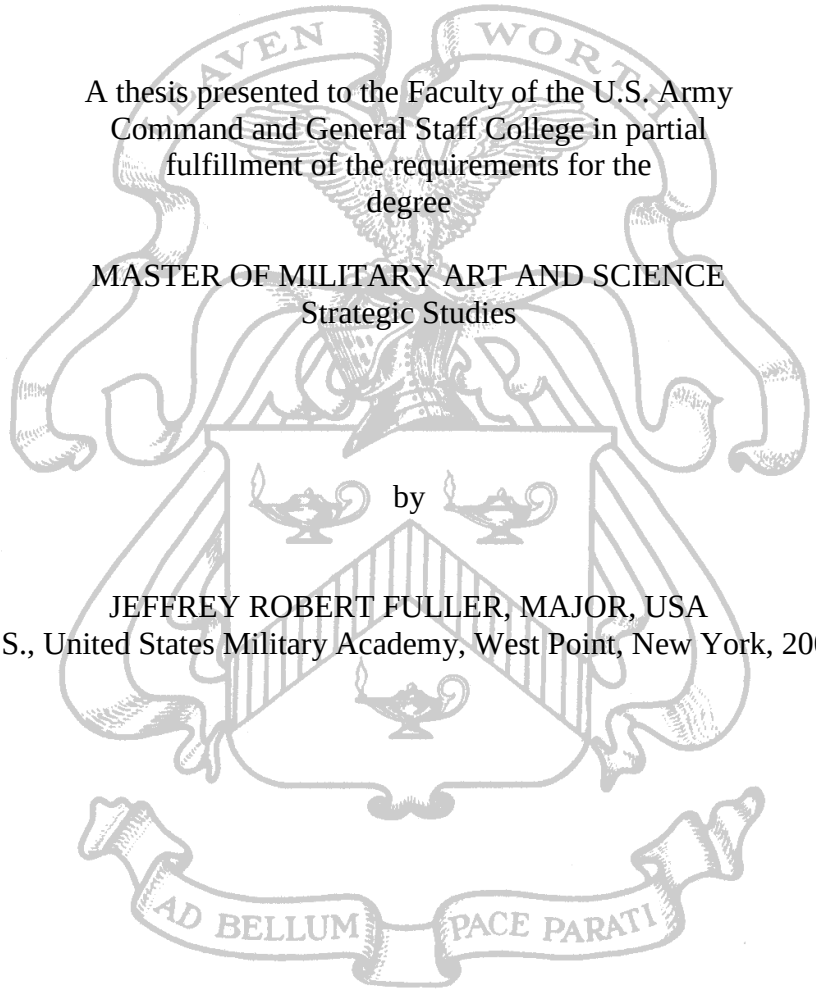
# UNITED STATES ARMY FIELD ARTILLERY AND THE HYBRID THREAT: IS IT TIME TO GET SMART?

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE
Strategic Studies

by

JEFFREY ROBERT FULLER, MAJOR, USA
B.S., United States Military Academy, West Point, New York, 2001




Fort Leavenworth, Kansas
2014-01

# REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 0704-0188*



| **1. REPORT DATE** *(DD-MM-YYYY)* | **2. REPORT TYPE** | **3. DATES COVERED** *(From - To)* |
|---|---|---|
| 13-06-2014 | Master's Thesis | AUG 2013 – JUNE 2014 |

**4. TITLE AND SUBTITLE**

United States Army Field Artillery and the Hybrid Threat: Is it Time to Get Smart?

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**

MAJ Jeffrey R. Fuller

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**

U.S. Army Command and General Staff College
ATTN: ATZL-SWD-GD
Fort Leavenworth, KS 66027-2301

**8. PERFORMING ORG REPORT NUMBER**

**9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

**10. SPONSOR/MONITOR'S ACRONYM(S)**

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

**12. DISTRIBUTION / AVAILABILITY STATEMENT**

Approved for Public Release; Distribution is Unlimited

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**

Is the United States Army Field Artillery still capable of successfully countering the Hybrid Threat, and what role would precision smart munitions play in developing such a capability? Precision smart munitions were, at one time, considered a necessary capability, but as time progressed and new threats developed, the need for such a capability dwindled. Previous research examines whether current capabilities can doctrinally employ field artillery, but there is little research examining whether or not doctrinally employed field artillery is capable of addressing the Hybrid Threat described in current Army doctrine, specifically the threat of conventional enemy forces. In this thesis I examine U.S. Army Field Artillery doctrine, organization, and materiel and determine that capability gaps do exist against the conventional forces of the Hybrid Threat. While smart munitions are not the only solution to these gaps, this thesis argues that they do offer a solution and provides recommendations as to how they can better prepare the U.S. Army Field Artillery for future adversaries.

**15. SUBJECT TERMS**

U.S. Army Field Artillery, Hybrid Threat, Precision Smart Munitions, SADARM, DOTMLPF

| **16. SECURITY CLASSIFICATION OF:** | | | **17. LIMITATION OF ABSTRACT** | **18. NUMBER OF PAGES** | **19a. NAME OF RESPONSIBLE PERSON** |
|---|---|---|---|---|---|
| **a. REPORT** | **b. ABSTRACT** | **c. THIS PAGE** | | | **19b. PHONE NUMBER** *(include area code)* |
| (U) | (U) | (U) | (U) | 84 | |

**Standard Form 298 (Rev. 8-98)**
**Prescribed by ANSI Std. Z39.18**

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

Name of Candidate: MAJ Jeffrey R. Fuller

Thesis Title: United States Army Field Artillery and the Hybrid Threat: Is it Time to Get Smart?

Approved by:

_____, Thesis Committee Chair
LTC Kenneth D. Slover, M.S.

_____, Member
Jackie D. Kem, Ph.D.

_____, Member
LtCol Scott J. Roxburgh, M.A.

Accepted this 13th day of June 2014 by:

_____, Director, Graduate Degree Programs
Robert F. Baumann, Ph.D.

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

UNITED STATES ARMY FIELD ARTILLERY AND THE HYBRID THREAT: IS IT TIME TO GET SMART?, by MAJ Jeffrey R. Fuller, 84 pages.

Is the United States Army Field Artillery still capable of successfully countering the Hybrid Threat, and what role would precision smart munitions play in developing such a capability? Precision smart munitions were, at one time, considered a necessary capability, but as time progressed and new threats developed, the need for such a capability dwindled. Previous research examines whether current capabilities can doctrinally employ field artillery, but there is little research examining whether or not doctrinally employed field artillery is capable of addressing the Hybrid Threat described in current Army doctrine, specifically the threat of conventional enemy forces. In this thesis I examine U.S. Army Field Artillery doctrine, organization, and materiel and determine that capability gaps do exist against the conventional forces of the Hybrid Threat. While smart munitions are not the only solution to these gaps, this thesis argues that they do offer a solution and provides recommendations as to how they can better prepare the U.S. Army Field Artillery for future adversaries.

# ACKNOWLEDGMENTS

I would like to acknowledge and thank my thesis committee members. Their support and guidance through topic changes and multiple plans for addressing said topic were instrumental in transforming my abstract ideas and opinions into a coherent product. Also, none of this would have been possible if it were not for the support of my family. My wife Kate endured many late nights, long hours at the library, and a seemingly endless amount of frustration. Stephen, David, and Matthew allowed me to postpone projects and trips to the driving range. Through it all, they continued to provide the love, support, and encouragement that got me through to the end.

TABLE OF CONTENTS

Page

# ACRONYMS

| | |
|---|---|
| ADRP | Army Doctrine Reference Publication |
| ATACMS | Army Tactical Missile System |
| ATP | Army Techniques Publication |
| BAT | Brilliant Anti-Tank |
| BCT | Brigade Combat Team |
| DOTMLPF | Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities |
| DPICM | Dual Purpose Improved Conventional Munitions |
| FA | Field Artillery |
| FM | Field Manual |
| G-MLRS | Guided Multiple Launch Rocket System |
| GPS | Global Positioning System |
| MLRS | Multiple Launch Rocket System |
| SADARM | Sense and Destroy Armor |
| TC | Training Curricular |
| USAFA | United States Army Field Artillery |

ILLUSTRATIONS

Page

TABLES

Page

# CHAPTER 1

# INTRODUCTION

> We can't know with absolute certainty what the future of warfare will hold, but we do know it will be exceedingly complex, unpredictable, and – as they say in the staff colleges – "unstructured." Just think about the range of security challenges we face right now beyond Iraq and Afghanistan: terrorism and terrorists in search of weapons of mass destruction, Iran, North Korea, military modernization programs in Russia and China, failed and failing states, revolution in the Middle East, cyber, piracy, proliferation, natural and man-made disasters, and more.
>
> — Hon. Robert M. Gates

## The Hybrid Threat

U.S. Army doctrine describing the Hybrid Threat model facing future forces addresses a need to revisit a previously identified gap in the U.S. Army Field Artillery's (USAFA) capability set. The Hybrid Threat model is described in the U.S. Department of the Army's Training Curricular (TC) 7-100, *Hybrid Threat* and TC 7-100.2, *Opposing Force Tactics*. These two documents describe the enemy threat currently used for U.S. Army training scenarios. They describe the Hybrid Threat as "the diverse and dynamic combination of regular forces, irregular forces, and/or criminal elements all unified to achieve mutually benefitting effects" (Headquarters, Department of the Army 2010, v). It goes on to further explain "Hybrid Threats can combine state-based, conventional military forces—sophisticated weapons, command and control, and combined arms tactics—with attributes usually associated with insurgent and criminal organizations" (Headquarters, Department of the Army 2010, v). This is the doctrinal opposing force used for training in planning and field exercises. In addition to the irregular force and criminal element component the U.S. Army gained experience fighting in Iraq and

Afghanistan, it requires U.S. forces to prepare for major combat operations with the uniformed military of another state (Headquarters, Department of the Army 2010, vi).

While the U.S. Army is accustomed to classifying opposing forces in terms of conventional and unconventional threats, a versatile Hybrid Threat does not. This threat model transitions along this capability spectrum as required to gain the best advantage. The organized military force utilizing conventional weapons and tactics component of the Hybrid Threat model is most similar to the mechanized threat for which precision smart munitions were initially conceived when the Field Artillery (FA) capabilities faced a technological disadvantage in terms of its ability to affect the second and third echelon forces of a Soviet advance. While the U.S. Army is no longer facing the Cold War scale of Soviet formations, a Hybrid Threat model anticipates the enemy will possess and tactically employ armored vehicles.

TC7-100.2 goes on to describe situations in which the enemy has air parity and possible local air superiority. Air supremacy enjoyed by the U.S. Air Force in Operation Desert Storm and Operation Iraqi Freedom is not assumed against the Hybrid Threat. The Hybrid Threat's ability to employ an integrated air defense system will reduce the U.S. Army's ability to fully rely on the U.S. Air Force to engage and destroy moving, armored targets beyond the range of direct fire weapons systems. In other words, the conventional aspect of the Hybrid Threat model has the ability to closely replicate the conditions that required so much of the USAFA during the Cold War.

Historically, the United States has a poor track record when it comes to anticipating the location or nature of future conflicts. In 2011, the Secretary of Defense said "when it comes to predicting the nature and location of our next military

engagements, since Vietnam, our record has been perfect. We have never once gotten it right" (Gates 2011). The Hybrid Threat takes into account trends from previous conflicts while at the same time balancing existing capabilities of potential future adversaries. It requires the U.S. Army to maintain the capabilities developed over the past decade of persistent conflict and the revitalization of skills and capabilities deemed unnecessary in a counter insurgency environment for quite some time. Future adversaries will adapt to exploit weaknesses so the USAFA must ensure it is adaptable and its weaknesses are difficult to exploit.

## The Story of Precision Smart Munitions

Following the Vietnam War and the advent of the Soviet threat, the U.S. Army was faced with a dilemma. The Soviet forces had overwhelming numbers of land forces and the U.S. Air Force's preoccupation with air-to-air combat precluded them from affecting the ground component of the battle. This left the mission of destroying as many armored forces as possible to the USAFA elements before they reached direct fire range. This task was in addition to its primary mission of engaging the numerically superior Soviet artillery forces (McKenney 2007, 285). Such a tasking, however, posed a problem because in previous conflicts, FA was only attributed with approximately one percent of tank kills (Hall 1981, 9). Additionally, Soviet forces were expanding the use of armor on capabilities outside of tanks and mechanized infantry, further reducing the portion of the Soviet force vulnerable to artillery fires.

In its post-Vietnam configuration, the USAFA was ill-suited to meet the demands of Airland Battle doctrine. The 1986 version of Field Manual (FM) 100-5, *Operations*, had the tasks of delaying, disrupting, and suppressing the enemy in deep operations. This

is likely due to the fact that in 1981, Army studies estimated that the USAFA needed as many as 1,500 conventional, high explosive rounds to achieve one kill on a hardened, moving target (Hall 1981, 9).

The solution to this problem lay in the development of new munitions with increased accuracy and lethality against armored, moving targets. The result of this development strategy was the cannon-launched guided projectile, otherwise known as the M712 Copperhead, which was approved for development in 1979 and fielded in 1984 (McKenney 2007, 286). The first artillery fired, laser guided munition, the Copperhead, could "hit and destroy laser designated stationary and moving point targets with less than three rounds" (Hall 1981, 9). This improved the USAFA's ability to destroy armored targets, but did not completely meet the needs of the identified capability gap. This could explain the exclusion of the term "destroy" from the description of the USAFA role in Airland Battle in 1986. In 1981, as final testing and initial production of the Copperhead round was taking place, the Army was in the process of developing an additional munition.

