVs are intended to provide RSTA at the company level. The Class II UAV is to be vehicle mounted and have a vertical takeoff and landing capability. Its planned distinguishing capability is that it can designate targets both day and night and in adverse weather at a distance of 2 kilometers from the UAV, enabling the company commander to employ line-of-sight, BLOS, and NLOS fires. It can also provide limited communications relays. Class II UAVs are intended to have an endurance of 120 minutes over a 16 kilometer area and an 11,000 foot maximum ceiling.

Class III UAVs. Class III UAVs are to be multifunctional systems intended to be employed at the battalion level. A Class III UAV encompasses all capabilities found in the Class I and II UAVs and are planned to also provide an enhanced communications relay capability, mine detection, chemical, biological, radiological, and nuclear detection, and meteorological survey. The Class III UAV is to be able to take off and land without a dedicated airfield and is intended to be able to stay aloft for 6 hours over a 40 kilometer area with a maximum ceiling of 12,000 feet.

Class IV UAVs. Class IV UAVs are intended to provide the FCS brigade commander with a long endurance capability encompassing all functions in Class I through Class III UAVs. It is intended to stay aloft for 72 continuous hours and operate over a 75 kilometer radius with a maximum ceiling of 16,500 feet. It is also planned to interface with other manned and unmanned aerial vehicles and be able to take off and land without a dedicated airfield.

Unmanned Ground Vehicles (UGVs)¹⁴⁹

Armed Robotic Vehicle (ARV). The ARV is intended to come in two variants — the Assault variant and the Reconnaissance, Surveillance, and Target Acquisition (RSTA) variant. The two variants are to share a common chassis. The Assault variant is to provide remote reconnaissance capability, deploy sensors, and employ its direct fire weapons and special munitions at targets such as buildings, bunkers, and tunnels. It is also intended to be able to conduct battle damage assessments, act as a communications relay, and support both mounted and dismounted forces with direct and anti-tank fire as well as occupy key terrain. The RSTA version is to have similar capabilities but is not intended to provide direct support fire to mounted or dismounted troops.

Small Unmanned Ground Vehicle (SUGV). The SUGV is a small, lightweight, manportable UGV capable of operating in urban terrain, tunnels, and caves. The SUGV will weigh 30 pounds, operate for 6 hours without a battery recharge, and have a one kilometer ground range and a 200 meter tunnel range. Its modular design will permit a variety of payloads which will enable it to perform high-risk intelligence, surveillance, and reconnaissance (ISR) missions, and chemical weapons or toxic industrial chemical reconnaissance.

¹⁴⁹ Unless otherwise noted, information for these descriptions are taken from two Army sources: The Army's *FCS 18+1+1 White Paper*, dated Oct. 15, 2004 and the *FCS 2005 Flipbook*, dated Aug. 26, 2004.

Multifunctional Utility/Logistics and Equipment Vehicle (MULE). The MULE is a UGV that will support dismounted infantry. It is to come in three variants sharing a common chassis - (transport, countermine, and the Armed Robotic Vehicle - Assault - Light (ARV-A-L)). The transport variant is to be able to carry 1,900 to 2,400 pounds of equipment and rucksacks for dismounted infantry and follow them in complex and rough terrain. The countermine variant is to have the capability to detect, mark, and neutralize anti-tank mines. The ARV-A-L variant is to incorporate a weapons package and a RSTA package to support dismounted infantry operations. The MULE is intended to have a 100 kilometer road, and 50 kilometer cross country, range.

Unattended Ground Sensors (UGS)¹⁵⁰

UGS are divided into two groups — Tactical UGS and Urban UGS — and are described as follows:

Tactical UGS. Tactical UGS include intelligence, surveillance, and reconnaissance (ISR) sensors and Chemical, Biological, Radiological, and Nuclear (CBRN) sensors. These sensors are to employ a variety of sensing technologies and integrated into the overall FCS network. They are intended to be deployed by hand, by vehicle, or by robot and have a 48 hour endurance. They are intended to be expendable, low-cost sensors used for such tasks as perimeter defense, surveillance, target acquisition, and CBRN early warning.

Urban UGS. Urban UGS can also be employed by soldiers, vehicles, or robots and are intended to provide situation awareness inside and outside of buildings for force protection and also for previously-cleared buildings and areas.

