

United States Marine Corps
Command and Staff College
Marine Corps University
2076 South Street
Marine Corps Combat Development Command
Quantico, Virginia 22134-5068

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**CAPABILITY GAPS CAUSED BY ARMY MODULARITY: A NEED FOR AIR
DEFENSE AT THE TACTICAL LEVEL**

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MAJ PATRICK COSTELLO, U.S. ARMY

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Mentor and Oral Defense Committee Member: Charles D. McKenna, Ph.D.

Approved: Charles D. McKenna

Date: 16 APRIL 2009

Oral Defense Committee Member: Craig A. Swanson, Ph.D.

Approved: Craig A. Swanson

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EXECUTIVE SUMMARY

Title: Capability Gaps Caused by Army Modularity: A Need for Air Defense at the Tactical Level

Author: MAJ Patrick Costello, U.S. Army

Thesis: The inactivation of the Short-Range Air Defense Artillery Battalions has created unintended capability gaps at the tactical level that prevent the modular Brigade Combat Team from being truly expeditionary by denying them the organic ability to manage friendly airspace, and to provide early warning and air defense against both traditional and asymmetric threats. A requirement does exist for Air Defense Artillery capability across the full spectrum of operations.

Discussion: The Army's transformation into a modular force has created capability gaps that make it unprepared to effectively operate in the future operational environment. Increasing friendly command and control requirements caused by an increased use of unmanned aerial systems make the Sentinel Radar a necessary component of the modular Brigade Combat Team. Additionally, potential adversaries seek to counter our strength of air superiority and defense against tactical ballistic missiles through acquisition and use of unmanned aerial systems, cruise missiles, and rockets and mortars. The current Army force structure relies on ad-hoc task organization and provides only a limited capability against these threats.

Conclusion: The Army has assumed risk in the removal of vital Air Defense Artillery assets from the tactical level, decisions that were made that are ignorant to threats in the future operational environment. Gaps exist in ADA capability at the tactical level across the full spectrum of operations, and despite the requirement, ADA is the only combat arms branch that has not remained as part of the new modular force. A permanent requirement exists across the full spectrum of operations, at the tactical level, for the capabilities brought by the Sentinel, and at the higher end for dedicated ADA assets. Adversaries trying to exploit seams in Army capability through both asymmetric and conventional means will characterize the future operational environment. The Air Defense Branch must move beyond a sole focus of the TBM threat and also shift its attention to counter emerging threats seen across worldwide conflicts. Additionally, acquisition efforts must address the evolving threat and be integrated with greater Army initiatives.

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List of Abbreviations and Acronyms

A2C2	Army Airspace Command and Control
AC	Active Component
ADA	Air Defense Artillery
ADAM	Air Defense and Airspace Management
AFATDS	Advance Field Artillery Tactical Data System
AMD	Air and Missile Defense
AMDPCS	Air and Missile Defense Planning and Control System
AWACS	Airborne Warning and Control System
BCT	Brigade Combat Team
BN	Battalion
BTRY	Battery
CIWS	Close In Weapon System
CM	Cruise Missile
EW	Early Warning
FAAD C2I	Forward Area Air Defense Command Control and Integration
FCS	Future Combat Systems
HMMWV	High Mobility Multi-Purpose Wheeled Vehicle
JLTV	Joint Light Tactical Vehicle
JSTARS	Joint Surveillance and Target Attack Radar System
LAAD	Low Altitude Air Defense
MTOE	Modified Table of Organization and Elements
OIF	Operation Iraqi Freedom
OEF	Operation Enduring Freedom
PLA	People's Liberation Army
RAM	Rockets, Artillery, and Mortars
SHORAD	Short Range Air Defense
SLAMRAAM	Surfaced Launched Air-to-Air Medium Range Missile
TBM	Tactical Ballistic Missile
UAS	Unmanned Aerial System
WAVES	Wireless Audio and Visual Emergency System

Preface

The Army has assumed risk in the elimination of Short-Range Air Defense (SHORAD) units from tactical formations. Assignments in these units, in garrison and combat, in Air Defense acquisition positions, and a tour on the Army Staff drove me to write this paper. Firsthand experience shows the value of SHORAD from stability and support to major combat operations. I believe that the Air Defense branch has struggled to maintain relevancy in years of air superiority, but decisions that have been made are based on past experience of decision makers rather than the future threat. The Army has significant decisions to make regarding force structure beyond Iraq and Afghanistan based on emerging threats demonstrated in conflicts around the world.

I would like to acknowledge the family, friends, peers, and superiors that have helped me during my research and writing of this paper. Specifically, the input from my dad, several General Officers, both retired and active duty, and my former Battalion Commander, COL Donald Fryc, was invaluable. All of these people sacrificed their valuable time to discuss my thoughts, offer theirs, and let a young field grade officer vent his feelings. Without their extensive knowledge and insight on the topic this paper would not have been possible. I owe special thanks to the members of my Marine Corps Command and Staff College seminar that spent many hours listening to me try to explain Army structure, and reading or re-reading my work. Last, but not least, I appreciate the patience shown by my fiancé, Rachel, who put up with my complaining, my absence at the library, and hours of staring aimlessly at my computer. Her dedication throughout this whole process reaffirms my desire to spend the rest of my life with her.

Introduction

"In October 1999 the Army announced its intentions to transform its forces into a more strategically responsive force that could more rapidly deploy and effectively operate in all types of military operations, whether small-scale contingencies or major theater wars."¹ Post 9/11 the Army began its largest transformation and reorganization since World War II. This effort, known as modularity, was intended to provide commanders with forces capable of operating across the full spectrum of operations. The 2008 Army Posture statement defines this as a "more agile, responsive, campaign quality and expeditionary Army."² This marks a move from a force based on a division to a more expeditionary brigade-centric organization. One of the major actions to support this transformation was the elimination of the Short Range Air Defense (SHORAD) Battalions (BN) from the division force structure. The inactivation of the SHORAD Battalions has created unintended capability gaps at the tactical level that prevent the modular Brigade Combat Team (BCT) from being truly expeditionary by denying them the organic ability to manage friendly airspace, and to provide early warning and air defense against both traditional and asymmetric threats. A requirement does exist for Air Defense Artillery (ADA) capability across the full spectrum of operations (see Figure 1, pg 23).

Methodology

This paper will first address Army modularity and, more specifically, its effects on the BCTs, focusing on the ADA capabilities that have been lost as a result of transformation. Next, to determine if a requirement exists for an ADA capability, the future threat will be characterized through an examination of current and recent conflicts along the full spectrum of operations. The shortfalls in the current force structure will then be addressed, followed by a discussion of

how the future force needs to be structured and equipped to counter potential Air and Missile Defense (AMD) threats, allowing tactical units to operate effectively in future theaters of war.

Air Defense and Modularity

The mission of U.S. Army Air Defense Artillery is to protect the force and selected geopolitical assets from aerial attack, missile attack, and surveillance.³

FM 3-01.85

Prior to transformation there were ten active component (AC) SHORAD BNs tasked to provide air defense and early warning (EW) to their respective divisions. Batteries (BTRYs) from the SHORAD BNs habitually would be task organized to the maneuver brigades of the division, providing both Stinger Missile-based weapons platforms and two Sentinel Radars. Dismounted Stinger teams, Avengers, or Linebackers would provide the BCT localized low altitude air defense (LAAD) while the radars would provide the supported commander with a local air picture used for both early warning of air attack or surveillance, and situational awareness of friendly aerial assets. SHORAD assets are also far more maneuverable and deployable than CORPS level air defense assets (Patriot), and therefore able to keep pace with the supported force.