This new munition was a fire-and-forget round that delivered submunitions capable of utilizing millimeter wave technology to identify and engage targets without terminal guidance from the firing unit or an observer. It was the first in a new family of munitions deemed "smart" or "brilliant" due to their ability to autonomously identify then engage stationary and moving targets. This would allow the engagement of targets beyond the approximately 20 kilometer range of the Copperhead by eliminating the necessity for an observation team or for an aircraft to have a direct line-of-sight to the target (Hall 1981, 12). The result was the development of the 155mm search and destroy

armor (SADARM) submunition as well as the brilliant anti-tank (BAT) submunition for the multiple launch rocket system (MLRS). These capabilities along with the submunitions delivered by cannon and rocket artillery's dual purpose improved conventional munition (DPICM) rounds promised to make the USAFA an effective weapon against the Soviet armored threat.

The need for these capabilities remained throughout the Cold War and on into the 1990s, but the technology to achieve these capabilities never materialized. Low-rate, initial production began, but never progressed to full-rate production. The technology for the Copperhead was based on existing technology used in laser-guided munitions for the U.S. Air Force and was developed relatively quickly, but the SADARM utilized millimeter wave technology; a concept not utilized in existing munitions at the time. The same applied for the infrared and acoustic locating technology utilized in the BAT. Therefore, the Copperhead rounds were ready to employ in support of Operation Desert Storm in 1991, but SADARM and BAT were not yet a part of the inventory.

Despite the fact they were absent from Operation Desert Storm with no significant drawbacks, development of smart munitions continued throughout the 1990s. However, their failure to enter full-rate production finally resulted in the project's cancellation. During the Iraq ground offensive of 2003, completed SADARM rounds from the low-rate initial production were deployed with elements of the 3d Infantry Division. They were employed against Iraqi armored vehicles and received favorable reviews (Pitts 2003, 4). After the initial assault into Iraq and subsequent transition to counterinsurgency operations, the need to conduct deep strike operations on second-echelon, enemy forces did not present itself again.

The transition of operations to urban settings and the lack of enemy armor on the battlefield in Iraq and Afghanistan coincided with a change in the employment of artillery. The Global War on Terror progressed, and the SADARM and BAT submunitions lost all funding before they could be fielded or further utilized in combat. Favorable reviews did not withstand the realities of urban operations and the perception that the U. S. Army would not face multiple echelons of enemy armored forces again.

The new operational environment, however, did not have the same effect on precision guided munitions. Even though Copperhead rounds have the disadvantage of the time required to employ lasing teams, the M982 Excalibur, M30 and M31 guided multiple launch rocket systems (G-MLRS), and Army Tactical Missile System (ATACMS) became the weapons of choice. Today, they constitute the only alternative to high explosive area munitions or "dumb" artillery rounds. However, precision guided munitions have their limitations.

All three munitions provide precision by means of Global Positioning System (GPS) guidance in flight and have no requirement for any type of designation. The Excalibur and the unitary versions of the G-MLRS and ATACMS deliver effects through explosive blasts and fragmentation and do not utilize shaped charges. The Excalibur, therefore, has a limited ability to penetrate armor. The G-MLRS and ATACMS compensate for this through higher explosive yields, but their strategic value and inability to engage moving targets decreases the ability to employ them against heavily armored vehicles. Additionally, the United States will soon phase out the use of submunitions that do not have a less than one percent dud rate so, the G-MLRS and ATACMS designed to carry DPICM will no longer be used unless they can be modified to meet the new

standards (Gates memorandum to the Secretaries of the military departments June 19, 2008).

Those dud-producing submunitions are currently the only USAFA capability specifically designed for use against an armored target. They are still considered an area effect munition, although GPS-guided rockets and missiles can deliver them. The added precision only affects the accuracy of the dispersion of the submunitions and not the dud rate. Due to the possible collateral damage and risk to friendly forces in the Middle East, DPICM use was restricted during Operation Enduring Freedom and Operation Iraqi Freedom. Once DPICM is phased out at the end of 2018, there will no longer be a capability specifically designed for use against armored targets.

The USAFA's 155mm high explosive area munitions have the ability to affect armored targets; therefore the Excalibur round is effective, depending on the desired result, as an anti-armor munition. A direct hit from a single Excalibur round is capable of rendering an armored vehicle incapable of continuing its mission through the degradation of mobility or communications capabilities. However, this is most effective against stationary vehicles. Also, high explosive munitions used for this purpose are most effectively employed in large numbers. The use of Excalibur rounds to achieve the desired effects against stationary armored vehicles, let alone against a moving target, is prohibitive in terms of both cost and available inventory.

The USAFA never achieved all of the capabilities necessary to execute Airland Battle doctrine. The SADARM technology did not develop at a fast enough rate to enter service before the end of the Cold War. The air superiority enjoyed during Operation Desert Storm defeated the sense of urgency to develop an artillery capability to address a

mission that the U. S. Air Force had the ability to solely accomplish. The capability gap initially driving the development of smart munitions faded as a USAFA priority; consequently the development was not resourced.

## The Question

Current Army doctrine regarding the future threat clearly demonstrates that the capability requirement originally driving the development of precision smart munitions still exists. The means to address this requirement, however, did not shape the current USAFA proponent's development of employment tactics or equipment requests. The U.S. Army has neither precision smart munitions nor a plan to develop them. The Copperhead round has not evolved beyond its initial form. Precision guided munitions rely on GPS technology and do not have the ability to independently designate targets or adjust if the targets are mobile.

This thesis seeks to determine if the USAFA is capable of addressing the conventional aspect of the Hybrid Threat model. Over the past decade, the nature of the conflicts in Iraq and Afghanistan resulted in a shift of focus away from conventional threats. Doctrinal, organizational, and materiel requirements of the USAFA branch shifted as well. While it built the capacity necessary for and proved itself capable of countering the irregular forces and criminal elements of the Hybrid Threat, the question remains whether or not a capability gap exists against a conventional, armored threat. This paper will analyze the requirements of doctrine, organization, and materiel to identify any shortcomings in the USAFA's capabilities. If capability gaps do exist, this paper will seek to answer the secondary question of whether the USAFA can mitigate them by restarting the development of precision smart munitions.

## Limitations and Delimitations

The major limitation of this research is the current state of USAFA doctrine. The more current manuals omit, contradict, or no longer explain equipment and techniques that exist in former, potentially obsolete, doctrine. The U.S. Army Combined Arms Center is in the midst of an initiative known as Doctrine 2015, which will update and reorganize all Army doctrine. In the meantime, the available approved doctrine, no matter how old, must suffice, so this thesis will only consider those manuals currently approved and published by the Army Publishing Directorate (see table 1).

Table 1. Current USAFA Doctrinal Publications

| Publication | Subject | Issue Date |
|---|---|---|
| ADP 3-09 | Fires | AUG 2012 |
| ADRP 3-09 | Fires | AUG 2012 |
| ATP 3-09.24 | Techniques for the Fires Brigade | NOV 2012 |
| ATP 3-09.30 | Techniques for Observed Fire | AUG 2013 |
| ATP 3-09.32 | JFIRE Multi-Service TTPs For the Joint Application of Firepower | NOV 2012 |
| ATP 3-09.34 | Kill Box Multi-Service TTPs | APR 2014 |
| ATP 3-09.60 | MLRS and High Mobility Artillery Rocket System Operations | JAN 2014 |
| FM 3-09 | Field Artillery Operations and Fire Support | APR 2014 |
| FM 3-09.12 | Field Artillery Target Acquisition | JUN 2002 |
| FM 3-09.15 | Field Artillery Meteorology | OCT 2007 |
| FM 3-09.21 | The Field Artillery Battalion | MAR 2001 |
| FM 3-09.70 | M109A6 Howitzer (Paladin) Operations | AUG 2000 |
| FM 3-60 | The Targeting Process | NOV 2010 |
| FM 6-2 | Field Artillery Survey | SEP 1993 |
| FM 6-20-20 | Fire Support at Battalion Task Force and Below | DEC 1991 |
| FM 6-20-30 | Fire Support for Corps and Division Operations | OCT 1989 |
| FM 6-20-40 | Fire Support for Brigade Operations (Heavy) | JAN 1990 |
| FM 6-20-50 | Fire Support for Brigade Operations (Light) | JAN 1990 |
| FM 6-40 | Field Artillery Manual Cannon Gunnery | APR 1996 |
| FM 6-50 | The Field Artillery Cannon Battery | DEC 1996 |
| TC 3-09.8 | Field Artillery Gunnery | NOV 2013 |
| TC 3-09.31 | Fire Support Training for the Brigade Combat Team Commander | NOV 2013 |

*Source*: Army Publishing Directorate, Doctrine and training publications: 6 series Collection, http://armypubs.army.mil/doctrine/6_Series_Collection_1.html (accessed 7 May 2014).

A major delimitation of this thesis is that it will only examine the effects deliverable by a USAFA battalion in direct support of a Brigade Combat Team (BCT). Every active BCT has an organic USAFA battalion containing at least one battery of either towed or self-propelled 155mm howitzers. The 155mm shell was the smallest artillery shell designed to deliver former precision smart munitions. A cannon battalion is also the USAFA asset most likely to be employed against the conventional aspect of the Hybrid Threat model in support of a BCT.

The munitions discussed as a solution to potential capability gaps are theoretical precision smart munitions. These are not to be confused with precision guided munitions. Precision guided munitions utilize GPS or inertial guidance systems that allow them to make corrections to their flight paths once they have been fired. However, the target grid must be designated prior to launch and they cannot deviate from that target grid once fired. Precision smart munitions are terminally guided and fuzed; fired in the general vicinity of known or suspect targets. Once within range of the target area, the munition or submunitions begin scanning the environment through a number of means, such as millimeter wave, infrared, or acoustic, in order to identify then engage targets. The round does not correct for its originally targeted grid, rather, it can engage any target within its search area, compensating for vehicle movement.

Also, this thesis examines the USAFA and not the fires warfighting function. The fires warfighting function involves the USAFA, but it also includes other effects-delivering assets such as U.S. Air Force fixed-wing aviation, U.S. Army rotary-wing aviation, electronic warfare, information operations, and unmanned aerial vehicles. The fires warfighting function has a wide range of capabilities it can employ against the

particular problem set discussed in this thesis, but this paper will only look at the role played by the USAFA.

USAFA capabilities will only be examined against the conventional weapons and tactics described within the Hybrid Threat model. The USAFA refined its skills and capabilities employing effects against irregular forces and operating in urban environments for over 13 years in Iraq and Afghanistan. This thesis will not question those capabilities or the success of their employment, but rather examine if other capabilities have atrophied over an extended period of irregular warfare.

Finally, in an effort to limit the scope of this thesis, only three aspects of the doctrine, organization, training, materiel, leadership, personnel, and facilities (DOTMLPF) construct will be analyzed. In particular, this paper will look at doctrine, organization, and materiel. All three play a role in the USAFA's ability to support Unified Land Operations and the U.S. Army's ability to support the strategic objectives of the nation. If analysis does indicate that a capability gap exists in one of those areas, the capabilities of the theoretical precision smart munitions discussed earlier will be applied as a possible materiel solution.

## Assumption

The primary assumption used to facilitate this research is that U.S. Army and joint aviation firepower will not be effective in the initial stages of a conflict against the Hybrid Threat model's conventional forces. U.S. forces experienced little threat to aviation assets in previous conflicts such as Iraq and Afghanistan, but it is dangerous to assume such air superiority is universal. The limited threat to rotary-wing aviation in Afghanistan and threats to fixed-wing aviation in conflicts such as Kosovo highlight the

dangers even irregular forces can pose. TC 7-100 and, more recently, the *2014 Quadrennial Defense Review* both describe a future threat capable of denying U.S. forces access to airspace. The USAFA should not expect to fight completely deprived of joint assets. In the initial stages of a conflict, however, it is reasonable to assume, at the very least, that the USAFA will be responsible for setting the conditions, through shaping fires in the deep area against armored targets and suppression of enemy air defense assets that will later allow the successful integration of all fires assets.

## Chapter Summary

This chapter introduced the Hybrid Threat model, which revisits a capability requirement that originally inspired the USAFA to develop precision smart munitions. Although development of precision smart munitions ended over 10 years ago, the Hybrid Threat model indicates that the threat still exists. This leads to the question of whether the USAFA is prepared to engage the conventional weapons and tactics of the Hybrid threat model. This chapter also explained the limitations, delimitations, and an assumption that help frame and facilitate the research and will also explore the role a theoretical precision smart munition capability might play in meeting any capability requirements that exist.

Having introduced smart munitions and their previous role with the USAFA and having laid out the Hybrid Threat that the U.S. Army expects to face and trains to fight, the next chapter will review and discuss trends in literature covering this topic.

# CHAPTER 2

# LITERATURE REVIEW

> The cannon-launched guided projectile M712 (Copperhead) is a 155-mm, separate-loading, laser-guided HE projectile. It is heavier (137.6 pounds) and longer (54 inches) than the standard 155-mm projectile. The A4712 projectile consists of three main sections: a guidance section (forward), warhead section (center), and control section (rear). The guidance section contains the seeker head assembly and the electronics assembly. The nose of the projectile houses a laser seeker in a plastic cone. The warhead section contains an HE antitank warhead consisting of 14.75 pounds of composition B. The control section includes the fins and wings that deploy in flight and allow the round limited maneuverability.
>
> — Headquarters, Department of the Army, FM 6-40

The question at hand is whether the USAFA branch's capabilities address the conventional weapons and tactics of the Hybrid Threat model. If there are capability gaps, the secondary question asks what role the reintroduction of precision smart munitions can play in resolving them. The USAFA's ability to integrate into operational doctrine and provide fires against the predicted threat was a common topic in the years following the end of the Vietnam War. From Airland Battle through Unified Land Operations, authors both within and outside of the branch sought to answer what its role in operations is and if the capability exists to accomplish that role.

Professional journals such as the *Field Artillery Journal*, later titled *Field Artillery* and eventually *Fires!*, published by the U.S. Field Artillery School at Fort Sill, Oklahoma, contain articles addressing this topic. These articles range from opinion pieces to updates on doctrine and practices to reports on developing projects. They also provide strategies for moving forward written by the Chief of Field Artillery at Fort Sill. The journals provide a long-running historical account of USAFA trends, priorities, technological development, and expectations of USAFA capabilities in changing

operational environments. The majority of these papers originates from within the USAFA branch and should, therefore, be considered parochial towards advocacy of the USAFA. However, they do contain opinions critical of the USAFA trends of the time.

