Future Combat System: Is It Worth It?

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I. Introduction

The Army's Future Combat System (FCS), authorized in 2003, is the service's major modernization effort for the next 20 years. It intends to integrate 14 components (manned ground vehicles, unmanned aerial systems, unattended ground systems and unmanned ground vehicles) into a system-of-systems network in order to provide near-perfect situational awareness. In theory, this condition would virtually eliminate uncertainty and close-in combat from future warfare. It would also enable substantial reductions in the weight of armored vehicles. The trade-off is less mass but more information.

The FCS concept, as authorized in 2003, envisioned equipping 15 combat brigades for $91.4 billion. It proposed 18 separate components (all linked to an advanced information and communications network), promised better situational awareness, speed and lethality, and boasted it could counter any potential threat. It also planned for a 20-ton manned ground vehicle (MGV) to replace Abrams tanks (70 tons), Bradley fighting vehicles and M113-based vehicles, so that an entire FCS Brigade Combat Team (BCTs) could be transported by C-130 aircraft in five days.

Flash forward to 2008. The program's scope of 18 systems has been reduced to 14; costs have increased 76 percent; the contract has been overhauled; eight years have been added to the development phase, and few of the necessary technical components are ready for demonstration or production. The core impetus of FCS development, that a 20-ton vehicle could provide the needed level of protection for soldiers in an environment of rising lethality, was never feasible, and it is questioned if many other components can realistically be fielded.[1] The relevance of potential FCS capabilities for current and future strategic needs is also the subject of debate.

February 2009 marks the date of the FCS Preliminary Design Review (PDR), and it will likely be the last opportunity to restructure the program before many production commitments are locked in. The PDR seeks answers to three questions: (1) Are FCS capabilities relevant for current needs, (2) Can FCS be completed under the current schedule and budget, and (3) Should FCS be kept as is, restructured or terminated? The following essay develops answers to these questions, based on an examination of current FCS progress and the contemporary combat environment. The first five sections analyze

the FCS schedule, budget, oversight and other areas of concern. The sixth examines the basic assumptions upon which FCS is built, and the relevancy of the system to current and future missions. The analysis concludes FCS must be restructured and limited, and provides a series of recommendations for the 2009 design review.

II. Testing

Because the thousands of systems requirements that have progressed at different schedules, in 2003 the Army decided to test and produce components in "spin-outs" based on when the different components would be ready. Spin-Out One, which started in 2008, tests unattended ground sensors, Non-Line of Sight Launch System, two Joint Tactical Radio System (JTRS) radios, integrated computer systems and battle command software subsystems at Fort Bliss, Texas. Spin-Out Two is scheduled to start in 2010, and tests upgraded JTRS, the Active Protective System (APS), and mast-mounted sensors for Stryker armored combat vehicles.[2] Spin-Out Three is scheduled to start in 2012 and will test small unmanned ground vehicles, unmanned airborne assets, and full FCS battle command capability. Eventually, plans are to outfit 15 FCS brigades (out of the 48 planned for post-modularity transformation), at a cost of $6.7 billion per brigade, an increase from an original estimate of $5.3 billion per brigade.[3] The idea that the FCS equipment will reach less than a third of Army combat force raises serious questions about the program's utility.

It is reasonable that FCS organizers implemented different schedules based on varying levels of readiness. However, there are several problems with the spin-out approach. The majority of components have not met readiness levels as scheduled; even if they do in the future, there is no gap in the time scheduled between technology development and production. In fact, for some components, the phases overlap each other. Technology development will continue until 2013, the year for production to start; SDD is scheduled to continue until 2017.[4] For production to occur, decisions to authorize it must be made in years prior, before much of the technology can be demonstrated to be effective.

Thus, the program is a highly concurrent one – an element that runs against the recent announcement by DOD's "acquisition czar," John Young, that DOD would re-adopt "fly before you buy" acquisition concepts.[5] All of the 44 identified critical technologies were scheduled to have reached Technology Readiness Level (TRL) 6 ("System/subsystem model or prototype demonstration in a relevant environment") by 2006.[6] DOD's policy preference has been to have technologies reach TRL 6 before starting product development, which for FCS was in 2003. As of July 2007, only 32 critical technologies have reached TRL 6; the other 12 are not expected to reach TRL 6 until at least the preliminary design review in 2009. FCS essentially is still in early development, not logically ready for production decisions in the near future.

