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Chemical Corps Smoke: Is There a Future in the Army of the Twenty-First Century?

by

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Chemical Corps Smoke: Is There a Future in the Army of the Twenty-First Century?

A thesis presented to the Faculty of the U.S. Army
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fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by

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1998

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ABSTRACT

IS THERE A SMOKE/OBSCURANTS REQUIREMENT FOR THE TWENTY-FIRST CENTURY MANEUVER FORCE AND, IF SO, WILL THE CHEMICAL CORPS SMOKE/OBSCURANTS MEET IT? by MAJ William E. King IV, USA, 83 pages.

Today's Army is transitioning it's warfighting focus from superiority of technology and industry to information dominance. If the Army's smoke generating organizations are going to remain viable, they must enhance the joint force's ability to win in future warfare. They must be able to achieve electromagnetic spectrum supremacy and meet the needs of the twenty first century joint force throughout the range of conflict. This twenty first century obscurant capability must be able to defeat and/or control reconnaissance, surveillance, and target acquisition (RSTA) sensors and targets at the tactical, operational and strategic levels of war. I present a comparison of the twenty-first century maneuver force smoke/obscurant requirements and point out where the Chemical Corps smoke and obscurants development plan meet these requirements in doctrine, training, leader development, organization, material, and soldiers (DTLOMS). I also suggest where the Chemical Corps needs to take further action to fill shortfalls in all twenty first century operational requirements. This study investigates whether Army smoke generating units will remain a vital asset or become a liability to the twenty-first century joint force. It also suggests obscurant mission changes throughout the spectrum of conflict on the future battlefield.

My presentation is relevant to the following topics: camouflage, concealment, countermeasures, deception, operational uses, smoke systems and materials, information operations, OPSEC, protection, multispectral obscurants, sensors, future, smoke, obscurants, and command and control weapons (C2W) attack and protection.

ACKNOWLEDGMENTS

I am truly indebted to all of those who have contributed ideas and information in the development of this study. Many of my views and the foundation for this thesis were formulated during my early years as a Smoke Platoon Leader, Smoke Company Executive Officer, and Heavy Division Chemical Company Commander and have continued to evolve everyday since. The smoke soldier is truly a dedicated chemical soldier with a demonstrated warrior ethos in all of his actions. The opportunity to work with many of our nations finest leaders and soldiers is an opportunity I will soon not forget and continue to look forward too.

I am grateful to Dr. Burton Wright, Colonels Darryl Kilgore and Richard Weiner and Lieutenant Colonel Mike Brown, who have continued to provide excellent advice and mentorship. I thank you for your commitment for professional excellence and for your trust and confidence in my abilities.

I am indebted to my MMAS committee, Lieutenant Colonel Max Kline, Majors Jeff Turner and John Schatzel, and Dr. Bruce Leeson for their keen insight and endless encouragement. You have provided direction and focus that allowed me to produce a meaningful and thought provoking endeavor.

The MMAS program offered by the Command and General Staff College is a program I will continue to support throughout my career. The program offers professional military officers the opportunity to conduct study beneficial to themselves and the Army.

Finally, to my wonderful family—Elaine, Quentin, Morgan, Kathleen, and Kyle. Your love, patience, support, and willingness to sacrifice throughout the years and particularly in the formulation of this thesis has been a constant source of encouragement.

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LIST OF ABBREVIATIONS

AO	Area of Operations
CD ROM	Compact Disk Read Only Memory
CS	Combat Support
CSS	Combat Service Support
DEW	Directed Energy Weapon
DIS	Distributed Interactive Simulation
DTLOMS	Doctrine, Training, Leader Development, Organization, Material, and Soldier
EAD	Echelons Above Division
EM	Electro Magnetic
EMP	Electro Magnetic Pulse
HEW	High Energy Weapon
IR	Infrared
LOS	Line of Sight
METL	Mission Essential Task List
MMW	Millimeter Wave
NMS	National Military Strategy
RISTA	Reconnaissance, Intelligence, Surveillance, and Target Acquisition
RMA	Revolution in Military Affairs

SASO	Stability and Support Operations (formally Operations Other Than War)
UV	Ultraviolet

CHAPTER ONE

INTRODUCTION

In this thesis, I examine the role of deliberate smoke and obscurant application and its relevance to twenty-first century maneuver force battlefield success. I conducted a comparison between the twenty-first, century maneuver force vision for the conduct of operations and the Chemical Corps smoke vision. I conclude with observations as to their compatibility and supportability. My primary conclusion is that smoke and obscurance are an advantageous battlefield asset and should be adequately resourced, developed, and integrated into appropriate maneuver tactical and operational training and exercises.

Evolving Strategic Environment

The Secretary of the Army the Honorable Togo West and Army Chief of Staff General Dennis Reimer introduced the new final draft of FM 100-5 with this description of the Army's emerging environment, "The world has entered a period of radical and often violent change. The threats today are more diverse, yet less predictable, than during any other period in our history; they are, however, just as real."[1] The rise and fall of political entities generate ideological friction, and, all too frequently, result in volatile governmental instabilities.

Accordingly, as the world's powers shift, the National Military Strategy evolves. "The National Military Strategy currently focuses us now and into the future on: regional conflicts; crisis response; power projection; and joint, coalition, and interagency operations; all in a wide variety of environments against unpredictable threats."[2] The military has seen, in recent times, a considerable increase in our nation's reliance upon our military's tactical capability to achieve pinpoint strategic objectives while diplomacy

continues on a parallel effort.[3] With the end of the cold war and the emergence of third world hotspots, it is not the same world environment as that of the previous half century. Recent operations in Southwest Asia, Panama, Somalia, Rwanda, Haiti, and Bosnia have given a preview of the challenges that lie ahead and the wide range of missions the twenty-first century Army must be capable of accomplishing. They "illustrate the complexity of force projection operations across the range of military operations and amplify the future critical role technology will play, even in relatively low technological environments."[4]

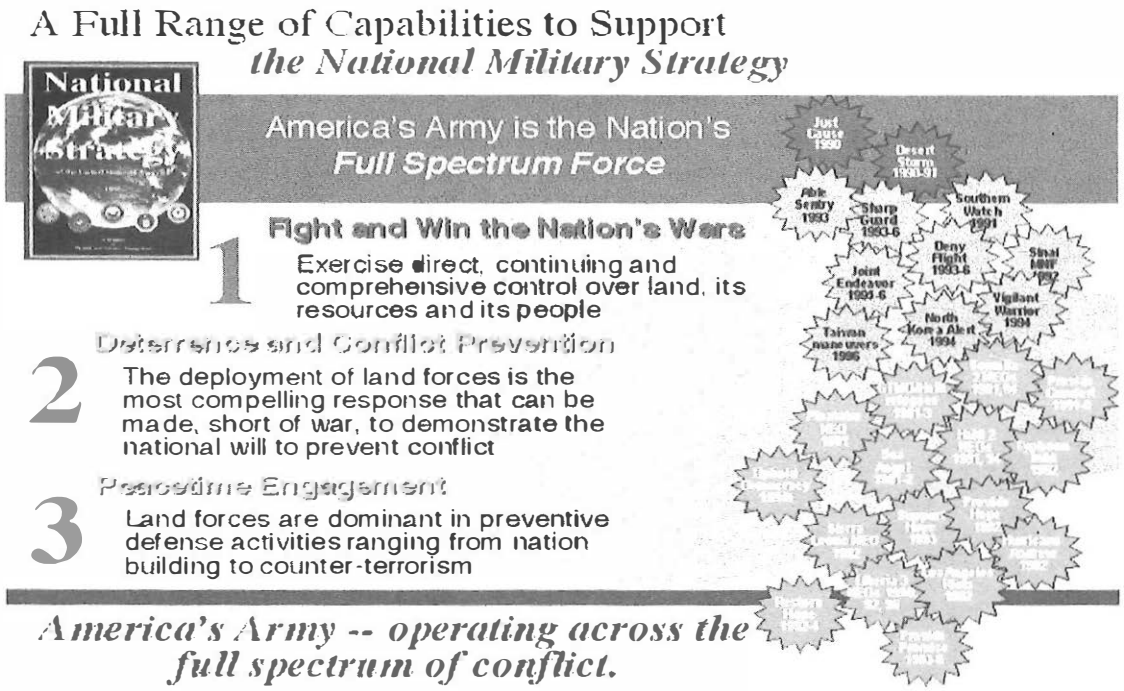

Figure 1. Full Range of Capabilities to Support the National Military Strategy, Source: CSA Briefing "America's Army…Introduction to the 21st Century," 7 November 1997.

Furthermore, as I will define later in greater detail, recent support and stability operations "reinforce the premise that conducting information operations to gain information dominance will be critical to the successful conduct of future decisive operations."[5]

Army's Plan to Meet New Strategic Era

The military focuses their national and tactical intelligence on an opposing force, determine the enemy strategic center of gravity and applies only the force and resources necessary to defeat or destroy the target. Thus, with minimal cost, the nation will win its strategic goal.

In an era unstable, unpredictable, and possibly more volatile than ever before, the Army must prepare to meet new challenges. The Army must be able to defeat an enemy armed with machetes and rifles as well as those armed with tanks, planes, and weapons of mass destruction. One factor that has not changed, though, is that the Army is successful only when it is able to apply its capabilities in a way that imposes its will on the enemy.

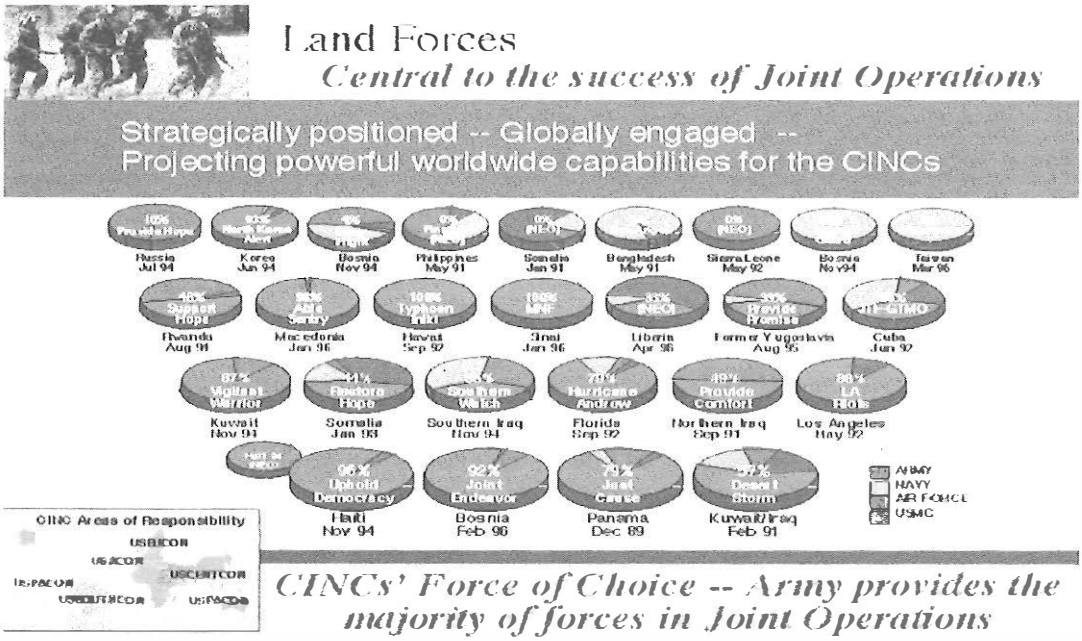

Figure 2. Land Forces Central to the Success of Joint Operations, Source: CSA Briefing "America's Army…Introduction to the 21st Century," 7 November 1997.

The Army must also recognize that the success on past battlefields has resulted not so much from technological advances, but from innovative ways of considering and combining available technologies as they apply to warfighting.[6] One of the most explicit examples of this was the introduction of the armored vehicle in World War I. Until the armored vehicle was integrated with fire and maneuver, its early use was disastrous. These primitive tanks, deployed in small groups, seemed to draw fire and quickly fell prey to massed fires and mechanical failures.[7] The combination of new technology with the time-proven principles of warfare usually results in successful operations. But the Army's challenge today is more complicated than just integrating new equipment. The evolution into the twenty-first century force is more than just a matter of upgrading the weapon systems. It is a total reshaping of the Army, as it is known. The system critically important to ensure new technology is fully integrated across the full spectrum of the

Army is through the framework of TRADOC's domains: doctrine, training, leader development, organization, material, and soldiers (DTLOMS).

In the past, the Army's strategy has been to produce mass quantities of equipment and forces from the vast industrial base and to forward position only enough of them to act as an immediate response force until the rest of the vast armored forces could be deployed. The US has built a machine that, while a formidable military force, as compared to the requirements of the twenty-first century, is cumbersome and costly to maintain and very time consuming to deploy. Such a superstructure is unable to cover all of today's global contingencies and too unwieldy for any immediate deployment of vast armored forces. This mammoth organization was not designed for immediate and sustained armored offensive exploits from a CONUS base. The US Army has had to initially deploy light combat and logistical forces to defend a theater until an armored force, large enough to transition to the offense, is repositioned. This is not so anymore.

Twenty-First Century Patterns of Operations

Current senior military leaders believe that "future warfare will be fought as a series of linear and non-linear battles resulting in no single avenue of enemy approach. In fact, future commanders will seek to avoid linear actions, close-in combat, stable fronts, and long operational pauses."[8] "Recent US operations show that deep battle has advanced beyond the concept of attacking the enemy's follow-on forces in a sequenced approach to one of simultaneous attack to stun, then rapidly defeat the enemy. Commanders will place greater emphasis on operational and/or tactical level raids, combined with deep strikes, to break up an enemy's formation from within."[9]

The nature of warfare in the century will focus on the use of smaller more lethal tactical forces. "Technology has developed to a point where combined lethality can be organized into smaller tactical packages."[10] "Future operations will capitalize on the concentration of joint and combined arms effects, combined when necessary with the actual physical massing of forces. These effects will be directed toward precision attacks on critical information management nodes, key strategic assets, and enemy fighting formations."[11]

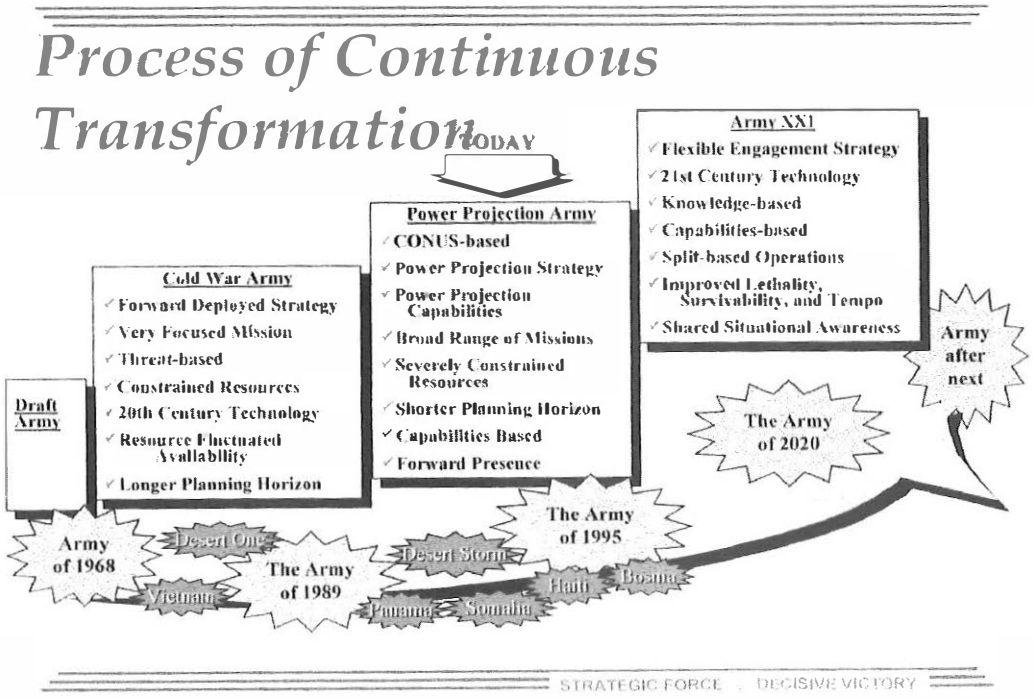

Figure 3. Our Process of Continuous Transformation, Source: CSA Briefing "America's Army… Introduction to the 21st Century, " 7 November 1997.