Similar questions have also been the topics of research papers at institutions such as the Naval Postgraduate School, the U.S. Army Command and General Staff College, the School of Advanced Military Studies, and the U.S. Army War College. USAFA officers also write the majority of these papers, but tend to be more critical of the branch. These papers also tend to be very forward-looking. The majority of these papers focuses on only one of the requirements of DOTMLPF, questions whether the USAFA is still relevant, or describes recommendations for improvements. While few of the most recent papers do not specifically discuss smart munitions, their analysis of USAFA capabilities is extremely useful and shows a pattern of concern about the USAFA's ability to succeed in future conflicts.

For this study, the review of pertinent literature is divided into four periods. The first period encompasses the time following the end of the war in Vietnam through the invasion of Kuwait. The second period covers Operations Desert Shield and Desert Storm through the terrorist attacks of 11 September 2001. The third period encompasses the Global War on Terror beginning with the attacks of 11 September 2001 to the troop drawdown in Iraq in 2011. The final period covers 2012 through the writing of this thesis. All four blocks cover distinct periods in terms of operational doctrine and trends concerning the USAFA's role in supporting that doctrine. They all begin and end with significant events that challenged previous thoughts, conceptions, processes, and notions and inspired significant new approaches to USAFA doctrine, organization, and materiel.

Finally, a review of current, U.S. Army doctrine concludes the chapter. In order to accurately identify capability gaps in the USAFA's ability to engage the conventional force aspect of the Hybrid Threat model, it is first necessary to understand how the U.S. Army and USAFA operate. The only period covered specifically relating to U.S. Army doctrine is the final one discussed earlier, which encompasses post-drawdown in Iraq to the time of this writing. While past doctrine is mentioned throughout the review of professional writings and papers, current doctrine determines if a capability gap exists and whether smart munitions are capable of filling a potential need.

## Post Vietnam through the Invasion of Kuwait: 1975-1990

Following the end of the Vietnam War, the USAFA found itself in a necessary period of transformation. The U.S. Army was transitioning opponents from one with a combination of conventional and guerrilla threats, like those faced in Vietnam, to the predominantly conventional force threat of the Soviet Army. Additionally, the opposing forces in Vietnam did not rely heavily on advanced technology, while the Soviet forces possessed capabilities that initially surpassed our own (McKenney 2007, 285-287).

The USAFA faced a technological disadvantage in terms of its ability to affect the second and third echelon forces of a Soviet advance. Accordingly, this period saw significant improvements in the materiel capabilities of the USAFA in terms of both munitions and delivery systems. During this time, the USAFA first proposed the development of precision guided and precision smart munitions. The former, realized as the Copperhead round, provided USAFA with the ability to economically employ destructive fires against moving, armored vehicles in the close fight. The latter, once developed, would allow the employment of that same economic and precise capability at

greater distances against follow-on forces. It is important to note that precision guided and precision smart capabilities were not restricted just to one type of delivery system. Also, both initial proposals required the ability to engage both stationary and moving targets.

## Field Artillery Professional Journals

During this period, most topics discussed in the *Field Artillery Journal* cover themes of post-Vietnam organizational changes, new equipment and capabilities, and the future threat. That future threat, in the form of the Soviet Union, received the most attention and was actually the primary driver or influencer of the other two themes. The primary issue was that the U.S. Army, as a whole, was faced with the threat of aggression in Europe by a well-organized, modern military that was numerically superior. The *Field Artillery Journal* analyzed how the USAFA should have and did develop its doctrine, organization, and materiel to support such a fight. These topics continued to be discussed through the end of the Cold War in 1991.

As long as the Soviet threat existed, developing capabilities to counter it was a USAFA priority. Its answer to superior Soviet numbers was improved cannons, the ability to range reserve forces waiting to be committed, and improving efficiency in order to better support the combined arms fight. A discussion on the state of the USAFA by the U.S. Field Artillery School Commandant in 1982 remarked that "the long awaited Copperhead rolls out this year and, with it, for the first time in history, the mighty tank and other elusive point targets will fall prey to the King of Battle" (Dinges 1982, 1). This was a reference to the USAFA's desire to more effectively engage the Soviet armored threat. Example of *Field Artillery Journal* articles such as "Evolving Field Artillery

Tactics and Techniques," "Attack of the Armored Targets," "Soviet Artillery Massing Capability," "Soviet Artillery—The Mechanized Threat," and "The Challenges of Our Changing Time" provide an additional glimpse into the topics relevant to USAFA leaders and professionals at that time.

The discussion of the challenges faced in achieving these goals included the drawdown of Army personnel and innovation that surpassed the available technology. However, the need for these capabilities was enough to overcome such obstacles and provided extra emphasis on the aspects of DOTMLPF the USAFA could change in order to meet the U.S. Army's needs. By the end of this period, the *Field Artillery Journal* coverage included the introduction of Copperhead rounds and the development of tactics, techniques, and procedures for their employment. It also continued to address the need for smart munitions.

As forces began preparing for Operation Desert Shield, the Soviet threat that drove the developments and discussions of the past 15 years all but faded from the pages of the *Field Artillery Journal*. The end of this period also saw the beginnings of more constrained spending on research and development. Early in 1990, the USAFA Commandant stated, "the realities of fiscal constraint are forcing us to rethink our approaches to these challenges" (Hallada 1990, 1). He implied that the earlier period of developing capabilities across most aspects of the DOTMLPF spectrum was nearing an end and that efforts in the future required more specific actions.

## Research Papers

Surprisingly few papers in this period discussed precision smart or precision guided munitions or even the new materiel capabilities needed by the USAFA to address

the Soviet threat. Instead, they focused on achieving success with the assets already available by modifying how the USAFA trained, fought, and manned organizations. One paper even discussed the USAFA's ability to adequately contribute to early-stage insurgencies. Written in 1987, in an almost exact counter to this thesis, it implied that during that period, the USAFA had over-developed its capabilities for a conventional fight at the expense of being effective against a non-conventional threat.

One paper written for the U.S. Army War College in 1987 discussed training deficiencies by examining USAFA performance at the National Training Center. The Copperhead precision guided munitions were a part of the U.S. Army inventory for three years prior, but the author cited problems relevant to the current discussion such as difficulty accurately massing fires on moving targets. The author quotes a former Observer-Controller from the National Training Center who stated that USAFA performance trends displayed an inability to accurately mass two or more batteries or 16 cannons (Shaw 1987, 2). This comment is indicative of two issues. The first is that precision munitions alone did not provide a complete solution for the USAFA's trouble to engage moving, armored targets. The second is just how difficult it was for the USAFA to employ the alternative to precision guided or precision smart munitions. Shaw did discuss the applicability of both in the situation but, as his thesis primarily focused on areas where USAFA training was lacking, he discussed the additional training requirements such munitions required to be effectively employed.

A second paper written in 1987 for the U.S. Army's School of Advanced Military Studies researched whether or not, the recent focus on the conventional, Soviet threat, caused the USAFA branch's ability to conduct counterinsurgency operations to atrophy.

The author argued that the use of massed fires was not economical and had too much of a negative effect on non-combatants. In his conclusion he stated that "The United States Army should continue efforts to improve the lethality of artillery ammunition," (Hoffer 1987, 39) and that "Our present narrow focus on the Central European battlefield, with its demand for massive centralized fire support, does not prepare artillerymen for the Army's most likely future conflict" (Hoffer 1987, 40).

While Hoffer's monograph looked toward different results, it is similar in structure to this paper in that it questions the USAFA's ability to accurately predict its next fight. It also questioned the emphasis on one set of capabilities as a result of that prediction. Hoffer then recommended the reexamination of USAFA training, doctrine, materiel, and organization in order to better balance its capabilities and prevent capability gaps in its ability to execute counter insurgency operations. This is significant in that it shows historical precedence for this current research. In the past, the USAFA faced similar issues of remaining relevant for the future fight while regarding the capabilities necessary if that prediction should prove incorrect.

## Operation Desert Shield to 11 September 2001: 1991-2001

Following Saddam Hussein's invasion of Kuwait, the U.S. Army found itself in a unique situation. After developing doctrine, organizations, and materiel capabilities for close to fifteen years, it finally had the opportunity to test it against an opponent. While the Iraqi Army was not the Soviet force the U.S. Army had trained to fight, it did possess similar equipment and conventional tactics. The U.S. military performed well against the Iraqi Army, but the success proved harmful to the future development of USAFA capabilities.

The U.S. Air Force quickly established air superiority during Operation Desert Storm, which was not challenged again in Operation Enduring Freedom or in Operation Iraqi Freedom. The assumption in Airland Battle doctrine that the U.S. Air Force would be too engaged with an opposing air force to contribute to shaping operations in the deep area did not apply in those theaters. As long as there was no opponent that at least maintained air parity, the need for the USAFA to accurately engage moving, armored vehicles or provide suppression of enemy air defense at greater ranges was nonexistent.

The effectiveness of our direct fire systems against enemy armor vehicles also mitigated the requirement for the USAFA to engage them. The range and accuracy of our direct fire systems, to include our attack aviation, surpassed the Iraqis in the close area, and the U.S. Air Force was free to engage second-echelon in the deep area. With many other capabilities destroying moving, armored targets, the USAFA's primary mission was counterfire against enemy artillery units.

## Field Artillery Professional Journals

In the summer of 1991, the themes dominating the pages of the *Field Artillery Journal* were all related to the performance of the USAFA during Operations Desert Shield and Desert Storm. The topics of the previous 15 years discussed the theory of emerging capabilities, and this period began with discussions of those capabilities' application in combat and the future of the USAFA. Articles with titles such as "Reshaping the Field Artillery" already began the discussion of how to effectively draw down the size and role of the USAFA. The SADARM submunition earlier intended to engage moving, second-echelon forces was now described as "primarily designed for counterfire" (Anderson 1991, 11). Terminally guided submunitions for delivery by

MLRS are the only asset discussed as a capability in development for the engagement of moving targets.

Performance reviews of USAFA in Operation Desert Storm were overwhelmingly positive, which is expected in a USAFA professional journal. Many articles address how recent experiences in Operation Desert Storm reemphasized the need to continue development of smart munitions, other emerging technologies not mature enough to have taken part in the most recent conflict, and more efficient means of delivering munitions of all types. However, these discussions of the future USAFA development of the USAFA continue uninfluenced by other discussions in the *Field Artillery Journal* about changing threats. One author states, "the challenge facing [the USAFA] in the decade of the 90s is to respond to global contingencies with a significantly smaller Army" (Anderson 1991, 11). However, by the end of this period, the *Field Artillery Journal's* articles on capabilities development move forward in spite of the indications that the environments and organizations in which they will be used were rapidly changing.

## Research Papers

Papers written during this period tend to be more critical of the USAFA and offer a more unbiased opinion of future requirements. They do not attempt to specifically define the future threat, but admit that it is changing and will not be the same encountered during Operation Desert Storm. They look to a "much more diverse" threat providing a "broad spectrum of operational challenges," including an unconventional threat (Page 1991, 2-3). They also discuss the USAFA's need to maintain capabilities across the range of military operations.

One paper written for the U.S. Army's School of Advanced Military Studies in 1997 specifically looks at the shortcomings of the USAFA's performance in Operation Desert Storm, the role of the USAFA in the deep fight under Airland Battle doctrine, and the capabilities required to maintain fires dominance on the future battlefield. In a discussion of the USAFA's recent performance, the author states that "greatest limitations in fires lethality was the inability of the most responsive and low risk fires asset, artillery systems, to efficiently destroy enemy tanks" (Schultz 1997, 27). The only munition in use designed for this task was the Copperhead, but the author also points out that it was "severely limited in its range and dependence on a separate laser designator" (Schultz 1997, 39).

As Schultz analyzes the USAFA's ability to contribute to the deep fight, he discusses the role that the two previously mentioned shortcomings play in creating a capability gap. He also discusses the justification for the USAFA to fill that gap in the Airland Battle doctrine. The author discusses the roles of U.S. Army attack aviation and the U.S. Air Force in defeating armored targets and in shaping deep operations. He also postulates that the threat of enemy air defense systems to attack aviation and the need to ensure air superiority are competing requirements that will prevent either asset from completely assuming responsibility for deep operations. The USAFA, he concludes, must fill that gap and continue to develop the capabilities such as SADARM and BAT, in order to ensure fires dominance on the future battlefield and contribute to Airland Battle doctrine.

## The Global War on Terror through the Drawdown in Iraq: 2001-2011

The Global War on Terror saw a significant change in the employment of the USAFA as well as the capabilities required of them. The U.S. Army found itself fighting a protracted counterinsurgency in Iraq. Even though the opponent in Afghanistan occasionally resorted to conventional battles with ambushes on convoys and attacks on forward operating bases, armored enemy vehicles did not make an appearance on the battlefield after the initial days of Operation Iraqi Freedom. Contrary to previous full spectrum operations, the U.S. Army put the USAFA in reserve with FA units deployed to both theaters serving as motorized infantry units, transportation units, and military and police training teams.

Operation Anaconda, which took place at the beginning period of Operation Enduring Freedom, was criticized after the fact for not utilizing FA assets. In Iraq, U.S. BCTs kept as little as one platoon of howitzers in their traditional role of delivering fires. The lack of a clearly defined and distinguishable enemy and a public aversion to collateral damage minimized the role of lethal fires and, in both operations, created an emphasis on non-lethal effects. The requirement to observe all indirect fires for accuracy propelled the development of precision guided munitions and further reduced the need for precision smart munitions.

