U.S. Army Heritage and Education Center

Historical Services Division

A History of the Army's Future: 1990-2018
v. 2.0

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U.S.ARMY

THE UNITED STATES ARMY WAR COLLEGE

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"If you don't know what the future is, that is still no excuse for not working it."[1]
Col. (Ret.) Robert Killebrew
Army After Next (AAN) Project Founder

EXECUTIVE SUMMARY

The establishment of Army Futures Command (AFC) in August 2018 was the most significant change to the Institutional Army in a generation, and it signaled the value the Army placed on studying the future. While the establishment of a new four star headquarters might be seen as a bold move, it was in reality the culmination of 30 years of future development in the Army. Those three decades saw the development of numerous structures designed to examine the potential for future concepts and technology, with uneven success. The processes were good, but technological overreach, and over 20 years of war in the Middle East, doomed most efforts to put useful concepts into practice. Army visionaries such as Generals William E. DePuy and Donn A. Starry had planned for the future as early as the 1970s with an eye on the past, and initiated the programs and doctrine necessary to transform and modernize the Army following Vietnam.

Operation DESERT STORM ushered in a decade of uncertainty for the Army. The collapse of the USSR in 1991, America's peer competitor since the end of World War II, splintered former Soviet satellite states into independent entities struggling for sovereignty and survival. Army leadership in the 1990s recognized the widespread fracturing of the global landscape following the Soviet Union's demise and focused on creating lighter, rapidly deployable forces to meet a wide range of contingencies. The Army began by creating several forward-looking efforts, first to define the modern battlefield, then to identify what technologies existed, and finally to determine which ones were needed for future warfare. Chief of Staff Gen. Gordon Sullivan (1991-1995)

[1] Interview with Col. (Ret.) Robert Killebrew, Senior Officer Oral History Program (SOOHP), Project 2000-2, Interviewed by Lt. Col. Gregg Martin, November 30, 1999 (Hereafter, Killebrew MHI Interview), 11.

directed the implementation of the new Louisiana Maneuvers (LAM), a rebrand of the corps-level Army maneuvers executed prior to World War II that helped train commanders on the kind of warfare they would face in the near future. The LAM focused on testing modern technologies and personnel in coordinating and winning a multiple-theater fight in unstable regions with limited resources. Force XXI examined new and emerging technologies for use in the early 21st century, while Army After Next (AAN) looked ahead 30 years to consider the needs of the Army in a future well over the horizon. Generals Sullivan and Eric Shinseki faced an unstable global environment, necessitating the creation of forces with a wide range of capabilities. The modernization process was inhibited by budget cuts, strength reductions, multiple wars and combat deployments, and the transformation of brigades to the BCT structure.

The CSA's Strategic Studies Group (SSG) had warned that the AirLand Battle Doctrine that had served the Army so well in Operation DESERT STORM might not be appropriate for the future battlefield.[2] AirLand Battle, and the technology that made it successful, was specifically designed to be used in a European scenario against an overwhelming Soviet enemy. When it was used against a large but much less capable enemy, even in a different environment, it was successful. It did not however, prepare the Army for the multiple and varied enemies that it has faced in the 21st century. Moreover, it drove a dependence on high technology and heavy combined arms forces that became less useful when faced with challenging environments such as those in the Balkans, Iraq, and Afghanistan.

With the development of any doctrine or technology, the Army needs to periodically "take a knee," and evaluate whether or not the technology or doctrine is adequate. The 1993 version of FM 100-5, *Operations*, crystallized the "lessons learned" from Operation DESERT STORM. While the new manual recognized the changes in the world, it codified the notion of nearly perfect systems with precision strike capabilities for high-tech weapons inflicting maximum damage on the enemy with minimum friendly casualties:

> The '86 version [of FM 100-5] was rooted in Cold War assumptions of nuclear deterrence, containment, and large linear campaigns. The '93 version recognizes the changed geo-strategic conditions and the fact that conflicts will tend to be regional and multipolar as opposed to bipolar. Given near "perfect," near real time intelligence systems, sufficient lethality with precision strike systems, and massing of lethal effects, operations may be nonlinear and therefore not subject to all the tactical constraints of the linear battlefield. Additionally, the '93 version

[2] "Final Report of the Special Study Group for General Gordon R. Sullivan, Vice Chief of Staff," June 14, 1991, p. III-9, Gordon R. Sullivan Papers, U.S. Army Heritage and Education Center (USAHEC), Carlisle, PA.

stresses the use of “overwhelming” force as a way of achieving decisive victory with minimum cost to friendly forces.[3]

This emphasis on precision strike has enshrined the assumption that all future problems could be solved with technology and focused future conceptual development efforts on the use of technological advances.

Some of the technology designed for Force XXI, such as Force XXI Battle Command for Brigade and Below (FBCB2), Blue Force Tracker (BFT), and Unmanned Aerial Vehicles (UAVs), have been used and proven in combat. Others, such as Future Combat Systems (FCS) and Comanche, were canceled after years of development and billions of dollars wasted. If the AFC is to be successful it must use a realistic technology development process and also reform the acquisition process.

Shinseki, CSA 1999-2003, continued this progression into the 21st century, launching the Army on a modernization program designed to use advanced technology to “revolutionize” operations. The FCS, however, touted “pie in the sky” capabilities based on nonexistent or unproven technology. The technological challenges and rising costs of the proposed system and the ongoing requirements to support two wars forced the cancellation of the system six years after initiation.

[3] HQ, TRADOC, "Reader's Guide to FM 100-5, 1986-1993: Comparison," 2.

I. Introduction: The collapse of the Soviet Union in 1991 fractured America's peer competitor into a number of smaller states battling internal and external forces for national sovereignty. Post-DESERT STORM fiscal and force reductions motivated Army leadership to create a leaner, more rapidly deployable force with lethal capabilities to operate on an increasingly complex battlefield.

When Sullivan became the Army Chief of Staff in 1991, he convened a Special Study Group (SSG) to conduct an assessment of the Army and to help him prepare to guide the Army during his assignment as CSA. Sullivan assumed the position after Operation DESERT STORM as the Army continued its post-Cold War drawdown. Sullivan valued the lessons of history to inform the future, and the legacy of Task Force Smith from the early days of the Korean War haunted him. The Army that numbered some eight million Soldiers in 1945 and had defeated enemies on four continents had been drastically reduced by 1950, and had lost its edge. Sullivan was determined to keep the Army sharp through modernization, while meeting requirements to draw down.

The Army's recent combat experience in Operation DESERT STORM provided an opportunity to evaluate the AirLand Battle Doctrine. The CSA's SSG warned that, while AirLand Battle worked well in that recent conflict, it might not be appropriate for the future battlefield.[4] AirLand Battle relied on new technology and was specifically designed to be used in a European scenario against an overwhelming Soviet enemy. When it was used against a large but much less capable enemy, even in a different environment, it was successful. It did not however, prepare the Army for the multiple and varied enemies that it was likely to face in the 21st century. Moreover, it drove a dependence on high technology and heavy combined arms forces that became less useful when faced with challenging environments such as those in the Balkans, Iraq, and Afghanistan.

The SSG determined that the CSA's vision of a "Trained and Ready Army" lay at the center of six interconnected imperatives: Quality People, Training, Force Mix, Doctrine, Modernization, and Leader Development. These formed the focus of Sullivan's tenure as CSA. While each of the six was crucially important, Sullivan left his greatest legacy in the processes and organizations he created for developing doctrine. Those processes were good, but the doctrine was developed based on inaccurate assumptions. Nevertheless, the framework Sullivan created is worthy of examination.

Frameworks for Developing the Future Force

Louisiana Maneuvers Task Force: Sullivan determined that the Cold War-era Concepts Based Requirements System (CBRS) was not adequate for developing new concepts for the future. He knew that he was not building an Army for the next couple of years, he was building the Army of the 21st century. Sullivan often used the lessons of history to inform his vision of the future, and used specific historical examples to

[4] "Final Report of the Special Study Group for General Gordon R. Sullivan, Vice Chief of Staff," June 14, 1991, p. III-9, Gordon R. Sullivan Papers, USAHEC.

illustrate his points. After he assumed office, Sullivan began writing letters to every senior commander and staff officer, explaining his vision of the Army and the importance of their jobs to it. Almost all of these had some reference to building the future Army. Using the historical example of Gen. George C. Marshall's Louisiana Maneuvers from pre-World War II days, Sullivan designed the new Louisiana Maneuvers because, "I was compelled by the power of Marshall's ideas and his intent to conduct experiments that would be the basis for designing new units and battlefield processes."[5] Sullivan knew that Marshall used the original Louisiana Maneuvers to create an Army to fight a war whose dimensions and tactics he knew. Sullivan created the new Louisiana Maneuvers Task Force to prepare the Army to look at an uncertain future. In a message in March 1992 to all the four-star generals in the Army, Sullivan acknowledged his intellectual debt to Marshall, and explained his concept of the Louisiana Maneuvers.