One element, the Non-Line of Sight Cannon (an MGV) is planned to be fielded by Fiscal Year 2010, before there is evidence of technological readiness of all necessary components. The Active Protection System (the hit avoidance system to protect vehicles from incoming rounds) is not expected to reach TRL 6 until after the 2009 PDR. The

2007 Report by the Director of Operational Test and Evaluation (DOT & E) states that "it is not yet clear whether their [APS technologies] performance will make up for lesser levels of MGV armor protection."[7] Further, even if the MGVs perform to expectation, their survivability in close combat depends on the development of the System-of-Systems Common Operating Environment (SOSCOE) network, which is not scheduled to have a major demonstration until 2012. If allowed to press ahead, the Army will produce this MGV without the assurance that the network is actually a viable product.

The Government Accountability Office (GAO) has expressed concern over the sequencing of the FCS schedule, especially that production decisions are being made soon after or even before adequate testing has been completed. However, the Army rejected GAO's assessment of a less concurrent schedule, arguing that GAO is using a single weapons system mindset. The Army's logic would appear to be that the more complex a system is, the less it requires an assurance that it all works before production decisions are made.

In response to criticisms of the risks inherent in the FCS approach, the Army assures critics the schedule is on track and maintains that the FCS Brigade Combat Team (BCT) is developing "holistic brigade sets of capabilities that will defeat *any future threat* (emphasis added)."[8]

III. Budget

Not only has the projected cost of FCS development and acquisition increased significantly, FCS has not yet reached the critical design review (scheduled for 2011); it is *after* this point that most development cost growth occurs. The Congressional Budget Office (CBO) estimates that costs could grow 60 percent.[9] Therefore, it is hard to have confidence in the cost estimate put forward by the Army. By the time of initial production, the Army will have spent 80 percent of its development funds, before crucial network development and demonstration. Even if all technology is developed and performs as expected, there is the danger that FCS is simply too expensive. As retired Army Col. Greg Wilcox observes, once FCS equipment is in service, "We can't afford to lose one!"[10]

Additionally, two separate entities, the Institute for Defense Analyses (IDA) and DOD's Cost Analysis Improvement Group (CAIG), have performed independent cost estimates, and their cost projections are substantially higher than the Army's. IDA examined only RDT & E (Research, Development, Test and Evaluation) costs, which it estimates to reach $38.1 billion, compared to the Army's $25.1 billion. The CAIG estimated total program costs to be between $203.3 and $233.9 billion, which is substantially higher than the Army's $160.9 billion figure.[11] The Army has refused to reconcile the numbers offered from IDA and CAIG, arguing that their estimates for software costs were too high and that they included additional work in the later years of development.

The Army's $160.9 billion projection is a 76 percent increase from the original $91.4 billion estimate. It is worth noting that, in 2006, 4 of the 18 systems were cut, but the

$160 billion price tag stayed approximately the same; this was the second program restructuring.[12] FY 2009 marks the first year of a funding shift: funds for RDT & E will start to decrease and costs for procurement will increase; respectively, $3.2 billion and $331 million. The Senate has fully funded this budget request for 2009.[13] However, the House Armed Services Committee is expected to vote for a $200 million cut from the FY 2009 request.[14]

As RDT & E concludes and procurement starts to take over, between years 2015 and 2022, the Army is projected to spend at least $10 billion a year on procurement for FCS, with CBO estimating this figure may reach $16 billion per year.[15] The Army is projected to receive $20 billion a year for procurement for the entire service during these years. If the Army spends $10-16 billion on FCS each year, only $4-10 billion is left for all of the service's other procurement and modernization priorities.

In response to congressional budget cuts to FCS of $789 million from FY 2006-2008, the Army has requested to shift funds to FCS from other service programs and to make internal shifts within FCS: $78 million from other programs and $174.5 million from within ($250 million total).[16] When considering the necessary tradeoffs within the service for FCS, it is evident that the Army is willing to cut other priorities in order to ensure the continuance of FCS development. The Army has said that if necessary, it is prepared to pare off other elements of FCS, as it did in 2006; however, this seems in contrast with Deputy Chief of Staff Lt. Gen Stephen Speakes' comment in March 2008 that FCS is "non-negotiable" and that "the issue of affordability ought to be taken off the table."[17] Nevertheless, influential sub-committee chairmen Rep. John Murtha, D.-Pa., and Rep. Neil Abercrombie, D.-Hawaii, have suggested that FCS's budget may be further limited in the future, because of the lack of progress and other funding priorities.