### Field Artillery Professional Journals

The most significant changes in discussions of future USAFA capabilities took place during the first half of this period. As the Army became more deeply involved in the counterinsurgencies in both Afghanistan and Iraq, articles in the *Field Artillery*

*Journal* indicate shifting priorities for capabilities development. The discussions shift to employing fires in urban environments on non-contiguous battlefields, and for the first time, the balance between the development of precision guided and precision smart munitions shifts heavily toward the development of precision guided capabilities. One article even discusses the possibility of less-than-lethal artillery munitions to cope with the fact that "Americans have grown more intolerant of war casualties" (Black 2003, 5). In one description of the USAFA's role at the beginning of an issue of an issue dedicated to lethal and non-lethal fires and effects, the Chief of Field Artillery states that "the Field Artillery serves to destroy the enemy's warfighting capability" (Maples 2003, 1) rather than just the enemy.

Toward the end of this period, there is also a thematic shift from materiel development to the development of doctrine and organizations. Following the cancellation of several initiatives such as the non-line-of-sight cannon, discussions almost completely shift away from the development of materiel capabilities. In the discussions of organizational changes, very few discuss those changes in relation to the USAFA's ability to provide fires.

Near the end of 2005, articles such as "The Army's First Fires Brigade" and "FA Battery Trends in Stability and Support Operations—Simultaneous Maneuver and Fires Missions" not only describe how the USAFA branch was changing at an organizational level to better support maneuver commanders, but how they were adapting organizations at the tactical level to support operations in theater. The author of the latter article describes USAFA units that "often are asked simultaneously to maintain a firing capability, conduct fixed-site security, conduct counter-improvised explosive device

operations and patrols, and perform civil-military operations" (Morrison 2005, 36). Of the author's six issues that USAFA units routinely struggle with, only one relates to the delivery of fires.

By the end of this period, when U.S. forces withdraw from Iraq, smart munitions development is only rarely mentioned in the journal now titled *Fires!*, a convergence of both Field Artillery and Air Defense Artillery discussion in one publication. Future uncertainty is once again a key topic, but where previous themes involved developing robust capabilities in preparation for uncertain environments, the themes near the end of this period are more centered on developing capabilities across alternate aspects of DOTMLPF with training and leadership at the forefront. Precision guided munitions are given credit for having "changed the way we fight wars" (Forsyth 2011, 23), but the discussions within the USAFA professional journals imply that future challenges will be met through better training and leader development.

## Research Papers

The majority of papers written during this period focuses on precision guided munitions, their role in operations during this period, suggestions for future implementation, and whether or not they meet the future needs of the USAFA. Some of the papers only focus on past employment of precision guided munitions and how they affected operations in Iraq and Afghanistan. An equal share examines their applicability in the future. While no papers question the benefits of their past use, they do indicate room for improvement in the future, as well as situations in which precision guided munitions do not apply.

In a paper written for the U.S. Naval War College in 2003, the author questions whether or not the military has developed an over reliance on precision munitions, thus creating a vulnerability in situations where these munitions cannot be employed (Kaufman 2003, 1). He is specifically speaking of the U.S. Air Force capabilities, but his argument has relevance for the USAFA as well. His paper does not argue for the development of new technologies. Rather, it argues that a more balanced approach using both precision and non-precision munitions would better serve the U.S. Air Force by utilizing its primary strengths, which are versatility and flexibility (Kaufman 2003, 15).

A paper written for the U.S. Army War College in 2006 questions whether the advent of precision munitions had fundamentally changed the role of the USAFA. Specifically, he addresses whether there is the "potential for precision delivery to supplant high explosive 'dumb round' area suppression as the traditional role of the artillery" (Waters 2006, iii). The author argues that this would be cost prohibitive both in training and in combat. Similar to the previous author, he argues that such a course of action does not take into account situations in which precision munitions are not effective. His research concludes, "precision munitions alone cannot satisfy the target engagement requirements that are likely to appear on a future full spectrum battlefield" (Waters 2006, 14).

Another paper written in 2010 for the U.S. Army War College examines whether the decade's emphasis on counter-insurgency operations has left the USAFA untrained and unprepared to confront a conventional threat. The author states, "the greatest national security threat is major war against another military power" which "requires that U.S. military forces be able to operate across the full range of potential conflicts" (Drago

2010, 3). He notes that the USAFA has let its core competency, employing lethal fires, atrophy. The assertion is that just the capability of employing fires, let alone employing them en masse against a moving target is lacking in the USAFA. As such, he argues that without a rebalance of training focus, the USAFA will be unprepared to fight and win against another conventional force.

## Drawdown in Iraq and Onward: 2012-2014

Following the withdrawal of U.S. military forces from Iraq in 2011, the USAFA found itself in a situation similar to that experience after the withdrawal of forces from Vietnam. After nearly a decade of conducting counterinsurgency operations against an unconventional force, the USAFA needed to evaluate its capabilities against the threat it was most likely to next encounter. Following the Vietnam War, the threat was clearly the Soviet military, but post-Iraq, the composition of the future threat was less clearly defined. Additionally, the employment of the USAFA's capabilities in Iraq was dissimilar to its employment in Vietnam.

In Vietnam, the USAFA primarily conducted its fire support role and maintained its capability to mass indirect fires. Post-Vietnam units were trained, but the question was whether they were correctly organized and had the proper equipment to win against the Soviets. In Iraq, USAFA units primarily owned battle space and served in non-standard roles such as motorized infantry units. As articles and papers from the previous period display, there was a serious concern that not only was the USAFA not equipped or organized for a Hybrid Threat, but also that, unlike after the end of the Vietnam War, it was no longer trained either.

Relevant professional journal articles and research papers written during this post-Iraq period examine the U.S. Army's and, specifically, the USAFA's preparedness to combat the Hybrid Threat force described in current U.S. Army doctrine. All tend to show a concern for the past decade's overemphasis on counterinsurgency operations and operations in urban environments. Also, in acknowledgement of the fiscally austere times that usually follow periods of protracted military operations, very few authors recommend materiel solutions to their problems. Instead they favor less costly adjustments to organization, doctrine, and leadership. Most suggest a broader approach that encompasses several DOTMLPF aspects.

## Field Artillery Professional Journals

In this current period of *Fires!*, discussions of capabilities development receive very little coverage. With the drawdown in Iraq complete and one in Afghanistan beginning, the themes are primarily the development of personnel and doctrine. Rather than developing new equipment and munitions to address the current operating environment, articles focus on adapting USAFA doctrine, tactics, techniques, and procedures to make the most efficient use of our current capabilities. The trend during this period is to describe the changes the USAFA is undertaking to remain relevant and ready without describing the problems or capability gaps that necessitated the changes in the first place.

In the first issues of *Fires!* in 2012, the Commanding General of the Fires Center of Excellence states that "the past 10 years of war have drastically changed our doctrine, equipment, organization and leader development; however, in the midst of all this change one critical asset remains steadfast: the Fires Soldier" (Halverson 2012, 4). He implies

that the key to preparing for future conflict lies within the DOTMLPF aspects of personnel and leadership. He further explains the challenges faced by the USAFA with the statement, "The challenge and operating environment is to retain the knowledge of the last 10 years of conflict, which has focused primarily on wide area security, while maintaining our ability to conduct combined arms maneuver in a joint environment" (Halverson 2012, 4). He makes no mention of materiel or organizational approaches that might better prepare the USAFA for the future.

At the beginning of 2013, the Chief of Field Artillery provides an assessment of the USAFA over the previous year. One significant development discussed is the performance of Joint Fires Observers trained to control U.S. Air Force fixed-wing assets in combat. The implication is that by making the USAFA better able to integrate joint assets, the USAFA can fill a capability gap and engage deep or moving targets, without developing new materiel. He goes on to describe changes in the USAFA's doctrine, organization, and leader development process. While there is significant explanation of what these changes did, there is little discussion of why they were necessary. He finishes his article by stating that the USAFA must ensure it "remain[s] attentive to the operational requirements and [is] postured to provide the appropriate Fires solutions" (McKiernan 2013, 9). However, the problems that require these solutions are not discussed.

## Research Papers

Research papers written after the drawdown in Iraq tend to fill the informational gaps left by the USAFA professional journals. There are not many significant articles about preparing the USAFA for the conventional aspect of the Hybrid Threat model,

rather a significant discussion of how to prepare BCTs and the U.S. Army as a whole to face the Hybrid Threat. These indicate an understanding that capability gaps exist against the Hybrid Threat model, but not that those gaps have been examined from the perspective of the USAFA.

In a paper written in 2012 for the U.S. Army School of Advanced Military Studies, the author uses lessons from the 2006 Lebanon War and the 1996 Chechnya War to draw conclusions about five critical skill areas a BCT must have in order to successfully defeat a Hybrid Threat (Smith 2012, ii). He argues that current military doctrine proposes and describes a Hybrid Threat, but does not explain the skill sets necessary to defeat one. The author describes precision fires as one of the skill sets due to the requirement to employ accurate fires in an urban setting. He also discusses the need for maneuver elements and the USAFA to better integrate indirect fires into more conventional, offensive operations; particularly the massing of fires on a single target (Smith 2012, 36).

Another article written in 2013 for the School of Advanced Military Studies proposes that the USAFA can better prepare for operations under the U.S. Army's Unified Land Operations concept by further decentralizing assets and improving the range and precision of existing capabilities (Watson 2013, 24-28). He states that an increase in the range and precision of delivery systems and assets will offset the disadvantages of dispersion and still allow the USAFA to mass fires through space and time (Watson 2013, 22). In his discussion of munitions however, he only describes the USAFA's past success with suppressing targets rather than destroying them. He also only describes employment against large groups of targets rather than dispersed formations

(Watson 2013, 24). The theme of the author's paper leans more toward preparation for an unconventional threat or urban operations rather than the full spectrum of offensive operations described by the Hybrid Threat model.

A third article discusses the need to bring back the deep attack option for operational commanders. The author recommends the use of unmanned aircraft, though, to enable this capability (Brengle 2013, iii). While this does not suggest a role for the USAFA in providing the capability to shape deep operations, it is significant in that it acknowledges both the requirement and the necessity for such a capability to facilitate future operations.

## Relevant U.S. Army Doctrine

### Unified Land Operations

In order to understand where shortfalls in USAFA capabilities may exist, it is important to understand the U.S. Army's current operational concept and how fires and the USAFA play a part in that concept. Field manuals and Army techniques publications bridge the gap between the descriptive concepts described here and prescribe the actions the USAFA takes in support of these concepts. This portion of USAFA doctrine will be discussed later in chapter 4.

The current Army Operational Concept, Unified Land Operations, is described in Army Doctrine Reference Publication (ADRP) 3-0, *Unified Land Operations*.

> Unified Land Operations describes how the Army seizes, retains, and exploits the initiative to gain and maintain a position of relative advantage in sustained land operations through simultaneous offensive, defensive, and stability operations in order to prevent or deter conflict, prevail in war, and create the conditions for favorable conflict resolution. Unified land operations is the Army's operational concept and the Army's contribution to unified action. (Headquarters, Department of the Army 2012b, 1-1)

It also goes on to explain the threat that the Army Operational Concept is designed to defeat and provides a description and definition of the Hybrid Threat.

> The term hybrid threat has evolved to capture the seemingly increased complexity of operations, the multiplicity of actors involved, and the blurring between traditional elements of conflict. A hybrid threat is the diverse and dynamic combination of regular forces, irregular forces, terrorist forces, and/or criminal elements unified to achieve mutually benefitting effects. (Headquarters, Department of the Army 2012b, 1-3)

This publication also describes the Deep-Close-Security operational framework (see figure 1) often referenced in this thesis.

> Deep operations involve efforts to prevent uncommitted enemy forces from being committed in a coherent manner. The purpose of deep operations is frequently tied to other events distant in time, space, or both. Deep operations might aim to disrupt the movement of operational reserves, for example, or prevent the enemy from employing long-range cannon, rocket, or missile fires. (Headquarters, Department of the Army 2012b, 1-11)

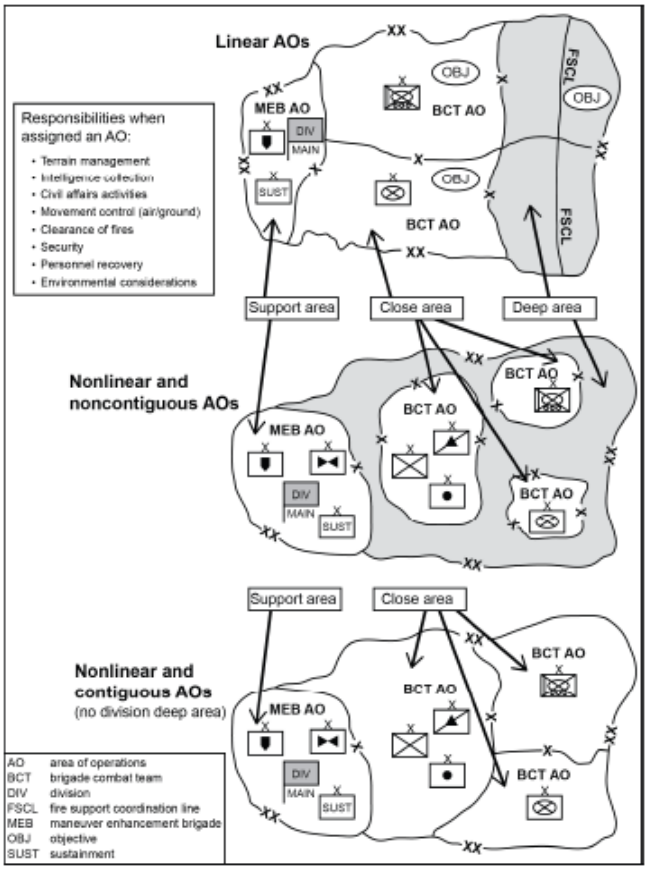



Figure 1. Example of deep-close-security operational framework

*Source*: Headquarters, Department of the Army, ADRP 3-0, *Unified Land Operations* (Washington, DC: Government Printing Office, 2012), 1-10.