> In a very different world, Marshall used the Louisiana Maneuvers to focus the Army: to shake out emerging Doctrine, to experiment with organizational design, to train the mobilizing force, to provide insights on material requirements, and to develop leaders. . . . Marshall, however, focused the Army on a war that he knew was coming; my goal is to posture the Army to protect the nation's enduring interests in an uncertain future.[6]

> My concept for LAM is to facilitate rapid development of simulation and to exercise techniques enabling us to experience what power projection means to the Army. The Army senior leadership will identify specific policy and warfighting issues and use those exercises and techniques to feed the executive decision-making process. Every level of warfighting and departmental function will be open for examination as issues are identified. Exercises, unit training, combat developments, and leader development will be linked in very synergistic (and sometimes invisible) ways. I see the Louisiana Maneuvers as a campaign in the fullest sense. It encompasses and extended operational context, linked operational objectives, strategic intent, branches, and sequels. LAM will be a vehicle for us to evaluate new concepts and ideas in "real-time" and short circuit shortcut Cold War policy decision methodologies. Louisiana Maneuvers will harness the energy of the changing Army and focus that energy on the standard of decisive victory. . . . By the end of FY 94, I want to know which of our policies are functional for our Army of the 21st century and which are not. Many policies

[5] James L. Yarrison, *The Modern Louisiana Maneuvers* (Washington: Center of Military History, 1999), vi.

[6] Message, Personal for Gen. John Galvin, et al., from Chief of Staff, Army, subj.: Louisiana Maneuvers 1994, March 7, 1992, Letters to Commanders, Binder, Gordon R. Sullivan Papers, USAHEC.

that shaped us since 1945 are enduring, others are no longer appropriate. LAM will help us know the difference.[7]

In June 1993, Sullivan sent one of his closest advisors, Brig. Gen. Harold W. Nelson, then serving as Chief of Military History, to the Orlando AUSA meeting. That meeting was focused on the Louisiana Maneuvers and Technology demonstrations. Nelson reported back on the dangers he saw in the demonstrations:

> I believe the Army of Desert Storm is being taken as a Baseline and "73 Easting" is becoming the standard for measurement. The data for "73 Easting" appears to have been collected assiduously, but the case seems too narrow (and too poorly-documented) to serve as an adequate standard: The enemy's mission, equipment/personnel status are still unknown; the [Close Air Support] CAS dimension is missing; indirect fire is negligible; ability/counter mobility had little bearing. . . . we have traditionally invented the standard scenario to reduce complexity in our simulations/test environment. That will be difficult to justify in the post-cold war setting where [Mission, Enemy, Terrain, Time and Troops Available] METT-T variations introduce dramatic differences.[8]

Figure 1 - Learning the Wrong Lessons

Blinded by Blitzkrieg: Battle of 73 Easting

The Battle of 73 Easting on February 26, 1991 was heralded as the Army's last great tank battle. The 2nd Armored Cavalry Regiment (ACR) commanded by Col. Leonard D. Holder, defeated two brigades of the Iraqi *Tawakalna Division* in a stunning display of technological and training overmatch. American tanks, emerging from a large sandstorm, engaged the entrenched enemy armor using thermal imaging sites (TIS) at 1600 hours; fighting ceased 75 minutes later. The 2nd ACR had fought outnumbered and won, destroying more than 400 enemy vehicles, including 160 main battle tanks, 180 personnel carriers, 80 wheeled vehicles, 12 artillery pieces and captured more than 1,300 prisoners in less than two hours of ground combat.

Nelson also warned that the digitized testing seemed to be skewed toward weapons: "They have been derivative, linking most of their development to the traditional area of

[7] White Paper, "Louisiana Maneuvers – Setting the Course," October 9, 1992, Letters to Commanders, Binder, Gordon R. Sullivan Papers, USAHEC.

[8] Memorandum for Record, Brig. Gen. Harold W. Nelson, June 15, 1993, subj.: Orlando AUSA Meeting - Louisiana Maneuvers (LAM), Harold W. Nelson Papers, unprocessed collection, USAHEC. The Battle of 73 Easting during Operation DESERT STORM had been hailed as the Army's last great tank battle, and was then being used as a simulation.

weapons design/test even though bigger systemic payoffs might lie in logistics or decision support." The Army, however, ignored Nelson's warning.[9]

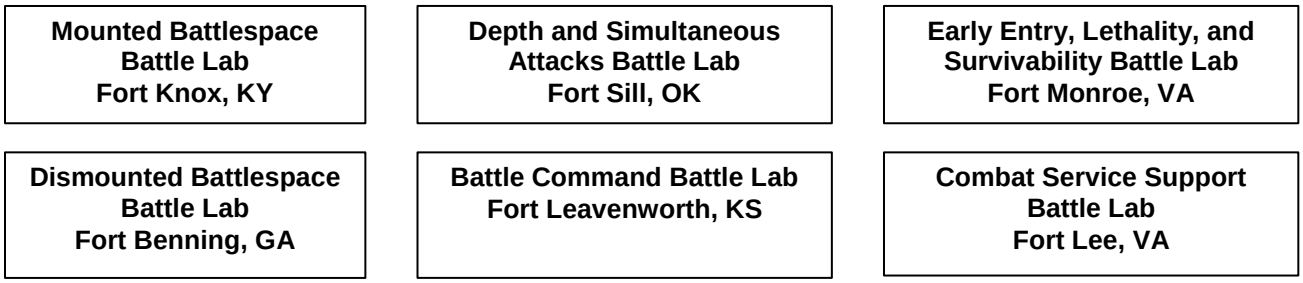
Sullivan's most important commander during this process was Gen. Frederick M. Franks Jr. (CG, TRADOC 1991-1994). In a July 1991 letter to Franks, Sullivan noted: "My hypothesis is that U. S. Grant's Wilderness Campaign was the first American Army campaign of the Industrial Age and Desert Shield/Storm was the first of the Post-Industrial Age." Sullivan's hypothesis was incorrect. While the Army did use a lot of sophisticated weaponry during Operation DESERT STORM, it should be considered the last campaign of the Industrial Age. The U.S. military faced a large and well-equipped enemy using tactics familiar from decades of practice for a war with the Soviet Union in Europe. The quarter-century since DESERT STORM, however, has seen the rise of non-state actors, and state actors using unconventional means, that forced the Army away from those more traditional tactics. U.S. Army missions in the 21st century have been characterized by stabilization, counterinsurgency, humanitarian and disaster relief, state-building, terrorist hunting, and advise-and-assist missions, with purely conventional military operations forming a small percentage.

Battle Labs: In order to "shake up" the Combat Developments process in the Army, Franks launched the Battle Labs initiative in 1992. The six Battle Labs were housed at the TRADOC schools (see Fig. 2). Franks outlined the purpose of the Battle Lab program in a white paper dated May 4, 1992: "Battle Labs will define capabilities, identify requirements, and determine priorities for [a] power projection Army." Franks also created the Battle Lab and Integration, Technology, and Concepts Directorate (BLITC) at TRADOC headquarters to oversee the activities of the battle labs. Franks saw the Battle Labs as a venue for experimentation in future forms of warfare and for inserting advanced technologies into the force.[10]

[9] Frank N. Schubert and Theresa L. Kraus, eds *The Whirlwind War: The United States Army in Operations DESERT SHIELD and DESERT STORM* (Washington: Center of Military History, 2000), 192. Stephen A. Borque, *Jayhawk! The VII Corps in the Persian Gulf War* (Washington: Center of Military History, 2002), 310, 330-331.

[10] Yarrison, *Modern Louisiana Maneuvers*, 24-25, 31n77.

Figure 2 – TRADOC Battle Labs



Source: James L. Yarrison, *The Modern Louisiana Maneuvers* (Washington: Center of Military History, 1999), 24-25.

Force XXI: Born in 1993, the Force XXI project saw the world and the U.S. Army on the cusp of transition between the Industrial Age of the 20th century and the Information Age of the 21st century.[11] Sullivan determined that information technology would probably have a revolutionary effect on how the Army functioned in the future.[12] The concept was promulgated in TRADOC Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full Dimensional Operations for the Strategic Army of the Early 21st Century* (August 1, 1994). The program recognized a changed future strategic environment in which the U.S. would face many different enemies than in the past. In the rush to define a new "information age," the term "information technology" did not merely refer to communications, but was used also as a metaphor for the high-tech revolution expected in the 21st century.

The Army was expected to develop "Full-Spectrum Dominance" in order to defeat a variety of enemies around the world. This concept envisioned a complete technological overmatch, not just in weapons, but especially in surveillance and information gathering and processing technology designed to reduce or eliminate the "fog of war." The supposed advanced technology would provide perfect situational awareness at all levels, creating "Full-Spectrum Dominance" from subterranean Earth to infinite space. The program spawned Task Force XXI, which used a digitized brigade formed from an existing brigade of the 4th Infantry Division in order to test Force XXI concepts and technology. In several Advanced Warfighting Experiments (AWE), the brigade tested new tactics and technology, such as the Force XXI Battle Command Brigade and Below (FBCB2) communications platform, which used new and emerging technologies such as Enhanced Position Location Reporting System (EPLRS) and Blue Force Tracker (BFT). The program leveraged cutting-edge technology from both Army

[11] TRADOC Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full Dimensional Operations for the Strategic Army of the Early 21st Century* (August 1, 1994), Fig. 1-1, pp. 1-2.

[12] Killebrew MHI Interview, 2.