SHORAD units provide two major capabilities to the supported maneuver commander. First, the Stinger missile based fire units provide LAAD against fixed and rotary winged threats, Unmanned Aerial Systems (UASs), and cruise missiles (CM). Second, the Sentinel Radars attached to the BCT provide a near real time air picture of friendly and enemy aerial platforms. This air picture is instrumental not only in EW but also in Army Airspace Command and Control (A2C2). The importance of A2C2 cannot be over-emphasized, as it is an integral part in de-confliction of airspace and clearance of fires, enabling units to coordinate surface fires effectively, providing aviation assets freedom of maneuver above the battlefield.

Under modularity nine of the ten AC SHORAD BNs were inactivated with the remaining

BN and National Guard assets pooled at the CORPS level to provide an "on call" air defense capability. The rationale for the elimination of the SHORAD units was that "U.S. tactical aircraft have rapidly achieved air superiority (and sometimes supremacy) in every conflict they have engaged in since World War II and that U.S. SHORAD units have not destroyed a hostile aircraft since 1950."⁴ This restructuring, when complete, would free up thousands of slots to support the Army transformation initiatives. The elimination of the SHORAD units would not only remove the weapon systems from the BCTs but the EW radars as well. This effort to "rebalance the Army force structure, whereby personnel spaces for lower-priority structure (e.g., field artillery and air defense specialties) are converted to higher-priority AC and RC structure (e.g., chemical, military police, engineer, medical, quartermaster, and transportation specialties)"⁵ seems aimed at the past and not the future.

Senior Army leaders continue to say that transformation is supporting what the future battlefield will look like. This rationale, while technically correct, is based on experience in past conflicts such as Korea, Vietnam, Panama, Kosovo, The Gulf War, Operation Iraqi Freedom (OIF), and Operation Enduring Freedom (OEF) rather than designing a force whose structure is based on emerging friendly and enemy technologies and enemy threats. Besides inferring that we will always maintain air superiority in future conflicts, another flaw in this rationale is that it assumes U.S. forces will always operate in mature theaters where there will be external means by which to receive EW from joint systems such as the Airborne Warning and Control System (AWACS) or Joint Surveillance and Target Attack Radar System (JSTARS), and local AD from PATRIOT missile BTRYs. Even if every theater of operations to which U.S. Armed Forces were committed were mature, these assets are either incapable of rapid maneuver or unconcerned with threats operating at lower altitudes.

One of the main tenets of modularity is the need for the Army to be more expeditionary, that is, operating independently without reliance on outside sources for support. This is accomplished by providing the joint force commander with BCTs that are designed to operate nearly autonomously in their battlespace,⁶ inferring no reliance on external support to complete mission essential tasks. Any dependence on external forces to function goes against the very idea of self-contained, expeditionary forces ready to fight upon deployment. The loss of capability previously provided by SHORAD units prevents the BCT commander, under the current organization, from meeting this intent. After transformation the only remaining ADA capability organic to the BCT resides within the Air Defense Airspace Management (ADAM) cell. However, without any organic equipment or source of data it must rely exclusively on external sources to function. Additionally, as depicted in current operations in support of OIF and OEF, ADAM cell Soldiers are often assigned other missions.

The Threat

We live in a world where global terrorism and extremist ideologies threaten our safety and our freedom. As we look to the future, we believe the coming decades are likely to be ones of persistent conflict—protracted confrontation among state, non-state, and individual actors who use violence to achieve their political and ideological ends. In this era of persistent conflict, the Army will continue to have a central role in implementing our national security strategy.⁷

The future operational environment is uncertain but it can be characterized by examining OIF, OEF, the 2006 Israel/Hezbollah War, the recent conflict between Russia and Georgia, and Chinese Military transformation to determine if a need for ADA capability exists at the BCT level. This examination provides possible contexts for facing both conventional and unconventional adversaries ranging from non-state actors or organizations with a military capability to countries with a more robust conventional force. Although not all-inclusive, it can be used to characterize the full spectrum of military operations. Because the U.S. military as a

whole currently has no peer competitor, adversaries are forced to seek an asymmetric advantage to exploit any perceived weaknesses.⁸

Opponents to the integration of ADA capability at the BCT level have seized upon the current conflicts in Iraq and Afghanistan. Air Defense units deployed in support of these operations have not operated in a traditional sense since April 2003, and on the surface it may appear such a capability is not required for a counter-insurgency fight. In OEF the Taliban never possessed traditional platforms such as fixed or rotary winged aircraft, UASs, or CMs that air defenders would normally be concerned about. In OIF, US air power and PATRIOT Missiles negated the Iraqi military's use of those assets. After the unexpected collapse of the Iraqi Military, Army Air Defenders took up non-standard missions such as convoy or forward operating base security, civil military operations, and other roles because the insurgency did not possess weapons that would require a traditional air defense capability.

This reasoning is unsound as a justification for the removal of ADA capability from the BCT because it ignores both friendly requirements and emerging enemy threats. In environments where the adversary does not possess aerial platforms, the EW provided by ADA radars is unnecessary. However, a friendly requirement for the radar's capability still exists. The Sentinel Radar is used by friendly forces for de-confliction of airspace and consequently in clearance of fires procedures. Even in a mature theater of operations, where external support can be relied upon to provide an air picture, the Sentinel Radar is the only asset that provides a local air picture under 3000' AGL, where most Army rotary wing and UASs operate. The presence of joint assets such as AWACS and JSTARS is not useful in these instances because these sources are unable to detect low and slow flying aerial platforms as their radars, to prevent clutter, filter out data under a certain altitude.⁹ The proliferation in use of UASs by U.S. Armed Forces makes

airspace management critical, especially in the execution of time sensitive fire missions. The use of UASs by Army forces has grown exponentially since 2001 and "reflects what will be an even more aggressive effort over the next 25 years"¹⁰ to field more unmanned systems. The concerns about overcrowded airspace and the requirement for Sentinel radars as outlined by combatant commanders in requests that have been addressed to the Army Staff.¹¹

The extensive use of rockets, artillery, and mortars (RAM) by insurgents represent threats that necessitate the presence of an ADA capability in OIF and OEF. In Iraq and Afghanistan casualties caused by indirect fire attacks are second only to those from improvised explosive devices.¹² In a 2004 operational needs statement combatant commanders outlined the need for a capability to counter these threats and reduce the number of casualties.¹³ This is a mission traditionally handled solely by the Field Artillery branch, but in response to the capability request, technologies and systems have been developed that involve ADA. By combining existing technology, systems, and sensor netting, a sense and warn system was developed to detect RAM threats and provide localized warning to soldiers, thereby minimizing casualties. AD systems play an integral part in this process, as the Forward Area Air Defense Command, Control, and Integration (FAAD C2I) system is used to correlate data from several sources. The FAAD C2I computer then passes that data to Field Artillery or other assets to process an appropriate response, i.e., counter-fire missions. To further this capability a spin off was developed by integrating the Navy Close In Weapon System (CIWS), or Phalanx, to intercept RAM targets before they impacted. The Sentinel Radar is a necessary component to prevent fratricide when the Phalanx intercept capability is present.