The U.S. Army executes Unified Land Operations through Decisive Action. Decisive Action is "the continuous, simultaneous combinations of offensive, defensive, and stability or defense support of civil authorities tasks" (Headquarters, Department of the Army 2012b, 2-2). It is important to note that ADRP 3-0 stresses the role of simultaneity when conducting Decisive Action. It describes simultaneity as not just conducting the full range of offensive, defensive, and stability operations, but conducting

them across the depth and breadth of the battlefield (Headquarters, Department of the Army 2012b, 2-4).

## Fires

ADRP 3-09, *Fires*, describes the role of all fires in the Army's Operational Concept. This publication does not just refer to the USAFA when discussing the role of fires. It defines fires as "the use of weapons systems to create a specific lethal or nonlethal effect on a target" and describes the fires warfighting function as "the related tasks and systems that provide collective and coordinated use of Army indirect fires, air and missile defense, and joint fires through the targeting process" (Headquarters, Department of the Army 2012a, 1-1). The U.S. Army chooses to define the warfighting function in terms of joint resources. This creates an inherent dependence on other services, such as the U.S. Air Force to provide some of the capabilities necessary to support Unified Land Operations. U.S. Army doctrine assumes that those other services will always be available to provide those capabilities, but as mentioned in the previous chapter, this thesis only considers FA assets and capabilities.

ADRP 3-09 also updates the doctrinal mission of the USAFA. "The mission of the Field Artillery is to destroy, defeat, or disrupt the enemy with integrated fires to enable maneuver commanders to dominate in unified land operations" (Headquarters, Department of the Army 2012a, 1-4). The previous definition published in 2011 in Field Manual (FM) 3-09, *Fire Support*, states, "The mission of the Field Artillery is to deliver fires and integrate those fires and scalable capabilities to enable commanders to dominate their operational environment in unified land operations" (Headquarters, Department of the Army 2011a, 1-2). The addition of integrated fires to the 2012 mission is important

because it adds the use of capabilities that are not inherent in the USAFA even though ADRP 3-09 defines the USAFA as "the equipment, supplies, ammunition, and personnel involved in the use of indirect fire cannon, rocket, or surface-to-surface missile launchers" (Headquarters, Department of the Army 2012a, 1-1). While the doctrinal definition of the USAFA describes its materiel capabilities as what can be found in the U.S. Army inventory, in order to accomplish its doctrinal mission, it must utilize capabilities it does not own.

ADRP 3-09 also describes fires in respect to the tenets of Unified Land Operations. Of interest are the descriptions of flexibility, lethality, and depth. In terms of flexibility, the ADRP states that fires must "utilize a versatile mix of capabilities" and that the best way to achieve this flexibility is through "decentralizing fires execution to the lowest level possible." Fires achieve lethality "through the application of scalable capabilities to create lethal effects by destroying, neutralizing, or suppressing the enemy." Finally, fires provide depth "through long-range acquisition and early engagement of targets" (Headquarters, Department of the Army 2012a, 1-5).

In support of Decisive Action, fires must meet the principle of scalability. This means they must be able to employ their capabilities "to a degree that allows intended effects to be achieved" and must have the characteristic of being able to mass area fires from "battalion sized firing units down to two weapons systems." The ability for smaller firing elements to mass "is enabled by system range capabilities, weapons platform capabilities, extended range communication, and the mission command network." (Headquarters, Department of the Army 2012a, 1-8). The final caveat to this discussion is the additional characteristic that fires are inherently joint. This primarily describes the

coordination that must take place across services for the safe and successful employment of fires, but also implies that fires must include capabilities from more than just the U.S. Army if they are to successfully support Decisive Action.

Finally, ADRP 3-09 describes the joint principle of mass as it relates to fires in support of Unified Land Operations. It states that while fires units are not massed in terms of physical location, "they must be able to provide maximum massed fires when and where they are required." Commanders are given the authority to mass fires as necessary depending on the situation at hand and the resources available (Headquarters, Department of the Army 2012a, 1-9).

## Hybrid Threat

Published in 2010, TC 7-100, *Hybrid Threat*, describes the most likely future threat for which the U.S. Army needs to be prepared, including how it will likely organize to fight, its strategy, its tactics, and its organization (Headquarters, Department of the Army 2010, iii). In its introduction, TC 7-100 points out that Hybrid Threats "may have the capacity to engage in major combat operations," which "employ all available combat power (directly and indirectly) to destroy an opponent's military capability, thereby decisively altering the military conditions within the operational environment" (Headquarters, Department of the Army 2010, vi).

One important characteristic of a Hybrid Threat is that it will attempt to neutralize the technological overmatch of its opponent. TC 7-100 describes the Hybrid Threat accomplishing this through the exploitation of terrain and weather, as well as the use of "low-cost GPS jammers to disrupt enemy precision munitions targeting" (Headquarters, Department of the Army 2010, 4-6). To support this effort, the Hybrid Threat will also

disperse capabilities such as man-portable air defense systems for use by both conventional and guerrilla forces (Headquarters, Department of the Army 2010, 6-6).

TC 7-100.2, *Opposing Force Tactics*, further describes the organization and tactics used by the Hybrid Threat to engage U.S. forces. The tactics laid out in this TC includes an enemy air force's ability to achieve air parity or even local air superiority. It states that if the Hybrid Threat does gain local air superiority, it "can produce a devastating impact against the enemy" (Headquarters, Department of the Army 2011b, 10-12). While this is in reference to the capabilities that local air superiority would allow the enemy to employ against U.S. ground forces, the effects U.S. fixed and rotary-wing aviation would not be able to use in this situation should also be considered. This is especially important considering the joint nature of fires capabilities previously discussed.

The Hybrid Threat will use air defense in support of its operations to "reduce the effectiveness of enemy air attacks and prevent enemy air action from interfering with maneuver force operations" (Headquarters, Department of the Army 2011b, 11-1). The Hybrid Threat's integrated air defense system "provides a continuous, unbroken (usually overlapping) umbrella of air defense coverage and present a significant threat to any potential [U.S.] air activity (Headquarters, Department of the Army 2011b, 11-3). Even if the Hybrid Threat's ability to gain local air superiority or air parity is discounted or neutralized, its ability to defend its air space is a significant obstacle to U.S. forces' ability to employ the integrated range of capabilities required for successful fires support of Unified Land Operations.

## Chapter Summary

This chapter summarized a selection of writings found within professional journals and research papers over the course of nearly three decades. It analyzed trends in USAFA's role supporting U.S. Army doctrine, potential capability gaps that occur as doctrine has changed, and how the USAFA has adapted and changed in order to account for perceived capability gaps. Finally, it concluded with an examination of current, relevant doctrine describing how the U.S. Army will fight in future conflicts, the threat it must be prepared to fight, and the USAFA's role in that fight.

The following chapter will discuss the research methodology this thesis uses to analyze the USAFA's capabilities across the spectrums of doctrine, organization, and materiel against the Hybrid Threat and determine if capability gaps exist.

# CHAPTER 3

# RESEARCH METHODOLOGY

> Many of the challenges we face are in the headlines every day - whether it be the aggressiveness of North Korea and Iran, the proliferation of weapons of mass destruction, continued turmoil across the Middle East and North Africa, or the growing threat of cyber-attacks. As a Joint Force and an Army, we must make decisions based on the context of the security environment and their historical experience, not false assumptions about the future.
>
> — GEN Raymond T. Odierno, 2013

Are the USAFA's capabilities sufficient to engage and defeat the conventional weapons and tactics of the Hybrid Threat model when employed as part of the Army's Operational Construct of Unified Land Operations? This thesis seeks to answer that question and potentially identify capability gaps that would hinder the USAFA's contribution to Unified Land Operations. If capability gaps are revealed, this thesis will then seek to determine what role, if any, the reintroduction of a theoretical precision smart munition might play in meeting those requirements.

To answer these questions, this thesis utilizes the following research methodology (see figure 2). The first step in this process is the introduction. The introduction introduces the topic, frames the problem, and states the question, which asks if the USAFA is capable of addressing the conventional aspect of the Hybrid Threat model. The limitations and delimitations assist in framing the problem and defining the scope of the research. The assumptions made to facilitate the research are also defined in this step. The literature review, which also informs the first step, is a review of the pertinent research, articles, and publications. This helps to establish the validity of the question and introduces additional related opinions and research. The second step is the data

presentation that takes place at the beginning of chapter 4 and answers what current FA doctrinal, organizational, and materiel capabilities provide as a solution. Step 3 analyzes the data, and the second part of chapter 4 compares it against the criteria defined in this chapter to determine if capability gaps exist. The last part of this step states the answer to the research question. Step 4 elaborates on the answer provided at the end of step 3 and provides rationale for how the thesis reached its conclusion. Finally, step 5 provides a proposed course of action and recommendations based on the answer to the research question and recommendations for future research on the topic.

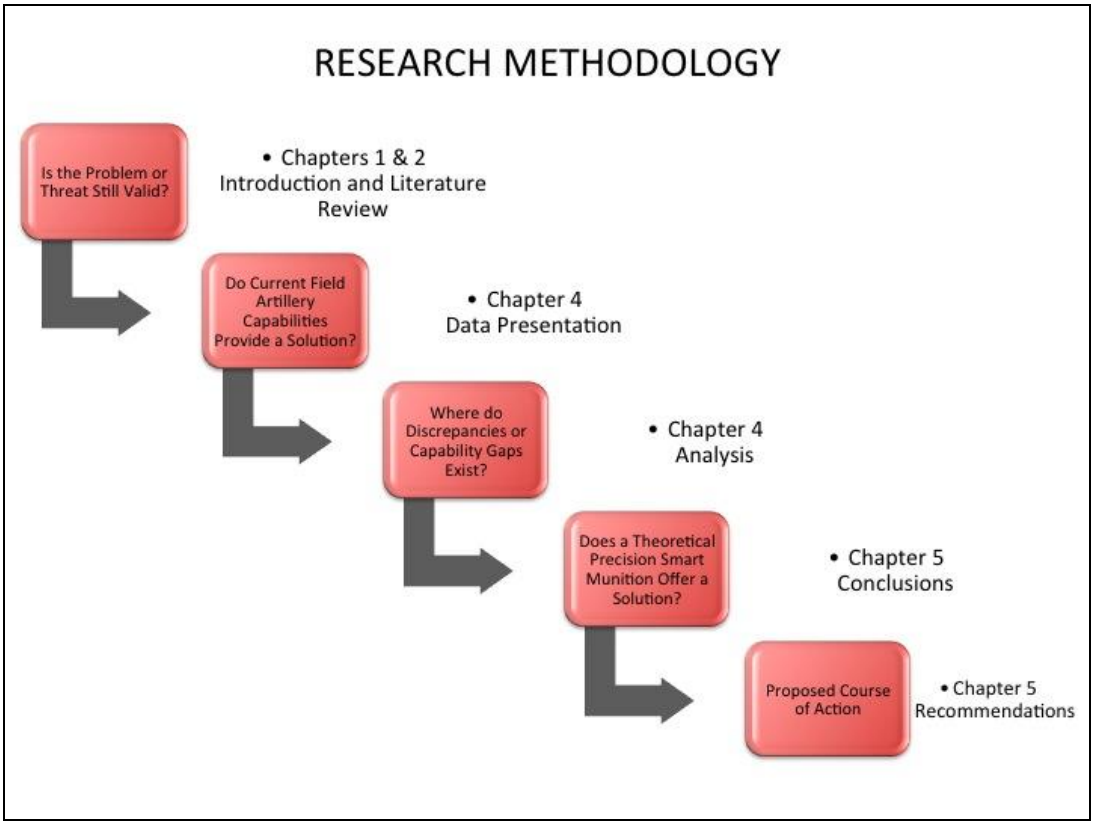



Figure 2. Research Methodology

*Source*: Created by author.

## Doctrine

In the analysis of doctrine, this thesis will address discrepancies between the employment of field artillery fires described in the Army's Operating Concept, Unified Land Operations and ADRP 3-09 and the more prescriptive doctrine described in publications such as Field Manual (FM) 3-09, *Fires* and FM 3-09.21, *Tactics, Techniques, and Procedures for the Field Artillery Battalion*. In particular, it will look at the employment of the USAFA as key aspect of the fires warfighting function. The topic of debate is current fires doctrine and how effectively it addresses the Hybrid Threat. Special consideration will be given to the possibility of a disparity between the doctrine describing the role of FA in Unified Land Operations and the doctrine prescribing methods for the employment of FA capabilities.

## Organization

The second area discussed will be USAFA organization. In particular, this thesis examines the capabilities present in a typical 155mm howitzer battalion or battery, and if those capabilities are adequate to deliver effects against conventional, armored elements of the Hybrid Threat model. The past decade of counter insurgency operations required changes in the FA organization at the operational and tactical levels to better support counterinsurgency operations. These changes may affect the FA units' ability to effectively and efficiently address mobile armored targets.

## Materiel

The previous two discussions lead to the analysis of an FA unit's materiel requirements. Specifically, this study analyzes the current capabilities of field artillery

munitions and their ability to deliver effects on a moving, armored target. The discussion includes the types of munitions available, the volume of fire necessary, and the delivered effect. This paper considers all current, doctrinal FA effects but provides extra emphasis on the destruction of the armored, moving vehicles. A portion of the discussion addresses the volume of fires necessary and the feasibility of employing the required volume. Several munitions exist in the current inventory that have the ability to affect a moving, armored target, but the volume required to do so may make its employment unfeasible or logistically unsupportable over the course of the battle.