Future forces will strike quick and hard at their objectives in order to achieve the desired tactical, operational, and strategic desired end states. Advanced future forces will possess the capability to achieve multiple operational objectives nearly simultaneously throughout a theater of operations. This simultaneity, coupled with the pervasive influence of near-real-time military and public communications, will blur and compress the traditional divisions between strategic, operational, and tactical levels of war.[12] Future maneuver commanders should be able to boldly take their objective with minimal expenditures and very few casualties, but their resources will be limited. There will be no room for anyone not making a critical contribution to the team. Tactical, operational, and strategic assets will have to be closely integrated to achieve the ultimate objective in a quick decisive manner.[13] With the transition to small, mobile strike forces has come the transition to a strategy of Information Dominance.[14]

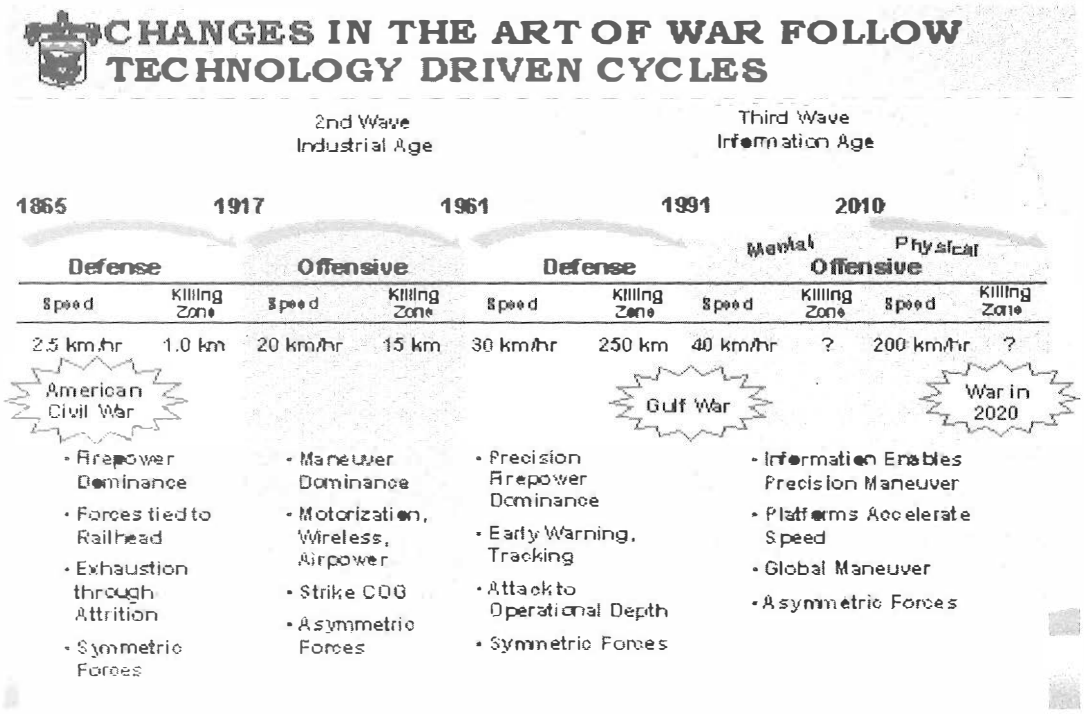

Figure 4. Changes in the Art of War Follow Technology Driven Cycles, Source: AAN Project Briefing "A Look into the Army After Next," 27 January 1998.

Importance of Smoke in the Transition to Information Dominance

Information dominance will not be limited to times of open hostilities. This future strategy is predicated upon exercising electromagnetic spectrum supremacy--a key element of information dominance. While currently control of the entire electromagnetic spectrum may be impossible, key portions must be commanded most of the time. Specifically, the very high frequency (VHF), super high frequency (SHF), extra high frequency (EHF), infared (IR), and visible regions must be controlled in order to maximize technology dominance. The use of battlefield intelligence as the focus of

operations will be the military's strength, but could also easily become an Achilles' heel.[15] Due to ever-increasing reliance on high technology systems that must operate unimpeded in certain ranges of the electromagnetic spectrum, protection of friendly information systems from the myriad threats, while denying the enemy use of his systems, will be absolutely critical. The ability to manipulate, isolate, or negate portions of the electromagnetic spectrum will be a key element of future military operations. Disruption of an opponent's ability to use these systems while protecting the military's own will prove crucial in the future.[16]

All war, both conventional and unconventional, is so very complex with the use of high technological air sorties, missiles, snipers, and mines; all add to the chaos of soldiers and tanks. Unconventional war or guerrilla tactics, including terrorist attacks, do not fight along fixed lines of contact and are even more chaotic. The Soviet Union recently saw this type of conflict in Afghanistan. The US also recently experienced this type of warfare in Somalia. In both cases, the Soviet Union and the US occasionally used smoke to seize the initiative and gain the advantage of key terrain, momentum, or time to overcome the detrimental effects of the unconventional force.

Multidirectional assaults, combined with massive amounts of information (satellite tracking of units, intercepted signals and messages, instantaneous global communication, and, of course, Cable News Network (CNN) battlefield analyses), can confound the enemy and make it difficult for him to distinguish between facts and impressions. When he begins to doubt the reliability of his information and is unable to rapidly discern the important from the inconsequential, he is left unprepared on the field. Smoke can conceal events and relationships that would otherwise be obvious. A

commander with a unit well trained in limited visibility operations can have a tremendous advantage over his enemy. When smoke hides the effects of the conflict and impedes the enemy's decision making, a resourceful commander can strike a lethal blow.

Purpose for Smoke and Obscurants

Deception, concealment, and protection have been some of the foremost benefits of smoke. On a battlefield already shrouded in the "fog of war," smoke can blur the enemy's physical perception and throw him into a state of confusion. If the enemy has not trained for operations in limited visibility, he may no longer comprehend the situation. At the tactical, operational, and possibly strategic levels, smoke amplifies the disorienting effects of conflict. Skillfully directed smoke, in conjunction with friendly decisive action, interrupts the enemy's decision-making process and most often leaves him in a total state of bewilderment.

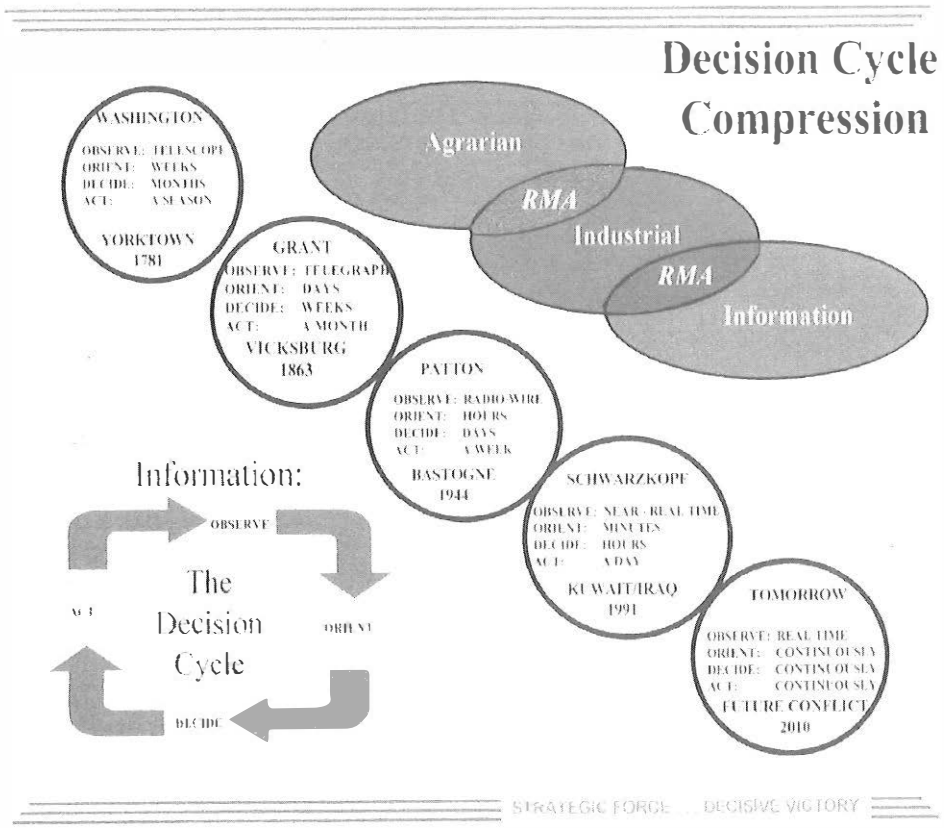

Figure 5. Decision Cycle Compression, Source: DCSOPS Briefing "Strategic Force..Decisive Victory'" 10 March 1997.

Obviously, smoke, alone, neither causes direct destruction nor is a sole influencing force in the course of a battle. It is, however, a method of increasing a commander's maneuver options while simultaneously restricting the enemy's combat effectiveness. Whether in a conventional or unconventional war, when properly used, smoke can be a powerful tool for the maneuver commander and an irrefutable combat multiplier.[17], [18], [19]

Before the Army's decides whether or not smoke units will be an asset or a liability in the twenty-first century battlefield, it ought to look at how smoke has been used in the past. The historical purposes and applications of smoke provide a foundation for understanding the significance of the contribution smoke has made to the battlefield.

History of Smoke Use

Smoke has been used with military forces as far back in history as 1700 with King Charles XII of Sweden crossing the Dvina River in the face of the opposing Polish-Saxon Army.[20] In the twentieth century, smoke has been used over and over to confuse the enemy. During World War I, the US realized a need for obscurants on the battlefields. With the extended range of indirect fire systems and the mobility offered by naval vessels, battlefield operations began taking on new dimensions. Commanders realized that unassisted frontal assaults were perhaps an obsolete method of warfighting. The requirement to conceal forces and vital assets gained momentum as the war progressed. As smoke and obscurants gained popularity, the military conducted several smoke experiments during this period. The use of white phosphorus and other types of smoke became a focal point of experiments for the newly established Chemical Warfare Service (CWS) of the Army.

After World War I, the Chemical Warfare Service continued experimenting to learn more about the affect of smoke and obscurant operations on the battlefield. One study was aimed at determining the tactical value of blinding smoke in preventing aimed rifle fires from hitting their targets. The results of this study are shown in the figure below. While this is only one example of the impact of smoke on operations, studies such as this

one prompted the military to seriously consider the advantages of using smoke and obscurants on the battlefield.

Stage #	Conditions	Shots Fired	Hits	Percent Hits
1st	No smoke	66	38	58%
2nd	Smoke on target	75	8	11%
3rd	Smoke on Firing line	75	2	3%

Figure 6. Tactical Value of Blinding Smoke in Preventing Aimed Rifle Fire, Source: Study conducted on 15 March 1927 by Major Leigh F. J. Zerbee, Chemical Warfare Service, Assistant Commandant, Chemical Warfare School, Aberdeen Proving Ground, Maryland

During World War II, in 1943, the British used smoke to conceal harbors, factories, and large cities from the Luftwaffe's relentless bombing.[21] In the same war, a year later, the US used smoke to conceal supply facilities and the invasion fleet at the Bizerte Harbor in North Africa from the attacking German aircraft. Official estimates are that only one third of the bombs hit their targets as a result of the use of smoke and obscurants.[22]

The Korean conflict also saw an extensive use of smoke to screen supply depots and harbors around Seoul, Puson, and Inchon against North Korean air attacks.[23] Years later, although the dense jungles of Viet Nam provided their own screening effect, smoke was occasionally used to mark targets and disengage enemy contact with light forces.[24]

More recently, in late 1990, during Desert Storm, the 59th Chemical Company demonstrated that, with only ten minutes' warning, they could mask the King Fahd International Airport and force enemy fighter-bombers up to an altitude just right for US stinger teams to shoot them down. Shortly thereafter, in January-February of 1991, the 68th and 44th Chemical Companies conducted a smoke mission along the Wadi Al Batin to aid in the 1st Calvary and VII Corps execution of the ARCENT deception plan. The

ARCENT deception Task Force (4-37 AR with numerous Corps and EAC units) was able to draw all but one Iraqi division east of the Wadi before the ground war was initiated.[25]

These are just a few examples of obscurance operations blinding and confusing the enemy, but they demonstrate the value of smoke. The question remains: Is there a future for the smoke platoon?

In this thesis, I examine the role of deliberate smoke and obscurant application and its relevance to the twenty-first century maneuver force battlefield success. I focus on a comparison of the century maneuver force smoke and obscurance requirements and the Chemical Corps' smoke vision and make conclusions as to their compatibility and supportability. If smoke and obscurance is an advantageous battlefield asset, then it should be fully resourced and integrated into all forms of maneuver training and exercises. If it is not an advantageous battlefield asset, then it should be retired.

Research Questions

The primary question that this thesis answers is, Is there a smoke requirement for the twenty-first century maneuver force and, if so, will the Chemical Corps' smoke vision meet it?

Supporting questions are, How can smoke support Information Dominance? and What is the Chemical Corps' vision for smoke units in the century?

I answer the first supporting question by examining possible uses of obscurants against specific targets or enemy capabilities. To answer the second supporting question, I express the Chemical Corps' vision for smoke units in terms of equipment, personnel, training, force structure and organization, and the contribution these units provide. I answer my primary question by contrasting the answers to my two supporting questions.

Underlying Assumption.

Since, the US Army has not confirmed or locked in the exact design and tactics, techniques, and procedures for the twenty-first century maneuver force, neither can it predict where and when the next battle will occur, I am basing my insights at specific points in time in relation to what I believe this force might be. Additionally to keep this thesis in an unclassified status, I will speak of the specific smoke requirements in general terms and capabilities and not identify specific pieces of equipment or align these capabilities against a specific country.

Significance of the Study

I have not found a publication that directly compares the century maneuver force smoke requirements to the Chemical Corps Smoke Vision. As a result, I believe my thesis will be the basis for future discussion and work to validate or further develop smoke and obscurant usage as a vital future asset.

Scope and Limitations

Due to the limited time to develop both the research into twenty-first century patterns of operations and how smoke and obscurants might meet those requirements, I did not fully investigate and cite the complete history of smoke and obscurants usage. Additionally, I refrained from using classified information to further illustrate my points in order to keep this thesis in an unclassified medium and thus distribute it more freely to cause discussion in regard to my recommendations.

Thesis Structure

To answer the thesis questions, the research addresses such key issues as: twenty-first century maneuver patterns of operations, the Chemical Corps' Smoke vision for the

twenty-first century, projected obscurant requirements for the maneuver force, and the nature of emerging technologies in obscurant application and uses. Chapter One provides the background for the thesis question, establishes the significance of the study, and provides key terminology.

Chapter Two contains a review of the literature and studies related to the thesis questions. The literature review is organized with general comments, trends and patterns, and key works. Included in the literature review are summaries of current manuals, pamphlets, reports, periodicals, articles, and books related to Force XXI concepts of operations, emerging and projected CRSTA systems and capabilities, emerging technologies in obscurant application, and the Chemical Corps' smoke vision for the twenty-first century.

Chapter Three presents the research methodology and the analysis used for this thesis. The research methodology describes the process and techniques used in examining the primary and secondary research questions. The hierarchy and relation between the research questions and issues are established. Each research question is further described and evaluation criteria are established. The analysis used describes the information gathered during the research and literature review. I define the twenty-first century patterns of operations, the requirements for the use of smoke and obscurants, and the Chemical Corps' vision in terms of DTLOMS to meet these smoke and obscurant requirements and compare them to determine their supportability.

Chapter Four contains the conclusions and presents the recommendations for future Chemical Corps' Smoke study, developments, and methods for its application at the tactical, operational, and strategic levels of conflict. Also, contained in chapter 4 are

my conclusions regarding the additional potential future uses of obscurants to support the twenty-first century maneuver force.

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[1] Honorable Togo West and GEN Dennis Reimer, Final Draft, FM 100-5, Operations (Washington, DC: Department of the Army, 5 August 1997), 2-4.

[2] General John M. Shalikashvili, National Military Strategy of the United States of America Shape, Respond, Prepare Now: A Military Strategy for the New Era (Washington, DC: Joint Chiefs of Staff, 1997), 2.