Although U.S. Armed Forces were not involved in the 2006 Israel/Hezbollah War several insights can be taken when considering it as a conflict between a conventional force and a non-

state actor or organization with a military arm. Unlike the insurgents in Iraq or Afghanistan, the Hezbollah organization in Lebanon has significant technologically advanced military capability, as shown by their unexpected use of asymmetric weapons during the war. "In July 2006, Hezbollah apparently surprised both Israeli and U.S. Intelligence organizations when it attacked an Israeli naval vessel with a C-802 anti-ship cruise missile."¹⁴ This appears to be the first widely documented use of a CM by a terrorist group, and in August 2006, the Israeli Air Force destroyed two armed Hezbollah UASs.¹⁵ Similarly, Hezbollah fired thousands of rockets into Israel during the course of the war, none of which were destroyed in flight. The recent use of these technologies may signify a shift in the military strategies of some potential adversaries. Although the use of UASs, CMs, and rockets by Hezbollah was unprecedented, to say it was unexpected is difficult to support. Ten years ago the FY98 Air and Missile Defense Master Plan outlined modernization plans in light of the future threat.

The evolving threat will take on new, stressing characteristics in the 21st century. Adversaries will closely observe U.S. capabilities in an effort to identify and exploit weaknesses using asymmetric approaches. An asymmetric approach by a future adversary seeks to negate U.S. capabilities by simple counters and avoids a direct match with U.S. strengths. Adversaries will try to exploit weaknesses in U.S. capabilities with simple counters, such as unmanned systems (TBMs, CMs, UASs, rockets).¹⁶

Russian use of airpower in the 2008 conflict with Georgia demonstrates that there are still countries that possess the capability to surge attack aircraft in large numbers, and at times, possibly challenge our superiority. Recalling the Cold War threat of the 1980's Russia surged Su-25 Frogfoots and Mi-24 Hind attack helicopters against the Georgian military and their facilities. "The early Russian air campaign was critical to Russia's rout of the Georgian military"¹⁷ Although Cold War era comparisons are difficult to draw today, this is one of only a few examples of a country outside of the U.S. using decisive airpower to crush the will of a foe.

Russia's conflict in Georgia came on the heels of Russian President Vladimir Putin's "announced plans to revive Russia's military power and restore its role as the world's leading producer of military aircraft."¹⁸ The Russian air force, previously plagued by a lack of funding that affected its ability to conduct training flights and support acquisition, has conducted several operations over the past several years that have signaled a changed in their strategy.¹⁹

China, through its current transformation of military forces, is a conventional military power that is attempting to pursue technologies that could challenge our perceived supremacy. The People's Liberation Army (PLA) is acquiring large numbers of CMs, and attempting to develop its air power through its unprecedented use of aircraft carriers and investment in training.²⁰ Simultaneously, the PLA is pursuing UAS technology for use in asymmetric operations. China's current acquisition strategy seems to be leaning towards a balance between conventional and asymmetric capability, with more technologically advanced aircraft and increased numbers of UASs and CMs.

While it is possible that the U.S. may never face Russia or China in direct conflict, both of these countries are actively seeking to improve and transform their militaries in response to lessons learned from the widely publicized American conflicts of the last twenty years. Moreover, both of these countries, and several others to include Iran and Syria, have demonstrated an increased willingness to share these technologies with other countries and groups. This enables them to avoid direct conflict with the U.S. while at the same time measure our response, and success or failure against these threats.

OIF, OEF, the Israel/Hezbollah War, the Russian conflict with Georgia, and China's military transformation portray conflict from insurgency to major combat operations against a conventional adversary. There is no way to accurately predict the actual threat in the future

operational environment but it can be hypothesized from current lessons learned across the full spectrum of operations. No doubt can exist that "potential adversaries will exploit from the global diffusion and proliferation of technologies such as cruise missiles and UASs"²¹ in an attempt to overcome the advantages that we have become accustomed to possessing.

We will confront highly adaptive and intelligent adversaries who will exploit technology, information, and cultural differences to threaten U.S. interests. Operations in the future will be executed in complex environments and will range from peace engagement, to counterinsurgency, to major combat operations. This era of persistent conflict will result in high demand for Army forces and capabilities.²²

This becomes even more probable as U.S. missile defense system capability has evolved against threats such as Tactical Ballistic Missiles (TBMs) since their infancy in the Gulf War. Until the U.S., in both capability and structure, demonstrates that it can effectively combat the use of such emerging threats they are an attractive alternative to adversaries trying to lessen our operational advantages.

For nearly sixty years the U.S. has enjoyed air superiority in every conflict in which we have been involved. This is a direct result of the significant investment that we have made militarily in terms of time, training, and money. Most potential adversaries are either incapable or unwilling to make this same investment to compete with the U.S. Air Force. Rather, UASs and CMs can be considered a "poor man's air force", seeking to achieve effects similar to that of fixed wing aircraft for a fraction of the investment.²³ Acquisition of these technologies coupled with development of more advanced anti-access systems aim to contest US dominance in the battlespace. As currently organized, Army units at the tactical level are incapable of countering or detecting these threats.

Current Organizational Shortfalls

The 2007 Army Modernization Plan lays out the broad framework of expectations for the

ADA branch to "provide air and missile defense to defeat hostile air and missile attacks, enhance situational understanding, and contribute to airspace management and force protection."²⁴

As previously discussed, the only organic ADA element at the tactical level within the U.S. Army is the ADAM cell in each BCT. ADAM cells are designed to provide the Commanders at BCTs, and Divisions enhanced situational awareness and airspace management capabilities. They also provide the interoperability link with joint, multinational and coalition forces.²⁵ The Army defines the function of the ADAM cell in FM 3-90.6, *The Brigade Combat Team*.

Upon contingency notification, the ADAM section conducts an assessment to determine if AMD augmentation from the corps SHORAD battalion is required. At this time the ADAM section recommends to the BCT commander whether or not to request a Sentinel sensor section from the corps. The ADAM section and tailored AMD augmentation force from the SHORAD battalion provide the active air defense over the brigade's distributed force operations in an uncertain and ambiguous battlefield environment.²⁶

This description fails to take into account any friendly mission such as A2C2 even though the manual names the ADAM cell as a participant in the process, and it is the only asset within the BCT that can receive or provide a real time depiction of the airspace. Additionally, it lends no credence to the competition that takes place for limited resources, such as radar, in a priority driven task organization.

The backbone of the ADAM cell is the suite of computers that comprise the Air and Missile Defense Planning and Control System (AMDPCS). AMDPCS provides the link with the various sensors that serve as data sources on the battlefield. However, when no radars are present (in this case Sentinel), and external sources such as PATRIOT radar, AWACS, or JSTARS are unavailable, enhanced situational awareness capability that the AMDPCS provides is ineffective. Furthermore, removing the radars from the BCT causes the soldiers and officers that man the ADAM cell to be used in other billets because they don't have the resources

necessary to execute their assigned mission.

This is especially the case today in Iraq and Afghanistan. Apart from the major urban areas around Baghdad, and other major air bases such as Balad, no source of data exists to enable the ADAM cell to function. An anonymous ADAM cell officer in charge, currently deployed to Afghanistan, has said that the equipment (without a source of data) is "useless", that his soldiers have been assigned to other duties, and he has not done anything Air Defense specific during his deployment²⁷. Given there is no air threat in those theaters and there is a lack of necessary equipment to function, his statements, and the actions to reassign him and his soldiers to non-standard missions are completely understandable. What is truly difficult to comprehend, though, is why the Army has budgeted through 2011 approximately \$287,298,000²⁸ to support research and development and fielding for ADAM cells and at the same time is taking away the equipment they require to function. Moreover, in a garrison environment, training on your assigned equipment becomes exponentially more difficult when you must rely on an external organization to provide the equipment with which you must train. What the dollar figure does not take into account is the amount of money and time spent to train soldiers to man and operate these systems. This logic again can be traced back to the assumption that U.S. Armed Forces will only operate in mature theaters where external sources of data are present.