## Criteria

The three DOTMLPF aspects just discussed will each be evaluated against three tasks. The three tasks are deliver effects against moving, armored targets, deliver effects to the deep area, and mass fires to achieve the desired effects without losing the element of surprise. If an aspect of DOTMLPF, as it currently exists in the USAFA, provides the capabilities to completely accomplish the task, it will receive a "yes." If the area's capabilities do not completely address the requirements, it will receive a "no," and a theoretical precision smart munition will be applied and analyzed as a possible solution. Precision smart munitions will receive a grade of "yes" or "no" depending on their ability to meet the requirements of the identified capability gaps. A "no" in any one aspect of DOTMLPF does not indicate that the USAFA is unprepared to engage the conventional weapons and tactics of the Hybrid Threat model. It simply indicates a capability gap. The overall ability of the USAFA will be judged on how potential gaps are defined and how much they limit the USAFA's contribution to Unified Land Operations. Once all data

have been presented and analyzed, this thesis will be able to present a completed version of the following table (see table 2)

Table 2. Example Evaluation Matrix

| | Deliver Effects Against Moving, Armored Targets | Deliver Effects to the Deep Area | Mass Fires | Precision Smart Munition Solution |
|---|---|---|---|---|
| Doctrine | | | | |
| Organization | | | | |
| Materiel | | | | |

*Source*: Created by author.

## Chapter Summary

This chapter laid out the research methodology used for this thesis. It explained the five steps that will ensure the problem is still valid, determine if the USAFA already has the capabilities to provide a solution, explore where capability gaps might exist, examine the capabilities of a theoretical precision smart munitions against any possible capability requirements, and propose recommendations for the FA branch and future research. It also explained the evaluation criteria used to answer the research question.

The next chapter will present the pertinent data and provide analysis in the areas of doctrine, organization, and materiel. It will describe possible capability gaps against the conventional aspect of the Hybrid Threat and whether or not smart munitions provide a solution to those gaps.

# CHAPTER 4

# DATA PRESENTATION AND ANALYSIS

> We will need capabilities that can operate effectively in contested environments and that can execute forced entry. This means capabilities that have greater operating ranges and are more interoperable with other systems and concepts and capabilities that will enable dispersed operations. We will need to continue to provide and enhance a network of systems that can defeat deeply buried and hardened targets and that can track and destroy mobile launchers. We need to begin to move away from traditional platforms and methods, without sacrificing the benefits of our current posture and capability set.
>
> — GEN Martin E. Dempsey, *2014 Quadrennial Defense Review*

This thesis seeks to determine if gaps exist in the USAFA's capabilities against the conventional aspect of the Hybrid Threat model. It will examine current USAFA doctrine, organization, and materiel employed as part of the U.S. Army's operating concept, Unified Land Operations. Precision smart munitions will then be discussed as a possible solution to the requirements created by potential capability gaps.

## Doctrine

The U.S. Army's operating concept, Unified Land Operations, utilizes the USAFA as part of the fires warfighting function. This warfighting function consists of the assets that provide "U.S. Army indirect fires, air and missile defense, and joint fires" (Headquarters, Department of the Army 2012b, 3-4). ADRP 3-0 does not further allocate tasks or responsibilities among those three assets. Air and missile defense and U.S. Army indirect fires each provide a set of capabilities unique to their respective delivery platforms. Joint fires integrate fires from additional components, which are predominantly, but not limited to, those delivered by fixed and rotary-wing aviation. These joint fires have the ability to provide capabilities in both the air and on the ground

and serve to augment some U.S. Army capabilities and provide coverage of gaps caused by the lack of others.

However, as explained in the delimitations in chapter 1, this thesis will only discuss the FA branch's contribution to Unified Land Operations, independent of joint fires. The assumption, also discussed earlier, is that the Hybrid Threat brings that capability to employ integrated air defense systems and its own aviation assets. Therefore, it can and will, at least in isolated situations, deny U.S. forces the use of Army rotary-wing aviation and Air Force or Naval fixed-wing aviation as well as unmanned aircraft from any service.

USAFA doctrine, therefore, must prescribe methods for the engagement of the conventional forces of the Hybrid Threat. This requires the doctrine to offer a solution for FA assets to deliver effects on armored stationary and moving targets. It must also be able to deliver these effects in the deep area of the deep-close-security operational framework. Finally, it must provide "maximum massed fires when and where they are required" (Headquarters, Department of the Army 2012a, 1-9).

In terms of the first requirement, engaging and delivering effects on armored targets, doctrine does provide guidance through its description of the munitions available. FM 3-09.21, *Tactics, Techniques, and Procedures for the Field Artillery Battalion*, published in 2001, prescribes the use of both Copperhead and DPICM against armored targets. Copperhead is described as effective against "moving or stationary hard targets" (Headquarters, Department of the Army 2001, 5-20) and DPICM as "most effective against lightly armored vehicles and other materials" utilizing "both a shaped charge and fragmentation to achieve its effects" (Headquarters, Department of the Army 2001, 5-10).

DPICM, however, is restricted by the considerations for use in the same manual due to its dud rate. Also, the most recent observed fires techniques described in Army Techniques Publication (ATP) 3-09.30, *Techniques for Observed Fire*, no longer list the Copperhead round and its employment procedures as a special munition available in the USAFA inventory.

FM 3-09 addresses the USAFA units' shortcomings engaging moving targets on its very first page. One of three given USAFA limitations is a "limited ability to engage moving targets" (Headquarters, Department of the Army 2014, 1-1). As the document that bridges the gap between descriptive and prescriptive USAFA doctrine, FM 3-09 does not delve further into the capabilities that address these issues or techniques to employ against moving targets. In fact, the issue is revisited later in the manual where it discusses the special considerations for the current precision munitions available. Describing precision artillery munitions in general, the manual states target location must be accurate to six meters in order to have the desired effects, and that the timeliness of the target location must also be taken into account (Headquarters, Department of the Army 2014, 2-20).

Recently published ATPs and FMs provide FA units little in terms of more prescriptive guidance and remain vague on how the USAFA addresses this capability gap. FM 3-09.21, only discuses moving targets in a brief description of the Copperhead munition (Headquarters, Department of the Army 2001, 5-20). ATP 3-09.30 only provides considerations as well as computational procedures and calculations for engaging a moving target with indirect fire. Beyond the basic math and some descriptions of equipment used to assist calculations, however, the difficulty discussed in FM 3-09 is

not addressed in other manuals. There are no descriptions of how indirect fires can or should be employed to improve the chances of achieving effects on moving targets.

The requirement for the USAFA to deliver effects to the deep area of the deep-close-security operational framework introduced in ADRP 3-0 is described in more detail in FM 3-09. "Field artillery supports ground and air operations by attacking the enemy force throughout the depth of its formations and provides specific target engagement such as suppression of enemy air defenses" (Headquarters, Department of the Army 2014, 1-2). The key to effectively doing this is through target acquisition, described as "the detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons" requiring the use of USAFA's forward observers and weapons-locating radars (Headquarters, Department of the Army 2014, 1-2). The primary goal of providing fires in the deep fight is to assist in shaping operations where other assets cannot contribute without considerable risk. This ability is described later in FM 3-09.

> Field artillery systems are fully capable of conducting long-range strikes with fires throughout the supported force area of operations and massing their effects under all weather conditions, day or night. They provide joint and land component commanders the capability to attack high-payoff targets out to the maximum range of the respective weapons system, when and where required. (Headquarters, Department of the Army 2014, 3-17)

With the listed, effective ranges of 155mm artillery munitions reaching as far as 30 kilometers, FA units have the ability deliver effects to the deep fight (Headquarters, Department of the Army 2014, 2-22). The follow-on discussion, however, is how to do it accurately.

The USAFA's weapons-locating radars have extensive ranges that provide accurate target location of enemy indirect fire delivery assets operating in the deep area. These assets, however, do not provide an ability to acquire accurate target location for

enemy maneuver, command and control, or logistical assets. For these types of targets, FM 3-09 prescribes the use of observers. These observers can consist of special operations teams, USAFA forward observers, signals intelligence collection assets, and manned and unmanned aircraft. Of these, the only dedicated assets the USAFA has are its organic forward observers.

USAFA doctrine describes specific assets and procedures for the observation of targets in the deep area. FM 3-09.12, *Tactics, techniques, and procedures for field artillery acquisition*, discusses the USAFA Striker platoon. "The Striker platoon is one of the brigade's main observation and surveillance assets and is heavily relied upon to provide observation and attack critical targets in the brigade deep fight" (Headquarters, Department of the Army 2002, 2-7). The Striker platoon is a fire support asset available to the BCT and should not be confused with the similar sounding but differently spelled Stryker vehicle. The Striker platoon provides the BCT with the capability to place persistent observation on targets in the deep area. USAFA doctrine, however, does not provide specific descriptions for the employment of forward observers in deep versus close areas. Additionally, proposed organizational models remove the Striker platoon from the brigade and reallocate the assets to its reconnaissance squadron. ATP 3-09.30 lists a general set of considerations for use when selecting and occupying an observation post such as security, communications, and observation. There is no discussion, however, about special considerations that may apply when observation teams are operating at the maximum range of the BCT's supporting artillery or outside of the direct fire support range of the maneuver element (Headquarters, Department of the Army 2013, 2-7).

As one of the offensive task considerations for USAFA units, FM 3-09 lists "massing fires to gain maximum efficiency and effectiveness" (Headquarters, Department of the Army 2014, 1-6). Mass is later defined as "fire from a number of weapons directed at a single point or small area" that seek to "maximize effectiveness of the initial volley on the intended target" (Headquarters, Department of the Army 2014, 2-2). The definition itself provides an accurate description of how the USAFA accomplishes this task. It also prevents unnecessary emphasis on the number of rounds fired to achieve mass through the traditional placement of a high volume of munitions on a single point or area. It points out that the placement of several precision munitions on separate points impacting simultaneously can also achieve mass as long as they achieve the effects described in the previous definition (Headquarters, Department of the Army 2014, 2-2).

FM 3-09 further expands the definition of what massed fires can achieve by defining the various effects the USAFA can accomplish with indirect fires. The mission of the USAFA defines its role in terms of three effects: destroy, neutralize, and suppress. These three terms alone describe a broad enough range of inflicted casualties and material damage to make the achievement of effects on a target possible regardless of how many rounds are fired. The effect with the largest requirement for resources and accuracy, destroy, is doctrinally achieved with as little as 30 percent casualties or material damage. The neutralization and suppression effects are achieved with as little as ten and three percent casualties or damage respectively. The additional effects of deceive, defeat, delay, disrupt, and divert are not defined in quantitative terms and instead only

describe how the artillery affects the enemy's ability to maneuver or continue its mission (Headquarters, Department of the Army 2014, 1-2 to 1-4).

As discussed earlier, doctrine only describes Copperhead and DPICM munitions for use against armored targets. The more recent the document, the less likely it is to discuss Copperhead as an option. The impact of this capability gap on stationary targets is minimal. Experiments conducted in 1988 as part of the Soviet Artillery Effects Study demonstrated the effectiveness of standard high-explosive 155mm artillery rounds on armored vehicles (see figure 3), but doctrine does not provide an adequate solution for its self-acknowledged shortcoming in the engagement of moving targets (Durham 2002, 11). The only solution provided is to rely on training and experience.

Figure 3. Photograph from the 1988 Soviet Artillery Effects Study showing the results of one 155mm high explosive round

*Source*: George A. Durham, "Who Says Dumb Artillery Rounds Can't Kill Armor?" *Field Artillery* (November-December 2002): 11.

Doctrinally, the USAFA provides adequate descriptive and prescriptive guidance for the delivery of most effects in the deep area and for the massing of fires to achieve those effects (see table 3). The broad range of effects described in FA doctrine greatly facilitates the USAFA's ability to contribute to Unified Land Operations. Capability gaps do exist, however, in the destructive effects that can be achieved on moving, armored targets.

Table 3. Evaluation of Doctrine

| | Deliver Effects Against Moving, Armored Targets | Deliver Effects to the Deep Area | Mass Fires |
|---|---|---|---|
| Doctrine | NO | YES | YES |

*Source*: Created by author.

## Organization

The capabilities of the USAFA branch's organization can be analyzed through the same categories as doctrine. In order to engage the conventional aspect of the Hybrid Threat model, the USAFA must be organized so that it can accomplish the key task of delivering effects on stationary or moving armored targets. Additionally, USAFA direct support battalions must be organized to accurately deliver those effects to the deep area of the deep-close-security operational framework and to mass fires in order to achieve the desired effects.

FM 3-09 prescribes one USAFA battalion as the smallest organization able to provide adequate fire support to a committed brigade (Headquarters, Department of the

Army 2014, 1-30). Current USAFA organization assigns a direct support battalion to every BCT. A USAFA battalion of 155mm M109A6 Paladin self-propelled howitzers, organized into three batteries of six guns each, supports each Armored BCT. Stryker BCTs each have a battalion of M777 155mm towed howitzers organized similarly to a M109A6 Paladin battalion. Infantry BCTs have a battalion consisting of two batteries, each with six M119A3 105mm towed howitzers and one battery with six M777s. This places the capability to deliver 155 munitions within every BCT in the active U.S. Army.

USAFA forward observers, the other half of engaging a target with munitions, are also similarly organized among BCTs. Each company or troop has an associated fire support team with the capability to locate targets, as well as call for and adjust indirect fires from the direct support FA battalion onto those targets. As described earlier, BCTs are also doctrinally allocated a striker platoon or combat observation lasing team to further enhance these capabilities.

This method of organization supports the ability to engage armored targets both in the close and in the deep areas. Even operating under the earlier assumption that precision and smart munitions have and only will exist in a 155mm format, current USAFA organization allows this capability to be delivered across all three BCT models. This organization also ensures that the USAFA is able to deliver those effects to the deep area. The addition of a 155mm capability to Infantry BCTs improved the portion of the deep area FA assets can affect by increasing its maximum range from 19.5 kilometers to 30 kilometers (Headquarters, Department of the Army 2014, 2-22).

The level of support that current USAFA organization provides to massing fires depends on the effect the USAFA is expected to deliver. Firing batteries in a USAFA

battalion are organized with the ability to operate as two independent firing platoons with three to four guns each (Headquarters, Department of the Army 2014, 1-40). When organized in such a manner, they can be dispersed across the supported BCT's area of operations. This facilitates their assignment in supporting roles to a larger number of subordinate units within the BCT, thereby providing extremely responsive fires throughout the brigade's area of operations. Dispersion not only improves responsiveness to the supported commander, but also improves survivability against any enemy counterfire threat by reducing firing signatures.