IV. Contract Oversight

Another controversial element of the FCS program is its contract. The Army utilized a unique approach called Lead Systems Integrator (LSI), a contractor it would appoint to oversee requirements for development, design and selection of major system and subsystem contractors. The Army argued FCS needed this approach, because it did not have the resources to manage the program internally, although it retains final approval of LSI's subcontracting and competition plans. Boeing was selected as the LSI, with Science Applications International Corporation (SAIC) also serving LSI functions. Over 250 subcontractors in 41 states and 220 Congressional districts have been commissioned.[18] There are red flags with the LSI model. There are concerns about ceding so much authority to an outside source and that the LSI will not perform adequate oversight on itself.

Also, theoretically, if a project is projected to cost more over the duration of the project than originally expected, a contractor's profit margin will stay tied to the original estimate; that way contractors do not have an incentive to raise costs. However, with FCS, as costs estimates increased, so did Boeing's profit margin. Its original contract was for 10 percent profits, with 5 percent performance incentives. When costs increased

by $6.4 billion, Boeing's profits rose by $960 million.[19] Also, Boeing was working under "Other Transaction Authority" (OTA), legal rules exempting it from federal truth-in-negotiating laws that require a contractor to give the government complete cost and price data. It did not appear that the Army was allowed to recoup funds if it determined the LSI had overcharged or costs were not fair and reasonable.[20]

In response to congressional objections, the FCS contract was restructured in 2006 so that Boeing's original profits would be only 3 percent, with the potential for an additional 9 percent in performance incentives – dropping Boeing's maximum profits from 15 to 12 percent, a profit margin that is still generous for a defense contract. However, though this restructuring lowered the profit margins, it still does not resolve the concern that having a contractor wear so many hats in the project decreases the Army's involvement in oversight. The Army for now is sticking with the LSI model for FCS, though Congress has prohibited DOD from awarding new contracts for LSI functions after 2010.

V. Other Issues of Concern

FCS success depends on at least 50 complementary programs that are developing according to their own schedules and budgets and technological challenges outside of the FCS program itself. Three notable programs are the Joint Tactical Radio System (JTRS), Warfighter Information Network—Tactical (WIN-T) and the Air Force Transformational Satellite Communications Program (TSAT). These programs have an estimated combined cost of $80 billion, up $29 billion from their original estimates.[21] Problems with these programs pose a significant risk to the FCS program.[22] The Army has strove of late to synchronize the schedules of these programs with FCS development, though the DOT & E 2007 annual report indicates that synchronization with JTRS and WIN-T is a work in progress and that "these non-FCS complementary programs remain a significant risk area for the FCS program."[23]

Also, there is the question of FCS compatibility with a joint operations structure. How well will an exclusively Army program (with the exception of the TSATs) fit in with joint operation planning and execution? Should any of the technologies be purchased and assigned to the other services? One example of how FCS is dependent on operating in a joint operations structure is its transportability question. Generally, brigades are transported by sea, but it had been envisioned that FCS will be transported by the Air Force's C-130s or C-17s into combat areas. However, the Air Force and Navy have learned that because of ever increasing low-altitude threats, such as surface-to-air missiles and rocket-propelled grenades (RPGs), it is preferable for them to operate in higher altitudes. If FCS is to be transported by air into combat zones, the Air Force has to facilitate this transportation scheme and devote more resources to countering low-altitude threats.[24]

Additionally, there is the question of present versus future priorities and capabilities. The Army has preferred to idealize about what technology it can build in 20 years that should hold its own against current threats, instead of considering rapid prototyping of commercial products in order to integrate technologies quickly into the force structure.

There is always merit in looking ahead to the future, but in the case of FCS, the Army seems to have overshot, ensuring that brigades in the 2020s will be prepared to counter more diverse threats, at the expense of solving current force problems in the present. An example is that because procurement funds will be tied up with FCS development, it is uncertain if there will be funds available for recapitalization of armored vehicles in the coming decades, some with technology from the 1960s. It will not be until the 2020s that FCS vehicles can completely substitute for the current aging fleet. Until then, many of the vehicles used will be past their programmed shelf life. It is estimated that $2 billion is needed annually 2010-2016 to maintain and upgrade the aging ground combat systems, and it is uncertain this can be afforded, even assuming no further FCS cost overruns – which is extremely optimistic, even unrealistic.[25]

VI. Basic Assumptions and Relevance

There are major concerns over FCS relevance for current and future missions. The 2005 Department of Defense Directive 3000.05 has given stability operations the same status as combat operations, and operations other than conventional combat will likely characterize many future missions. In Afghanistan, combined civil-military efforts such as Provincial Reconstruction Teams (PRTs) are working to extend government presence through reconstruction and development. These missions are heavily dependent on non-combat activities such as training indigenous military forces, developing the economy and building new government institutions. These operations are also highly dependent upon securing the local population.