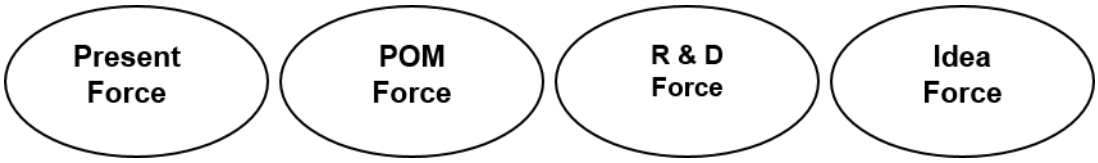
labs and off-the-shelf commercial items, and involved concepts and doctrine staffs from throughout TRADOC and all of the Battle Labs.

Army After Next: The Army After Next (AAN) project looked at the world 30 years out, beyond the Program Objective Memorandum (POM), beyond the current research and development cycle, in order to allow the consideration of concepts without regard to funding them. The program included an annual strategic wargame, a tactical wargame, and several smaller excursion games, culminating in an annual White Paper report to the Chief of Staff of the Army. The AAN project began in 1995 when Col. Robert Killebrew, then working as the acting Deputy Chief of Staff for Doctrine (DCSDOC) Headquarters, TRADOC, realized that the Army had not developed a way to look at the distant future. He and Col. Mike Starry began working to envision the future beyond the POM cycle. Killebrew reasoned, "If you don't know what the future is, that is still no excuse for not working it. So AAN started this way to help the Army think about the future of warfare."[13] Killebrew outlined the AAN project's four objectives:

- Help senior leaders understand the nature of future warfare.
- Make recommendations to the CSA on what the Army should do about it.
- Give the CSA a way to direct the Army's research and development efforts.
- Demonstrate to Congress that the Army had people capable of intelligent future research.[14]

When Maj. Gen. Robert Scales arrived at TRADOC as DCSDOC, Killebrew found a visionary leader who saw the value in fresh, even radical, thinking about the future. Scales and Killebrew developed the AAN structure that allowed the Army to think about the far future. They reasoned that the Army consisted of four forces (See Fig. 3).

Figure 3 - Four Future "Forces"



Source: Interview with Col. Robert Killebrew, Senior Officer Oral History Program (SOOHP), Project 2000-2, Interviewed by Lt. Col. Gregg Martin, November 30, 1999.

The present force is the force the Army takes to war, and little can be done to change it. Likewise, the POM Force (5-6 years out) has been funded and cannot be changed in any in any meaningful way, except by canceling programs. The R&D force

[13] Killebrew MHI Interview, 2-4.

[14] Killebrew MHI Interview, 12.

(5-20 years) can be affected, and should be periodically checked to ensure that the concepts under development still meet requirements. In the context of the time, Force XXI was the R&D Force, putting new and emerging technology into the field. AAN was the Idea Force (20-30 years) -- the force used to foster fresh thinking.[15]

Enjoying the support of the TRADOC Commander, Scales and Killebrew were able to bring on such luminary intellectual talents as Brig. Gen. (Ret) Huba Wass de Czege and Col. (Ret) Rick Sinnreich. The AAN project was pure, rather than applied, research, and many in the research and development community enthusiastically endorsed it. Killebrew quoted an Army scientist, "This is the first time I ever had anybody give me ideas that pulled me forward, instead of just having to turn around and look backwards and work on improving the force that already existed."[16] The program worked on relatively small budgets by leveraging staffs already working future projects in the Battle Labs, Army scientific labs, and schoolhouses. The Army project also linked to similar future projects in other services.

Gen. Dennis Reimer replaced Sullivan as CSA in 1995 and continued the development of future forces. The relationship between resourcing and strategy development did not escape the new chief:

> The bottom line up front is that in my mind, this was a resource drill, not a strategy drill. No matter how they tried to sugarcoat it, basically we couldn't get over the hurdle that this strategy was resource driven. . . . Basically we had, and still have, as far as I'm concerned, a mismatch in terms of resources and requirements. . . . Resources basically drove the QDR and it took a lot of coordination, a lot of effort on everybody's part.[17]

Reimer understood, however, that development of distant futures such as AAN was not an exact science:

> My idea there was to try to get a picture of what the world might look like in 2020 so that we had a mark on the wall as to what the Army needed to do in 2020. Otherwise we were in a change process and we didn't know exactly where that was leading. How do you predict the future in 2020 accurately? You don't. But what you try to do is not necessarily so much get it exactly right, but make sure you don't get it exactly wrong. And so AAN was all about trying to predict the future and also what the Army would be required to do in that future world. . . . What we tried to do was to project ourselves out to 2020 and then look back to

[15] Killebrew MHI Interview, 26-27.

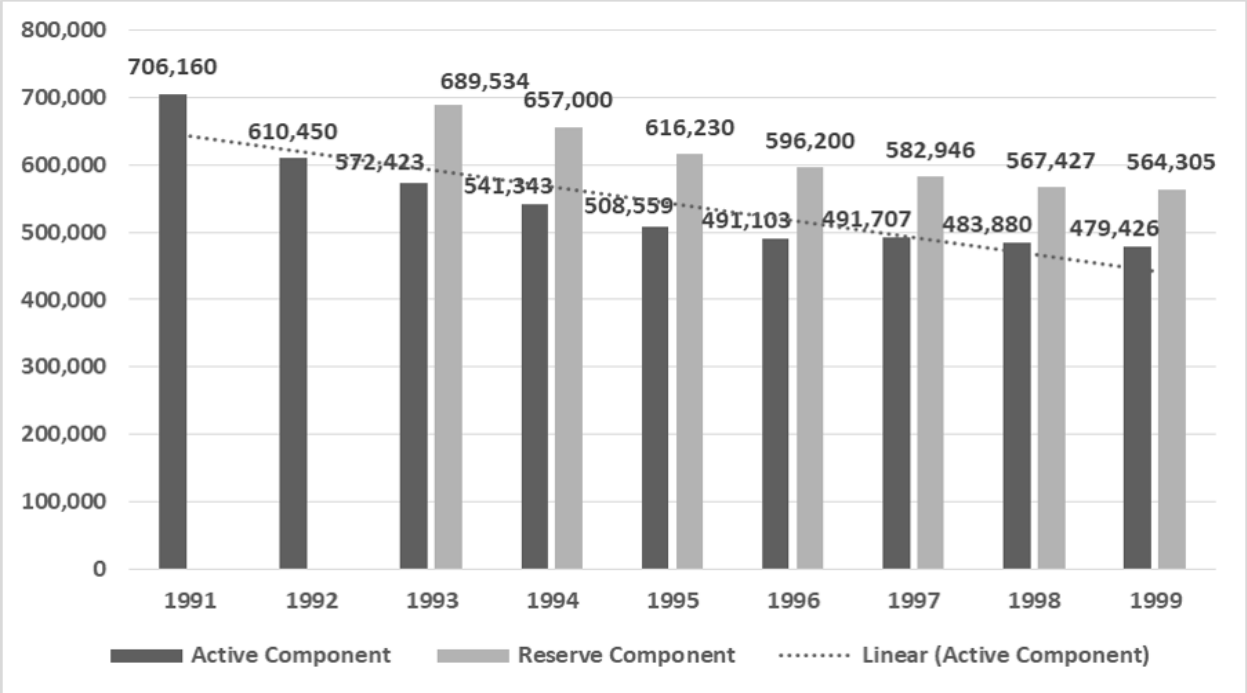
[16] Quoted in Interview with Killebrew MHI Interview, 26. This quote came from Killebrew's recollection, and is not intended to be a verbatim quote.

[17] Interview with Gen. Dennis J. Reimer, Senior Officer Oral History Program (SOOHP), Project 2000, Interviewed by Dr. Lewis Sorley, March 27, 2000, 263.

where we were today and to get the azimuth and path of change. We took note of the technologies needed in these projected futures and tried to tie our R & D investment program to these technologies. I was never totally satisfied that we did that as well as we should but we did make an attempt at it.[18]

Despite Reimer's support for, and understanding of, the need for futures programs, he was hampered by the realities of maintaining readiness of the current force in the face of the ongoing drawdown. Reimer was no stranger to the frameworks that Sullivan created, having served previously as VCSA and FORSCOM Commander. From 1991-1994, he had seen the Army's end strength drop by 32 percent (See Fig. 4). After a postwar high in 1992, the Army budget dropped 30 percent by the end of Reimer's tenure, but was beginning a slow recovery that would allow his successor, Shinseki, more latitude (See Fig. 5).

Figure 4 - Army End Strength 1991-1999



[18] Reimer OH, 315-316.