[3] US Army TRADOC, TRADOC Pam 525-5, Force XXI Operations (Washington, DC: Department of the Army, 1 August 1994), 1-5.

[4] US Army TRADOC, TRADOC Pam 525-75, Intel XXI A concept for Force XXI Intelligence Operations (Washington, DC: Department of the Army, 1 November 1996), i.

[5] Ibid, 3.

[6] Ibid, 1.5.

[7] Larry H. Addington, The Patterns of War Since The Eighteenth Century (Indianapolis: Indiana University Press, 1994), 155-158.

[8] TRADOC Pam 525-5, 2.9.

[9] Ibid, 2.9.

[10] Ibid, 3.10.

[11] Ibid, 3.21.

[12] Ibid, 2.9.

[13] Ibid, 3.1-3.21.

[14] Ibid, 1.4-1.5.

[15] Ibid, 3.6-3.7.

[16] Ibid, 2.7.

[17] MAJ Robert C. Neumann, "Smoke-An Analysis of an NTC Battle," Army Chemical Review, July 1993, 6.

[18] LTC Larry R. Jordan, "Battalion Commanders' View on the Use of Smoke," Proceedings of the Smoke/Obscurants Symposium X, 22-24 April 1986, 507.

[19] COL Benjamin Covington, "A Brigade Commanders' View of the Use of Smoke," Proceedings of the Smoke/Obscurants Symposium X, 22-24 April 1986, 445.

[20] Augustin M. Prentiss, Chemicals in War: A Treatise on Chemical Warfare... (NY: McGraw-Hill, 1937), 220.

[21] Leo P. Brophy, Wyndham D. Miles, and Rexmond C. Cochrane, The Technical Services -The Chemical Warfare Service: From Laboratory to Field (Washington, DC: Department of the Army, 1959), 211-215.

[22] Ibid, 211-215.

[23] Ibid, 211-215.

[24] Ibid, 211-215.

[25] LTC Darryl W. Kilgore, "Desert Shield/Desert Storm After Action Review" (2d Chemical Battalion, Fort Hood, TX, 30 May 1991), 1-5.

CHAPTER TWO

LITERATURE REVIEW

General

There was sufficient literature available to conduct adequate research for this thesis. The vast majority of the sources used to define the future patterns of conflict and the smoke and obscurant requirements to support this future force were derived from the TRADOC Pamphlet 525 series. The Chemical Corps' future smoke and obscurants vision was derived from a collection of project manager briefings and three series field manuals (FMs). Because this thesis examines developmental and preliminary operational concepts and organizational structures, much of the available research material was in draft form or in briefing format and not formalized in doctrine. Those items in doctrine are, for the most, part still operational concepts. As a result, the actual operational performance characteristics for some of these systems and concepts are estimates.

Trends and Patterns

Government sources provided most of the key works for this thesis. Government manuals and pamphlets defined the principles and characteristics for the twenty first century maneuver force.

Key Works

TRADOC Pam 525-5, Force XXI Operations, illustrates the Army's vision and basic concepts and requirements of Force XXI. TRADOC Pam 525-5 represents a baseline in the shaping of more definitive follow-on concepts for Army operations in the early twenty-first century. In the forward, it is explicitly stated that "TRADOC Pamphlet

525-5 is not a doctrinal publication, but rather a document of ideas."[1] In its pages are described the challenge of the future force characteristics, the future strategic environment and battlefield dynamics, and finally the future land operations attributes that serve as a guide for the design and development of Force XXI systems and concepts. The chapters on the future strategic environment and the nature of future land operations were particularly useful in helping to define the expected strategic, operational, and tactical environments in which the future smoke units will operate. The chapters on moving from concept to reality identified general and specific implications for the TRADOC domains of DTLOMS that are raised by twenty first century maneuver force operations. These DTLOMS implications provided a general framework for evaluations of the Chemical Corps' twenty first century vision initiatives.

TRADOC Pam 525-3, U.S. Army Operations Concept for Smoke and Obscurant Employment and Countermeasures, was critical because it outlined the Army's possible future smoke vision and basic concepts and requirements. TRADOC Pam 525-3 represents the Army's baseline in the shaping of more definitive follow-on concepts for Army smoke and obscurant operations in the early twenty-first century. In the forward it is explicitly stated that: "TRADOC Pamphlet 525-3 is not a doctrinal publication, but rather a document of ideas."[2] In its pages are suggested some of the challenges of the future smoke force characteristics and the future strategic, operational, and tactical environments and battlefield dynamics. These chapters provided the framework and general implications for the TRADOC domains of DTLOMS that are raised by twnety first century maneuver force operations.

Major General Ralph Wooten's Chemical Corps' twenty first century vision: Protecting the Force establishes the Chemical Corps' focus to prepare itself to support the tactical maneuver commander for Force XXI. The vision statement provides the conceptual connection between the Chemical Corps smoke units of today and the requirements for the Force XXI. The major driver behind the initiatives of the vision statement is the application of new technologies. In the few pages that address smoke and obscurant operations, the vision establishes the dimensions smoke units must dominate to be successful. It also lays out a brief history of smoke usage and sets the basic framework for where smoke capabilities are going in the near future. It concludes with a basic framework for capabilities, applications, and dimensions necessary for success in support of the tactical maneuver commander.

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[1] US Army TRADOC, TRADOC Pam 525-5, Force XXI Operations (Washington, DC: Department of the Army, 1 August 1994), i.

[2] US Army TRADOC, TRADOC Pam 525-3 (Initial Draft), U.S. Army Operations Concept for Smoke and Obscurant Employment and Countermeasures (Washington, DC: Department of the Army, 1 September 1994), i.

CHAPTER THREE

RESEARCH DESIGN

In this study, I first identify future trends in twenty-first century patterns of operations in a comparison with our current methods. From this study, I suggest possible requirements for twenty-first century smoke. I then compare these requirements against the Chemical Corps' smoke and obscurant vision and plan in terms of DTLOMS and conclude whether or not the vision meets the needs. I then compare the two visions for future operations and finalize this thesis with the conclusions of my comparison, highlight those areas where they do not support each other, and suggest any additional insights I have developed during this study.

ANALYSIS

In this chapter, I define the twenty-first century patterns of operations, point out the resulting smoke and obscurant requirements, and layout the Chemical Corps' smoke and obscurant vision/plan in terms of doctrine, training, leader development, organization, material, and soldier initiatives.

Twenty-First Century Patterns of Operations

Dramatic developments in both technology and doctrine have resulted in a revolution in military affairs, sometimes referred to as a military technical revolution, which will continue into the twenty-first century. Operations Just Cause, Desert Storm, and Restore Hope epitomize this revolution and offer the military a glimpse of the future. Notwithstanding these momentous changes, one aspect of human conflict remains unchanged: the paramount importance of land power as an essential element of any

security strategy and the consequent requirement to impose control over people, territory, and events. Land power equates to strategic staying power.

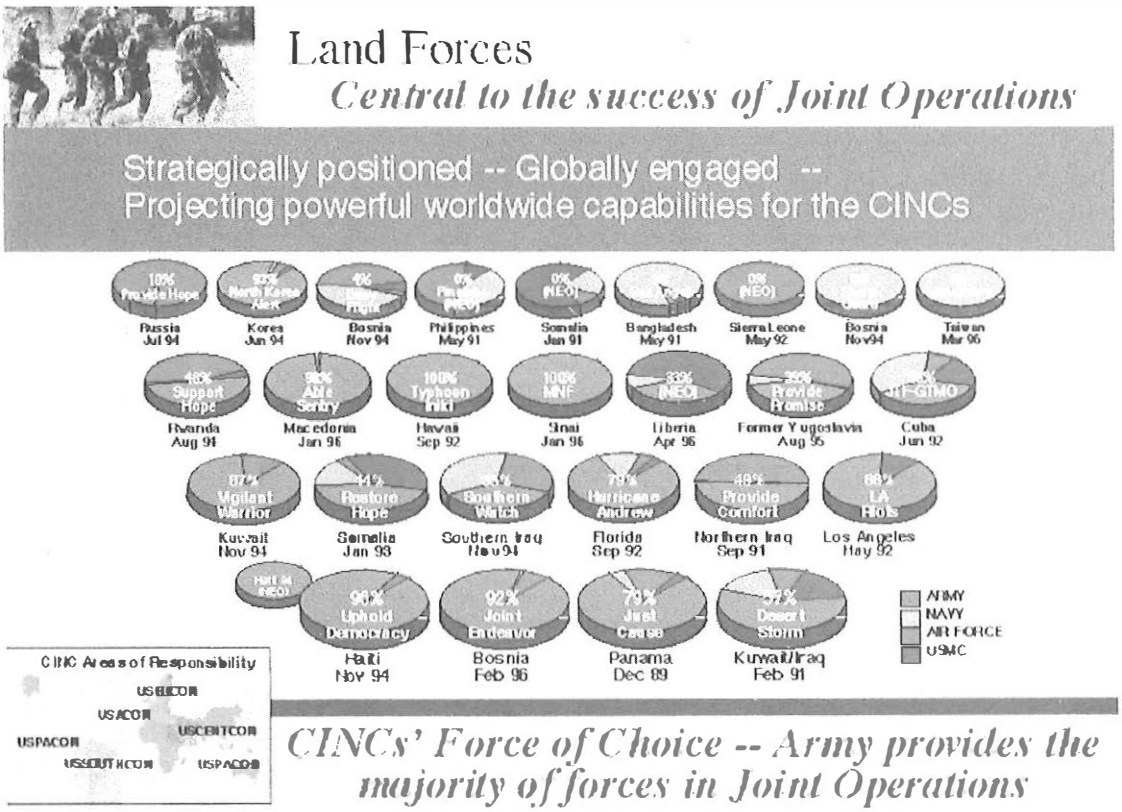

Figure 7. Land Forces Central to Success of Joint OPNS, Source: CSA Briefing "America's Army…Introduction to the 21st Century," 7 November 1997.

Future Battlefields Future conflicts can run the gamut from general war to Stability and Support Operations. Battle between mechanized forces will be similar to the armored operations of the past three decades. However, combat involving advanced, complex, adaptive armies will take the trends of Desert Storm forward to transform the battlefield. "Dominant aspects of the future conventional battlefield are battle command, extended battle space, simultaneity, and spectrum supremacy."[1]

Command will remain a combination of art and science. Yet the art will be more necessary now than before because commanders must apply principles and design considerations and frameworks in situations and scenarios they cannot predict with any certainty--truly a different demand on commanders than the relatively prescriptive and known scenarios of the cold war. Advances in information management and distribution will facilitate the horizontal integration of battlefield functions and aid commanders in tailoring forces and arranging them on land. New communication systems will allow nonhierarchical dissemination of intelligence, targeting, and other data at all levels. This new way of managing forces will alter, if not replace, traditional, hierarchical command structures with new, internetted designs. Accordingly, units, key nodes, and leaders will be more widely dispersed, leading to the continuation of the empty battlefield phenomenon. Because this internetted structure can diffuse command authority, new leadership and command approaches will be required. Thus, the diversity of operating environments, equipment sophistication, increased tempo, and substitution of situational knowledge for traditional physical control will place unprecedented demands on soldiers and leaders. To win on future battlefields, future leaders must be skilled in the art of military operations and capable of adjusting rapidly to the temporal and spatial variations of new battlefields.[2]

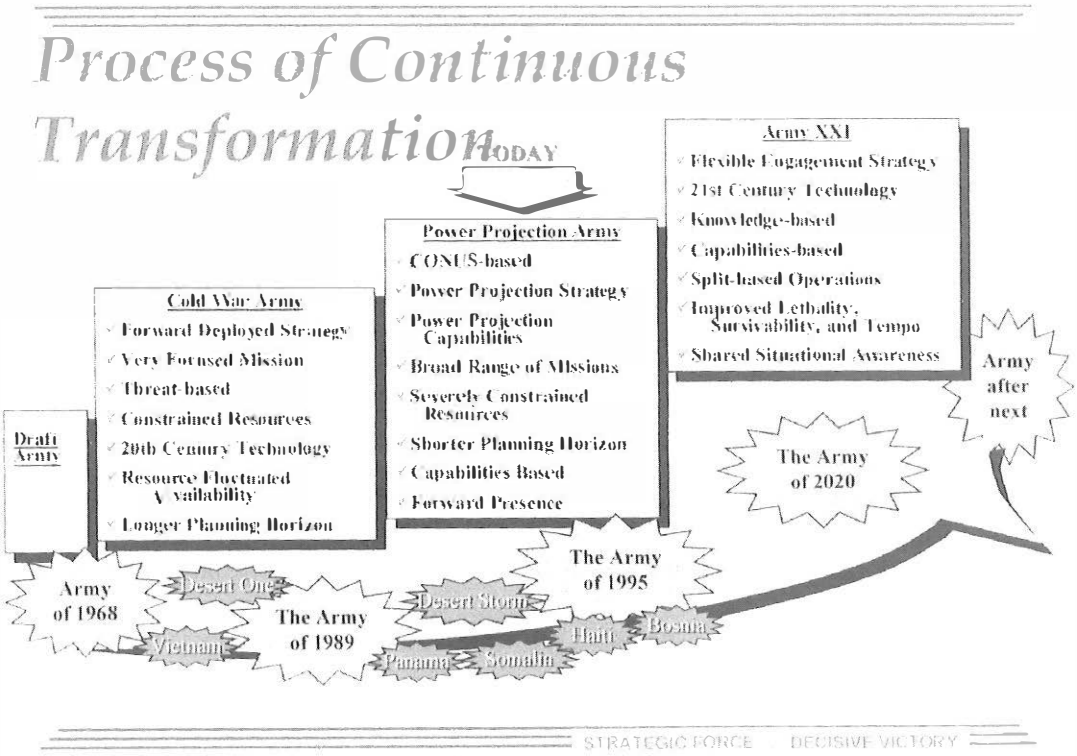

Figure 8. Our Process of Continuous Transformation, Source: CSA Briefing "America's Army... Introduction to the 21st Century," 7 November 1997.

Looking at conventional and high-intensity warfare, recent military-technical development point toward an increase in the depth, breadth, and height of the battlefield. This extension of the battle space, with fewer soldiers in it, is an evolutionary trend in the conduct of war. The continuing ability to target the enemy, combined with rapid information processing and distribution, smart systems, and smart munitions, will accelerate this phenomenon. As the maneuver forces seek to survive, formations will be more dispersed, contributing to the empty battlefield. Commanders will seek to avoid linear actions, close-in combat, stable fronts, and long operational pauses.

Recent US operations show that deep battle has advanced beyond the concept of attacking the enemy's follow on forces in a sequenced approach to shape the close battle to one of simultaneous attacks to stun, then rapidly defeat the enemy. Commanders may place greater emphasis on operational and/or tactical level raids, combined with deep strike means, to break up an enemy's formation from within. The relationship between fire and maneuver may undergo a transformation as we place increasing emphasis on simultaneous strikes throughout the battle space; maneuver forces may be physically massed for shorter periods of time.

The Revolution of Military Affairs (RMA) may transform the familiar form and structure of military campaigns as a chain of sequentially phased operations. Advanced forces will possess the capability to achieve multiple operational objectives nearly simultaneously throughout a theater of operations. This simultaneity, coupled with the pervasive influence of near real time military and public communications, will blur and compress the traditional divisions between strategic, operational, and tactical levels of war. The military has seen simultaneity first attempted in Grenada, followed by use in Just Cause in Panama, and Desert Storm against Iraq. During Desert Storm, no enemy force in the Kuwait theater was safe from simultaneous attack. Iraq was deaf, dumb, and blind. Though they relied on CNN and other US television stations for their intelligence, they had no idea that the US was coming or where the major attack would occur. The use of smoke to perform similar missions with regard to the enemy has been done in previous wars. No enemy force began to move until coalition ground forces attacked. The coalition massed those land forces for only a short period to gain the strategic staying power effect.[3]

Information technology advances will ensure that future operations will unfold before a global audience. Access to media will allow global or official audiences to become involved in, or react to, any and all events. Consequently, military operations, regardless of their importance, dimension, or location, will be conducted on a global stage. Tactical actions and hardship of soldiers and civilians alike will have an increasing impact on strategic decision making and dramatically alter the concept of time-time from crisis to expected action and time for actual conduct of operations. As in the past, real time visual images of operations, both positive and negative, will influence national will and popular support for them.