Although U.S. forces have been deployed for almost eight years in support of the Global War on Terrorism and the theaters are considered mature, there are still austere environments where BCTs operate daily without external support. In the previous section the acquisition of large numbers of UASs by our potential adversaries, failing/failed states, and non-state actors²⁹ was discussed. Simultaneously, the Army at the tactical level is going down that same path, pursuing its own UASs so as not to be forced to depend on U.S. Air Force or higher-level assets

for support. At the beginning of OIF the Army only had a few UASs. Now it has hundreds to satisfy an intelligence, surveillance, and reconnaissance capability appetite that Secretary of Defense Robert Gates has called "insatiable."³⁰ The increased use of UASs at the BCT, BN, and sometimes even platoon level has added importance to the A2C2 mission, which would grow even more difficult in a theater that presents an air threat. Whether to support airspace management and deconfliction, or clearance of fire missions, a real time air picture has to be available at the BCT level to effectively and successfully execute these missions.

At the CORPS level, the ADA force is organized into brigades consisting of a mix of PATRIOT and composite AMD battalions (assets from the former SHORAD BNs). These brigades are to be task organized when necessary to supply combatant commanders ADA forces to defend against the emerging threat of TBMs, CMs, and UASs.³¹

The composite battalions will also provide situational awareness and understanding of the third dimension, also to contribute to air-space command and control as well as contributing to integrated, operational force protection. Now one battalion in one modular formation can deal with four missions compared with than two years ago having 10 SHORAD battalions that could provide limited cruise missile defense, force protection for infantry or cavalry units and 10 battalions of PATRIOT, primarily focused on TBM with some capability against cruise missiles and UASs.³²

Unfortunately, the current organizational structure to provide this support cannot effectively support all facets of these missions. This 'on call' method of support is possible but it presents risks to both the ADA community and the Army as a whole. One of the principles of Army training is 'train as you fight',³³ and the Army must be willing to accept the inherent dangers associated with violating this principle if the current organizational force structure remains unchanged. It is not realistic that an AMD TF will deploy as a whole except in support of a major combat operation.

This point was made painfully clear at the onset of OIF. PATRIOT units that rarely

received the opportunity to train with maneuver forces were task organized with units with which neither had any familiarity. The PATRIOT forces were not trained and were ill equipped for the mission they were asked to accomplish.³⁴ Attaching units only episodically prevents both from full understanding of the capabilities, limitations, and managed expectations for either that come from routine association. The ADA community has worked extremely hard over the last fifteen years to develop those relationships, and had become a valued member of the combined arms team. This is shown as current division commanders that served as both BN and BCT commanders understand the need and importance of ADA capability. These commanders are the same ones that have seen the capability gaps in the current organization and have made requests through the Army Staff to change this situation.³⁵ Another risk associated with ad-hoc task organization remains. "However carefully the Army may plan, actual requirements for forces on campaign will always differ from planning figures,"³⁶ potentially depriving a commander with the forces necessary to operate effectively.

Under the current organization the Army risks the career development of ADA officers, NCOs, and soldiers who work outside of their branch frequently, and therefore better understand the needs of the supported force within their capabilities. Additionally, in the aforementioned ADAM cell example, a risk also exists developing leaders and soldiers who know nothing about their AD jobs because the positions they hold do not adequately prepare them for greater future responsibility within the branch. BCT commanders of today do not fully understand the AD capabilities because they are not provided with them. As they become the future senior leaders of the Army and the joint force, they will not have an understanding of how to employ these capabilities if the threat arises. At the same time, under the current organization, ADA soldiers now are not receiving adequate training on how to best integrate with a maneuver force. As new

threats and friendly capabilities emerge, "SHORAD units may become more important than ever,"³⁷ but the current force structure fails to take this into account.

The February 2009 destruction of an Iranian UAS³⁸ by the U.S. Air Force in Iraq provides a recent operational example of how U.S. Army tactical formations are not equipped to detect or counter any air threat. A military spokesman said, "the unmanned aerial vehicle was in Iraqi airspace for nearly one hour and ten minutes and well inside Iraqi territory before it was engaged."³⁹ Though the exact details of this event are classified, the UAS was reportedly destroyed only sixty miles from Baghdad.⁴⁰ The fact that it was allowed to fly undetected and unidentified for so long suggests a complacency that has developed after years of facing no air threat. If radars would have been present, and A2C2 procedures adhered to, the UAS could have been detected and engaged much earlier.

The Future

The move towards a BCT-centric force seems justified since, with the exception of the ground portion of the Gulf War (9 days) and the first thirty days of OIF, conflicts over the last twenty years have been on the lower end of the spectrum where smaller, more expeditionary forces were more appropriate. If the future operational environment will be defined by BCTs able to operate across the full spectrum of conflict in austere environments, they should retain the equipment that is necessary for them to operate. The former SHORAD organization and concept of support were outdated and oriented on a Cold War paradigm with a sole focus on protection from fixed and rotary winged threats. The Stinger missile, fielded more than twenty years ago with a planning range of only five kilometers, is no longer suited to counter new aerial threats that operate at extended ranges with significantly longer stand-off capability. A requirement exists at the tactical level for ADA capability, and the structure must be in keeping with the

vision of a transformed force; deployable, maneuverable, and capable. It is important while adding this capability to find the proper balance between added capability and size, so as not to increase greatly the size of the BCT and make its footprint unwieldy. Furthermore, efforts within the Air Defense community must be synchronized with greater Army transformation and acquisition efforts.

A large gray area exists when trying to determine the proper force structure, attempting to balance capability and size. Simply put, determining how much is enough but not too much? The ADA branch must better position SHORAD, and the Army at the tactical level, against new and ever evolving threats. In doing so decisions must be made about how to best posture the force, either through making ADA organic to the modular BCT, or by relying on ad-hoc or habitual task organization solutions. If ADA forces are going to be permanently assigned at the tactical level, apart from offering a greater capability against emerging threats, they must meet two main requirements. First and foremost, they must be within the vision of transformation, being highly deployable and maneuverable. Additionally, the size of the force cannot not be overburdening, either logistically or operationally, allowing the BCT to maintain an expeditionary character.

The first, and most urgent task that must be undertaken is the addition of at least one, but preferably two, Sentinel Radars to the Modified Table of Organization and Equipment (MTOE) for each BCT. The Sentinels will allow the ADAM cell to operate in the garrison environment and combat deployments. The seventy-five kilometer (planning) range of the radar will provide the commander with a requisite amount of enhanced situational awareness of the third dimension. As our adversaries work to develop anti-access systems, Sentinel Radars will play a vital role in initial entry operations, for both friendly C2 and early warning, until joint assets

become available. Furthermore, BCTs will be able to effectively execute the A2C2 missions, and avoid complete reliance on procedural control for crowded airspace.⁴¹ In this age of networked systems, and our technological superiority, procedural control should be the exception, not the rule. Introducing the Sentinel back into the BCT will facilitate the re-integration of the ADAM cell, and its soldiers, into the A2C2 mission and clearance of fires procedures with their Aviation and Field Artillery counterparts.