Too much dispersion, however, increases the difficulty in the massing of fires on single points or areas. The decentralized control increases the amount of coordination necessary to mass two or more platoons on a single target. Planners must ensure USAFA assets are not only positioned to best support respective maneuver units, but also so they can provide common support to targets that require massed systems to achieve effects. This organizational issue becomes more difficult to overcome as the targets requiring massed USAFA assets approach the maximum range of the capabilities. Dispersion also complicates the communications necessary to mass two or more platoons on a single target.

Current FA organization addresses the conventional aspect of the Hybrid Threat model with a few exceptions (see table 4). The presence of direct support USAFA battalions in every version of the U.S. Army's BCTs provides the capability to deliver effects against armored targets. Also, the presence of 155mm delivery assets in every direct support USAFA battalion expands the range of deliverable effects and improves the ability to deliver those effects in the deep area of operations. Without the addition of

specialized delivery or target acquisition units to the USAFA organization as a whole, little else can be changed about USAFA organization at the BCT level that would significantly improve either of these areas.

| Table 4. Evaluation of Organization | | | |
|---|---|---|---|
| | Deliver Effects Against Moving, Armored Targets | Deliver Effects to the Deep Area | Mass Fires |
| Organization | YES | YES | NO |

*Source*: Created by author.

Where USAFA organization creates a capability gap is in its ability to support the capability of massing fires. Massed fires are especially important against moving armored targets due to the larger number of munitions required to destroy them on the initial volley, as well as their increased probability of survival if the initial volley is insufficient. Accurate target location is not an issue given the current organization of FA units, but the delivery of the necessary amount of munitions on the first volley is an issue. In order to maintain the element of surprise, as well as to increase survivability by reducing firing signature of the firing unit, a sufficient number of rounds are fired on the first volley to achieve the desired effect (Headquarters, Department of the Army 2001, 5-8). If USAFA units are too dispersed to collectively accomplish this task in the first volley, smaller units must fire multiple volleys. This risks losing the element of surprise after the first volley and providing an opportunity for the target to move away from its original location.

## Materiel

The last area of analysis is USAFA materiel capabilities, which examines their effectiveness at engaging the conventional aspect of the Hybrid Threat model. Similar to doctrine and organization, USAFA materiel capabilities should allow it to deliver effects against stationary and moving armored targets. They should also allow the delivery accurate effects in the deep area of the deep-close-security operational framework, and effectively mass fires to achieve the desired effect on the enemy.

The USAFA currently employs three types of munitions able to deliver lethal effects on targets. Those categories are high explosive rounds, DPICM, and precision munitions. High explosive rounds are an area munition and are often referred to as dumb rounds because they follow a ballistic trajectory that cannot be adjusted in flight. They deliver effects through their explosive charge and fragmentation of the shell casing and function using delayed, point detonating, or proximity fuzes (Headquarters, Department of the Army 2011a, 2-17).

DPICM is a subset of area munitions that delivers effects through the distribution of submunitions delivered in 105mm and 155mm shells. Once deployed, DPICM submunitions utilize both a shaped charge and fragmentation to deliver effects on the intended target (Headquarters, Department of the Army 2001, 5-10). Dispersion patterns allow a single round to cover a larger area than a standard high explosive round and the shaped charges provide more effective penetration of armor than standard fragmentation.

Precision munitions consist of those munitions that have the ability to use guidance, such as GPS or reflected energy, to make corrections along its ballistic path up to the point of target impact or the dispersion of submunitions. Precision munitions have

the advantage of a terminal accuracy less than the radius of the lethal effects. As discussed earlier, doctrine describes both the Copperhead and the Excalibur rounds although it only provides implementation guidance for the Excalibur rounds. The Excalibur utilizes GPS guidance to engage the target and delivers effects similar to a standard high explosive round. It has the ability to utilize delay, proximity, and point detonating fuze settings and is accurate to less than 10 meters (Headquarters, Department of the Army 2014, 2-24).

As for the USAFA's ability to deliver effects on stationary and moving armored targets, it once again depends on which specific effects are desired. ATP 3-09.30 specifically states that Excalibur is not designed to be a tank killer (Headquarters, Department of the Army 2013, 6-1). However, even near hits with high explosive rounds have the ability to damage an armored vehicle enough to delay, disrupt, divert, neutralize, or suppress it whether it is moving or stationary. DPICM is specifically described as effective against light armor, but again, if the desired effect is not destruction, it is reasonable to assume that it could successfully be employed against more heavily armored vehicles. The larger dispersion pattern of DPICM submunitions improves the probability of a moving armored vehicle being caught within its area of lethal effects. With the exclusion of Copperhead from ATP 3-09.30, however, there is no longer a precision munition available for the engagement of moving targets.

All three types of munitions provide the USAFA with an excellent capability to deliver effects to the deep area of the battlefield. Both high explosive area munitions and DPICM have shell variants that utilize rocket assistance. This extends the effective range of high explosive area munitions to 30 kilometers and DPICM to approximately 28

kilometers. Excalibur does not utilize rocket assistance, but the unique nature of the munition and its non-ballistic trajectory allow it to engage targets at similar ranges (Headquarters, Department of the Army 2014, 2-22; Headquarters, Department of the Army 2013, 6-1).

High explosive and precision guided munitions deliver the same effects at their maximum range as they do at their minimum range, so they have the same capabilities in the deep area as they do in the close area. DPICM, on the other hand, actually has a larger dispersion pattern for its submunitions at its maximum range. Despite the fact that the rocket assisted variant utilizes fewer submunitions, it has a dispersion pattern of approximately 150 meters by 150 meters at the maximum range of the rocket assisted variant compared to approximately 50 meters by 120 meters when utilized at closer ranges. This means that not only can the USAFA deliver effects to the deep area, but that it can also deliver them over a larger area when delivered to the deep area rather than the close area (Headquarters, Department of the Army 2013, 6-7).

USAFA munitions provide a materiel solution to the capability requirement of massed fires in several ways. When using DPICM, massing of effects is achieved through the number of submunitions delivered with a single round. A standard DPICM round delivers 88 submunitions while the rocket assisted projectile delivers 72. Therefore, a single platoon of three howitzers has the ability to deliver up to 264 submunitions on the first volley (Headquarters, Department of the Army 2013, 6-6). Excalibur offers a different solution to mass. Utilizing the secondary definition provided in FM 3-09, Excalibur facilitates massed fires by providing the capability to accurately engage several point targets simultaneously (Headquarters, Department of the Army 2014, 2-2).

Once again, the USAFA's capabilities are only limited by the desired effect. The volume of munitions required to achieve destructive effects on an armored target limit the USAFA's ability to maintain the element of surprise and to maintain a relatively low firing signature for improved survivability of the firing unit. Precision guided munitions do not contribute to this USAFA capability because the Excalibur is not designed to kill tanks or other armored targets. The effects of DPICM are dispersed over a relatively large area and would require greater volumes of fire in order to achieve the necessary concentration of destructive effects on a target. High explosive area rounds deliver more concentrated effects, but the fragmentation they deliver is less effective than the shaped charges of DPICM. Therefore, high explosive area munitions also requires a greater concentration and volume of fire to destroy an armored vehicle.

USAFA munitions provide the ability to mass fires and deliver effects to the deep area. They also provide the capability to deliver most effects against the conventional aspect of the Hybrid Threat model, but a capability gap still exists (see table 5). The result of this gap is an inability to efficiently deliver destructive fires on moving, armored targets. Even though destroy is only one of eight effects artillery fires can deliver, it remains a key component of the USAFA mission.

Table 5. Evaluation of Materiel

| | Deliver Effects Against Moving, Armored Targets | Deliver Effects to the Deep Area | Mass Fires |
|---|---|---|---|
| Materiel | NO | YES | YES |

*Source*: Created by author.

## Precision Smart Munitions

Analysis of current USAFA doctrine, organization, and materiel identifies three capability gaps. Doctrinally, the USAFA admits a shortcoming in the ability to engage moving targets but does not describe a solution to the shortcoming. Current USAFA organization does not support the massing of effects on moving, armored targets. The volume of fire required cannot be efficiently delivered without reducing the dispersion of the firing units, and reducing the FA units' responsiveness to its supported maneuver units. Finally, there is a materiel gap that exists due to the lack of a munition designed to engage and destroy more than a lightly armored vehicle, as well as no munition designed to adjust for the displacement of a moving vehicle once the round as been fired.

The proposed solution is the development of a precision smart munition. A previous version of FM 3-09 published in 2011 defined precision smart munitions.

> A precision smart munition is a munition or submunition that autonomously searches for, detects, classifies, selects, and engages a target or targets. A precision smart munition has a limited target discrimination capability. Munitions such as the 155-mm M898 sense and destroy armor projectile have this capability. (Headquarters, Department of the Army 2011a, 2-17)

The doctrinal solution to this capability gap existed as late as 2011. Technical information for the implementation of precision smart munitions still exists in the USAFA's FM 6-40, *Field Artillery Manual Cannon Gunnery*, although the most recent publication date of this manual is 1999. As USAFA doctrine catches up with the reality of SADARM's cancellation, the capability gap first identified after the Vietnam War has reappeared. Reintroduction of a terminally guided and fuzed smart munition would once again provide a doctrinal solution for the engagement of moving targets.

Doctrine only provides two solutions for the engagement of armored targets. The first is the Copperhead round, which is no longer in use and has been phased out of the most recent publications. The second is DPICM, of which the use is heavily caveated due to the risk of unexploded submunitions creating a hazard on the battlefield. Precision smart munitions would provide an additional solution for this gap.

Organizationally, the USAFA direct support battalion is limited in its ability to mass fires, especially in the deep area of the deep-close-security operational framework. A precision smart munition provides a solution through its ability to improve the efficiency of the firing unit. If a smart munition provided the ability to independently identify then engage and destroy a target, the USAFA would once again have the ability to destroy an armored target with a single round. This capability would be similar to one previously enjoyed with Copperhead rounds, but with an extended range and without the requirement for persistent observation or designation. One firing platoon would theoretically have the ability to destroy three armored vehicles on the first volley. If the smart munition that provides this capability utilized submunitions similar to the SADARM, the effectiveness has the potential to be doubled.

Precision smart munitions do have their limitations in regards to this capability gap. As stated in the 2011 FM 3-09, they have a limited ability for target discrimination. This limitation is especially of concern in the close area because previous smart munitions were not capable of distinguishing between friendly and enemy vehicles, and they could increase the risk of fratricide if not carefully employed. A new precision smart munition would either be restricted to the deep area or outside of a certain proximity to friendly forces if this design issue could not be overcome.

Finally, the USAFA does not currently have a munition specifically designed to provide destructive effects on heavily armored targets such as tanks. The Copperhead was the last round in the USAFA inventory capable of providing this destructive effect. While DPICM and even high explosive rounds have the ability to efficiently provide other effects on armored targets, destruction of an armored target is much more difficult to achieve given the same assets. The original precision smart munitions, such as SADARM, were designed with that specific capability gap in mind and have the potential to provide that solution once again.

Additionally, there is currently no materiel capability within the USAFA for the engagement of moving targets. Specifically, a munition that has the ability to compensate for the vehicle's movement after the round has been fired. Copperhead provided this to an extent, as long as the vehicle remained within a certain distance of the original target location. Precision smart munitions would provide a similar capability without the requirement for designation from an observer. The removal of the requirement for target designation would improve the rounds usefulness, especially against faster moving targets. An observer could utilize the procedures outlined in FM 3-09.30 for engaging moving targets to place the rounds at a planned intercept point. This would permit a greater ability to compensate for area due to the round's ability to detect and engage targets within a given area on the ground.

## Chapter Summary

This chapter presented the research data and provided analysis of the USAFA's capabilities against the conventional weapons and tactics of the Hybrid Threat model. Based on the analysis of the presented data, the answer to the research question is yes

(see table 6). The USAFA is capable of engaging the conventional aspect of the Hybrid Threat model. The analysis of the USAFA's doctrine, organization, and materiel, however did reveal capability gaps that can be mitigated by the potential attributes of a theoretical precision smart munition.

Table 6. Evaluation Matrix

| | Deliver Effects Against Moving, Armored Targets | Deliver Effects to the Deep Area | Mass Fires | Precision Smart Munition Solution |
|---|---|---|---|---|
| Doctrine | NO | YES | YES | YES |
| Organization | YES | YES | NO | YES |
| Materiel | NO | YES | YES | YES |

*Source*: Created by author.

With the pertinent data presented and analyzed, the following chapter will summarize the conclusions to the question of whether or not the USAFA is prepared to defeat the conventional aspect of the Hybrid Threat model and the role smart munitions can play in solving the identified capability gaps. It will also provide recommendations for the USAFA and recommendations for future research.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

> My greatest concern is that we will not innovate quickly enough or deeply enough to be prepared for the future, for the world we will face 2 decades from now.
>
> — GEN Martin E. Dempsey, *2014 Quadrennial Defense Review*

The goal of this thesis is to determine if the USAFA is prepared to engaged and defeat the conventional weapons and tactics of the Hybrid Threat model. It analyzed USAFA capabilities in terms of current doctrine, organization, and materiel and their application against moving, armored targets under the Army operational construct of Unified Land Operations. As gaps were discovered, the capabilities of a theoretical precision smart munition were applied to determine if they could play a role in mitigating these requirements. This chapter will present rationale for the conclusions of the data analysis and provide recommendations both for the USAFA and for future research on this topic.

## Conclusions

As to the question of whether or not the USAFA is doctrinally, organizationally, and materially prepared to engage the conventional aspect of the Hybrid Threat model as part of Unified Land Operations, the answer is yes. Capability gaps do exist that the reintroduction of precision smart munitions provide a solution for, but they are narrowly defined and identified, and they primarily concern the USAFA's ability to deliver destructive effects on moving and armored targets. The research shows that despite the gaps, the USAFA's doctrine, organization, and current materiel capabilities adequately

allow it to deliver a variety of other effects against a conventional threat. Additionally, the USAFA possesses the capability to deliver these effects in the deep area of the deep-close-security operational framework, as well as the capability to mass fires to achieve these effects.