Most of the future conflicts involving the US Army will be Support and Stability Operations or low intensity conflicts, as few states will risk open war with the US.[4] However, the specter of open war against foes fielding advanced armor and mechanized-based armies must be considered. At this point, we can identify regions, if not specific countries, where the conditions to facilitate or cause high intensity conflict or overt military challenges to US interests exist. Relative improvement in potential threat force capabilities has two bounding principles. First, how much technology and weaponry a state can afford and integrate limits improvement. Second, knowing that states generally will arm to meet perceived regional threats, analysts can focus their analysis.

The Battle Dynamics As previously described, recent operations have given us a glimpse of the nature of future warfare. This glimpse has evolved into what we have named battle dynamics. These battle dynamics give us a framework to describe change and to begin our experimentation with hypotheses that predict outcomes to be confirmed in such experiments. These experiences, combined with our understanding of the

evolving strategic environment and the emerging National Security Strategy, help shape our vision of the early twenty-first century American military operations. Two key elements permeate all the battle dynamics. The first is that in the future joint land operations, force coherence and thus application of combat power can be achieved through shared knowledge of battlefield conditions versus traditional physical control means such as graphic control measures or geographical demarcation of areas of operations. The second element is our quality soldiers and their noncommissioned and officer leaders, trained and developed through education and training in our land warfare university. A description of the first principle of each of the battle dynamics follows.[5]

Battle command is the art of decision making, leading, and motivating informed soldiers and their organizations into action to accomplish missions at the least cost to soldiers. Characteristics of recent operations reinforce the notion that the ambiguities and complexities of future combat require even greater leadership skills and a shift in focus from the positioning of forces to the art of orchestrating the effects of those forces. With this shift, the roles of the commander and the soldiers will gain even greater importance.

Future battle command starts with competent commanders and noncommissioned officer leaders who have developed an intuitive sense of battle gained from study and experience. These leaders must demonstrate the ability to successfully command in a variety of missions, operational circumstances, and geographic environments. It also starts with quality soldiers at the center-soldiers with initiative, soldiers who contribute to the overall intent, far in excess of their numbers, because they are continuously informed. Despite advances in information technology, commanders, leaders, and soldiers will never perfect knowledge of the operational situation surrounding them. Yet, due to the

pace and complexity of future battle, commanders, more so than in the past, must accept uncertainty and not hesitate to act instead of waiting for more analysis or information. Commanders will frequently call upon intuitive skills gained from study and practice to bridge the gap and assist such actions. In addition, as a result of better information distribution, better-informed soldiers will significantly add to this capability to act and to sustain the needed tempo. Yet, as they have in the past, commanders will still have to be with soldiers, to feel their pride and their pain, to listen, then to decide and act at the least cost to them.

This future command system is obviously predicated upon our exercising spectrum supremacy, a key element of information operations.[6] While control of the entire electromagnetic spectrum is impossible, key portions must be commanded most of the time. The Army's use of information as the focus of operations will be strength but could also easily become an Achilles' heel. Protection of friendly information systems from the myriad threats, while denying the enemy use of his systems, will be absolutely critical. In the future, full dimensional information operations must be fully integrated into the planning, preparation, and rehearsal for every operation. Commanders must be personally involved in determining the vital role all aspects of information operations can play in the successful execution of military operations in war and Support and Stability Operations.

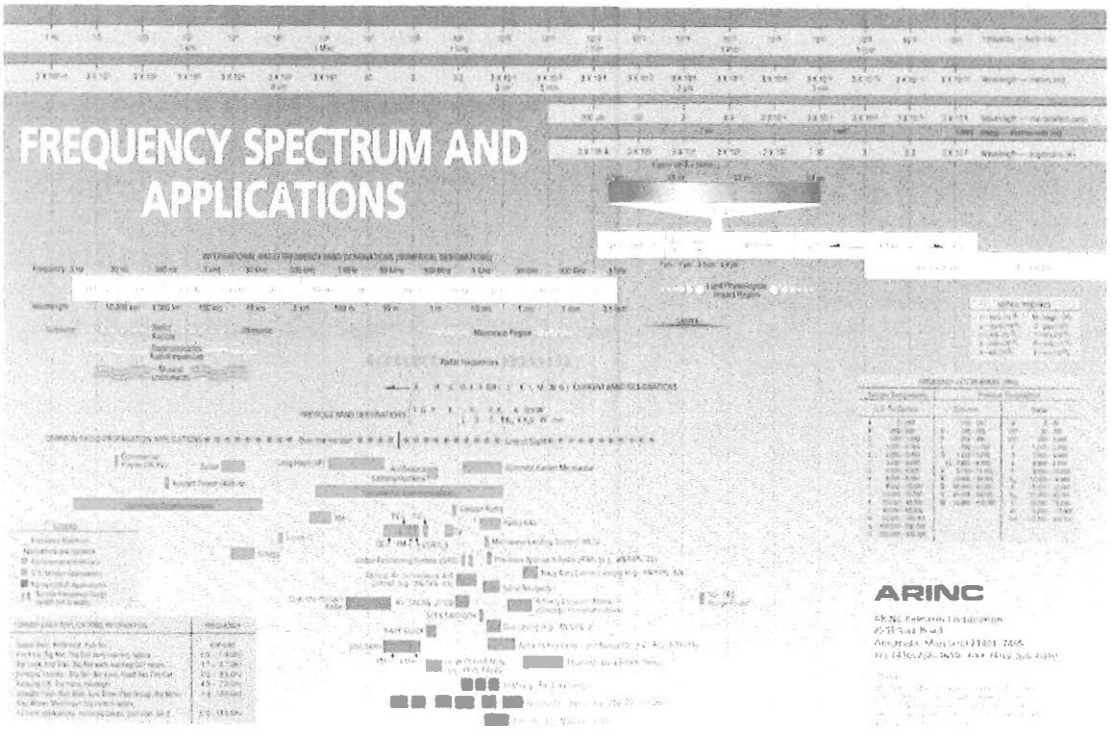

Figure 9. Frequency Spectrum And Application, Source: ARINC Research Corporation, 2551 Riva Road, Annapolis, MD 21401-7465

A joint concept, battle space, is closely associated with the components of battle command. Battle space is the concept that facilitates the type of innovative approach to warfighting required of leaders in future battles. Our forces will be able to dominate an expanded battle space. Such domination will be judged by the ability to be more lethal and survivable and operate at a tempo greater than any enemy will. We must dominate this battle space in war with the minimum number of our own troops in it. In Support and Stability operations, however, more land forces will be required to exercise population control or exercise control over terrain. The trend in combat is toward fewer soldiers in a given battle space; the trend in Support and Stability Operations is to be manpower intensive. Since battle space is not confined by time, boundaries, graphics,

countermeasures, or other physical constraints, it offers the commander a means to look at conditions beyond his traditionally defined area of operations that may affect or influence events within that area.[7]

In the physical sense, battle space is that volume determined by the maximum capabilities of a unit to acquire and engage the enemy. These capabilities will be greatly expanded by future technology. As addressed in the previous paragraphs, technological improvements in maneuver weapons systems, such as advanced optics, increased ranges, and digital electronics, will have a dramatic impact on tactical battle space. Advancements in stealth, metallurgy, propulsion, and suspension technology will result in faster, lighter, more lethal, and more survivable fighting systems. Advancements in camouflage, lightweight communications devices, and soldier protection will fully leverage individual soldier capabilities.

Well-equipped, future Army maneuver forces, operating at an operational tempo controlled by the commander within a given battle space, will use an expanded array of joint weapons systems to engage forces at greater distances with assured accuracy. Based on enhanced situational awareness, the operating tempo of these forces will be such that they will be able to outpace any adversary in both mounted and dismounted warfighting environments.

Information operations influence battle space by providing the commander the means required to better visualize the battle space while blinding or shaping an opposing commander's vision. Battle space then becomes a function of the commander's ability to use information provided by the command system previously described and employ his warfighting systems to achieve the necessary balance to ensure success.

Maneuver force is a critical element in maintaining dominance of battle space. A key element to sustain the maneuver force is force protection. Force protection is the process of finding the enemy and determining his capabilities. In order to effectively implement force protection, maneuver forces must be capable of conducting effective security operations. The use of improved reconnaissance, surveillance, and target acquisition (RSTA) sensors and unmanned vehicles will aid in this objective. Active counter-RSTA measures may include enhanced armor or ballistic protection, deception techniques, and fighting position enhancements for dismounted soldiers, weapons systems, and logistics sites. Passive force protection capabilities will include low observable technology, improved electronic countermeasures, and multispectral camouflage. Passive protection systems and actions must also be sought to protect forces operating within a given battle space where the use of weapons of mass destruction is likely.[8]

The domination of extended battle space will require agile and robust deep and simultaneous attack capabilities. As stated earlier, advances in this dynamic may drive a reassessment of the traditional relationship between fire and maneuver. Combining the concepts of deep operations and simultaneous attack using both lethal and nonlethal means creates a dynamic capability to extend the battle space in space, time, and purpose. It reduces, if not entirely eliminates, the time and need to shape the battle space into three distinct regions: Deep, Close, and Rear. It also facilitates full-dimensional attack of an enemy center of gravity and accelerates his defeat. Simply stated, depth and simultaneous attack will enable the commander to directly influence the enemy throughout the width, height, and depth of his battle space to stun, then rapidly defeat an enemy.[9] By massing

the effects of long and short range area and precision fires, integrating information operations designed to blind, demoralize, and deafen the enemy, concurrent with rapid combined arms ground and air maneuver, a larger and less agile enemy force can be quickly defeated. Although these attacks may not be simultaneous in application from the enemy's perspective, they will appear seamless and nearly simultaneous in effect.

A key component of depth and simultaneous attack will be measures taken to win the information war. These measures will include the establishment of electromagnetic spectrum supremacy through nonnuclear electromagnetic pulse generators, space based information denial systems, ground smoke and obscurants application, and computer viruses.

Depth and simultaneous attack will be a key characteristic of future American military operations and are referred to as distributed operations in the newest draft of Field Manual 100-5.[10] These operations will redefine the current ideas of deep, close and rear. The ultimate goal of depth and simultaneous attack is to overload the enemy's ability to cope by presenting an overwhelming number of actions throughout the depth of the battlefield. Successful force protection will prove essential.

The Chemical Corps' Smoke and Obscurants Vision/Plan

The Chemical Corps stated vision for smoke and obscurant application in the twenty-first century is:

> *The twenty-first century battle space requires total control of smoke and obscurant operations. Automated battle management tools will be used to plan, wargame, and predict coverage. These capabilities provide commanders with real time situational awareness of obscurant effects. This will allow commanders to carefully synchronize operations into the battle plan and achieve maximum degradation of the enemy's capability while limiting adverse effects on friendly operations.*

Commanders require a mix of capabilities so that smoke and obscurants can be employed in front line and rear areas, with a variety of effects. Obscurant technology must anticipate our adversaries' weapons development actions, and provide the capability required to degrade their performance as they modernize their force. [11]

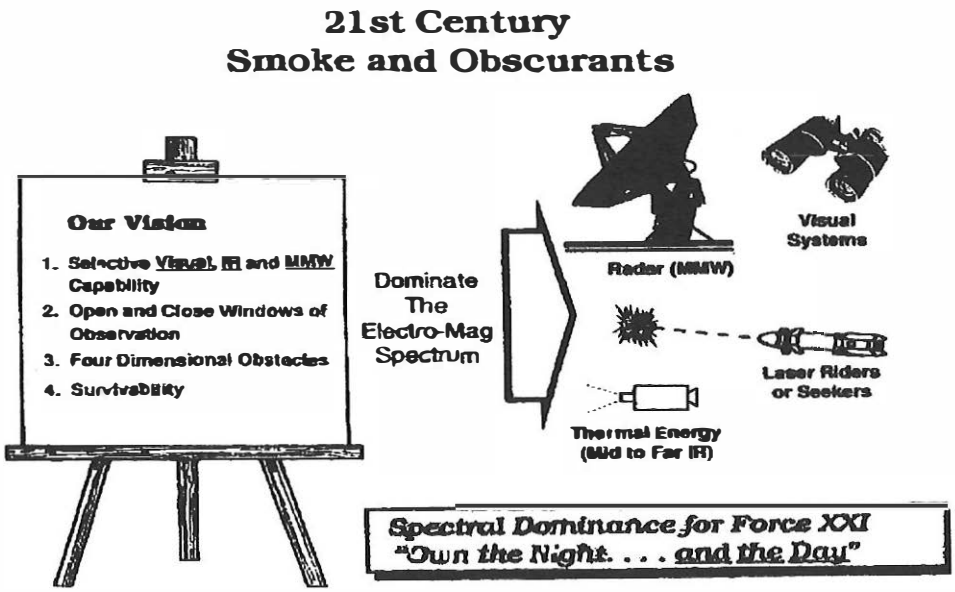

Figure 10. Twenty-first Century Smoke and Obscurants, Source: Commanding General Chemical and Biological Defense Command Briefing "A Look into the Future," 25 April 1997.

Obscurants are potential combat multipliers when used in support of combat operations. The Office of the Secretary of Defense, Joint Camouflage, Concealment and Deception Joint Task Force (OSD-JCCD) has conducted exercises that demonstrate the value that smoke and obscurants add to friendly combat capability. These exercises demonstrate that obscurants provide up to a forty percent decrease in the enemy's antiarmor effectiveness. In addition, visual smoke combined with thermal sensors and viewers measurably reduces the enemy's ability to engage friendly forces without

significantly degrading friendly combat capability. Obscurants preserve combat power and increase system survivability.[12]

New sensors abound in intelligence gathering, target acquisition, and weapons guidance and are increasingly available in the world marketplace. Countering enemy sensor systems is critical in preserving friendly combat power. Smoke and obscurants provide a cost effective sensor countermeasure that enhances maneuver force survivability by denying an enemy the use of his detection, target acquisition, weapons guidance, and directed energy systems. To meet the growing sensor threat, obscurant systems must emphasize large/limited area screening, self-protection, and projected capabilities that screen the military significant portions of the electromagnetic spectrum from the ultraviolet to the millimeter wavelengths.

Table 1. Electro-optical systems defeated by smoke.

Spectral Region	Electro-Optical System	Type of Smoke
Visible 0.40–0.75 mm	Viewers: – Daylight Sights – Naked Eye – Camera Lens – Binoculars/Standard Optics – Battlefield TV – CLOS Missiles (for example AT-3) – Night Sights	All
Near IR 0.75–4.00 mm	Viewers: – SACLOS Missiles (for example, AT-4 and AT-5) – Night Sights Sensors: – Laser Designators – Laser Range finders	All All
Mid-IR 4–14 mm	Viewers: – Passive Thermal Sights	WP, PWP, RP, Type III IR Obscurant, Dust
Far-IR 14 100 mm	Sensors: – Thermal Imagers – Terminal Homing Missiles (AT-6)	WP, PWP, RP, Type III IR Obscurant, Dust
MM Wave and Lower Frequency 1.10 mm	Radar Radio Microwaves	WP and PWP (Instantaneous Interruption Only), Developmental Obscurants
X Ray and Higher Frequency	Directed EMP Nuclear Weapons	Oil Smoke (Attenuation Only), Developmental Obscurants

Figure 11. Electro-optical Systems Defeated by Smoke, Source: Field Manual 3-50 Smoke Operations, 11 September 1996.