Fielding radars to the BCT is a difficult proposition as the Sentinels that were removed with the SHORAD BNs from division MTOEs were used to fill shortages within the Army National Guard. If the Army desires to provide BCTs with a real time air picture a choice must be made between stripping the National Guard of already limited assets, or funding the production of new radars. Given the intense competition for funding and in light of current conflicts, the second course of action does not seem feasible.⁴²

In 2004 the Army awarded a contract for production of the Surfaced Launched Medium Range Air-to-Air Missile (SLAMRAAM) weapon system.⁴³ SLAMRAAM is designed to provide a near term capability to maneuver forces to counter CMs, UASs, and rotary and fixed winged aircraft beyond the range of current Stinger-based weapon systems.⁴⁴ The Army defines the role of SLAMRAAM as "assets are incorporated into the air defense plan and can be co-located with PATRIOT to provide 360 degree defense coverage of PATRIOT dead zones while the other SLAMRAAM systems travel and provide coverage for maneuver forces."⁴⁵ SLAMRAAM promises to add greater capability, flexibility, and protection to maneuver commanders. Additionally, in concert with Army transformation imperatives, it is designed to be rapidly deployable and highly mobile. This system, if integrated into modular BCT formations, has the ability to provide the maneuver commander greater ADA capability with

fewer systems; coverage that was once was provided by and Air Defense BTRY can now be provided by as little as a platoon.

The SLAMRAAM System in an order of magnitude increases in the operational environment against Cruise Missiles, Unmanned Aircraft Systems, Fixed Wing, and Rotary Wing aircraft over Stinger based systems. A Beyond Line of Sight/ Non-line of capability is provided by SLAMRAAM to achieve a threat overmatch.⁴⁶

Three problems exist with the SLAMRAAM weapon system and its planned integration into Air Defense organizations. The first issue deals with the aforementioned risks of ad-hoc task organization. The second is that SLAMRAAM is designed on the High Mobility Multipurpose Wheeled Vehicle (HMMWV) platform. Currently the Army and the Marine Corps are examining HMMWV replacement options, to be known as the Joint Light Tactical Vehicle. The HMMWV has been deemed "inadequate for the current operational environment, it has serious survivability, mobility, reliability and operational flexibility limitations."⁴⁷ Under current restrictions in place in Iraq and Afghanistan the SLAMRAAM vehicle would be limited to forward operating bases because of the lack of force protection it offers. Initial SLAMRAAM fielding now scheduled for the last quarter of fiscal year 2011⁴⁸ and JLTV production to begin roughly at the same time, SLAMRAAM will have a short life if its capabilities are not integrated into the JLTV platform. Finally, SLAMRAAM, unlike the Avenger, does not possess any capability other than air defense. The Avenger, outfitted with the M3P .50 caliber machine gun, offered flexibility to maneuver commanders to use air defenders in other missions when no air threat was present, as well as providing general force protection or self defense. These factors, coupled with delays in the acquisition process, and subsequent budget cuts,⁴⁹ put the SLAMRAAM program at significant risk if it is not accelerated.

In 2008 the Army began the process of designating C-RAM as a program of record, and in doing so, acknowledged that an enduring requirement exists to counter indirect fire attacks.

The system has proven itself as a valuable addition to force protection measures by providing a localized warning and limited intercept capability against indirect fire attacks in Iraq. This success, coupled with the program of record status, means that the C-RAM capability is not a theater specific solution. However, the current material solution should have little longevity beyond current conflicts. The current C-RAM capability has not been pushed down to the Army as a whole; specialized units that have been uniquely formed for this specific mission are accomplishing it. As previously discussed the system is scalable based on the specific operating environment. Capability ranges from a simple sense and warn function to the intercept version where vital structures or resources must be protected. The sense and warn capability needs to be promulgated throughout the BCTs or the Army. Studies conducted have shown that the presence of the sense and warn capability alone, if heeded, can reduce casualties upwards of 80 percent.⁵⁰ This is easily accomplished, as all the necessary equipment, except the Wireless Audio Visual Emergency System (WAVES), is already organic to the BCT. By making software upgrades to the ADAM cell systems and the Field Artillery's Advanced Field Artillery Tactical Data Systems (AFATDS), and adding the WAVES, the sense and warn capability could be an inherent capability of the BCT. The presence of a Sentinel, to prevent fratricide, to this structure would make an intercept capability a simple "plug and play" addition when necessary.

The current C-RAM intercept configuration should remain a theater specific solution; it is unwieldy and not maneuverable or easily deployable. The Phalanx gun is mounted on the back of a flatbed trailer and requires fiber cable to be laid to operate. Although a need for an intercept capability may exist, the time and infrastructure involved to accommodate this weapons system make it only appropriate for very few areas in a mature theater. Additionally, the current intercept method is a kinetic one, firing thousands of rounds to destroy one incoming mortar or

rocket. The objective C-RAM system needs to provide a mobile capability, taking advantage of wireless technology over secure tactical networks, to sense and warn against, and intercept RAM threats. Whether through an improved round or directed energy solution, a more efficient means of destroying RAM threats must be developed.

The 2006 Base Realignment and Closure Commission voted to move the ADA Headquarters from Ft. Bliss, Texas to Ft. Sill, Oklahoma, co-located with the Field Artillery Headquarters.⁵¹ The two branches recently formed the Fires Center of Excellence. This formation presents several new opportunities that the branches need to take advantage of. Significant cross-training opportunities exist, as well as refining the doctrine and tactics, techniques and procedures that are shared between the two branches. Jointly a multi-mission radar needs to be developed that leverages capabilities of the Sentinel and existing Field Artillery fire direction radars; providing a capability to manage airspace, and provide EW and fire direction against both RAM and traditional rotary and fixed winged threats. A multi-mission radar would lessen the footprint of the BCT, and be especially useful in the application of the C-RAM capability. As technology advances future integration onto mobile platforms such as envisioned by the networked Future Combat Systems (FCS) is possible. These advances should be integrated at the BCT level within the Field Artillery BN.

Independently the ADA branch needs to focus on providing a near term capability at the BCT level to counter emerging threats. The effort to integrate the SLAMRAAM capability on the HMMWV replacement must begin now. Future acquisition strategies need to incorporate capability into joint platforms and the FCS system of systems, and be multi-mission capable to provide flexibility to maneuver commanders. Beyond the immediate return of the Sentinel Radar to the BCT level, this should be followed by the re-integration of fire units after they have been

integrated onto JLTV. Until that time, even with the challenges of providing support to simultaneous conflicts, combined arms training opportunities need to be maximized.

Additionally, new threat sets need to be incorporated in to the Army's combat training centers to address threats that are more in line with the current and future operational environments.

Conclusion

Through the Army's transformation to a modular force, organizational structure decisions were made that ignore threats in the future operational environment.

Air and Missile Defense is critical to the defense of our nation, deployed forces, friends and allies. The proliferation of ballistic/cruise missiles and related technologies and the increasing availability of unmanned aerial vehicles, all of which can be used to deliver weapons of mass destruction, are the more significant threats to the current global security environment.⁵²

Gaps exist in ADA capability at the tactical level across the full spectrum of operations, and despite the requirement, ADA is the only combat arms branch that has not remained as part of the new modular force. This prevents the Army from being "more strategically responsive across the entire range of military operations required by the 21st century security environment."⁵³ A permanent requirement exists across the full spectrum of operations, at the tactical level, for the capabilities brought by the Sentinel, and at the higher end for dedicated ADA assets. To fulfill this need, one ADA platoon, with Sentinel, should be permanently task organized within either the Special Troops or Field Artillery Battalions within the modular BCT. This will help meet the requirement outlined in FM 3.0 of being able to operate simultaneously in offensive, defensive, and stability or civil support operations.⁵⁴ Adversaries trying to exploit seams in Army capability through both asymmetric and conventional means will characterize the future operational environment. The Air Defense Branch must move beyond the sole focus of the TBM threat and also shift its attention to counter emerging threats across worldwide conflicts. Additionally, acquisition efforts must address the evolving threat and be integrated

with greater Army initiatives. If risk was going to be taken by removing ADA capability at the tactical level it should have been done at the conclusion of the Cold War,⁵⁵ and not in this era of conflict.