Correspondingly, in April, Defense Secretary Robert Gates emphasized the future capabilities most relevant to the Army and Air Force. Conflict, as he put it, will be political in nature and success "will depend less on imposing one's will on the enemy or putting bombs on targets… ultimate success or failure will increasingly depend more on shaping the behavior of others, friends and adversaries, and most importantly, the people in between."[26] Gates called for the Air Force to incorporate the "gray zone between war and peace," by integrating civilians from NGOs and the government into its thinking, as well as being more linked to land operations. New doctrines and approaches toward stability operations can drive technological developments – such as small diameter munitions that are better suited to operations where enemies are mixed in with civilian populations. In both addresses, Gates emphasized the human elements of doctrinal change, as well as the need for future developments to support stability operations.

Given the realities of these future missions, the basic assumptions upon which FCS is built are cause for concern. The most fundamental assumption FCS is predicated upon is the idea of "dominant battlefield knowledge." Instead of equipping soldiers with heavy armor to protect them from direct fire, FCS integrates a massive amount of information to show soldiers where an enemy is before they are surprised. This light armor means the "survivability" of FCS depends upon soldiers using FCS getting the first shot. In an open battlefield, the premise is that a lighter, faster and more aware brigade could prevail over enemy vehicles. However, in Operation Iraqi Freedom the preferred method of engaging enemy forces was precision air strikes.[27] Retired Army Col. Douglas Macgregor has

emphasized that FCS incorrectly assumes technology has eliminated the "close fight," – something that is not readily apparent considering insurgent tactics in Iraq and Afghanistan.[28] These wars suggest asymmetric tactics utilizing surprise and deception will continue to be challenges.

For example, in Afghanistan, between 2005 and 2006 the number of suicide attacks increased five-fold from 27 to 139, and remotely detonated bombings doubled from 783 to 1,677.[29] According to the Office of the Secretary of Defense (OSD) as of May 2008, improvised explosive devices (IEDs) have accounted for around 23,746 out of 36,498 total casualties in Iraq and Afghanistan.[30] While many measures are being used to counter the threat of IEDs, the trend has been to move away from lighter vehicles – instead continually up-armoring vehicles. As Gates points out, "MRAPs [Mine Resistant Ambush Protected] have performed. There have been 150-plus attacks so far on MRAPs and all but six soldiers have survived. The casualty rate is one-third that of a Humvee, less than half that of an Abrams tank."[31] The current need of the Army does not appear to be lighter, faster forces but rather armored vehicles that can withstand IEDs, and, likely, explosively formed projectiles (EFPs).

Beyond this current need for armor, experience in Iraq and Afghanistan also suggests that to win wars where the population is the center of gravity, the use of air power and "precision" weapons must be carefully considered. One questions whether the "just in time" FCS response to threats will be able to consider the strategic implications of strikes in a nonlinear environment without risking the survivability of soldiers in FCS vehicles. In urban areas, complex structures and battle spaces mean enemies can surround themselves with civilians or valuable infrastructure. The ability of even precision air power to engage enemy forces in a way supporting the overall strategic objective will be difficult in urban terrain. For example, many key components of FCS promoted as break-through capabilities are already present on current battlefields: UAVs, global communication networks, linked sensor-to-shooter capabilities (both from UAV and ground-launched platforms), and distributed operations facilitated by satellite communications.[32] While these technologies have aided operations in important ways, the types of capabilities they provide have proven completely insufficient to eliminate the "close" fight. Furthermore, in both Iraq and Afghanistan, relying on air power resulted in numerable civilian casualties, which worked against the strategic goals of the United States and NATO. Furthermore, mechanizing conflict, particularly in stability operations and population-centric warfare, has the potential to remove soldiers even farther from the situation on the ground.