Non-Line-of-Sight Launch System (NLOS-LS) and Intelligent Munitions System (IMS).

NLOS-LS. NLOS-LS is to consist of a family of missiles in a deployable, platform-independent, container launch unit (CLU), which can be fired in an unmanned and remote mode. Each CLU is to have a fire control system and 15 missiles consisting of Precision Attack Missiles (PAM) and Loitering Attack Missiles (LAM).

The PAM is to have two employment modes — a direct-fire and a fast attack mode or a boost-glide mode. The missile is intended to receive target information prior to launch and receive and respond to target location updates while in flight. The PAM can be fired in the laser-designated mode and transmit near real-time target imagery prior to impact. The PAM is intended to be used against heavily armored targets.

The LAM is to provide imagery for search, surveillance, targeting, and battle damage assessment (BDA) and can also serve as an airborne radio retransmission

¹⁵⁰ Ibid.

sight. LAMs are to be capable of flying long distances with significant loiter times. LAMs are intended to be re-programmed in flight and attack, high value, fleeting targets.

IMS. IMS is intended to be an unattended munitions system, consisting of a variety of lethal and non-lethal munitions and can be used for filling gaps, isolating enemy forces or objectives, and controlling non-combatant movement with nonlethal munitions. IMS is to have an on-off capability and can be recovered and re-employed if not used. It can also self destruct if required and is to have an anti-tamper capability. IMS is eventually intended to replace most current U.S. anti-personnel mines.

The Network¹⁵¹

The FCS network is considered the most crucial system of all 18 systems and, according to the CSA, General Schoomaker, “the toughest part of the program will be assembling the network that ties the system of systems together.”¹⁵² The FCS network is to consist of four interactive components — the System-of-Systems Common Operating Environment (SOSCOE); Battle Command (BC) software; communications and computers (CC); and intelligence, reconnaissance and surveillance (ISR) systems.

System-of-Systems Common Operating Environment (SOSCOE). The SOSCOE is to enable the integration of a variety of software packages into the FCS network. It is intended to use commercial, off-the-shelf hardware and allow for the integration of critical interoperability packages that translate Army, Navy, Air Force, Marine Corps, and allied message formats into internal FCS message formats.

Battle Command (BC) Software. Battle Command mission applications are to include mission planning and preparation, situational understanding, battle command and mission execution, and warfighter-machine interface.

Mission Planning and Preparation. Consists of 16 different functions that provide FCS units with the following automated capabilities:

- The development of deliberate, anticipatory, and rapid-response plans;
- The ability to perform plan assessments and evaluations;
- The ability to perform terrain analysis;
- The conduct of mission rehearsals; and
- The conduct of after action reviews.

Situation Understanding. This consists of 10 different packages that allow the user to better comprehend their surroundings. These packages employ map information and a variety of databases that help to determine enemy locations and capabilities, infer enemy intentions, and assess the threat to U.S. forces.

¹⁵¹ Ibid.

¹⁵² “House Moves to Double Stryker Budget in Effort to Help Reset the Force,” *Inside the Army*, June 21, 2004.

Battle Command and Execution. This package contains a variety of planning and decision aids to help commanders make rapid, informed, and accurate decisions during battle. These packages can also be used in the training and rehearsal modes.

Warfighter-Machine Interface Package. This package receives soldier-generated information and displays information across all FCS platforms for soldier use.

Communications and Computer (CC) Systems. The Communications and Computer network is intended to provide secure, reliable access to information over extended distances and complex terrain. This network is not intended to rely on a large and separate infrastructure because it is to be embedded in the FCS mobile platforms and move with the combat units. The communications network is to consist of a variety of systems such as the Joint Tactical Radio System (JTRS); Wideband Network Waveform and Soldier Radio Waveform systems; Network Data Link; and the Warfighter Information Network Tactical (WIN-T).

Intelligence, Reconnaissance and Surveillance (ISR) Systems. The Intelligence, Reconnaissance and Surveillance System is to be a distributed and networked array of multispectral ISR sensors intended to provide timely and accurate situational awareness to the FCS force. In addition, the ISR system is intended to help FCS formations avoid enemy fires while providing precision, networked fires to the unit.

The Soldier

All dismounted soldiers are to wear the Land Warrior combat ensemble, which includes enhanced body protection, an embedded computer/communication system, and a family of new personal weapons.