Glossary

ADAM Cell- The ADAM Cell is a fusion of both Air Defense Artillery and Aviation systems and personnel. Maximizes the effectiveness of the brigade combat team airspace by deconflicting all rotary and fixed-wing aircraft, UASs, and fires assets in the brigade combat team area of operations. This is accomplished by systems such as the Tactical Airspace Integration System (TAIS), Air Defense Systems Integrator (ADSI), Air and Missile Defense Workstation (AMDWS), and Forward Area Air Defense (FAAD) system, plus a versatile radio suite consisting of UHF, VHF, HF, and satellite communications radios. All these systems reside in the ADAM shelter (AN/TSQ-282D) and are remotely linked into the tactical operations center.

AMDPCS- The Air/Missile Defense Planning and Control System (AMDPCS) combines a fire control system; common air and missile defense (AMD) planning; battlespace situational awareness; and joint, interoperable battle management; and command, control, communications, computers, and intelligence capability. AMDPCS consists of sheltered systems with integrated communications equipment that provide air defense artillery brigades with a fire control system for monitoring and controlling engagement operations by subordinate battalions via the Air Defense System Integrator (ADSI). AMDPCS provides a common air and missile defense staff planning and battlespace situational awareness tool to achieve a common tactical and operational air picture via the Air and Missile Defense Workstation (AMDWS). The AMDWS is fielded to AMD units at all echelons of command, battery through theater

Avenger- The Avenger Air Defense System is a weapon system used by both the Army and the Marine Corps that provides mobile, short- range air defense protection for ground units against cruise missiles, unmanned aerial vehicles, low-flying fixed-wing aircraft, and helicopters. The system consists of a gyro-stabilized air defense turret mounted on a modified heavy High Mobility Multipurpose Wheeled Vehicle (HMMWV). The turret has two Stinger missile launcher pods, each capable of firing up to 4 fire-and-forget infrared/ultraviolet stinger missiles.

AWACS- An Airborne Early Warning and Control (AEW&C) system is an airborne radar system designed to detect aircraft. Used at a high altitude, the radars allow the operators to distinguish between friendly and hostile aircraft hundreds of miles away.

C-RAM- The Counter - Rockets, Artillery, and Mortars (C-RAM) system interconnects and coordinates sensors with Shape, Warning, Intercept, and Response systems through Command and Control. The systems then Sense RAM launches, Warn troops, Intercept and destroy the RAM threat in flight, coordinate Response to the Ram launch point, and collect data to enable the US commander to Shape the battle to deny enemy RAM attacks. The C-RAM system also monitors friendly ground and air assets, to preclude collateral damage during engagements.

JSTARS- The E-8 Joint Surveillance Target Attack Radar System (Joint STARS) is a United States Air Force airborne battle management and command and control (C2) platform that conducts ground surveillance to develop an understanding of the enemy situation and to support attack operations and targeting that contributes to the delay, disruption and destruction of enemy

forces.

Linebacker- An air defense variant of the M2A2 Bradley Fighting vehicles with the TOW missile system replaced with a four-tube Stinger missile system.

Phalanx- A Close-in weapon system (CIWS), a naval shipboard point-defense weapon for detecting and destroying incoming anti-ship missiles and enemy aircraft at short range. Has been integrated into the C-RAM system to provide an intercept capability against RAM threats.

Sentinel Radar- The AN/MPQ-64 Sentinel is a three-dimensional radar used to alert and queue Short Range Air Defense (SHORAD) weapons to the locations of hostile targets approaching their front line forces.

SLAMRAAM- The Surfaced-Launched Advanced Medium Range Air-to-Air Missile (SLAMRAAM) is the Army's future short-range air defense weapon. The SLAMRAAM program is intended to eventually replace all the Army's short-range air defense weapon systems that employ the Stinger missile. The SLAMRAAM system intends to give the Army the capability to engage targets (including cruise missiles and helicopters) to beyond line-of-sight and at greater ranges than the Stinger-based systems. SLAMRAAM is also intended to defend against the evolving air threat from unmanned aerial vehicles and cruise missiles.

Stinger Missile- The FIM-92 Stinger is a personal portable infrared homing surface-to-air missile developed in the United States and entered into service in 1981.

WAVES- The WAVES (Wireless Audio Visual Emergency System) Mass Notification and Personnel Alerting System provides fast and precise communication before, during, and after an emergency. When integrated into the C-RAM architecture it provides a localized audio and visual warning to affected areas.

Appendix A

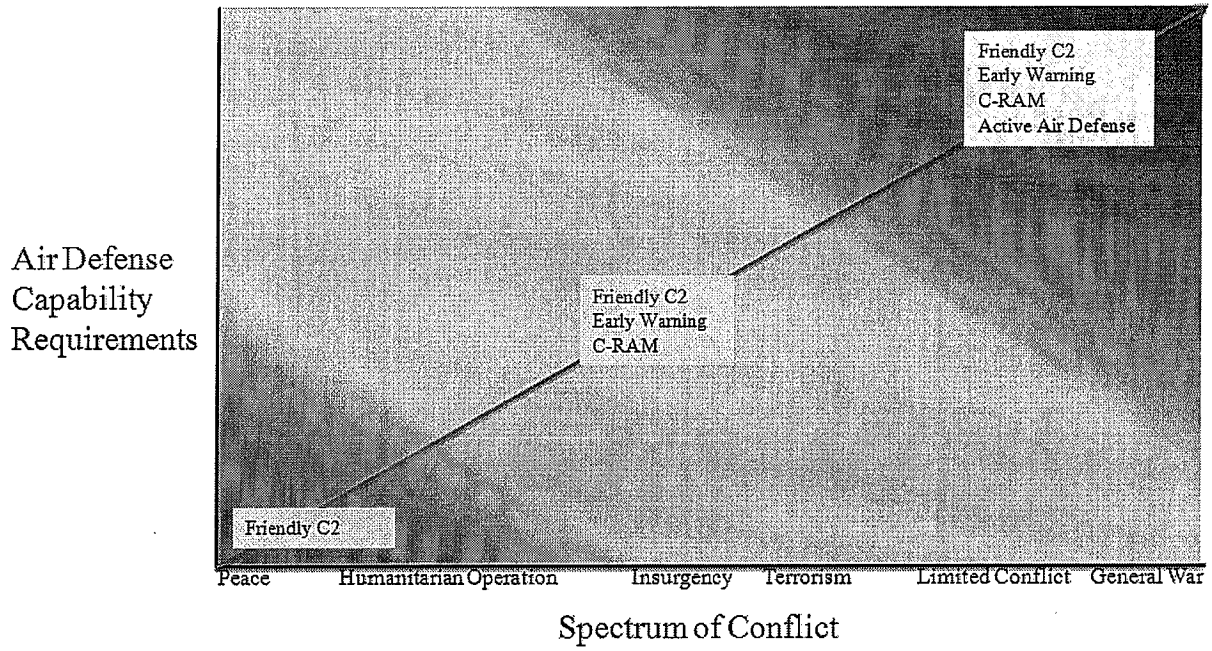


Figure 1 - Air Defense Capability Requirements across the Full Spectrum of Conflict