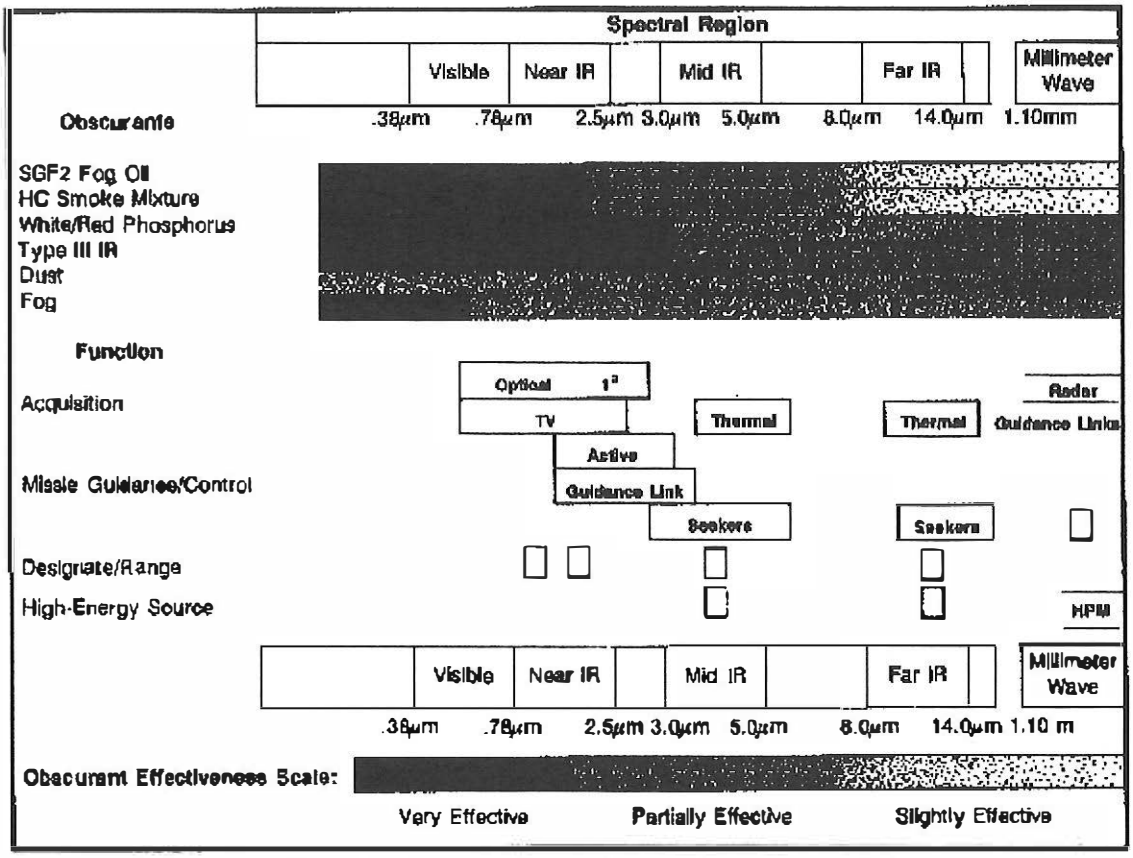

Figure 16. Obscurant effects on battlefield electro-optical devices.

Figure 12. Obscurant Effects on Battlefield Electro-optical Devices, Source: Field Manual 3-50, Smoke Operations, 11 September 1996.

The twenty-first century maneuver commander will be equipped with a variety of sensors that will provide him with a detailed picture of the friendly force, the battle space, and threat operations. Sensors in support of obscurant operations will assist the commander and staff with sufficient information to plan and conduct smoke missions, as well as to determine optimal movement routes, battle locations, and weapons systems to close with and destroy. Sensors will be employed to monitor vehicle logistical status and

to report the level of attenuation achieved by natural and manmade obscurants presently on the battlefield.

A family of sensors will be used to confirm or deny the location of obscurants, both natural and manmade, the level of attenuation caused, and the frequencies at which the obscurant is causing attenuation. Incorporating this information into both smoke mission management and the scheme of maneuver will provide the friendly commander with a significant tactical advantage over his threat counterpart. This information will allow commanders and staffs to compare the frequencies used by friendly and threat RISTA systems to the frequencies being attenuated on the battlefield to determine which friendly systems will be successful and which threat systems will be degraded or defeated. During friendly smoke operations, the data received will assist in determining if satisfactory coverage has been achieved, if not, then where assets must be shifted to achieve the desired state of obscuration.[13]

These sensor systems will be accurately and reliably deployed throughout the depth of the battle space using a variety of technologies; manpacked, vehicle mounted, ground mounted projectile, air and space based. The information gathered by these sensors will provide the maneuver commander vital information for mission planning. This increased situational awareness provides operational planners with the necessary information that will assist in determining the optimal weapons array, movement routes, and battle locations that will synergistically combine to set the parameters for success.

Battlefield commanders will require a mix of obscurant capabilities that can successfully attenuate a variety of threat RISTA systems operating from the ultraviolet (UV) through the far millimeter wave (MMW) portion of the spectrum. While control of

the entire electromagnetic spectrum may be impossible, key portions must be commanded most of the time. Specifically, the very high frequency (VHF), super high frequency (SHF), extra high frequency (EHF), infrared (IR), and visible regions must be controlled in order to maximize the technological dominance. Future obscurants will allow the commander the flexibility required to defeat threat RISTA systems in diverse environments based on mission needs. The twenty-first century maneuver commander will use obscurants that take full advantage of the technology base already established in the commercial sector.

Army Smoke and Obscurants Program must be designed to:	Through:
Protect The Force	Degrade/prevent visual or nonvisual observation, targeting, or acquisition of friendly forces
Shape The Battlefield	Allow the enemy to see what we want him to see, and conceal what we want to conceal; support counter-reconnaissance
Dominate The Electromagnetic Spectrum	Tactical commander's quick response tool to open and close 4-dimensional "windows":
Disrupt Enemy Operational Tempo	Slow confuse and desynchronize enemy operations, allows our commanders to thicken the fog of war
Deceive The Enemy	Use to conceal or draw attention to friendly ops, when integrated into a comprehensive deception plan

Figure 13. US Army Chemical Corps' Future Smoke and Obscurants, Source: US Army Chemical School 21st Century Vision Statement, 1 February 1996.[14]

Future Maneuver and Chemical Corps Smoke and Obscurants Vision

Implications in Terms of DTLOMS

The most viable framework in which to address the implications of the twenty-first century land warfare is in terms of their impact on the TRADOC domains: doctrine, training, leader development, organizations, material, and soldiers or DTLOMS.[15]

Future Maneuver Doctrine. The Army will continue to be a doctrinally based institution. Thus, while doctrine will remain the primary means of embodying the Army's ideas on how to think about land operations, a hallmark of American doctrine will be its versatility and adaptability. Consequently, future doctrine will be increasingly influenced by a number of factors, among them changing strategy, developments in human sciences, and information technologies. Information age technology will have a profound impact on both the doctrinal process and, of course, doctrine itself. Doctrine must serve as a catalyst for change, explaining the changes in a language that all soldiers and leaders can fully understand. The major thrust in future doctrine development will be living doctrine based on a fluid, strategic environment, lessons learned from ongoing operations, emergence of new warfighting technologies, and results of simulations and battle lab experimentation.[16]

As the twenty-first century land force refines new ideas and concepts, their doctrinal relevance will be quickly captured in manuals and ultimately through CD-ROM (compact disk read-only memory) type technology--communicated throughout the Army. Key to this timeliness will be electronic staffing whereby Army learning and combat training centers, major commands, doctrine developers, operational planners, and subject-matter experts will form an internetted system for the development of relevant doctrine.

Versatility will be a key characteristic of future doctrine. With the advent of wider roles and missions in the future, the twenty-first century Army will have to interface with other services, foreign forces, government, and even nongovernment agencies, in doctrine development. The critical importance of developing doctrine for multinational operations, tailored for traditional allies and even likely coalition partners, will require command emphasis. The expanding scope and unpredictable nature of future military operations make doctrinal initiatives along these lines essential for success in war and Support and Stability Operations. Progressive, timely, relevant, and flexible doctrine will prove critical to success on future battlefields and noncombat areas of operation.[17]

Chemical Corps Doctrine. The Chemical Corps primary doctrine sources for smoke and obscurants application are FM 3-50 Smoke Operations and FM 3-101-1 Smoke Squad/Platoon Operations Tactics, Techniques and Procedures. Currently they address the basic principles for smoke and obscurant application in the visual and IR ranges.

Future Smoke and Obscurant Missions. Smoke and obscurants are employed to dominate the electromagnetic spectrum, from the ultraviolet through the millimeter wave portion of the spectrum, in support of offensive and defensive operations. Smoke and obscurants disrupt enemy combat operations and support deception operations throughout the depth of the battle space, in any intensity of conflict, through the selective denial of electromagnetic frequencies. This capability translates into the following missions:[18]

1. Degrade the Enemy's Ability to See. The enemy's ability to see includes his unaided vision and electro-optical means of surveillance, detection, identification, and target acquisition from the ground, aerial, or space based platforms. The projection of

visual, infrared or millimeter wave (monospectral, bispectral, multispectral) obscurants on an enemy's position, or between enemy and friendly positions, reduces his observation of friendly forces. It also reduces his intelligence gathering abilities and organic target acquisition capability. Friendly forces could use these between target designation devices and targets to blind surveillance, target acquisition, and fire control systems, or defeat precision guided munitions. Coverage hides relevant target location cues causing the mean aim point error to double. Proper obscurant application increases wrong target attacks from four to seventeen percent and reduces target acquisition distance by fifty percent. Obscurants can mask key terrain features used as navigational aids, deny the enemy the use of air avenues of approach or deny the use of air battle positions. They can deny the enemy the use of air assault landing sites/drop zones or approaches to amphibious landings. Future obscurants will attenuate terrain radar systems by masking terrain, inducing false readings, and causing system overload.[19]

2. Disrupt Enemy's Ability to Communicate. The enemy's ability to communicate will include the full range of oral and visual signals and electromagnetic transmissions. The projection or generation of various obscurants on enemy positions or between enemy signal relay points reduces his ability to send and receive visual and electromagnetic signals. The enemy's ability to see and communicate is critical to his force effectiveness. Obscurants on an enemy position can disrupt his command, control, communications, intelligence, movement, and operations. Obscurants placed on an attacking force may cause it to modify its speed, change its axis of advance, deploy prematurely or too late, and rely on nonvisual means of command and control. Obscurants on a defending enemy force will isolate positions and degrade the execution of planned shifts, withdrawals, and

counterattacks. Future obscurants will attenuate the threat's communications but will permit selected frequencies to pass allowing uninterrupted friendly and coalition communications.[20]

3. Conceal Friendly Operations. Smoke and obscurants can conceal combat operations by defeating enemy electro-optical surveillance systems. Battle positions prepared under the concealment of obscurants will deny the enemy critical battle space information of unit size, strength, location, and activity. Obscurants can conceal combat support (CS) and combat service support (CSS) activities, such as decontamination, refueling/rearming, clearing the battlefield of casualties, and denying the enemy clear targets or tactical information. Friendly forces are particularly vulnerable to direct fire weapons during movement; obscurants over and around maneuver elements deny accurate fire on combat vehicles and troops. Self-screening vehicular systems can break the guidance link of an antitank guided missile and allow evasive maneuvers. Obscurants have proven to reduce target acquisition distance by fifty percent and increase aborted attacks over five-fold.[21]

4. Deception. Smoke and obscurants can serve as a deception tool to assist in building both mass and economy of force effects. Large area obscurants can be used with battlefield deception techniques to enhance the realism of dummy unit locations and create illusions of friendly size and intent. Obscurants can be employed on multiple avenues of movement by employing smoke generators, pots, or indirect assets to deceive the enemy as to the main effort. Based on enemy target acquisition means, obscurant clouds can be used with other deception techniques such as decoys, movement, radio-frequency emitters, heat sources, and corner reflectors to create target signatures. Future

obscurants may contain hot spots and metallic additives to replicate heat and radar reflection of vehicles and structures.[22]

5. Identify and Signal. Smoke readily attracts visual attention. It can be used to mark locations on the ground and transmit signals. Projecting obscurants onto enemy positions can mark targets for air attacks and other weapon systems. In dense forests, smoke projectiles are useful for adjusting artillery. Colored smoke grenades can be used to identify unmarked landing and drop zones and indicate wind direction for the pilots. Smoke grenades can also be used to relay prearranged messages or codes or temporarily disrupt munition guidance for closed line of sight weapons.[23]

6. Defeat Energy Weapons. Advances in high power microwave and millimeter wave target acquisition systems have led to speculation that weapons could use electro-magnetic (EM) energy against distant targets. This EM stress would induce system failure through degradation of electronic components, personnel disablement, or structural damage. Other weapons that can damage personnel and material though electromagnetic energy transfer include electromagnetic pulse (EMP), kinetic energy, and lasers. Obscurants cannot defeat all weapons effects (e.g., gamma radiation). However, specially designed obscurants that reflect, absorb, or scatter specific wavelengths could potentially provide partial protection against directed-energy weapons and thermal radiation.[24]

7. Enhance Friendly Weapon System Effectiveness. Obscurants produce synergistic effects that beneficially influence military operations. They create perceptions of isolation, uncertainty, and encapsulation in the enemy soldier. This reduces his effectiveness and raises his susceptibility to stress. When overwhelming powerful

weapons have been used, obscurants can conceal the visual indicators of their use and increase their lethality. Smoke and obscurants cause psychological and physiological stress and disorientation, like being lost in a fog bank. When employed in mass quantities across large areas, they interfere with detection and reaction to obstacles, barriers, minefields, and suppress flash ranging techniques. Obscurants isolate enemy elements to facilitate their defeat in detail. Obscurants support counter-electronic warfare by forcing the enemy to use electronic transmissions more frequently and less effectively. In battlefield deception, smoke enhances the use of decoys and dummies by concealing the real and portraying the false. Future obscurants may provide a warning (color change) when they encounter chemical or biological agent/vectors. Investigations are proceeding in methods to use smoke clouds combined with additional reactive properties for terrain, facility, equipment, and personnel decontamination.[25]

8. Training. Training friendly forces to operate in an obscured environment must include new innovative obscurant employment techniques for both offensive and defensive operations. Leaders must develop their professional understanding of obscurant effects, electro-optical system behavior, logistics, micrometeorological constraints, threat obscurant tactics and available countermeasures, as they pertain to military operations. Tactical command and staff training must include a realistic portrayal of obscurant and countermeasure effects, constraints, and restraints while soldier training must address physiological and psychological effects.[26]

9. Joint Operations. Obscurants can support operations in a littoral environment from beach preparation through follow on missions. During the initial assault, indirect obscurants placed between the beach and the enemy will deny the defender the use of his

surveillance and target acquisition systems. Infrared and millimeter wave screens will be used on or in front of the enemy positions. Signaling smoke may be used to mark lanes or unit boundaries. When possible, canopy smoke will be used to reduce vulnerability to enemy air attacks while minimizing disruption to assault activities. Once ashore, the landing force will use smoke pots, smoke generators, and artillery smoke to conceal continued landing operations, consolidation and forward movement. Smoke and obscurants can be used in conjunction with other decoy devices to defend and protect air bases and their critical nodes. Smoke and obscurants defeat precision guided munitions' ability to lock on to their targets. They also eliminate the target reference point that an enemy aircraft bomber needs to determine when to release his munitions. When used with other decoy devices, airfield protection is increased up to sixty five percent.[27]

10. Stability and Support Operations (SASO). During low intensity conflict and stability and support operations, obscurants primarily support small unit operations and deception plans. Signaling smoke is used extensively in support of air-ground operations. Immediate employment of smoke grenades and smoke pots is used to counter an enemy attack or to screen maneuver, counterattacks, or disengagement operations. Medium and large area screens will be generated for both day and night operations to conceal friendly operations and deceive the enemy. Where speed is critical, fields of smoke pots may be air dropped from helicopters. Obscurants will deny enemy forces visual observation of troops and equipment assembly areas, weapons positions, combat service support installations, river-crossing sites, and landing of air mobile forces. Friendly forces will take maximum advantage of technical superiority of friendly acquisition systems to operate through smoke.[28]

Doctrine Comparison. Results from the comparison of the two visions indicate that the Chemical Corps smoke and obscurants vision needs to include further discussion and exploration in terms of tactics, techniques, and procedures in the use of an automated smoke and obscurant battle management system for staff planning and mission execution. It must also identify the need for obscurant application outside the ultraviolet to the millimeter wave ranges of the electromagnetic spectrum to include very high frequency (VHF) and high frequency (HF) in order to attack extended communications capabilities and further application as a non-lethal offensive weapon. Support to the Joint Force Commander also needs further development for joint application and integration into the full range of operations.

Future Maneuver Training. Training in support of future full dimensional operations will cause the twenty-first century Army to realign the three pillars of the Army training system: institutional, unit, and self-development. The integration of those three training strategies will yield more fully a seamless future training strategy for every soldier and unit. The future training strategy will continue to be task-based trained to a standard under varying conditions. All training executed in the institution and in the unit or by the individual soldier will directly contribute to improved soldier, leader, and unit mission readiness.