The Hybrid Threat model attempts to achieve a balanced approach preparing the U.S. Army for the possibility of once again facing a near-peer adversary and maintaining the lessons learned from the past decade of fighting an unconventional threat in urban environments. As such, the conventional aspect of the Hybrid Threat model demands the USAFA's attention, but it cannot monopolize it. The sweeping changes to doctrine, organization, and materiel that took place after the Vietnam War in response to the threat of the Soviet Army are neither possible nor prudent in light of what the entire Hybrid Threat model offers.

A reliance on fires doctrine on the integration of joint capabilities is understandable. Were current USAFA materiel capabilities not subject to change, the risk posed by this strategy would be acceptable. However, this is not the case and, in turn, it creates risk in the USAFA's ability to support Unified Land Operations and U.S. strategic objectives. The USAFA already retired its only laser guided munition, and the DPICM capability is in danger of being retired as well if the dud rate of its submunitions cannot be improved. The loss of these capabilities, coupled with the enemy's ability to employ integrated air defense systems to deny access to their air space, presents a significant risk to the U.S. Army's ability to execute Unified Land Operations against a conventional threat.

## Recommendations

### Recommendations for the USAFA

Just as the Hybrid Threat model seeks to prevent an unbalanced focus on one type of threat, the USAFA should seek to prevent an unbalanced reliance on joint fires as the sole assets capable of delivering destructive effects on moving and armored targets. The U.S. Army and the USAFA would be well-served in restarting the research and development of precision smart munitions. Such a capability would provide the USAFA and the U.S. Army with a more available, flexible, and scalable capability to engage conventional forces.

In addition to a near-peer threat having the capability to deny access to airspace, the U.S. Air Force is limited in the number of assets it has to apply against a conventional enemy force. Assets must be prioritized among the ground forces requesting their support and the need to support air interdiction and other missions. If a near-peer adversary employs its own aviation assets, U.S. aviation assets would be less concentrated due to even distribution across the battlefield. With every active BCT possessing the ability to deliver 155mm artillery munitions, a precision smart munition would make the capability to engage moving and armored targets more readily available across the U.S. Army. It would provide a BCT supported by a USAFA battalion this capability immediately upon arrival in an immature theater of operations. It would also provide BCTs this capability 24 hours a day in all environmental conditions.

A precision smart munition capability within the USAFA would also provide more flexibility for U.S. forces. Joint assets and U.S. Army aviation could be used to weigh the main efforts and decisive operations. The amount of risk a commander would

have to assume in assigning one unit priority of attack aviation or joint fires assets would be significantly mitigated. All direct support FA battalions would have the ability to engage moving, armored targets while shaping operations in the deep area. The augmented ability for smaller USAFA units to mass fires provided by precision smart munitions would also provide a commander with more flexibility in assigning missions to the FA battalion as well. A smaller firing unit could efficiently and effectively provide suppression of armored enemy air defense assets for larger friendly formations. This would free up the remaining USAFA assets to provide close fires in support of maneuver elements or deep fires in support of shaping operations.

Finally, the use of precision smart munitions would also provide the U.S. Army and the USAFA with more scalable capabilities. Just as Excalibur provides the USAFA the ability to apply precise, destructive effects on point targets with minimal collateral damage in urban environments, a precision smart munition would provide the same ability on the conventional battlefield. Precision attacks from a round or submunition able to independently identify and engage a target would result in much less collateral damage than massing high explosive area munitions. They would also reduce the risk of unexploded ordinance from DPICM submunitions affecting friendly forces.

## Recommendations for Future Research

This topic has a great deal of potential for future research. Two areas that should be considered are training and MLRS. A concern raised in several journal articles and research papers was that the USAFA lacked training in massing indirect fires on moving targets. One research paper author even discussed the difficulties in training such a task. As FM 3-09 recommends a reliance on training and experience as a method of mitigating

the difficulties encountered when trying to accomplish this task, further research into how to better train this skill would prove worthwhile to the USAFA community. Precision smart munitions and their effects on training this task could also factor into such research.

This paper only discussed USAFA capabilities and precision smart munitions as they relate to direct support FA cannon battalions. A study of the capabilities of MLRS rockets and ATACMS, as well as other general support assets, could work with this study to provide a more comprehensive examination of the USAFA's total capabilities against the conventional aspect of the Hybrid Threat model. A study of DOTMLPF aspects other than training and those researched here would also be useful. They could further examine USAFA capabilities and how they would be affected by the reintroduction of precision smart munitions. This would support or refute the argument that they are a viable technology for the U.S. Army.

## The Opportunity at Hand

The USAFA is currently presented with a unique opportunity to resolve its capability gaps and posture itself to be ready and relevant against future threats. The past decade of war in Iraq and Afghanistan provided the USAFA with the training, technology, capability, and experience to fight and succeed against unconventional threats in urban settings. The priority for the Department of Defense is now rebalancing the force to ensure it is equally as prepared for a conventional threat. As stated in the *2014 Quadrennial Defense Review*, "The end of U.S.-led combat operations in Afghanistan provides the Army with an opportunity to prepare more broadly for the full range of future challenges" (Department of Defense 2014, 29).

The report acknowledges that the U.S. military "has not kept pace with the need to modernize" (Department of Defense 2014, 27). It asserts that in order to continue to project power and win decisively the military must "refine [its] doctrine, modernize [its] capabilities, and regain [its] proficiency to conduct forcible entry and large-scale combined arms maneuver operations against larger and more capable adversaries than we have confronted over the past decade" (Department of Defense 2014, 37). In support of this, the report proposes that the Department of Defense "will sustain priority investments in science, technology, research, and development" (Department of Defense 2014, vii).

With the Department of Defense committed to modernizing technology in order to compensate for reductions in other, and in order to keep pace with future threats, the conditions are ideal for the USAFA to once again start research and development on a precision smart munition. Leveraging technology developed over the course of previous projects as well as the efficiencies such a capability provides, the USAFA has the ability to make a very strong case in its favor. Former Secretary of Defense Donald Rumsfeld once told Soldiers in Kuwait that "you go to war with the Army you have. They're not the Army you might want or wish to have at a later time" (Rumsfeld 2004). The USAFA needs to take advantage of this opportunity and make sure that the next time it goes to war, the capabilites it wants are the capabilities it already has.

ILLUSTRATIONS

Figure 4. An artist's concept of smart munitions

*Source*: James F. Hall, "Precision Guided Artillery: First and Second Generation Projectiles," *Field Artillery Journal* 49, no. 3 (May-June 1981): 10.

Figure 5. An artist's concept of SADARM employment

*Source*: Michael W. Hustead, "Fire Support Mission Area Analysis: Impact of Precision Guided Munitions," *Field Artillery Journal* 49, no. 3(May-June 1981): 20.

# GLOSSARY

Deceive. The act of drawing the attention and forces of an enemy from the point of the principal operation.

Defeat. A tactical mission task that occurs when an enemy force has temporarily or permanently lost the physical means or the will to fight.

Delay. To slow the time of arrival of enemy forces or capabilities or alter the ability of the enemy or adversary to project forces or capabilities.

Destroy. In the context of the computed effects of field artillery fires, destruction renders a target out of action permanently or ineffective for a long period of time, producing at least 30-percent casualties or materiel damage.

Direct support. A support relationship requiring a force to support another specific force and authorizing it to answer directly to the supported force's request for assistance.

Disrupt. A tactical mission task in which a commander integrates direct and indirect fires, terrain, and obstacles to upset an enemy's formation or tempo, interrupt his timetable, or cause enemy forces to commit prematurely or attack in a piecemeal fashion

Neutralize. In the context of the computed effects of field artillery fires renders a target ineffective for a short period of time, producing at least 10-percent casualties or materiel damage.

Operational framework. The arrangement of friendly forces and resources in time, space, and purpose with respect to each other and the enemy or situation. It consists of the area of operations, battlespace, and battlefield organization.

Precision guided munition. A guided weapon intended to destroy a point target and minimize collateral damage.

Precision munition. A munition that corrects for ballistic conditions using guidance and control up to the aimpoint or submunitions dispense with terminal accuracy less than the lethal radius of effects.

Precision smart munition. A munition or submunition that autonomously searches for, detects, classifies, selects, and engages a target or targets. A precision smart munition has a limited target discrimination capability.

Suppress. In the context of the computed effects of field artillery fires, renders a target ineffective for a short period of time producing at least 3-percent casualties or materiel damage.

REFERENCE LIST

Anderson, COL E. G. III. 1991. Reshaping the field artillery. *Field Artillery* (June): 11-15.

Black, Kenneth L. 2003. Future operations for nonlethal artillery. *Field Artillery* (March-April): 4-9.

Brengle, MAJ John W. Returning the deep attack as an option for the operational commander. Monograph, School of Advanced Military Studies, 2013.

Department of Defense. 2014. *Quadrennial defense review*. Washington, DC: Government Printing Office.

Dinges, MG Edward A. 1982. On the move. *Field Artillery Journal* 50, no. 4 (July-August): 1.

Drago, COL John P. Rebalancing the artillery to meet current and future challenges. Strategy research project, U.S. Army War College, 2010.

Durham, George A. 2002. Who says dumb artillery rounds can't kill armor? *Field Artillery* (November-December): 8-11.

Forsyth, LTC Michael. 2011. Redefining mass. *Fires!* (July-August): 22-23.

Gates, Hon. Robert M. 2008. Memorandum to the Secretaries of the military departments about the Department of Defense policy on cluster munitions and unintended harm to civilians. June 19. http://www.defense.gov/news/d20080709cmpolicy.pdf (accessed 6 May 2014).

Gates, Hon. Robert M. 2011. Speech to the United States Corps of Cadets, United States Military Academy, West Point, NY. February 25. http://www.defense.gov/speeches/speech.aspx?speechid=1539 (accessed 4 May 2014).

Hall, James F. 1981. Precision guided artillery: First and second generation projectiles. *Field Artillery Journal* 49, no. 3 (May-June): 9-12.

Hallada, MG Raphael J. 1990. On the move. *Field Artillery* (February): 1.

Halverson, MG David D. 2012. Commanding general's forward: Success through soldiers, leaders. *Fires!* (January-February): 4-5.

Headquarters, Department of the Army, 1999. Field Manual 6-40, *Tactics, techniques, and procedures for field artillery manual cannon gunnery*. Washington, DC: Government Printing Office.

———. 2001. Field Manual (FM) 3-09.21, *Tactics, techniques, and procedures for the field artillery battalion*. Washington, DC: Government Printing Office.

———. 2002. Field Manual (FM) 3-09.12, *Tactics, techniques, and procedure for the field artillery battalion.* Washington, DC: Government Printing Office.

———. 2010. Training Curricular (TC) 7-100, *Hybrid threat*. Washington, DC: Government Printing Office.

———. 2011a. Field Manual (FM) 3-09, *Fire support*. Washington, DC: Government Printing Office.

———. 2011b. Training Curricular (TC) 7-100.2, *Opposing force tactics*. Washington, DC: Government Printing Office.

———. 2012a. Army Doctrine Reference Pamphlet (ADRP) 3-09, *Fires*. Washington, DC: Government Printing Office.

———. 2012b. Army Doctrine Reference Pamphlet (ADRP) 3-0, *Unified land operations*. Washington, DC: Government Printing Office.

———. 2013. Army Techniques Publication (ATP) 3-09.30, *Techniques for observed fire*. Washington, DC: Government Printing Office.

———. 2014. Field Manual (FM) 3-09, *Field artillery operations and fire support*. Washington, DC: Government Printing Office.

Hoffer, MAJ Edward E. Field artillery support for counterinsurgency operations: Combat power or counterproductive? Monograph, School of Advanced Military Studies, 1987.

Hustead, Michael W. "Fire support mission area analysis: Impact of precision guided munitions." *Field Artillery Journal* 49, no. 3(May-June 1981): 19-29.

Kaufman, MAJ Randy L. Precision guided weapons: Panacea or pitfall for the joint task force commander. Student paper, Naval War College, 2003.

Maples, MG Michael D. 2003. The update point, lethal and nonlethal fires and effects. *Field Artillery* (March-April): 1.

McKenney, Janice E. 2007. *The organizational history of field artillery, 1775-2003.* Washington, DC: Center of Military History.

McKiernan, BG Brian J. 2013. Looking back over 2012, the legacy of the "king of battle" continues. *Fires!* (January-February): 6-9.

Morrison, MAJ Jerome S. II. 2005. FA battery trends in stability and support operations, simultaneous maneuver and fires missions. *Field Artillery* (November-December): 36-39.

Page, CPT John Mann. The optimal force mix and allocation of fires for the future field artillery. Master's thesis, Naval Postgraduate School, 1991.

Pitts, LTC William G. 2003. Overview; Field artillery in Operation Iraqi Freedom. *Field Artillery* (September-October): 2-4.

Rumsfeld, Hon. Donald H. 2004. Town hall meeting, Kuwait. 8 December. http://www.defense.gov/transcripts/transcript.aspx?transcriptid=1980 (accessed 2 May 2014).

Schultz, MAJ Gregory B. Dominant fires: Division XXI's lethal edge. Monograph, School of Advanced Military Studies, 1997.

Shaw, LTC C. Raymond Jr. The field artillery dilemma: NTC lessons learned, to believe or not to believe. Individual essay, U.S. Army War College, 1987.

Smith, LTC Robert L. Preparing the brigade combat team for the hybrid threat. Monograph, School of Advanced Military Studies, 2012.

Waters, COL Mark L. Precision and the blue collar artillery. Strategy research project, U.S. Army War College, 2006.

Watson, MAJ Sherman C. Artillery is here to stay–for now. Monograph, School of Advanced Military Studies, 2013.