When a group of soldiers is trained to conduct warfighting in an environment where huge segments of the decision making process are automated, which is the intent of FCS design, soldiers may not develop an understanding of how the larger structure of decision making is built, nor develop an appreciation of how aspects of the process are connected. The informational capability FCS is designed to provide would give soldiers greater situational awareness in an open battlefield. There are several assumed advantages to this, including reducing incidents of friendly fire. However, this information will not help soldiers understand who, in the population, is a threat. It remains unclear what degree of

granularity this data can or will contain. Will soldiers be capable of discerning enemy insurgents planting an IED from a group of men working alongside a road?

Counterinsurgency doctrine and trends in current wars suggest the type of information most useful lies in the realm of social networks, intelligence gathering and understanding how to develop key relationships to accomplish objectives. As Macgregor put it, "When the systems fail, when the network goes down, when the tactical operations center is partially or completely destroyed, the danger exists that soldiers will not be able to construct a coherent view of operations, a profoundly intellectual activity that is largely independent of technology." In addition, even when the system is working, its information is typically imperfect, as has been so often the case in both Iraq and Afghanistan. The picture of the external world presented by FCS and its existing precursor systems can and will often be a clear picture, but also both incomplete and inaccurate. FCS and the thinking behind it present the tremendously serious problem of a clear but false image of the external situation. Technology, while potentially a major asset and force enabler, can also become an Achilles' heel in the real world.

While technology is an enabler of immense value, the threats posed by cyber-attacks, jamming or other disruption may prove entirely disabling if weapons systems, such as FCS, are dependent upon a network. One of the key issues in a 1997 Army After Next Winter Wargame was that the tools creating "dominant battlespace knowledge," such as satellites, networks and communication nodes, became the center of gravity for competitors.[33] FCS may leave soldiers vulnerable, given Chinese development of anti-satellite weaponry and the real and increasing threat of cyber-attack from both state and non-state actors. A network disruption, in effect, could leave soldiers without armor, without information and thus without adequate survivability.

The enormous cost associated with FCS may not ensure long-term dominance in the information spectrum. Technology advances quickly, and the cost of innovation often exceeds the cost of emulation. The British at the height of their power, for example, pioneered aircraft carriers –however, Americans and Japanese benefited by experimenting, adapting and improving upon the technology. Also, given economic and strategic realities, there is a genuine need to balance current demands with what may be needed in future conflicts. Weapons systems supported now should be relevant to the types of operations being witnessed in Iraq or Afghanistan. Whether or not counterinsurgency is the "future" of U.S. engagement – the tactics seen in Iraq and Afghanistan are ones that work against a technologically advanced, dominant power. Thus, there is a strong case that IEDs, suicide bombings, ambushes, information operations and indirect attacks – collectively identified by some as "Fourth Generation Warfare" - will continue to be dominant challenges. The reliance of FCS upon software and space assets optimized for a conventional warfare scenario is also very major cause for concern, especially when the procurement strategies of these complex systems are extremely difficult to afford.

VII. Recommendations

This May, Secretary Gates indicated that "there is too much of a tendency towards what might be called 'Next-War-itis' – the propensity of much of the defense establishment to be in favor of what might be needed in a future conflict."[34] He advocated for focusing on what needs to be done now, as he contended that "the kinds of capabilities we will most likely need in the years ahead will often resemble the kinds of capabilities we need today." These remarks contrast sharply with the FCS timelines and structure, which are unlikely to produce tangible benefits for soldiers for at least another five years.

Six years into program development and on the cusp of production decisions is a reasonable time to expect the original potentialities of FCS to be materializing. As this is hardly the case, it is imperative that FCS requires realistic and successful testing of prototypes before production decisions, has more comprehensive oversight, establishes a better business model for scheduling decisions and is restructured based on which technologies are proven and ready and relevant.

The FCS schedule needs to be restructured so that there is more time between testing and production decisions; this avoids the likely and realistic eventuality that significant problems will be found and have to be corrected during production. Also, in order to prevent future problems, using surrogate equipment in testing that supports production decisions should not be allowed – currently the Army is engaged in this. For example, the 2007 DOT & E report warns that for "adequate operational testing" of lethality and survivability, a high fidelity Real Time Casualty Assessment (RTCA) system is required. However, the Army is using the Multiple Integrated Laser Engagement Systems (MILES) for operational testing instead of developing an RTCA system – the DOT & E deems this "not satisfactory."[35] There needs to be clear criteria established to assess what performance can be delivered before production is authorized and these criteria should include testing production-realistic prototypes. It would also be useful to perform testing beyond the confines of the Army, which has proven itself to be so completely committed to system success and approval: to ensure rigor in the test process, Marines or other non-Army test participants as adversaries would provide a degree of assurance that field tests were not "cooperative."