Figure 5 - Army Budget ($M) 1991-1999

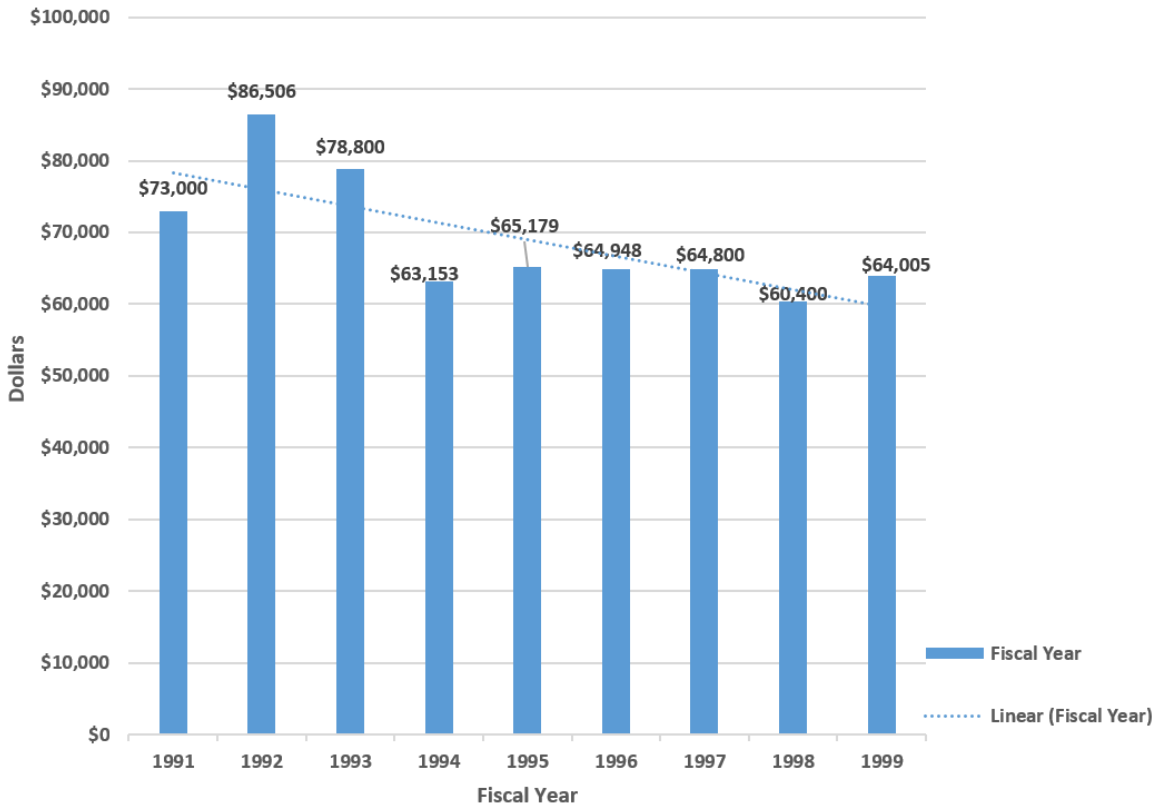


Figure 6 - A Dissenting Opinion

Too Much of a Good Thing is Not Good

While the AAN project did enjoy support from the CSA and the TRADOC CG and others, the concepts and doctrine community resented the intrusion into what it considered the "CD" lane. Even TRADOC CG Gen. William Hartzog eventually became concerned lest AAN distract intellectual effort from the larger Force XXI Project. Notably, Army G-3 Lt. Gen. Eric Shinseki was not a fan of the program, and when he became Chief of Staff of the Army, he folded it into his larger Army Transformation Campaign Plan.

AAN Assumptions: The AAN program was founded on some basic assumptions that turned out to be either partially or completely wrong:

- **Most Conflicts Would Involve High-Intensity, State-to-State Combat**

Despite the loss of a peer competitor with the fall of the Soviet Union, the AAN wargames and concept development process continued to focus on large-scale conventional combat between nations, or major regional conflict operations (MRCs). This only began to change after the 2004 wargame, and more significantly, after the initial phase of combat operations in Iraq ended and both Iraq and Afghanistan settled into counterinsurgency operations.[19] Most of the combat actions in which the Army has been involved since the end of the Cold War did not involve direct state on state actions.

- **Army Forces Must Be Deployed Very Early in a Crisis**

The Army has maintained a "forced entry" capability in the form of airborne and special forces units since the end of World War II. The AAN concept envisioned the same sort of capability, but with a much heavier and more capable force. Each AAN "battle force" included several hundred organic Army heavy lift VTOL (vertical takeoff and landing) aircraft with intercontinental range that could self-deploy the force.[20] The focus on transportability limited the weapons and protective armor of the platforms.

- **Army Operations Would Be Supported by Intratheater Air Mobility of Light Mechanized/Motorized Forces**

Because the AAN Program operated beyond the POM cycle, AAN wargamers considered options without regard to cost. This was liberating and allowed for a free flow of ideas, but in some cases the ideas went beyond the bounds of rationality, even given lack of future constraints. The AAN envisioned an "air mechanization" concept for rapidly maneuvering Army units both to and within the theater via organic heavy lift VTOL aircraft. This fascination with VTOL aircraft grew out of the then-current development of the V-22 Osprey for the Marine Corps, which reached Low Rate Initial Production (LRIP) in 1997. The AAN concept envisioned a tilt-rotor aircraft like the V-22, but the size of a C-130. These aircraft would be Army assets, so that they would not be subject to tasking by USTRANSCOM. There was little discussion as to how the Army's

[19] Christopher G. Pernin, Elliott Axelbrand, Jeffrey A. Drenzer, Brain B. Dille, John Gordon IV, Bruce J. Held, K. Scott McMahon, Walter L. Perry, Christopher Rizzi, Akhil R. Shah, Peter A. Wilson, Jerry M. Sollinger, *Lessons from the Army's Future Combat Systems Program* (Santa Monica: RAND Corporation, 2012), 11. At that time, the wargames had become joint exercises with the Army and JFCOM, as it became increasingly apparent that Iraq- and Afghanistan-like conflicts might become the norm for future combat operations for the foreseeable future. These wargames went through multiple changes as "Army Transformation Wargame" and then "Unified Quest."

[20] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 12-13.

possession of these aircraft would affect its priority for movement of other, non-AAN forces to and within the theater.[21]

While AAN logistics considerations focused on reducing the logistics requirements and footprint, there was no discussion of how to mitigate the greatly increased requirement for fuel that these aircraft would generate. AAN planners did not know at the time all the difficulties the V-22 program would encounter throughout production and in combat usage. The aircraft combines the characteristics of an airplane with those of a helicopter, and the odd pairing and potential cost of the system caused the Army to pass on an earlier version in 1982. The Marines' initial success by 1997, however, drove renewed Army interest.

The uneven success of the Osprey program provides a cautionary tale for the AAN program, which reached for unproven technologies with an unlimited budget. A GAO audit in 2009 revealed that, though the V-22 provided some improved capabilities, it could not accomplish all the missions of the legacy helicopters it was designed to replace. It could not carry the payloads or numbers of troops for which it was designed, and additional additions to the aircraft to improve its flight characteristics reduced its carrying capacity even further. Moreover, the aircraft maintained a consistently lower operational readiness status than either its own planning factors or legacy helicopters. Some of its readiness problems stemmed from unreliable spare parts, and the large number of spare parts required increased logistics requirements both afloat and ashore.

Finally, the audit revealed that the cost per flying hour for each V-22 was $11,000, which is more than double the estimate for the vehicle, and 140% higher than the cost per flying hour for the CH-46E, which it was designed to replace. Both the GAO and DOD operational testers determined that the V-22 was operationally effective, but not operationally suitable even after 20 years of development. To an AAN planner looking 30 years out, that is an important data point. The VTOL aircraft envisioned by Army planners was expected to be more than twice the size of the V-22, to greatly increase the level of complexity.[22]

- **Future Army Forces Would Dominate Any Type of Conflict**

Joint Vision 2010 envisioned a future force optimized for "high intensity conventional military operations," but it would also be able to "dominate the full range of military operations from humanitarian assistance, through peace operations, up to and into the

[21] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 15.

[22] Michael J. Sullivan, Director, Acquisition and Sourcing Management, GAO, "V-22 Osprey Aircraft: Assessments Needed to Address Operational and Cost Concerns to Define Future Investments," Testimony Before the Committee on Oversight and Government Reform, House of Representatives, June 23, 2009, 3-11.

highest intensity conflict."[23] The AAN force, however, was only focused on high intensity conflict and there was no discussion of wargaming for other scenarios. The dangers uncovered in Iraq and Afghanistan that drove the development of the Mine Resistant Ambush Protected (MRAP), for instance, were not addressed in AAN. The AAN force focused on rapid forced entry, dominant military operations, and quick withdrawal.[24] The Army's experience in Operation Iraqi Freedom proved the fallacy of this assumption. President George W. Bush declared an end to combat operations in May 2003, with plans to begin withdrawing forces within 6 months. The nature of the conflict however, kept U.S. troops in Iraq for 8.5 more years.

- **Very High Levels of Situational Awareness Would Be Available to Army Forces**

The AAN/Objective Force assumed that future U.S. forces would have unprecedented levels of knowledge of their operational environment. The development and widespread of UAVs and other platforms has greatly enhanced the commander's ability to "see" the battlefield. This strict focus on targeting and intelligence gathering has yielded great results in those areas, but whether or not this translates to "knowledge of the operational environment" is a different issue. The wars in Iraq and Afghanistan have demonstrated that the "fog of war" still exists despite the plethora of manned and unmanned intelligence platforms designed to provide situational awareness, and in some cases the reliance on technology has exacerbated rather than eliminated the problem.