Several trends and factors will influence what the twenty-first century Army trains, how it trains, when it trains, and where. Although the downward trend in the size of the force will stabilize, the Army will be smaller than the one that served our Nation through the early 1990s. The world continues to be an unstable and dangerous place facing various threats with a wide range of military, economic, and technological

capabilities. The Army will continue to focus on maintaining its technological advantage over these varying threats. Army scenarios in which soldiers will be employed cover the full range of military operations, but virtually all will involve joint operations and most, particularly in Support and Stability Operations, will be combined. Environmental constraints and reduced training funds will further limit large-scale field exercises.[29]

This smaller, more lethal, more flexible Army must ensure that what it trains will contribute to the wider variety of missions in which it might be employed. It is essential that new soldiers at all levels be instilled with the warrior ethos. That part of institutional training must remain constant. The Army will have to examine and modify the current mix of institutional and unit training. This will impact the total Army and result in modified mobilization training strategies. The smaller force will have fewer individual specialties for both officers and enlisted soldiers.[30] Training in the various levels of joint operations will occur earlier in a soldier's career. Units will continue to concentrate their training on the mission essential task list (METL); however, elements of that will change to meet diverse future combat and support and stability operations scenarios. Regional orientation will not be possible for active component units but will for early deploying reserve component units.

Major changes will occur in the way the twenty-first century Army is able to train and thus sustain its ability to operate and execute their assigned missions. This will lead to the merging of individual, unit, and self-development parts into a seamless Army training system. For a variety of reasons, the number of installations on which traditional institutional training takes place will decrease as will the number of installations on which major (battalion level and above) field exercises will occur. However, these

installations will be internetted and interconnected to facilitate both individual and collective training at all levels. Individual skill training refreshers and sustainment will be available to each soldier. Databases will be available to the soldier routinely to address lessons learned from previous operations, worldwide political and demographic information, or expert individual specialty training requirements. It will be a classroom without walls. The capability to interconnect virtual live and constructive simulations for unit training across the full range of military operations will be necessary and must be embedded in our equipment. Distributed interactive simulations will tie geographically dispersed units together for training and actual mission rehearsal. This capability will be required in order to become a joint team. However, the essence of land combat is control achieved by operations on a variety of terrain.[31] Thus, for units at battalion and below where teamwork skills are rapidly perishable, especially for the higher tempo twenty-first century operations, continuous field environment training, especially at combat training centers, is essential. This is so because it is at our combat training centers where soldiers, leaders, and units experience a realistic, tough battle scenario that requires synchronized execution at all levels. This must continue.

Chemical Corps Training. From the institutional level, officer basic and advance courses and NCO professional development system much teach the specific impacts of obscurants on friendly and enemy weapons systems and available countermeasures to operate effectively in an obscured environment.

At the unit and individual training levels solutions must be included that incorporate distributed interactive simulation learning. The Chemical Corps has just recently developed and fielded one such system. The M56 interactive CD ROM training

will enhance the smoke system operators' technical knowledge about the equipment and smoke system as a whole. This CD-ROM training represents a low cost alternative but still high impact training for our future spectrum supremacy managers. This computer-based system will be available to the lowest level smoke units, training units, and other units that could integrate smoke and obscurants into their operations. Another advantage of the M56 interactive CD-ROM training is the ability to train our smoke specialist without any possible health hazards, any damage to the environment, or any other associated physiological related safety variables.[32] Though it is not totally self-sustaining and does not completely replace the need for practical application, it does provide and basis to sustain limited proficiency in resource constrained times.

The future smoke and obscurant management system will have the capability to efficiently plan, rehearse, assess effectiveness of smoke clouds, determine windows of opportunities, and monitor smoke and obscurant missions. Through the aggressive employment of obscurants on the battlefield we will dominate the electromagnetic spectrum and significantly reduce the threat's ability to acquire targets and to employ his smart weapons.

Training Comparison. Results of the comparison of the future training requirements indicate the Army's inadequate integration of smoke and obscurance into both actual and simulated exercises at all levels. Additionally, the Chemical Corps' vision lacks the emphasis of the various global threats and threat sensors arrays, the joint perspective for smoke and obscurant application, and the emphasis on maintaining the warrior ethos while preparing for the more common support and stability operations,

contributes to the Army's inadequate integration of smoke and obscurance into both actual and simulated exercises at all levels.

Future Maneuver Leader Development. The Army's future leaders will be fundamentally competent and have the necessary intuitive sense of operational units and soldiers. The twenty-first century Army will have a higher leader to led ratio. Leaders will have a keen awareness of the world and how the role of military force operates in that world. Future leaders will have a broader understanding of war and the art of command.[33]

Future leaders must understand the changing nature of the legitimacy of command authority. While position and rank, along with accumulated and demonstrated wisdom and judgement, will still provide command authority, authority gained heretofore by possession of more information will change. Leaders must exploit the potential to be found in military organizations that are flatter, internetted, and where quality soldiers with expanded and timely information are able to reach their full potential for initiative and action within the overall intent when given that opportunity.

Future Army leaders must be able to fully exploit the opportunities that command systems, such as the one described herein, provide. They cannot use these systems to second guess or interfere with the command prerogatives of subordinate commanders. They must have such intuitive skills such as vision, innovation, adaptability, and creativity and the ability to simplify complexities and clarify ambiguities all while operating under stress.

Leaders will be schooled in joint and multinational operations and skilled in synchronizing and harmonizing all aspects of combat and noncombat operations. Future

leaders will have a higher level of doctrine-based skills, knowledge, attitudes, and experience to apply the battlefield operating systems to a wider range of complex contingency missions. In fact, the complex nature of future operations may require leaders of greater experience and rank commanding at lower levels than ever before. Regardless of experience or rank, all future leaders will be called upon to make rapid, doctrinally sound decisions as they plan and execute missions in more diverse, high-pressure operational environments. Tactical level leaders, for example, must be prepared to make decisions, such as those involving rules of engagement and others that may have major strategic consequence, under the scrutiny of the international media.[34]

Chemical Corps Leader Development. The lack of adequate obscurant modeling, simulation and wargaming capability hinders the ability of the Army leaders to fully understand the capabilities and limitations of battle space obscurants. It is critical that the battle labs, senior command and staff schools, and other TRADOC centers incorporate these features into wargames to properly assist in leader development.[35]

Chemical officers must develop a much greater level of expertise in the field behavior of obscurants, their effects on the variety of currently fielded RISTA systems, and their relationship to military operations. This will improve the chemical officer's ability to make sound recommendations to the commander regarding the use of friendly smoke assets, implementing countermeasures, and the optimal use of friendly RISTA systems operating in an obscured environment.

Realistic use of obscurants and obscurant countermeasures during field training allows unit leaders to develop an appreciation of its multiplicative combat value and of

the challenges they impose on the operational and logistical aspects of military operations.

Army senior level schools should include instruction in planning considerations and potential impacts of obscurants. Leaders must train obscuration operations as both a task and as a battlefield condition under which mission/branch specific collective and individual tasks are performed.[36]

Comparison of Leader Development. Results of the comparison indicates the Army needs to better train its senior leaders at all levels in the effects gained from the use smoke and obscurants to maintain spectrum supremacy. This can be partially accomplished through more realistic portrayal of smoke and obscurants use in exercises. Additionally, the Chemical Corps vision needs to focus training to develop Chemical Corps leaders to have such intuitive skills such as vision, innovation, adaptability, and creativity and the ability to simplify complexities and clarify ambiguities all while operating under stress. Chemical Corps leaders must also be schooled in joint and multinational operations and skilled in synchronizing and harmonizing all aspects of combat and noncombat operations.

Future Maneuver Organization. The future Army will be smaller yet have new, expanded, and diverse missions in an unpredictable, rapidly changing world environment. These factors mandate change to the way we organize. First, it is essential that we be able to rapidly tailor organizations for operations. Second, we must organize around information processing and dissemination. Third, leader to led ratio must change and be flexible for specific missions. Likewise, staffs may not be constant in size, but be tailorable to the mission. Fourth, we must organize around the division as the major

tactical formation with the capability to tailor it for specific mission purposes. Fifth, combat support and combat service support must be modular, then capable of task organizing for the mission. Future organizational design will capitalize on the full range of mission capabilities available in the Total Force structure, leading to the success that is essential for knowledge based operations. The twenty-first century units led by innovative commanders more than likely will be modular in design, allowing the rapid tailoring of units to operate within any potential contingency situation in joint and multinational operations. Based on these factors, experimentation in organizational design, along with technological advances, material, and supporting operational concepts, will be essential to evaluate and refine the future concepts of the type described herein. For example, objectives such as sensor to shooter links will drive changes in our approach to fire support and, in turn, the organizations that provide and coordinate fires. The logistics demands of future force projection operations call for a reassessment of existing combat and combat support structures as well as a determination of the relevance or utility of some branches/corps.[37]

As mentioned earlier, digitization of the battlefield and other advances in information technology will result in smaller staffs and highly mobile command posts at all levels of command. Even though staffs will be generally smaller, new information technologies will allow them to perform more functions. Organizations at lower levels will be able to perform joint and multiservice functions previously conducted at much higher levels. In essence, functions at all organizational levels must be reevaluated.

Organizational design must maximize the use of technologies that will allow functions to be performed on a remote stationary location. Organizational designers will

use technology advances to decrease the size of units while expanding lethality. survivability, and deployability. Home or remote stationary capabilities will reduce deployability requirements, provide for continuity of operations, and reduce personnel requirements through versatile/multiple use of stationary assets.[38]

The success of twenty-first century operations will depend on spectrum supremacy. As a result, future organizational design must consider increased use of electronic and directed energy warfare. More activity in the electromagnetic spectrum will result in new staff functions and possibly organizations to manage those operations.

Future operations will be joint, often combined, and frequently interagency or with nongovernemnt organizations. A structure should exist at the appropriate level to properly coordinate staff actions among agencies, services, and coalitions, instead of organizing ad hoc to accomplish the missions.[39]

Chemical Corps Organization. No specific force structure changes have been identified as a result of this concept. However, with the ongoing development of Task Force XXI, Division XXI, and Corps XXI structure it becomes increasingly apparent that the Army's generated obscurant assets will not be assigned to tactical units.

The current force structure plan sends all generated obscurant assets to the Corps level. The Chemical School's proposal has not been finalized; however, the broad-based capability remains the same. The Corps requires sufficient assets to support each brigade level combat and combat service support operation. Based on our current allocation rules, with a smoke platoon's capability equating to one unit, a standard five and a third division heavy corps requires sixty units of smoke capability. These units will consist of some combination of mechanized, motorized, and dual-purpose elements.[40]

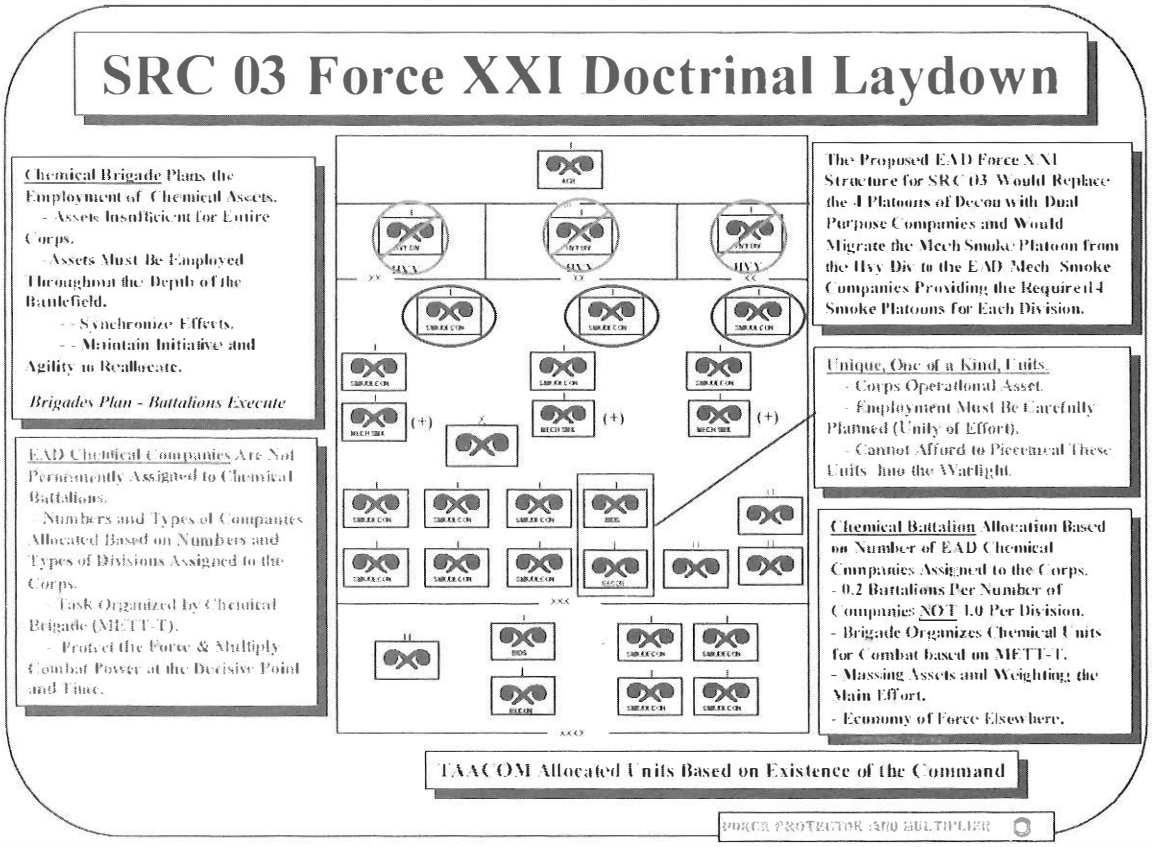

Figure 14. Chemical Corps Tactical Unit Future Force Structure, Source: US Army Chemical Corps Total Army Analysis Briefing "US Chemical Corps..Force Multiplier," 10 November 1997.

The specific operational and maintenance manning of obscurants generating systems should be developed keeping in mind that the near, mid, and far term solutions mandate the use of nondevelopmental and partially developed items. The logistical

impact of these items must be thoroughly worked to allow integration of maintenance procedures and repair parts requisition into the Army system. The increased sophistication of these systems requires a higher level of knowledge, skills, and attributes than would normally be required of a chemical officer or NCO.

Comparison of the Organizations. Results from the comparison of organization visions indicate a need for the Chemical Corps to organize smoke and obscurant capability that is modular in design, allowing the rapid tailoring of units to operate within any potential contingency situation in joint and multinational operations. Since the success of twenty-first century operations will depend on Spectrum Supremacy and since increased activity in the electromagnetic spectrum will result in new staff functions, the Chemical Corps staff officer must be trained more as a spectrum manager. In addition, since future operations will be joint, often combined, and frequently interagency or with nongovernment organizations, chemical advanced courses must incorporate this training into the training scenarios.

Future Maneuver Material. A force projection Army must be versatile, lethal, deployable, sustainable, and capable of victory in the nation's wars and support and stability operations. It must be responsive to meet the challenges of full dimensional operations. The material requirements to support this emerging warfighting concept are both revolutionary and evolutionary. Leveraging technologies that are horizontally integrated into weapons systems and platforms will drive the future material capabilities described herein.[41]

The effects of a smaller Army will demand use of highly technical systems that will increase battlefield tempo, lethality, and survivability.