Notes

- ¹ U.S. Government Accountability Office, *Military Transformation: Army Actions Needed to Enhance Formation of Future Interim Brigade Combat Teams* (Washington, DC: Government Accountability Office, 2002), 1.
- ² U.S. Congress, *A Statement on the Posture of the United States Army 2008*, 110th Cong, 2nd sess., 2008, 14.
- ³ Headquarters Department of the Army, *Patriot Battalion and Battery Operations*, FM 3-01.85 (Washington, DC: U.S. Department of the Army, May 2002), 1.
- ⁴ Congressional Budget Office, *Budget Options* (Washington, DC: Congressional Budget Office, 2005), 12.
- ⁵ Lynn E. Davis and others, *Stretched Thin: Army Forces for Sustained Operations* (Santa Monica, CA: Rand, 2005), 12.
- ⁶ Based on the author's personal experience dealing with capabilities integration, and requirements during the Army Requirements and Resourcing Board, while assigned to the Army Staff
- ⁷ U.S. Congress, *A Statement on the Posture of the United States Army 2008*, 110th Cong, 2nd sess., 2008, ii.
- ⁸ Headquarters Department of the Army, *The Infantry Battalion*, FM 3-21.20 (Washington, DC: U.S. Department of the Army, December 2006), 1-16.
- ⁹ D.M. Gormley, "Missile Defense Myopia: Lessons from the Iraq War." *Survival* vol. 45, no.4 (Winter 2003-2004), 61-86.
- ¹⁰ Associated Press, "Rise of the Machines: UAV use Soars," January 2, 2008, <http://www.military.com/NewsContent/0,13319,159220,00.html> (accessed January 28, 2009).
- ¹¹ Based on the author's personal experience dealing with capabilities integration, and requirements during the Army Requirements and Resourcing Board, while assigned to the Army Staff
- ¹² Multi-National Force Iraq, *Operational Needs Statement*, 22 June 2004.
- ¹³ Ibid.
- ¹⁴ Jennifer Kline, "Special Report: Challenges of Iranian Missile Proliferation -Part II, Assistance to Hezbollah," *WMD Insights*, October 2006, http://www.wmdinsights.com/I9/I9_ME1_ChallengesofIran_2.htm (accessed December 19, 2008).
- ¹⁵ Ibid
- ¹⁶ Department of the Army, HQ United States Army Air Defense Artillery School, *FY 98 Air and Missile Defense Master Plan*, 1998, <http://www.fas.org/spp/starwars/docops/amd/Chapter-1.htm> (accessed November 20, 2008).
- ¹⁷ The Georgia Russia War (2008), <http://www.historyguy.com/georgia-russia-war.htm> (accessed December 28, 2009).
- ¹⁸ Luke Harding, "Putin Hopes to Revive Russian Air Power," *The Sydney Morning Herald*, August 23, 2007, <http://www.smh.com.au/news/world/putin-hopes-to-revive-russian-air-power/2007/08/22/1187462353567.html> (accessed 28 December, 2009).
- ¹⁹ Petrov, Nikita, "Outside View: Russian Air Power," *The Washington Times*, August 28, 2008, <http://www.washingtontimes.com/news/2008/aug/21/outside-view-russian-air-power/> (accessed December 28, 2008).
- ²⁰ U.S. Department of Defense. *Annual Report to Congress: Military Power of the People's Republic of China*. Washington, DC: Department of Defense, 2008, 2.
- ²¹ Headquarters United States Marine Corps, *Marine Corps Operating Concepts for a Changing Security Environment*, (Washington, DC: U.S. Marine Corps, June 2007), 38.
- ²² U.S. Congress, *A Statement on the Posture of the United States Army 2008*, 110th Cong, 2nd sess., 2008, 2.
- ²³ Gormley. p. 62.
- ²⁴ Headquarters Department of the Army, *2007 Army Modernization Plan* (Washington, DC: Headquarters Department of the Army, March 2007), 32.

- ²⁵ Headquarters Department of the Army, *Department of the Army Fiscal Year 2009 Budget Estimates* (Washington, DC: U.S. Department of the Army, February 2008), item 102 p. 1.
- ²⁶ Headquarters Department of the Army, *The Brigade Combat Team*, FM 3-90.6 (Washington, DC: U.S. Department of the Army, August 2006), 11-22.
- ²⁷ Anonymous, email message to author, January 14, 2009.
- ²⁸ Headquarters Department of the Army, *Department of the Army Fiscal Year 2009 Budget Estimates* (Washington, DC: U.S. Department of the Army, February 2008), item 102 p. 1.
- ²⁹ Estimates (Unclassified) are that more than 40 countries possess a UAS capability. This number does not include non-state actors or terrorist organizations.
- ³⁰ Hoffman, Michael, and Kris Osborn, "Finally Ground Rules for Air Ops," *Defense News*, September 15, 2008, <http://www.defensenews.com/story.php?i=3723662> (accessed January 4, 2009).
- ³¹ Headquarters Department of the Army, *2007 Army Modernization Plan* (Washington, DC: Headquarters Department of the Army, March 2007), 32.
- ³² Roosevelt, Ann, "Army Air Defense Artillery Moves To Composite, Modular Units," *Defense Daily*, March 1, 2005, http://findarticles.com/p/articles/mi_6712/is_/ai_n29169461 (accessed January 4, 2009).
- ³³ Headquarters Department of the Army, *Training for Full Spectrum Operations*, FM 7.0 (Washington, DC: U.S. Department of the Army, December 2008), 2-5.
- ³⁴ Based on the author's personal experience as a SHORAD Battery Commander during OIF
- ³⁵ Based on the author's personal experience dealing with capabilities integration, and requirements during the Army Requirements and Resourcing Board, while assigned to the Army Staff
- ³⁶ Headquarters Department of the Army, *The Modular Force*, FM 3-0.1 (Washington, DC: U.S. Department of the Army, January 2008), 2-5.
- ³⁷ Congressional Budget Office, *Budget Options* (Washington, DC: Congressional Budget Office, 2005), 12.
- ³⁸ Byers, David, "US Shot Down Iranian Drone Over Iraq," *Times Online*, 16 March, 2009, http://www.timesonline.co.uk/tol/news/world/middle_east/article5919425.ece (accessed 18 March, 2009).
- ³⁹ Ibid.
- ⁴⁰ Ibid.
- ⁴¹ Based on the author's personal experience dealing with capabilities integration, and requirements during the Army Requirements and Resourcing Board, while assigned to the Army Staff.
- ⁴² MG Robert Lennox (Assistant Army Deputy Chief of Staff G-3/5/7), in discussion with the author, January 2009.
- ⁴³ Surface-Launched AMRAAM (SL-AMRAAM / CLAWS) Medium-Range Air Defence System, USA, <http://www.army-technology.com/projects/surface-launched/>, (accessed 27 January 2009).
- ⁴⁴ Headquarters Department of the Army, *Surface Launched Advanced Medium Range Air-to-Air Missile (SLAAMRAM) Battery Operations*, FM 3-01.10 (Washington DC: U.S. Department of the Army, Draft), 1-1.
- ⁴⁵ Ibid.
- ⁴⁶ Ibid., 1-4.
- ⁴⁷ Joint Light Tactical Vehicle (JLTV), <https://www.marcorsyscom.usmc.mil/peolandsystems/jltv.aspx>, (accessed 27 January 2009).
- ⁴⁸ LTC Todd Puhmann (Force Management Office, Army G-3/5/7), in discussion with the author, February 2009.
- ⁴⁹ Senate Report 109-254 - National Defense Authorization Act for Fiscal Year 2007, http://www.thomas.gov/cgi-bin/cpquery/?&sid=cp109hv1Mh&refer=&r_n=sr254.109&db_id=109&item=&sel=TOC_168528&, (accessed 14 January 2009).
- ⁵⁰ Based on the authors experience as the C-RAM evaluator serving in the Army Test and Evaluation Command.