Tensions developed in the process when some AAN advocates began to add force structure to the "idea" force. On the one hand, this was a necessary component to make the war games run; on the other, force structure tended to limit future possibilities. The AAN clearly needed both -- a vision of the future, grounded in the possible. The difficulty with AAN is that it looked *too* far out. Linking Force XXI and AAN together allowed for a tiered system of development, but AAN was so far out as to be unrealistic. Moreover, both Force XXI and AAN sought to develop concepts based on a flawed assumption -- all of the future forces envisioned a large, conventional war with a near-peer enemy. The whole AAN concept of "Full-Spectrum Dominance" was loosely based on Operation JUST CAUSE, with a simultaneous take down of all critical nodes and complete domination of the battlefield from Earth to space. While the development of intelligence-gathering platforms, especially UAVs, has expanded exponentially in the 21st century, much of the rest of the future forces and vision from 1998 would be incompatible with today's battlefields.

The term "out of the box" thinking became the bumper sticker of the day, the "box" being conventional thinking. There is value to disregarding conventional thinking to get to new concepts, but AAN disregarded the wrong conventions. Ignoring current

[23] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 13-14

[24] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 13-14.

budget restrictions to imagine the future is helpful, ignoring the laws of physics is not. The AAN project had lofty goals, and pure research provided some valuable insights. For instance, the concept of arming unmanned aerial vehicles (UAV) first came out of an AAN war game. The problem with AAN program was an evident lack of understanding of the possibilities and limitations of technology.

Army Transformation Campaign

Chief of Staff Shinseki issued his *Army Vision* statement in 1999, which built upon the work started by his predecessors and emphasized lighter, lethal, and rapidly deployable units available to move by air to counter any threat to U.S. interests. His vision of the future included transformation "into a force that is strategically responsive and dominant at every point on the spectrum of conflict." The Chief's vision built on the AAN assumptions and included a brigade capable of deploying to any location in the world in 96 hours, a division in five days, and five divisions within a month. The keys to success included units light enough to move on available airframes, but with enough firepower and intelligence acquisition systems to permit it to survive and succeed on the battlefield. [25]

Recent combat has shown, however, that increased technology does not make up for inadequate armor protection. In 2003, shortly after the supposed end of combat operations in Iraq, American Soldiers began encountering Improvised Explosive Devices (IEDs). Vastly outgunned by hi-tech weaponry, the Iraqis resorted to an unconventional weapon aimed at soft side and lightly armored vehicles and produced large numbers of casualties. From 2005 to 2008, IEDs produced 50 to 80% of all U.S. fatalities.[26] The Army, however, was initially uninterested in fielding the MRAP, until pushed to do so by Congress. After an initial slow start, by the end of OIF in 2011 more than 15,000 MRAPs had been delivered to Iraq and Afghanistan.[27]

Objective Force Task Force (OFTF): The Army Transformation Campaign Plan scope necessitated the creation of a separate management entity, which became the Task Force Future Combat Systems, later changed to the Objective Force Task Force (OFTF). The OFTF, established in November 2000 under Lt. Gen. Joseph M. Cosumano, Jr., served to:

> Integrate, coordinate and assess related efforts in the Concepts, Requirements, S&T [Science and Technology] (including DARPA) and Acquisition disciplines to

[25] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 9.

[26] Christopher J. Lamb, Matthew J. Schmidt, and Berit G. Fitzsimons, *MRAPS, Irregular Warfare, and Pentagon Reform* (Washington: National Defense University, Institute for National Strategic Studies, June 2009), 1.

[27] Dale P. Woodhouse, "MRAP's Future with the Army," Army Sustainment 43, no. 2 (March-April 2011).

ensure that the established milestones of 2003 technology decisions and 2006 Systems Development and Demonstration (SDD) decision are met.[28]

Planners created three forces (phases), reminiscent of those envisioned by Scales and Killebrew, required to achieve the level of mobility and firepower articulated by the CSA: the Legacy Force, the Interim Force, and the Objective Force.

- *Legacy Force* - The existing conventional capabilities available to the Army.
- *Interim Force* - Units with the minimal logistical support of light units, while possessing the firepower equivalent of a heavy unit and computerized information systems providing a first strike capability to U.S. forces.
- *Future Force* - Termed the Objective Force, would become the U.S. Army of the 21st Century.[29]

The Army also created the *Initial Force*, a fourth category designed to bridge the transition from the Legacy to the Interim Forces. The Initial Force served as the testbed unit for the transition from the division-based force to combat brigade-sized element with internal sustainment capabilities. The 3rd Brigade, 2nd Infantry Division and 1st Brigade, 25th Infantry Division became the first Interim Force units.[30]

Futures Development at TRADOC

From the time Sullivan charged Franks with developing the future force until 2018, TRADOC retained responsibility for developing the future force. The organizations and framework for doing so within TRADOC, however, have changed over time. The Futures Directorate in DCSDOC was created in 1995 and charged with developing Force XXI and AAN concepts. In 2003, TRADOC CG Gen. Kevin Byrnes merged the functions of OFTF and the Futures directorate into a new Futures Center, designed to "develop and integrate in the joint warfighting environment, all aspects of the future force from Concepts to capability."[31] The new center assumed the following missions:

- Development of joint doctrine within TRADOC
- Objective force integration into a joint operational environment
- Evolution of future force from conceptualization to capability development

[28] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 26.

[29] John Riggs, interview with Michele Norris, *National Public Radio*, April 13, 2006.

[30] Christopher N. Koontz, *Department of the Army Historical Summary: Fiscal Year 2001* (Washington: Center of Military History, 2011), 22.

[31] Benjamin King, *Victory Starts Here: A Short 40-year History of the US Army Training and Doctrine Command* (Fort Leavenworth, KS: Combat Studies Institute Press, 2013), 15.

- Development and integration of Doctrine, Organization, Training, Materiel, Leader Development, Personnel and Facilities (DOTMLPF) capabilities

TRADOC linked the development of current and future concepts and doctrine in the Army Capabilities and Integration Center (ARCIC), which replaced the TRADOC Futures Center in 2006. ARCIC was responsible for determining and integrating force requirements and synchronizing the development of Doctrine, Organization, Training, Material, Leadership in Education, Personnel and Facilities (DOTMLPF) across the Army. ARCIC also identified capability gaps and provided analytical support for DOTMLPF of developments, validated research and development priorities for the Army, and developed and validated integrated operational architectures supporting combat capabilities.[32]

The unique challenges of Army Transformation required the creation of a specialized organization within the Futures Center. The Future Force Integration Division (FFID), created in 2005, focused on testing on information technologies of a Future Combat System (FCS) modular brigade. The ARCIC received additional personnel authorizations permitting FFID to simulate a division headquarters staff, a component of the FCS Brigade Combat Team (BCT) testing, which began in 2010 using a BCT from 1st Armored Division. The FFID became the Brigade Modernization Command (BMC) in 2011 with the mission of providing DOTMLPF assessments of the BCT to the Army. The BMC continues to put new technologies through simulated combat conditions and remains a directorate within ARCIC. The future of Army futures thinking remains to be seen with the establishment of Army Futures Command and the reorganization of ARCIC.

Lessons Learned?

The Army collects lessons well, but does not always learn them. Some of the most brutal lessons the Army has collected in recent years concern acquisitions, particularly those that failed. Two of them, Comanche and FCS, provide cautionary tales for future technology developers.

Comanche

The RAH-66 Comanche attack helicopter program provides a case study in Army acquisition programs and policies in the post-Soviet era. The Comanche program's technological overreach eventually doomed it, as challenges and cost overruns eventually resulted in the cancellation of the program. The Comanche was designed as a light Reconnaissance/Attack helicopter to replace the OH-58 Kiowa, with improved characteristics. The Comanche would:

[32] HQ, TRADOC, "Army Capabilities Integration Center History, 2010-2011."

- Be lighter than the AH-64, made of composite materials
- Be easily transportable but self-deployable to 1200 nautical miles
- Incorporate stealth technology, sophisticated avionics, and a digital fly-by-wire flight control system
- Include a single 20 mm three-barrel XM301 rotary cannon; six AGM-114 Hellfire air-to-ground missiles or up to twelve AIM-92 Stinger air-to-air missiles (carried internally); up to four Hellfire missiles or a maximum of eight Stinger missiles (carried externally, but reducing stealth characteristics)

Comanche was an expensive machine designed with state-of-the-art technologies to dominate existing and future battlefields. Costs increased as development time lengthened, while the threat it was designed to meet changed. The result was an aircraft so specialized and expensive that it was unaffordable, and if it were purchased, it would be too risky to fly in combat. The new threat rendered the modernized capabilities obsolete. A multi-theater war began in the midst of the AH-66's design and testing, forcing Army senior leaders to divest funding from the Comanche program into the war effort.

Gen. Richard A. Cody, VCSA, recommended the cancellation since the AH-66 "was designed for a threat that has not materialized." As an attack aviation battalion commander, Cody had led the first assault on a critical radar site to launch the ground phase of Operation Desert Storm. He had used AH-64 Apaches on the mission, but argued the new Comanche could not fulfill that role:

> Comanche was designed for low-observable [missions], to be able to fight at night, to do those type of direct action missions and high pay-off target missions. I said in the design of the aircraft, to get that radar cross section fuselage, we'd probably at $28 to $30 million a copy, we'd probably never fly in the daytime. So we're going to end up with an aircraft that we wouldn't fly in the daytime. . . . and if we put capabilities on that aircraft [AH-66] to fight in the daytime, it breaks up the radar cross section.[33]

The Army concurred with Cody's recommendation and in 2004 cancelled the AH-66 program. Fiscal allocations for 121 Comanches were re-purposed, permitting the Army to purchase 796 aircraft for active and USAR units while modernizing and rebuilding more than 1,400 for use in the Total Army.[34]

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[33] Interview with Gen. (Ret.) Richard A. Cody, Senior Officer Oral History Program (SOOHP), Interviewed by Dr. Michael E. Lynch, November 21, 2017.