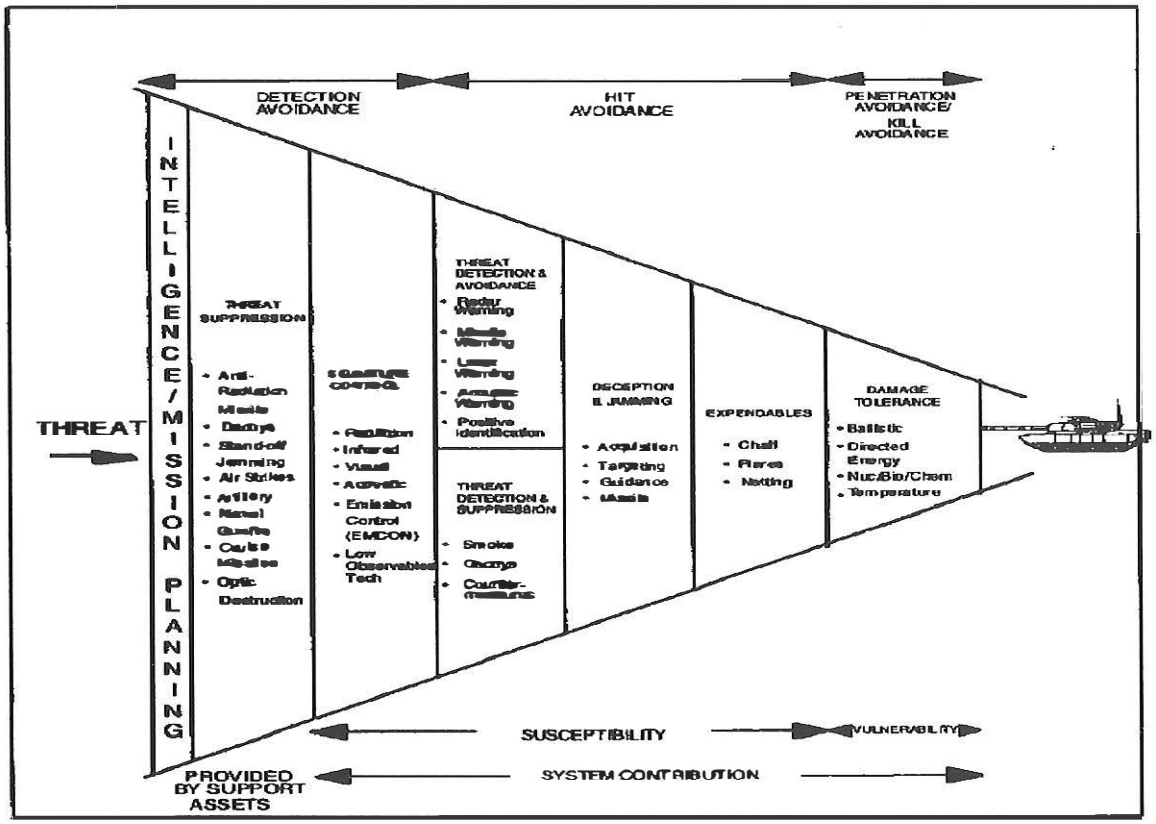

Figure 1.3-1. Spectrum of Survivability Enhancement Opportunities

Figure 15. Spectrum of Survivability Enhancement Opportunities, Source: The Army Systems Survivability Strategy "Lethality/Survivability Battlelab Report," December 1996.

Material enhancements, upgrades, research, and development must focus on the capabilities to meet the following:[42]

1. The force projection Army must be able to quickly project lethal and survivable combat power across the range of military operations around the globe. Emphasis must be on designing, developing, and procuring weapons systems, multispectral smoke and obscurant platforms, support equipment, and sustaining equipment that is light, durable,

and multipurpose, with a significantly smaller footprint to meet mobility requirements. Embedded technologies will increase the availability, reliability, and maintainability of systems that support extended logistical lines.[43]

2. Improved intelligence and advanced information systems, along with high technology weapons, will greatly expand the battle space of future maneuver formations. The use of deep precision strike weapons, sensors, brilliant munitions, electromagnetic cloaking obscurants, and smart weapons will allow combat forces to apply overwhelming firepower within their battle space.[44]

Future operations will rely greatly upon space based intelligence and communications system. Satellites backed up by wide band terrestrial means will be significant, providing a capability to pass greatly increased quantities of data. Requirements also exist to possess electronic warfare protection features, antisatellite capabilities, and amplified electronic warfare attack and protection systems. The future battlefield will require the capability to access the enemy strength, location, and movement over wide areas; to communicate with and coordinate forces over great distances; to accurately position friendly ground forces; and to acquire targets and guide weapons to those targets far beyond the forward trace of troops of a routine operation. Space systems will provide surveillance, communications, weather environmental contamination and terrain data, and positioning and targeting capabilities that will give tactical commanders at all levels a comprehensive knowledge of the battlefield.[45]

Chemical Corps Material. New sensors abound in intelligence gathering, target acquisition, and weapon guidance systems. Smoke and obscurants provide a cost effective sensor countermeasure that enhances maneuver force survivability.

Survivability is based primarily on avoidance and is defined in the following criteria: avoid being detected, if detected avoid being acquired as a target, if acquired as a target, avoid being hit, avoid being penetrated, if penetrated avoid being killed. Smoke and obscurants greatly enhances the ability to avoid detection, acquisition, and engagement portions of this equation.

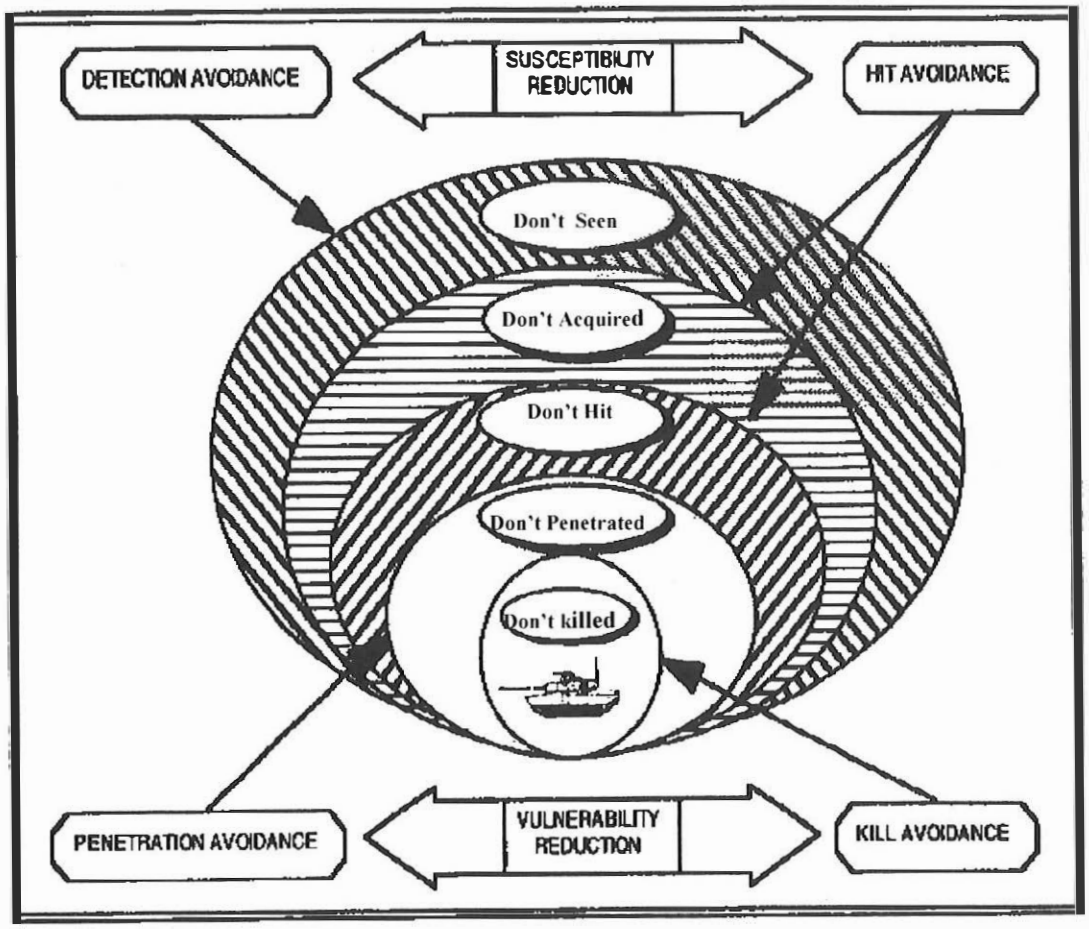

Figure 1.2-1. Threat Avoidance Categories

Figure 16. Threat Avoidance Categories, Source: The Army Systems Survivability Strategy "Lethality/Survivability Battlelab Report," December 1996.

To meet the growing sensor threat, we must continue to develop and/or improve smoke programs that emphasize large area smoke screening systems, self protection smoke systems, and projected smoke systems that screen in the visual, infrared, and millimeter wave length regions of the electromagnetic spectrum. Currently, the Army has recently fielded two new systems that are the first generation precursors to what the Army will need in the twenty-first century: the M56 Motorized Smoke Generator "Coyote" and the M58 Mechanized Smoke Generator "Wolf". The M56 and the M58 are designed with same turbine based, multispectral smoke generator technology. The M56 uses the M1097 High Mobility Multipurpose Wheeled Vehicle (HMMWV) as the carrier while the M58 resides on the M113A3.

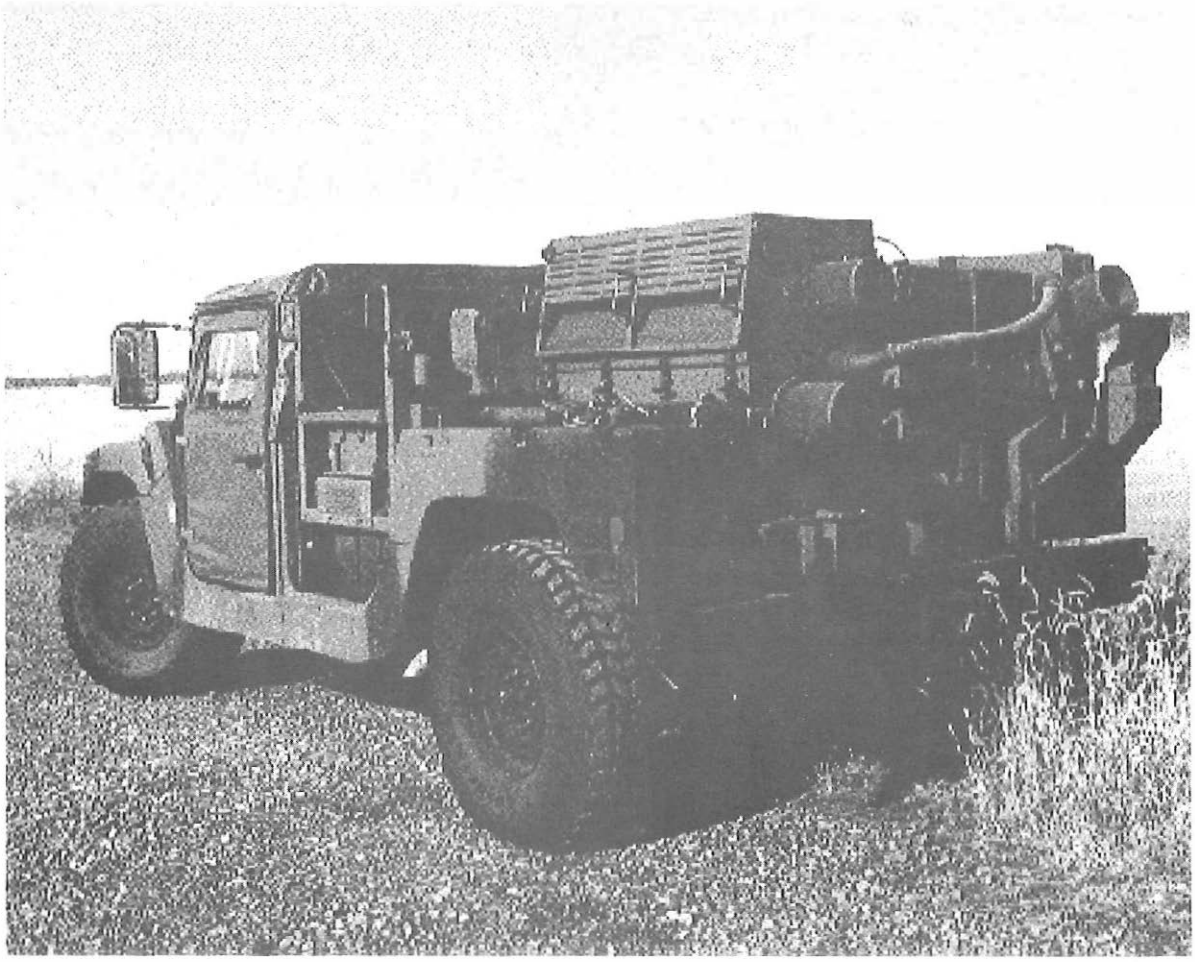

Figure 17. M56 Motorized Smoke Generator "Coyote," Source: Project Manager Smoke and Obscurants Homepage, 12 April 1998.

The M56 was developed to meet the US Army's urgent requirement for a highly mobile, multispectral, large area obscuration capability to support light and airborne maneuver units. It represents the first new smoke generator technology that the US Army has developed since the 1940's. The M56 Smoke Generator System operates either on the move or stationary and can selectively provide visual, infrared (0.7 to 12 um), or combined visual/infrared screening on demand at variable flow rates. Its primary mission is to defeat enemy sensors and smart munitions such as tank thermal sights, guided

munitions, directed energy weapons, and other systems operating in the visual through far-infrared regions of the electromagnetic spectrum. A preplanned material change to add a ½ hour millimeter wave obscuring capability will defeat enemy radar RISTA devices and weapon systems. The system is powered by a turbine engine, provides hot exhaust for vaporizing fog oil, JP8 or diesel, bleeds air that powers an air ejector for disseminating infrared obscurants, and generates electrical power that runs various pumps and motors. The system is controlled from the HMMWV's cab by either the driver or operator, and is extremely simple to operate and maintain. No special tools, test equipment, or changes to existing Military Occupational Specialty (MOS) skill levels are necessary.

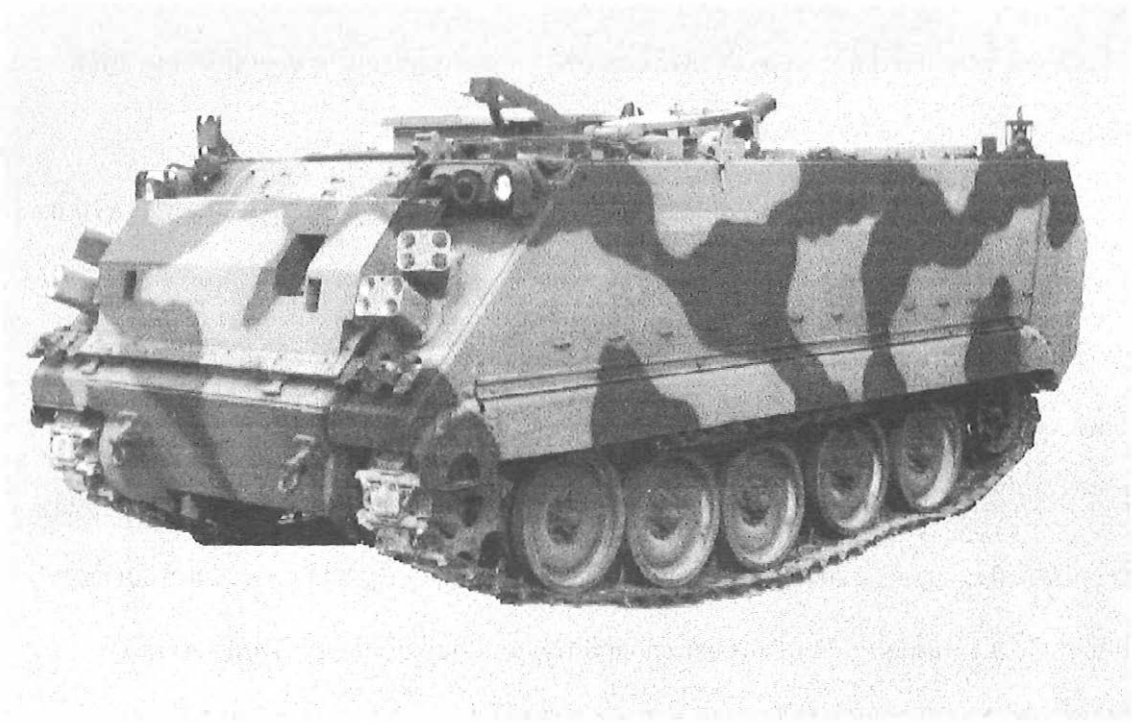

Figure 18. M58 Mechanized Smoke Generator "Wolf," Source: Project Manager Smoke and Obscurants Homepage, 12 April 1998.