Along with objective, observable criteria to support go/no-go decisions, OSD needs to heighten its oversight on FCS, as the LSI model limits the amount of oversight the Army is able to perform. OSD has already taken over the JTRS program because of delays and technical difficulties during its development.

Congress also needs to play a more pro-active role in oversight. Despite GAO, CBO and CRS reports voicing concerns about the progress of FCS, the Senate fully funded FY 2009 FCS development and procurement requests, and the House of Representatives budget reductions was both extremely minor and non-relevant to the major issues. Congress needs to tie funding availability to capabilities that are actually demonstrated in a rigorous, objective test and evaluation environment under a realistic schedule and a contracting procedure set up for contractors to have an incentive to stay on schedule and budget.

There is some concern that once production for one element of FCS begins, a need to sustain its industrial base will be created. In other words, there will be an argument that FCS should continue because American jobs are tied to its production. It may be the case that, instead of reorganizing the program, additional elements need to be cut, so that only those demonstrating performance and relevance are fielded.

Though the Army insists that each component of FCS is crucial, even "non-negotiable," the reality is that funding priorities and development stagnation will require FCS to be restructured after its 2009 review; Deputy Under Secretary of Defense for Acquisition and Technology James Finley confirms this is very likely. The Army needs to assess which programs are most vital and feasible, in order to determine which programs may be kept. The GAO has recently recommended breaking up the FCS program and fielding only a subset of components that are demonstrated to actually work. This must be done in a highly realistic, rigorous test environment that exploits the known characteristics of war as it exists today. The House Armed Services air and land forces subcommittee also favors some elements of this approach, voting in May to shift FCS funds from long-term components to near-term elements that likely can be fielded by 2011. Additionally, CBO offers four proposals for FCS reduction schemes: each retaining a scaled-down version of the network and funding upgrades for current armored vehicles. Each emphasizes a different element of FCS capabilities: information collection, long-range strike capabilities, new vehicular technology, or simply the network. [36]

Based on the considerations of relevance, performance, cost feasibility and program management, it seems that the information collection elements, such as UAVs and UGSs should be explored under the test and evaluation scheme discussed above. These are not only the least expensive, able to be fielded quickly, can be produced with less risk – but also have proven valuable in current conflicts. Given that all 15 planned FCS BCTs will not be using FCS MGVs until 2030, that recapitalization of current aging armored vehicles is urgent, and that the FCS vehicles may be less survivable than current vehicles, it is safer for current needs to appropriate funds for maintaining and upgrading current vehicles instead of spending the next two decades developing and fielding FCS MGVs.

As GAO indicates, 2009 is a "critical juncture" in FCS decision-making. It is the last viable opportunity to restructure and downsize FCS components before production commitments. Limiting FCS to components that are proven effective, more readily producible and relevant for current and likely future needs creates the possibility that FCS will prove valuable in warfare as it actually exists. Otherwise, it is very possible that most of $200 billion in taxpayer dollars will be found to have gone to waste.