[34] William M. Donnelly, Department of the Army Historical Summary: Fiscal Year 2004 (Washington: Center of Military History, 2015), 61.

Future Combat Systems

Background. The Future Combat Systems (FCS) Program, the largest planned acquisition program in Army history, provides a cautionary tale for futurists anxious to embrace technology. The AFC should carefully study the history of this program to avoid similar pitfalls in the future. The FCS program was intended to provide the weapons and computer systems, including individual digital systems, for the Objective Force. The precepts outlined in Shinseki's *Army Vision* provided the broad guidelines for the Future Combat Systems program. His mandate to deploy forces, adequate to engage a wide range of threats within 96 hours, required that all vehicles in the FCS family could be moved on C-17 or C-130 airframes. The impetus to simultaneously develop, test, and field a wide range of systems and vehicles using advanced, but untested, technologies created unforeseen problems as the program matured.

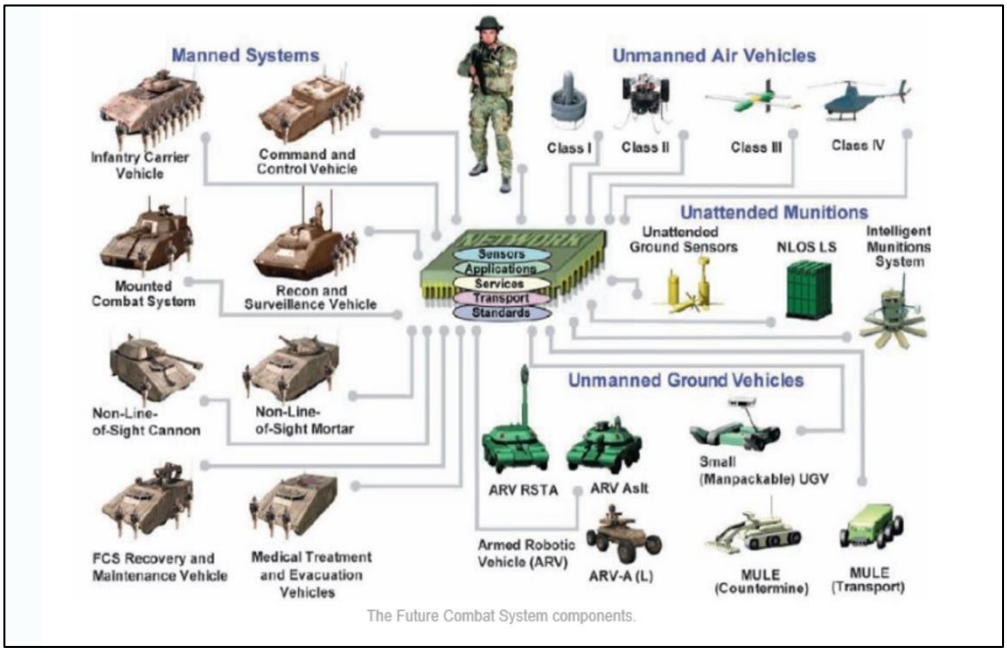
FCS was originally designed with attributes unlike all past Army acquisition programs. It was large, complex, and expected to be accomplished in a short period of time. It was also a new method for ushering in large-scale Army change—namely, by going through an acquisition program to bring in new concepts and doctrine, new technologies, and a newly integrated brigade formation all at once. Because of these attributes, the program experienced significant turbulence throughout its history. After nine years and $87 billion, the FCS program was cancelled in 2009. Despite parts being saved for other programs, the failure of FCS destroyed confidence in the Army's acquisition processes.[35]

***System Design*.** The FCS generated the term "system of systems" for use in a brigade structure intended to operate under emerging doctrine while integrated by a wireless network. The Army selected eighteen systems for development in the FCS program (see Fig. 7).[36] These included both manned systems and unmanned ground and air vehicles coordinated using an integrated computer system. The FCS was intended to be a follow on to the "Big 5" weapons systems of the 1980s (M1 Main Battle Tank, M2/3 Infantry/Cavalry Fighting Vehicle, UH-60 Utility Helicopter, AH-64 Attack Helicopter, and Patriot Air Defense Missile System). It included an entire brigade's worth of equipment, with both manned and unmanned vehicles and a suite of sensors, to be developed and fielded simultaneously and designed to function on the battlefield of the future. The FCS system would include doctrine being developed simultaneously. The FCS, however, experienced several difficulties.

[35] Mark L. Bradley, *Department of the Army Historical Summary: Fiscal Year 2009* (Washington: Center of Military History, 2015), 42-43.

[36] Congressional Budget Office. *The Army's Future Combat System Programs and Alternatives* (Washington: Government Printing Office, 2006), xi.

Figure 7 - Future Combat Systems



- *Inaccurate Understanding***.** The attempt to develop a family of systems based on the experience of the Big 5 was grounded in an inaccurate understanding of the Big 5 system. Those five systems began as individual replacements for existing systems, with the exception of Patriot. They were developed independently, using current and emerging technology for the time, with planned upgrades. Each went through a long Research and Development (R&D) cycle, independent of the others. They became the "Big 5" when the AirLand Battle Doctrine was developed, with an eye toward making best use of the new technologies. Fielding of the Big 5 became essential to execute AirLand Battle doctrine. Grouped together as a system of systems, the Big 5 also gave the Army a wedge in budget negotiations in Congress similar to the "big-ticket" items of the other services. Attempting to field the FCS as a "system of systems" became too complicated to work. Each was developed over a period of several years, using current and emerging technology (See Fig. 8). Some were fielded with then-current technology, but with upgrades planned. The M-1, for example, was fielded with a 105 mm main gun for the first Low Rate Initial Production (LRIP) Models, but the M1A1 began full production with the 120 mm main gun.[37]

[37] Dietrich, Steve, and Bruce R. Pirnie, "Developing the Armored Force: Experiences and Visions," An Interview Maj. Gen. Robert J. Sunnell (Washington: Center of History, 1989), 16.

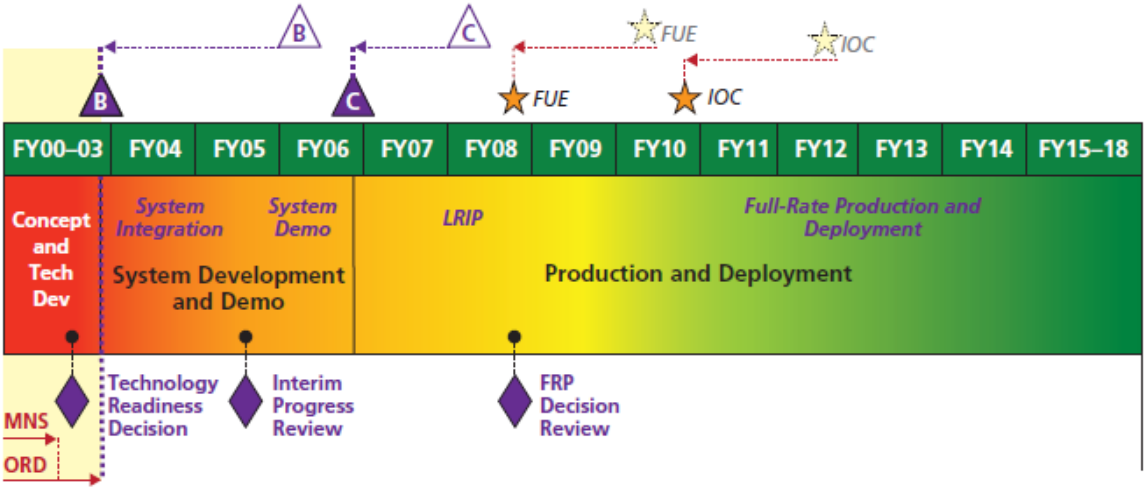
Figure 8 - Vietnam-era Replacement Weapons System Development

Program	Product	Purpose	Conceptual Date	Fielding Date
XM-1	M-1 Abrams	Replacement for M-60	1972	1980
Mechanized Infantry Combat Vehicle (MICV)	M-2 Bradley Infantry Fighting Vehicle	Replacement for M113	1972	1981
Utility Tactical Transport Aircraft System (UTTAS)	UH-60 Blackhawk	Replacement for UH-1	1969	1979
Advanced Attack Helicopter (AAH) System	AH-64 Attack Helicopter	Replacement for AH-1	1972	1983
Surface-to-Air Missile-Developmental (SAM-D)	Patriot Air Defense Missile System	Replacement for HAWK missile defense system	1965	1984

Sources: Frank N. Schubert and Theresa Kraus, eds., The Whirlwind War: The United States Army in Operations DESERT SHIELD and DESERT STORM *(Washington: Center of Military History, 2000), 29-33. Lenwood Y. Brown, ed.,* Department of the Army Historical Summary, Fiscal Year 1980 *(Washington: Center of Military History), 235.*

- *Timeline Acceleration*. The FCS, on the other hand, planned to use "revolutionary" technologies to develop an entire suite of systems simultaneously. Rather than using incremental development and emerging technologies currently available, the FCS program looked for "leap ahead" technologies. The AAN program had envisioned systems development over a period of decades, and FCS originally began the same way: Concepts Development beginning in 2000 and Full-Rate Production 10 to 15 years later. The first unit would reach Initial Operational Capability (IOC) by 2012. Such a schedule would roughly match the development time of previous Big 5 systems. But the Army leadership began to feel external pressure to prove the Army's relevance, and in 2001 decided to accelerate the timeline. To meet the new timeline, Milestone B (end of Concept and Technology Development [CTD] phase) was shifted from FY06 to FY03; Milestone C (end of Engineering and Manufacturing Development [EMD] phase) shifted from FY08 to FY06; Low Rate Initial Production (LRIP) to begin in FY08, with First Unit Equipped (FUE) shifted from FY10 to FY08; and Initial Operational Capability (IOC) advanced from FY 12 to FY 10. With unproven technology, undeveloped doctrine, and lack of enough qualified people in the acquisition chain, these program accelerations proved disastrous for the program (see Fig. 9).