Used as a heavy and armored force close combat multiplier, the M58 provides the armored protection necessary for it to be deployed in forward battle areas to deny the enemy essential information by concealing his M1 and M2/3 maneuver forces, breaching operations, river crossings, and recovery operations. Through the integration of numerous subsystems, the M58 meets the requirements identified to defeat electro-optical devices operating in the visual and infrared wavelengths. Both the M56 and M58 are equipped with a Smoke Generating System capable of producing 1 to 1 ½ hours of continuous visual and/or ½ hour of infrared cloud without resupply of obscurant. A preplanned material change to add a ½ hour millimeter wave obscuring capability will defeat enemy

radar RISTA devices and weapon systems. The smoke generation equipment of the M56 and M58 are very similar except the M58 smoke control panel is operated from within the armored protection of the M113A3.

No matter how effective the M56 and M58 may currently seem to be, we need a technological breakthrough to find one truly multispectral material. Having the capability to produce obscurants that will effectively defeat high tech ground, air, and space based electro-optical systems is a major priority for the U. S. military. [46]

New equipment design must emphasize system safety, simplified logistic support concepts, and avoidance of health hazards. Tactics, techniques, and procedures for use will include a consideration of soldier capabilities and human factor engineering to simplify employment, command and control, logistical support, and operation of the equipment. Unless precluded by overriding operational constraints, all smoke agents to be used in proximity to friendly troops will be nontoxic.[47]

The following new material systems require research and development. These material capabilities are required to support the overall concept of obscurant employment and countermeasures. [48]

1. Development of an automated capability to wargame, plan, and monitor obscurant operations. It must access current and future command, control, communications, computers and intelligence systems (C4I), military database, Internet, micrometeorological data, battle space obscurant visualization assets, and obscurant asset administration/logistics data. It must also conduct parametric analysis, provide management and decision making tools, and provide a three-dimensional display of obscurant and countermeasure effects.

2. Improved obscurants that effectively attenuate electromagnetic emissions from the ultraviolet through the far millimeter wavelengths using either/or energy based system or a particulate additive that minimizes volume/mass requirements.

3. Obscurant pots, drums, generators, and projectable rounds that can be tuned, on site, to block selected frequencies, from the UV through MMW wave lengths, while remaining transparent to others.

4. Smoke systems that produce heat and radar cross section signatures to better replicate target or terrain features. Smoke and obscurant systems that create clouds of varying heat and density for decoy and deception operations.

5. Obscurants that change the speed at which sound propagates through the air, hence interfering with the sound ranging techniques.

6. The capability to safely employ tailorable and predictable nonlethal materials to attain the effects to degrade enemy personnel, material, and equipment throughout the battlefield. It must be environmentally and occupationally safe.

7. Sensors with automated capability to identify and classify battlefield-employed obscurants, measuring concentration levels, and provide notification to both friendly elements and staff planners.

8. Small, lightweight and modular, tactical obscurant generating systems that can be tailored for specific missions such as breaching, bridging, close and deep attack, and logistical operations.

9. Fixed facility smoke capability for prolonged use in static, hardened positions. It must be remotely controllable from a single location and integrated into the facility's micrometeorological information system and provide automated control of generator

operations in changing climatic conditions, ensuring complete coverage. Fixed site obscuration capability requires a renewed emphasis.

Comparison of the Materials. Results of the comparison indicate a need for the Chemical Corps to develop rapidly, deployable, smoke systems and obscurants that are not only not ground based but are capable of indirect or aerial and sea based application to manipulate other regions of the electromagnetic spectrum beyond the visible, infrared, and millimeter wave. In addition, the Chemical Corps smoke and obscurants vision needs to include further discussion and exploration in the development of an automated smoke and obscurant battle management system for staff planning and smoke and obscurant mission execution.

Future Maneuver Soldiers. Quality soldiers, trained and led by competent and caring leaders, will remain key to success on future battlefields. Soldiers in the twenty-first century will be faced with a wide variety of challenges in preparing for and executing missions in full dimensional operations. They will be trained on selected critical individual tasks in initial entry training to ensure they are immediately deployable upon joining their first unit. They will be familiar with the wide variety of tasks expected of them and the equipment they will use. The battlefield contribution of the individual quality soldiers will continue to increase and, indeed, is at the root of knowledge-based operations.[49]

Increased flexibility and adaptability will be required at all levels. Training and leader development will focus on preparing junior officer and noncommissioned officer leaders for vastly increased responsibility at a much lower rank and earlier in their careers than is the case today.

Soldiers will be exposed to a wide diversity of operations in different geographical environments, often on short notice. Soldiers' equipment will be designed for these realities. Individuals will be equipped with personal protection systems and communications and weapons systems that will allow them to respond instantly to the chain of command and to rapidly changing situations. Human science will greatly improve soldier training and education as well as individual physical and mental readiness in preparation for the rigors of the high tempo, high technology operations described herein.[50]

Chemical Corps Soldiers. Future soldiers will be faced with a variety of challenges in preparing for and executing full dimensional operations. We need to build soldier and leader confidence in the use of obscurants through rigorous training programs that prove how obscurants effect both threat and friendly RISTA systems and how to overcome the effects of obscurants through the use of countermeasures. The capability of the current and future RISTA systems will directly affect the soldier's ability to accomplish the mission. Awareness of obscurant capability and its contribution is critical in developing the complete soldier and becomes more important as the Army evolves into the twenty-first century.[51]

Comparison of the Soldiers Visions. Results of the comparison indicates a need for both the Army and Chemical Corps to build soldier and leader confidence in the use of smoke and obscurants. Only through rigorous training programs can this critical confidence demonstrate how obscurants effect both threat and friendly RISTA systems and how they may overcome the effects of obscurants through the use of countermeasures. Awareness of obscurant capability and its contribution is critical in

developing the complete soldier and becomes more important as the Army evolves into the twenty-first century.

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[1] US Army TRADOC, TRADOC Pam 525-5, Force XXI Operations (Washington, D.C.: Department of the Army, 1 August 1994), 2-8.

[2] Ibid, 2-8.

[3] Ibid, 2-9.

[4] Ibid, 2-10.

[5] Ibid, 3-8.

[6] Ibid, 3-6.

[7] Ibid, 3-8.

[8] Ibid, 3-10.

[9] Ibid, 3-10.

[10] US Army Combined Arms Center, FM 100-5 Draft, Operations (Washington, DC: Department of the Army, 23 March 1998), 2.42-2.43.

[11] MG Ralph Wooten, Chemical Corps' 21st Century Vision Protecting the Force, 15.

[12] US Army TRADOC, TRADOC Pam 525-3, US Army Concept for Smoke and Obscurant Employment and Countermeasures (Washington, D.C.: Department of the Army, 1 September 1997), 4.

[13] Ibid, 6.

[14] MG Ralph Wooten, 15.

[15] TRADOC Pam 525-5, 4-1.

[16] Ibid, 4-1.

[17] Ibid, 4-2.

[18] TRADOC Pam 525-3, 8-11.

[19] Ibid, 8.

[20] Ibid, 9.

[21] Ibid, 9.

[22] Ibid, 10.

[23] Ibid, 10.

[24] Ibid, 10.

[25] Ibid, 10.

[26] Ibid, 10.

[27] David G. Curry, Christopher L. Riley, and Randall R. Williams, "An Objective Quantification of Limited-Area Smoke Screens Against Airborne Attacks," Proceedings of the Smoke Symposium , 1995.

[28] TRADOC Pam 525-3, 11.

[29] TRADOC Pam 525-5, 4-3.

[30] Ibid, 4-3.

[31] Ibid, 4-3.

[32] TRADOC Pam 525-3, 29.

[33] TRADOC Pam 525-5, 4-4.

[34] Ibid, 4-4.

[35] TRADOC Pam 525-3, 29.

[36] Ibid, 30.

[37] TRADOC Pam 525-5, 4-5.

[38] Ibid, 4-6.

[39] Ibid, 4-6.

[40] TRADOC Pam 525-3, 30.

[41] TRADOC Pam 525-5, 4-7.

[42] Ibid, 4-8.

[43] Ibid, 4-8.

[44] Ibid, 4-8.

[45] Ibid, 4-8.

[46] MG George E. Friel Keynote Address for Smoke Symposium XVIII, Campaign to the 21st Century, 1.

[47] TRADOC Pam 525-3, 32.

[48] Ibid, 31-32.

[49] TRADOC Pam 525-5, 4-10.

[50] Ibid, 4-10.

[51] TRADOC Pam 525-3, 32-33.

CHAPTER FOUR

CONCLUSION

In the twenty-first century there will be a significant change in the Army's smoke and obscurant doctrine. Today, the role is in passive defense and is viewed as a combat multiplier with the mission of providing force protection. In the twenty-first century this passive role will supplement an aggressive mission of attacking threat sensors and seekers. Military leaders should expect future adversaries to use multispectral targeting and acquisition systems. Smoke and obscurants should be designed to attenuate those enemy frequencies used for target acquisition, target lock, guidance, control, arming, or activation. Friendly forces will use information and communication networks while significantly reducing the threats use. This will limit them from determining the course of action resulting in an inability to respond aggressively to our operations. Since the reduction in atmospheric transmission is wavelength dependent, an obscurant that significantly degrades one wavelength may have no effect on others. In other words we will tune our smoke capabilities to obscure the enemy's wavelength without disrupting our operations.

By 2010, the nation will have built an Army that is knowledge based and have this distinct advantage over any competitor. Future victories will be based around the need to build a balance between the monumental killing power and the ability to maneuver to gain positional advantage. However, the killing zone, the distance across which a body of soldiers must cross, will likely become enormous. In Napoleon's day, it was 150 meters. It expanded an order of magnitude with the muzzle loaded rifle and it expanded by an order of magnitude again with indirect fire in World War I. In the Gulf

War, the killing zone was about 120 miles wide and 350 miles deep. Probably by 2020, that may double again and will be tremendously more deadly. Traversing this distance without a corresponding increase in speed requires nullifying the enemy's ability to identify and acquire targets.

Battle space obscurants will continue as a dominating factor in land warfare, well into the next century. Dominating the electromagnetic spectrum is vital to set the parameter for success and obscurants will continue in this role. Continued study and investigation will provide significant appreciation of the capability and potential for its battle space and support and stability operations.

Joint or multi-service study must allow us to focus this endeavor and leverage our combined talent and capital. Our current approach to obscurant system development divides our resources and pits the interested parties against each other. Unity of effort will synergistically improve our research and development capabilities and perhaps gave our combined forces the precise tools required to exploit the electromagnetic spectrum to its full capability.

The future smoke and obscurant management system must have the capability to efficiently plan, rehearse, assess effectiveness of smoke clouds, determine windows of opportunities, and monitor smoke and obscurant missions. Through the aggressive employment of obscurants on the battlefield we will dominate the electromagnetic spectrum and significantly reduce the threat's ability to acquire targets and to employ his smart weapons.

In the twenty-first century, obscurants must also have a non-lethal attack role and must be recognized as another weapon for the warfighter to defeat the threat's combat

power. Smoke and obscurants in both passive and non-lethal operations must establish spectrum supremacy and contribute to the ultimate success during twenty-first century land combat.

There are two parts to the answer for the focal question Is there a smoke and obscurant requirement for the twenty-first century maneuver force and, if so, will the Chemical Corps vision meet it? I believe I have clearly showed the criticality of smoke and obscurance to the success of the information dominance based future force. To answer the second portion of the question I have indicated the near term support of the Chemical Corps vision for smoke and obscurants to meet the needs to sustain that force. However, the Chemical Corps vision provides near term development to meet those needs and lacks the foresight to bridge the 2010 gap as indicated by the following shortfalls.

In order to maximize the effects of smoke and obscurants capability and complete the bridge to support the twenty-first century battlefield, the Chemical Corps needs to address the following identified shortfalls based on my research.

1. The Chemical Corps needs a comprehensive obscurant automated battle space management system that provides an integrated wargaming, planning, vulnerability analysis, and assessment capability to optimize obscurant assets and countermeasures.

2. The Chemical Corps needs a networked obscurant detector/sensor array and a selective obscurant warning capability.

3. The Chemical Corps needs a tailorable battle space obscurant delivery capability and capacity that provides the variety and diversity of effects required for

operations throughout the depth of the battle space. This requires other dimensional generators in addition to ground based generators.

4. The Chemical Corps needs a battle space obscurant whose material properties or applications are occupationally and environmentally nonhazardous as well as multifinctional.

5. The Chemical Corps vision needs to address the use of smoke and obscurants as a means to interfere with electromagnetic transmissions as a nonlethal offensive weapon.

6. The Chemical Corps smoke and obscurant vision needs to address the use of multispectral obscurants in the microwave, millimeter wave, and radio frequency ranges. It also needs to address obscurant countermeasures to defeat directed energy weapons and sensors.

7. The Chemical Corps needs a program that stresses the need for obscurant technology to anticipate enemy's weapons development processes and continue to give us the capability to degrade his performance as he modernizes his force.

8. The Chemical Corps vision needs to address joint synergy. There is no identification of systems or application for the other services use of smoke and obscurants.

9. The Chemical Corps doctrine must address all of the above applications in both terms of general applications and tactics, techniques, and procedures at both the tactical and operational levels in terms for the Joint Force Commander and all subordinate elements.

GLOSSARY

Battlespace – components of this space are determined by the maximum capabilities of friendly and enemy forces to acquire and dominate each other by fires and maneuver and in the electromagnetic spectrum.[1]

Bispectral Obscurant - an obscurant that blocks or attenuates two portions of the electromagnetic spectrum (such as visual and infrared).[2]

CRSTA – counter-reconnaissance, surveillance, and target acquisition (sensors that conduct these missions).[3]

Directed Energy – a highly directed beam of concentrated electromagnetic energy; types of directed systems with the highest potential are laser, radio frequency, and particle beam.[4]

Electromagnetic Spectrum – the entire range of radiation that includes in order of decreasing frequency, cosmic rays, gamma rays, x-rays, ultraviolet radiation, visible light, infrared radiation, microwave, and radio waves. [5]

Electro-optical System – a device that detects targets by converting the electromagnetic radiation (visible, infrared, microwave) given off by the target into electric current; this current is amplified, then used to power a viewer or targeting system; this device can detect targets not visible to the naked eye.[6]

Information Age – the future time period when social, cultural, and economic patterns will reflect the decentralized, nonhierarchical flow of information; contrast this to the more centralized, hierarchical social, cultural, and economic patterns that reflect the Industrial Age's mechanization of production systems.[7]

Information Operations – continuous combined arms operations that enable, enhance, and protect the commander's decision cycle and execution while influencing an opponent's operations are accomplished through effective intelligence, command and control, and command and control warfare operations, supported by all available friendly information systems; battle command information operations are conducted across the full range of military operations. [8]

Information Warfare – actions taken to preserve the integrity of one's own information system from exploitation, to corrupt or destroy an adversary's information system, and in the process, to achieve an information advantage in the application of force.[9]

Nonlethal Warfare- actions taken by weapon systems with the intent to compel or deter adversaries by acting on human capabilities or material while minimizing killing and destruction of equipment or facilities.[10]

Obscurant – a substance that decreases the level of energy available for the functions of seekers, trackers, and vision-enhancement devices.[11]

Smoke - a particulate of solid or liquid, part of low-vapor pressure that settles out slowly under gravity; smoke particles range downward from about 5 micrometers in diameter to less than 0.1 micrometers in diameter; vapor made up of small particles of matter from incomplete burning of materials.[12] It is also defined as a cloud of fine particles. The more common military term, smokescreen is defined as dense smoke used to conceal military operations or something used to conceal plans or intentions.

Spectrum Supremacy – control over the required portions of the electromagnetic spectrum to enable the conduct of Force XXI Operations.[13]

[1] US Army TRADOC, TRADOC Pam 525-5, Force XXI Operations (Washington, DC: Department of the Army, 1 August 1994), Glossary-1.

[2] US Army Chemical School, FM 3-50, Smoke Operations (Washington, DC: Department of the Army, 4 December 1990), 99.

[3] Ibid, 99.

[4] TRADOC Pam 525-5, Glossary-2.

[5] FM 3-50, 73.

[6] Ibid, 99.

[7] TRADOC Pam 525-5, Glossary-4.

[8] Ibid, Glossary-4.

[9] Ibid, Glossary-5.

[10] US Army TRADOC, TRADOC Pam 525-73, Concept for Nonlethal Capabilities in Army Operations (Washington, DC: Department of the Army, 1 December 1996), 12.

[11] FM 3-50, 101.

[12] Ibid, 101.

[13] TRADOC Pam 525-5, Glossary-7.

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