Endnotes

[1] Col. Macgregor: There is now discussion inside the program about the unavoidable survivability requirement that drives armored vehicles up to 30 or 40 tons, something experts in the field of armor anticipated 8 years ago.
[2] Recognizing the FCS program's failure to date to create a survivable common chassis for FCS, General Dynamics Land Systems (GDLS) hopes to promote its controversial armored truck as the future FCS common chassis. Given the Stryker's inherent lack of survivability and firepower in close combat and associated off-road mobility problems, this approach is a potential disaster the Army should seek to avoid. (Macgregor).
[3] U.S. Congressional Budget Office (CBO), "The Army's Future Combat Systems Program," Statement of J. Michael Gilmore, Assistant Director, before the Subcommittee on Tactical Air and Land Forces, Committee on Armed Services, U.S. House of Representatives, April 4, 2006, 7-8. http://www.cbo.gov/ftpdocs/71xx/doc7122/04-04-FutureCombatSystems.pdf. CBO reported that in 2003, the program's total acquisition cost for 15 brigades (RDT&E and procurement) was projected to be about $80 billion, which would come out to $5.3 billion per brigade.
[4] U.S. Government Accountability Office (GAO), "Defense Acquisitions: 2009 Is a Critical Juncture for the Army's Future Combat System." Report to Congressional Committees, March 2008, 26. http://www.gao.gov/new.items/d08408.pdf
[5] Young, John J., Jr., "Memorandum for Secretaries of the Military Departments: Prototyping and Competition," Under Secretary of Defense for Acquisitions, Technology, and Logistics, 19 September 2007. http://pogoblog.typepad.com/pogo/files/prototyping_and_competition_memo_by_atl.pdf.
[6] GAO, 2008, 60.
[7] Director, Operational Test and Evaluation (DOT&E), "FY 2007 Annual Report: Future Combat Systems (FCS) Overview," U.S. Department of Defense, December 2007, 85.
[8] "Army Assessment of Government Accountability Office Reports," U.S. Department of Defense, 2008, 1. https://www.fcs.army.mil/downloads/pdf/Army_Assessment_of_2008_FCS_GAO_Reports.pdf.
[9] CBO, 2006, 7.
[10] Interview with Ret. Col. Greg Wilcox, USA, 14 April 2008.
[11] GAO, 2008, 41.
[12] Class II and III UAVs were eliminated, the Armed Robotic Vehicle—Reconnaissance, Surveillance, and Target Acquisition was deferred until the Army builds FY 2010 Program Objective Memorandum (POM), and the Intelligence Munitions System was separated from the FCS program. Andrew Feichert, "The Army's Future Combat System (FCS): Background and Issues for Congress," Congressional Research Service (CRS) Report for Congress, 11 October 2007, 6. http://www.fas.org/sgp/crs/weapons/RL32888.pdf.
[13] Daniel Wasserbly, "Service requests $331 million for procurement," *Inside the Army*, 11 February 2008; Daniel Wasserbly and Marjorie Censer, "Senate Authorizers Fully Fund FCS, Boost JIEDDO Funds," *InsideDefense.com*, 1 May 2008.
[14] Daniel Wasserbly, "House Panel Votes to Cut $200 Million from FCS, Boost Oversight," *InsideDefense.com*, 7 May 2008.
[15] GAO, "Defense Acquisitions: Improved Business Case is Needed for Future Combat System's Successful Outcome," Report to Congressional Committees, March 2006, 36. http://www.gao.gov/new.items/d06367.pdf.
[16] Marina Malenic, "Another Reprogramming Action on Capitol Hill," *Inside the Army*, 18 April 2008.
[17] Marina Malenic, "Speakes: FCS 'non-negotiable," *Inside the Army*, 3 March 2008.
[18] Alec Klein, "The Army's 200 Billion Dollar Makeover," *The Washington Post*, 7 December 2007.
[19] Stan Crock and Stanley Holmes, "The Right Stuff for GIs of the Future," *Business Week*, 15 August 2005.
[20] Renae Merle, "McCain, Auditors Question Army Modernization Effort," *The Washington Post*, 17 March 2005.
[21] Alec Klein, "Weapons Upgrade Faces Big Hurdles," *The Washington Post*, 8 April 2008.
[22] DOT&E, 85.
[23] DOT&E, 2007, 85.
[24] Peter A. Wilson, John Gordon IV, and David E. Johnson, "An Alternative Future Force: Building a Better Army," *Parameters*, 2003.
[25] CBO, 2006, 1.