Figure 9 - Early Schedule Expectations in the FCS Program



Source: Christopher G. Pernin, Elliott Axelbrand, Jeffrey A. Drenzer, Brain B. Dille, John Gordon IV, Bruce J. Held, K. Scott McMahon, Walter L. Perry, Christopher Rizzi, Akhil R. Shah, Peter A. Wilson, Jerry M. Sollinger, Lessons from the Army's Future Combat Systems Program *(Santa Monica: RAND Corporation, 2012), 31, Fig. 3.4.*

Army senior leadership stressed urgency in order to get the FCS program funded and fielded quickly. That involvement helped ensure funds availability, but narrow suspenses and aggressive requirements endangered the program by eliminating time to correct deficiencies as they appeared.

- *Combat Losses.* The FCS program reached Milestone B, the awarding of contracts, and the beginning of the Systems Development and Demonstration phase (SDD) in 2003, the same year that Al-Qaeda in Iraq (AQI) and other terrorist organizations used a wide range of Improvised Explosive Devices (IED) to attack U.S. personnel and destroy vehicles, including the 70-ton M1A1 main battle tank. Initial program requirements for a rapidly deployable force, including combat vehicles, had placed initial weight restrictions for FCS systems at 20 tons, one-third the size of an Abrams tank, but those enemy successes against the heaviest combat tanks alarmed Army leaders.[38] The Army refocused its efforts on vehicle survivability and protection, eliminating the requirement for the lighter systems in the FCS fleet. The Pentagon redirected $25 billion, not programmed into the FCS program, to begin purchasing an MRAP system.[39]

[38] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 54.

[39] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 48.

- *Increasing Costs.* A Congressional Budget Office (CBO) report noted that cost concerns forced the Army to modify the FCS program. The additional costs of funding combat operations in Iraq and Afghanistan, including acquisition costs, reduced funding available to the Objective Force. By 2006, the Army modified its plan and used a "spin off" method to send technologies developed for FCS directly to existing units.[40] The prospect of refitting entire brigades with FCS vehicles, weapons, and computer systems became an increasingly more costly proposition. Meanwhile, the Army continued converting units into modular combat and support brigades as envisioned in the Objective Force concept. Funding operations in Iraq and Afghanistan forced FCS restructuring starting in 2007, including eliminating four systems, reducing the estimated program cost from $120.2 billion to $113.3 billion.[41]

- *Biased Evaluations*. Army senior leaders' view of the future battlefield drove conceptual development. These requirements dictated rapidly deployable, lighter vehicles with reduced armor protection, and experimental wargames were designed to reinforce that requirement. The staged wargames justified the FCS program requirements without technical, operational, or organizational support.

The Global War on Terror eclipsed the need for FCS systems. The program consumed resources needed for a multi-theater war and Army senior leaders doubted the prototype vehicles' ability to both protect troops and to survive in combat. Secretary of Defense Robert Gates announced the decision to cancel the program in 2009. The FCS cost, estimated to reach $87 billion during the life of the program, figured prominently in the decision to cancel the initiative.[42]

While the cancellation of these programs may be correctly regarded as failures of the system that created them, some signs indicate that the Army may have indeed learned some lessons. The problems with the Comanche were identified early enough to cancel the program before production began, and this early identification of failure bought the Army some time. The great success of the cancellation, from the Army standpoint, was authorization to re-program funds already budgeted to other Army priorities, even within the same fiscal year. The FCS, on the other hand, serves as a talisman: the ghost of FCS continues to haunt the Army acquisition process. Just as DePuy and the officers of that generation used the "ghost of Vietnam" to change and invigorate training and re-build the Army after disaster, most current acquisitions and

[40] Mark D. Sherry, *Department of the Army Historical Summary: Fiscal Year 2006* (Washington: Center of Military History, 2013) 19.

[41] Pernin, et al., *Lessons from the Army's Future Combat Systems Program*, 45.

[42] Mark L. Bradley, *Department of the Army Historical Summary: Fiscal Year 2009* (Washington: Center of Military History, 2015), 42-43.

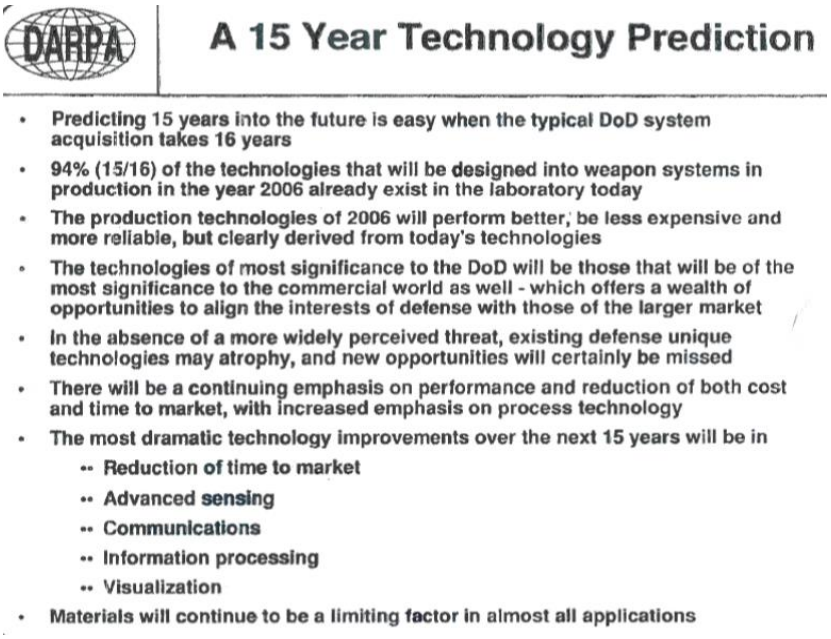
future planning documents refer to FCS as a reminder of a past not to be repeated. These lessons might have been learned.

Conclusions

While it is interesting and even critical to consider advanced technologies, it is even more important more to understand the realistic challenges to advancing technology. Those who grasp at futuristic solutions often cite Moore's law, which holds that computer processing speed doubles every 18 months, as both an example for the advancement of technology and a rallying cry to work at developing even better technology. This technological precept has been misused in the same way that history is often misused. Moore's Law is not a law at all, but rather an observation of the rate of change in the semiconductor industry. Moreover, the law's namesake, Gordon Moore, one of the cofounders of Intel Corporation, predicted in 2015 that Moore's law would die within the next decade or so as the industry reached the physical limits of semiconductors.[43] Despite this, futures advocates have used Moore's law as a clarion call to demand greater and greater advances in technology, even in areas that have nothing to do with computers. The Defense Advanced Research Projects Agency (DARPA) argues that most technologies that will be important in the future are already in production somewhere today, which reflects the incremental nature of system development. DARPA briefed Chief of Staff Sullivan in 1991 on technology predictions for the future (See Fig. 10).

[43] Rachel Courtland*, "Gordon Moore: The Man Whose Name Means Progress, The visionary engineer reflects on 50 years of Moore's Law," IEEE Spectrum: Special Report: 50 Years of Moore's Law* (Interview), March 23, 2015.

Figure 10 - DARPA Technology Prediction



Source: "DARPA: A 15 Year Technology Prediction," 1991, The Gordon R. Sullivan Papers, U.S. Army Heritage and Education Center, Carlisle Barracks, PA.

The Army established several new futures programs including the new Louisiana Maneuvers, Force XXI, and AAN to define the future battlefield and the weapons systems required to fight and win on it. Capabilities development shifted from threat-based, the method used in developing technologies required to defeat USSR land forces, to capabilities-based, the means required to win and succeed on the modern and future battlefields.

These requirement of an air-portable, rapidly deployable family of vehicles (including manned and unmanned) connected by a centralized computer system to meet a wide-range of threats served as the guidelines for the FCS. Army leaders looked back to the Big 5 systems employing the AirLand Battle doctrine to create the force that defeated the Iraqi forces in 100 hours of ground combat in February 1991. The historical truth is that all Big 5 programs began as independent systems, some more than five years before the Army published AirLand Battle.