⁵¹ Crawley, Jeff, "Fort Sill's ADA BRAC Expansion Locked On," *Ft. Sill Cannoneer*, January 23, 2009, <http://www.army.mil/-news/2009/01/23/16027-fort-sills-ada-brac-expansion-locked-on/> (accessed January 28, 2009).

⁵² 09-17 Space and Missile Defense, <http://www.ausa.org/legislation/agenda/OurResolutions2009/Pages/09-17SpaceandMissileDefense.aspx>, (accessed 27 January 2009).

⁵³ Torchbearer National Security Report, "The U.S. Army: A Modular Force for the 21st Century," The Association of the United States Army (AUSA), March 2005, p. 3.

⁵⁴ Headquarters Department of the Army, *Operations*, FM 3.0 (Washington, DC: U.S. Department of the Army, February 2008), vii.

⁵⁵ MG Robert Lennox (Assistant Army Deputy Chief of Staff G-3/5/7), in discussion with the author, January 2009.

Bibliography

- 09-17 Space and Missile Defense.
<http://www.ausa.org/legislation/agenda/OurResolutions2009/Pages/09-17SpaceandMissileDefense.aspx> (accessed January 27, 2009).
- Associated Press. *Rise of the Machines: UAV Use Soars*. January 2, 2008.
<http://www.military.com/NewsContent/0,13319,159220,00.html> (accessed December 28, 2008).
- Association of the United States Army. "The U.S. Army: A Modular Force for the 21st Century." *Torchbearer National Security Report*, March 2005.
- Byers, David. "US Shot Down Iranian Drone Over Iraq." *Times Online*. March 16, 2009.
http://www.timesonline.co.uk/tol/news/world/middle_east/article5919425.ece (accessed March 18, 2009).
- Congressional Budget Office. *Budget Option*. Washington D.C.: Congressional Budget Office, 2005.
- Crawley, Jeff. "Fort Sill's ADA BRAC Expansion Locked On." *Ft. Sill Cannoneer*. January 23, 2009.
<http://www.army.mil/-news/2009/01/23/16027-fort-sills-ada-brac-expansion-locked-on/> (accessed January 28, 2009).
- Davis, Lynn E., and others. *Stretched Thin: Army Forces for Sustained Operations*. Santa Monica: Rand, 2005.
- Department of the Army, HQ United States Army Air Defense Artillery School. "FY 98 Air and Missile Defense Master Plan, 1998." *Federation of American Scientists*.
<http://www.fas.org/spp/starwars/docops/amd/Chapter-1.htm> (accessed November 20, 2008).
- Gormley, D.M. "Missile Defense Myopia: Lessons from the Iraq War." *Survival* 45, no. 4 (Winter 2003-2004): 61-86.
- Harding, Luke. *Putin Hopes to Revive Russian Air Power*. August 23, 2007.
<http://www.smh.com.au/news/world/putin-hopes-to-revive-russian-air-power/2007/08/22/1187462353567.html> (accessed December 28, 2008).
- Headquarters, Department of the Army. *The Modular Force, FM 3-0.1*. Washington D.C.: U.S. Department of the Army, 2008.
- Headquarters, Department of the Army. *2007 Army Modernization Plan*. Washington D.C.: U.S. Department of the Army, 2007.
- . *Department of the Army Fiscal Year 2009 Budget Estimates*. Washington D.C.: U.S. Department of the Army, 2008.
- . *Operations, FM 3.0*. Washington D.C.: U.S. Department of the Army, 2008.
- . *Patriot Battalion and Battery Operations, FM 3-01.85*. Washington D.C.: U.S. Department of the Army, 2002.

- . *Surface Launched Advanced Medium Range Air-to-Air Missile (SLAMRAAM) Battery Operations, FM 3-01.10*. Washington D.C.: U.S. Department of the Army, Draft.
- . *The Brigade Combat Team, FM 3-90.6*. Washington D.C.: U.S. Department of the Army, 2006.
- . *The Infantry Battalion, FM 3-21.20*. Washington D.C.: U.S. Department of the Army, 2006.
- . *Training for Full Spectrum Operations, FM 7.0*. Washington D.C.: U.S. Department of the Army, 2008.
- Headquarters, United States Marine Corps. *Marine Corps Operating Concepts for a Changing Security Environment*. Washington D.C.: U.S. Marine Corps, 2007.
- Joint Light Tactical Vehicle (JLTV)*. <https://www.marcorsyscom.usmc.mil/peolandsystems/jltv.aspx> (accessed January 2009, 2009).
- Kline, Jennifer. "Special Report: Challenges of Iranian Missile Proliferation - Part ii, Assistance to Hezbollah." *WMD Insights*. October 2006. http://www.wmdinsights.com/i9/i9_me1_challengesofiran_2.htm (accessed December 19, 2008).
- Lennox, MG Robert, interview by Author. *Assistant Army Deputy Chief of Staff G-3/5/7* (January 14, 2009).
- Michael, Hoffman, and Kris Osborn. "Finally Ground Rules for Air Ops." *Defense News*. September 15, 2008. <http://www.defensenews.com/story.php?i=3723662> (accessed January 4, 2009).
- National Defense Authorization Act for Fiscal Year 2007*. http://www.thomas.gov/cgi-bin/cpquery/?&sid=cp109hv1Mh&refer=&r_n=sr254.109&db_id=109&item=&sel=TOC_168528& (accessed January 14, 2009).
- Petrov, Nikita. "Outside View: Russian Air Power." *The Washington Times*. August 21, 2008. <http://www.washingtontimes.com/news/2008/aug/21/outside-view-russian-air-power/> (accessed December 28, 2008).
- Puhrmann, LTC Todd, interview by Author. *Force Management Officer, Army G-3/5/7* (February 6, 2009).
- Roosevelt, Ann. *Army Air Defense Artillery Moves to Composite, Modular Units*. March 1, 2005. http://findarticles.com/p/articles/mi_6712/is_2005_March_1/ai_n29169461?tag=content;coll (accessed January 4, 2009).
- Surface-Launched AMRAAM (SL-AMRAAM / CLAWS) Medium-Range Air Defence System, USA*. <http://www.army-technology.com/projects/surface-launched/> (accessed January 27, 2009).
- The Georgia Russia War (2008)*. <http://www.historyguy.com/georgia-russia-war.htm> (accessed December 28, 2008).
- U.S. Congress. "A Statement on the Posture of the United States Army 2008." 110th Congress, 2nd sess.
- U.S. Department of Defense. *Annual Report to Congress: Military Power of the People's Republic of China*. Washington D.C.: Department of Defense, 2008.

U.S. Government Accountability Office. *Military Transformation: Army Actions Needed to Enhance Formation of the Future Interim Brigade Combat Teams*. Washington D.C.: U.S. Government Accountability Office, 2002.