[26] U.S. Secretary of Defense Robert M. Gates, Remarks at Maxwell-Gunter Air Force Base, Montgomery Alabama, 21 April 2008. http://www.defenselink.mil/transcripts/transcript.aspx?transcriptid=4214.
[27] Peter A. Wilson, John Fordon IV and David E. Johnson, "An Alternative Future Force: Building a Better Army," *Parameters*, Winter 2003-2004, 19-39.
[28] Interview with Ret. Col. Douglas A. Macgregor, USA, 17 April 2008.
[29] Seth G. Jones, "Getting Back on Track in Afghanistan," Testimony before the Committee on Foreign Affairs, Subcommittee on the Middle East and South Asia, U.S. House of Representatives, 2 April 2008. http://foreignaffairs.house.gov/110/Jon04022008.pdf.
[30] DOD Personnel and Military Casualty Statistics, , "Casualty Summary by Reason, October 7, 2001 through May 3, 2008." Defense Manpower Data Center http://siadapp.dmdc.osd.mil/personnel/CASUALTY/gwot_reason.pdf].http://siadapp.dmdc.osd.mil/personnel/CASUALTY/gwot_reason.pdf.
[31] U.S. Secretary of Defense Robert M. Gates, Remarks to the Heritage Foundation, Colorado Springs, Colorado, 13 May 2008. http://www.defenselink.mil/speeches/speech.aspx?speechid=1240.
[32] Interview with Ret. Col. Douglas A. Macgregor, USA, 17 April 2008.
[33] "Chapter Three: Issues from the Winter Wargame" *Issues from the 1997 Army After Next Winter Wargame*, RAND Corporation, 9. http://rand.org/pubs/monograph_reports/MR988/MR988.ch3.pdf.
[34] Secretary Gates, Remarks to the Heritage Foundation, 13 May 2008, http://www.defenselink.mil/speeches/speech.aspx?speechid=1240.
[35] DOT&E, 2007, 85. The DOT&E report does not offer a verdict on the OneTESS program (One Training and Evaluation Simulation System), an Army tactical engagement simulation system developed after MILES, which will also be used in FCS BCT simulations.
[36] CBO, 2006, 14.

Additional Resources:

General Information on Future Combat Systems (FCS):

Boeing-Integrated Defense Systems
http://www.boeing.com/defense-space/ic/fcs/bia/index.html

General Dynamics
http://www.gdls.com/programs/fcs.html

GlobalSecurity.org
http://www.globalsecurity.org/military/systems/ground/fcs-back.htm

Science Applications International Corporation
http://www.saic.com/

U.S. Army
http://www.army.mil/fcs/

Reports

Congressional Budget Office

- CBO Testimony: "The Army's Future Combat Systems Program" http://www.cbo.gov/ftpdocs/71xx/doc7122/04-04-FutureCombatSystems.pdf

- CBO Study: "The Army's Future Combat Systems Program & Alternatives"

http://www.cbo.gov/ftpdocs/74xx/doc7461/08-02-Army.pdf

Congressional Research Service

- "The Army's Future Combat System: Background and Issues for Congress" http://www.fas.org/sgp/crs/weapons/RL32888.pdf

Center for Defense Information

- "Fact Sheet on the Army's Future Combat System" http://www.cdi.org/program/document.cfm?DocumentID=4058&StartRow=1&ListRows=10&appendURL=&Orderby=D.DateLastUpdated%20deSC&programID=37&IssueID=0&Issue=&Date_From=&Date_To=&Keywords=FCS&ContentType=&Author=&from_page=documents.cfm

Government Accountability Office

- "2009 is a Critical Juncture for the Army's Future Combat System" http://www.gao.gov/new.items/d08408.pdf

- "Significant Challenges Ahead in Developing and Demonstrating Future Combat System's Network and Software" http://www.gao.gov/new.items/d08409.pdf

- "Defense Acquisitions: Future Combat System Risks Underscore the Importance of Oversight,"http://www.gao.gov/new.items/d07672t.pdf.

- "Defense Acquisitions: Future Combat Systems Challenges and Prospects for Success," http://www.gao.gov/new.items/d05442t.pdf.

- "Defense Acquisitions: The Army's Future Combat System's Features, Risks, and Alternatives,"http://www.gao.gov/new.items/d04635t.pdf.

- "Defense Acquisitions: Role of Lead Systems Integrator on Future Combat Systems Program Poses Oversight Challenges,"http://www.gao.gov/new.items/d07380.pdf.

- "Defense Acquisitions: Analysis of Process Used to Evaluate Active Protection Systems,"http://www.gao.gov/new.items/d07759.pdf.

Analysis

- GovernmentExecutive.com http://www.govexec.com/story_page.cfm?filepath=/features/0507-01/0507-01s3.htm

- Inside the Army, "Study: Army FCS Program Will Cost $13 Billion More Than Estimated," http://defense.iwpnewsstand.com/cs_newsletters.asp?NLN=ARMY

- Parameters, “An Alternative Future Force: Building a Better Army,” http://www.carlisle.army.mil/usawc/Parameters/03winter/wilson.htm

- Rand Corporation, “Exploring Advanced Technologies for the Future Combat Systems Program,” http://www.rand.org/pubs/monograph_reports/MR1332/.