Insurgencies in both Iraq and Afghanistan demonstrated a crude, but increasingly lethal capability against heavy conventional forces. Survivability and troop protection, reduced in the FCS family due to the air transportable requirements, became a central focus in upgrading existing systems and developing new ones. The Global War on Terror diverted monies from FCS, by 2009 an obsolete and expensive program, to provide the means requested by combatant commanders.

The FCS serves as a cautionary tale in projecting too far forward into the future and over-reliance on immature or undeveloped technologies. The revolutionary program

focused on employing state of the art technologies to interconnect a family of systems capable of rapidly deploying and defeating a wide range of threats in varying environments. The ambitious program's development increasingly consumed limited fiscal resources, but the modern battlefield's lethality and operational requirements ultimately doomed the Future Combat Systems.

A New Organization for the Future

Army Futures Command: In August 2018, the Army conducted its most significant reorganization in the last 40 years and created the Army Futures Command. The new command combines portions of existing organizations:

Table 1 - Army Futures Command Development

Donor Command	AFC Organization
TRADOC	Army Capabilities and Integration Center (ARCIC)
TRADOC	TRADOC Analysis Center
AMC	Army Material Systems Analysis Activity
AMC	Research and Development Command (RDECOM)
AMC	Army Test and Evaluation Command (ATEC)

It also contains eight new Cross Functional Teams (CFT) supporting the six modernization priorities:

Table 2 - Modernization Priorities and Cross Functional Teams

Modernization Priority	Cross Functional Teams
Long Range Precision Fires	
Next Generation Combat Vehicle	Next Generation Combat Vehicle
Future Vertical Lift	Future Vertical Lift
Network Command, Control, Communications, and Intelligence	a. Network Command, Control, Communications, and Intelligence b. Assured Positioning Navigation, and Timing
Air and Missile Defense	Air and Missile Defense
Soldier Lethality	a. Soldier Lethality b. Synthetic Training Environment

The purpose of the command is to combine all the Army's research, doctrinal development, acquisitions, testing, and modernization efforts under one headquarters. The challenge for the new command is to inculcate the lessons from previous modernization programs to prevent future failures.

Warnings for the Way Ahead

The challenge the Army Futures Command faces is not *what* to look for in the future, but rather *how* to look at that future. DePuy admitted in 1979 that when he organized TRADOC in 1973 under Operation STEADFAST, the combat developments process looked too far out. “One of the feelings I had was that they spent too much time on long-range studies -- Like the ‘Army 1990,’ ‘Army 2000,’ which never seem to cause anything to happen. Therefore I changed the focus and brought it way back in close. . . . there isn't anybody in TRADOC or CDC who can see further than the scientists or the engineers have already seen.”[44] This view, however, might not yield the advances in technology and doctrine the Army needs, and DePuy admitted that he had been accused of being too conservative.

- *Future Gazing* – One key to the progress of the previous future projects was the direct involvement of the visionary general officers who drove those processes – Gen. Sullivan with LAM, and Scales with AAN. With rank comes influence and resources. The Army has signaled the importance of future development with the assignment of senior leaders, not just in the highest positions, but in key positions such as leading the Cross Functional Teams. The Army Futures Command provides a mechanism to harness all the Army’s force development and acquisition brainpower and focus it on innovation, but that focus of process should be driven by a vision. It requires a Chief Futures Officer, a Future Gazer, who can not only organize, integrate, and streamline the futures development process but drive it forward.

- *Acquisitions Reform* – The creation of Army Futures Command also provides an opportunity to reform and improve some of the acquisition processes that have plagued Army combat developments for decades. The rapid acquisitions success of the early 21st century have been overshadowed by the failure of FCS and the high-profile cancellations of programs such as Comanche and Crusader. The “Army Strong: Equipped, Trained and Ready: Final Report of the 2010 Army Acquisition Review” known as the Decker-Wagner Report, was the latest in a series of studies dating back to 1970 that addressed the Army’s systemic acquisitions failures. While blame for some of those fiascoes might be shared with the Department of Defense, most belongs within the Army.

- *Beware the Big 6***.** The six modernization priorities provide broad focus areas for developing future technologies. The AFC must, however, guard against allowing the six modernization priorities to devolve into discrete programs focused on one system or weapon. Such a focus will either block development of newer, emerging technology, or else force a fixation on unproven technology. Remembering the FCS example, the AFC must also resist the temptation to merge the modernization priorities. The FCS failed partially because it was

[44] DePuy OH, 181.

touted to be a reincarnation of the Big 5, which reflected a misunderstanding of the nature of the Big 5 acquisition. During the development of the FCS, the Big 5 was often incorrectly characterized as a singular acquisition programs, rather than five discrete but complementary ones.

- *Reorganization or Reinforcing Failure?* Part of the planned structure of the AFC will include the Research, Development, and Engineering Command (RDECOM). The Decker-Wagner Report on acquisition reform analyzed the creation of RDECOM and found "no evidence of a major elimination of redundant effort, no significantly better leveraging of defense and commercial industry technology advancements, nor more products resulting from RDECOM HQ actions." One general officer interviewed for the study called the RDECOM a "failed experiment," while another said the creation of RDECOM had "Balkanized" the Life Cycle Management Commands. The Army refused the report's recommendation to break up RDECOM and use the resulting slots to create more Operations Research/Systems Analyst (ORSA) positions where they were needed. Whether or not the panel's critique of RDECOM was valid, the need for appropriate ORSA staffing was imperative to support the AFC mission.[45]

- *Beware of the Vanishing Tail***.** Every new future force structure or doctrine seems to include a plan for reduced logistics load. That is a chimera, however, as the logistics burden is not reduced but rather increased by the insertion of newer and more advanced technology. Some of this technology requires highly specialized contractors to repair and maintain, and all of it requires fuel, power generation, and spare parts to make it run. These people, military and civilian, must be fed, housed, and protected, which requires force structure and infrastructure. None of the Cross Functional Teams (CFT) directly addresses sustainment or medical support. While the existing CFTs might include sustainment as part of concept and technology development, the lack of an overarching sustainment CFT removes sustainment and medical expertise from the process. The focus of the other CFTs also indicates a bias toward direct action, to the exclusion of the wide range of other missions the Army is called upon to perform. These include EAB logistics, medical, aerial resupply, engineer, intelligence, MP and detainee operations, CBRNE, and others.

- *Seduction of Precision***.** The increased development of and reliance on ever more advanced, futuristic weapons with overly-hyped precision strike capability has led planners to underestimate requirements for troops for other missions which cannot be performed by "silver bullets." The Army's recent experience in OIF exhibits the danger of relying too much on weapons designed for precision. This has in turn driven unrealistically small force projections that later needed to be

[45] Historical Services Division, *Lessons Denied: The Army's Failure to Reform Acquisitions*, (Carlisle, PA: U.S. Army Heritage and Education Center, 2018), 16-17. See also "Army Strong: Equipped, Trained and Ready: Final Report of the 2010 Army Acquisition Review" (Washington, DC: Office of the Secretary of the Army, January 2011), 119.

increased. Planning for such "silver bullets" has informed force structure and end strength decisions, and reductions in those areas have increased the operational tempo of the remaining force. That increased OPTEMPO is not sustainable over a period of several years, as the wars in Iraq and Afghanistan have shown, and has inhibited overall Army readiness.

- *Near Term v. Mid-Term v. Long Term*. The drive to develop advanced technologies for the future might have a tendency to crowd out the near and mid-term modernization requirements that are essential to readiness. The AFC will need to carefully manage all three priorities.

- *Beware of Complicating Complexity* - The AFC would do well to consider the examples of two weapons systems from the other services.

    - *Silver Bullet* - The Navy's new 600-foot destroyer, USS *Zumwalt,* heralded a new generation of "stealth" ships and promised a new land attack capability. But its $4.4 billion price tag forced the Navy to reduce its buy from 32 to 3. While this saved money in construction costs, the cancellation drove up the cost of Long Range Land-Attack Projectile (LRLAP) to be used with the Advanced Gun System (AGS), the key weapons system for the ship's land attack role. Two weeks after the lead ship in the class was commissioned, the Navy cancelled the purchase of the projectiles whose cost had run to $800,000 each.[46] The Navy now plans to convert the ships from a land-attack mission to an anti-surface, offensive strike platform using the Raytheon SM-6 missile. The conversion will cost an additional $89.7 million.[47]

    - *Bells and Whistles* - The Marine Corps worked through the initial years of difficulty with fielding the V-22 Osprey, eventually fielding 129 (including those in use in the Navy). The Marines began inserting reliability and capability improvements into the Osprey shortly after production began, and the addition of these "bells and whistles" added to the complexity of an already complex aircraft, and drove up production costs. That fleet includes more than 70 variants of the V-22, however, and now the service has begun a 5-year project to convert those 70 variants to 5. The initial budget for the Common Configuration-Readiness and Modernization (CC-RAM) Program prototype

[46] Christopher P. Cavas, "New Warship's Big Guns Have No Bullets," *Defense News*, November 6, 2016.

[47] David B. Larter, "The Navy's Stealth Destroyers to get New Weapons and a New Mission: Killing Ships," *Defense News*, February 15, 2018.

conversion was $57M, with an additional $70M in FY19 to continue modifications. Full costs of the program are unknown.[48]

[48] Megan Eckstein, “NAVAIR Kicking off V-22 Osprey Modernization Drive to Improve Commonality,” *USNI News*, September 14, 2017.

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