COUNTERFORCE TARGETING CAPABILITIES AND CHALLENGES

by

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Contents

Page

Disclaimer ..... *ii*

The Author ..... *iii*

I. Introduction 1

II. The Ideal Counterforce Capability 2

III. The Revolution in Accuracy 3

IV. Implications of Stealth for Counterforce Targeting 7

V. Solving the Challenge of Hardened Deeply Buried Targets 7

VI. Solving the Challenge of Targeting Mobile Missile Launchers 13

VII. U.S. Scud Hunt Needs and Shortfalls 15

VIII. Solving the Challenge of Targeting WMD Assets: Thermobaric (TB) and Agent Defeat Weapons (ADWs) 24

IX. Counterforce Science and Technology Support 27

X. Counterforce Targeting Planning Tools 29

XI. Counterforce Employment and Preemption Decisions 30

XII. Counterforce: The Way Ahead 34

Notes 37

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Counterforce Targeting Capabilities and Challenges

Barry R. Schneider

I. Introduction

Counterforce targeting is one of the important means of removing potential weapons of mass destruction (WMD) threats to the United States and its allies and is one of the multiple means available to thin out the weapons of mass destruction threat.

To fully understand what progress the United States has made in counterforce capability, as well as the continuing shortfalls and the way ahead, one has to search for answers to a few key questions, namely:

- What would the ideal counterforce capability entail?
- How has weapons accuracy changed warfare?
- What are the implications of stealth technology for counterforce?
- How can the U.S. military neutralize deeply buried hardened facilities and what challenges do these present to U.S. forces?
- How can the U.S. military defeat the threat of adversary missiles fired from transporter-erector-launchers? How capable are we at present? What needs to be done to neutralize such future "Scud Hunt" threats?
- How can the U.S. military eliminate enemy WMD assets without major collateral damage? How far have we come in creating thermobaric and agent defeat weapons for this purpose?
- What strides has the United States taken in Science and Technology to improve U.S. counterforce weapons capability?
- What advantages do new U.S. counterforce targeting planning tools such as the Counterproliferation Analysis and Planning System (CAPS) provide to commanders?

- When should and should not the United States leadership elect to employ counterforce attacks in a preemptive or preventive war mode?
- Finally, what future steps in organizing, training and equipping U.S. forces needs to be taken to make U.S. counterforce capabilities adequate to the challenges of finding, fixing, and destroying adversary WMD and other military assets in a time of war?

II. The Ideal Counterforce Capability

If one wanted to construct the ideal U.S. counterforce capability against potential adversary WMD assets, what might be its attributes? Clearly, one thing that would be essential to have is accurate target information. U.S. targeteers would need answers to such questions as: "Where, precisely are all the weapons, production facilities, storage facilities and launchers? What are the vulnerabilities of these assets? How could these assets be destroyed? Is a direct kill possible? If so, how? Or, must we be satisfied with inflicting a functional defeat? If so, how? In the case of attacking mobile or relocatable targets, how long do we have before they are likely to move again? If the target is a transporter-erector-launcher (TEL) about to launch a missile, how long is that launch cycle? If the target is a production or storage facility for WMD assets, what kinds of U.S. agent defeat weapons would be effective in either destroying it, disabling it, or denying access to it in such a way as to prevent collateral damage to adjacent civilians or friendly forces in the region?" Further, "How do we assess the results of strikes on known or suspected WMD targets, especially strikes with standoff weapon systems? Have these strikes released WMD agents into the atmosphere? What agent? How much? Where is it going?" These questions are very hard to answer with current capabilities. Clearly, you can't target enemy weapons of mass destruction if you don't know where they are. Nor can you efficiently negate them if you are uncertain about target characteristics or the results of your own strikes against such targets.

In addition to ascertaining precise target coordinates and characteristics, the ideal counterforce fighting force should be able to deliver their blows with

great accuracy. Counterforce units will need precision guided munitions (PGMs) to hit the bull's-eye when the balloon goes up.

Also required, when striking at such important targets, is a force that can apply discriminate lethality for tailored effects and minimal collateral damage. To get to targets before they are launched or moved, the ideal counterforce strike should minimize the time-to-target. Counterforce weapons should be able to penetrate unharmed to target, maintain all-weather precision, operate from extended range if necessary, or to be present continuously over likely target sets to reduce the sensor-to-shooter-to-target times. The counterforce weapon system used should match the appropriate weapon to each target to achieve the effects sought. Further, the ideal counterforce attack plan will minimize the dangers to air crews and ground units utilized in the attacks.[1]

Finally, for counterforce operations to be optimally employed, the United States needs a strategy and military doctrine that guides when, where, and how such counterforce actions should be triggered by top U.S. decision-makers. Further, reasoned decisions will be improved if policy-makers address some key questions before deciding on a particular course of action.

In the past dozen years since Desert Storm the United States military has dramatically improved its counterforce capabilities. Several areas deserve particular emphasis such as the revolutions in accuracy, stealth, penetrating warheads, other hard target defeat tools, various programs to track and destroy mobile missile launchers, agent defeat weapons, and analytic tools to assist the targeteer. Perhaps the single most significant improvement to the U.S. capability to attack and destroy enemy weapons of mass destruction targets in wartime is in the realm of accuracy.

III. The Revolution in Accuracy

There was a quantum leap in improvements in bombing accuracy from World War II to Desert Storm. A similar improvement in bombing accuracy and lethality occurred between Desert Storm (1991) and Operation Iraqi Freedom (2003), as U.S. forces employed far more precision guided munitions than were used in the first Gulf War.

During World War II very few aerial bombs dropped by aircraft ever hit their target. As many as a thousand sorties might be needed to destroy a single target in the era of the "dumb" bomb. Indeed, according to the United States Strategic Bombing Survey, issued at the end of the conflict, only about one in five bombs ever landed within 1,000 feet of their intended targets.[2]

In WWII, targeteers talked in terms of numbers of sorties per target destroyed. Today, with the advent of smart weapons with great accuracy and lethality, targeting specialists speak of targets destroyed per sortie since a single aircraft may destroy multiple targets in a single flight.

As Major General David A. Deptula, USAF, has noted, "even when control of the air was wrested from the Luftwaffe in the spring of 1944 and allied aircraft were free to roam the Axis skies, the level of 'precision' bombing still required a thousand aircraft to succeed against one target."[3]

During the last years of World War II, even with air superiority, allied bomber attacks against various German industrial sectors took months of bombing to achieve even modest success against fixed targets. Massed air attacks and tons of bombs were required to eliminate targets like a bridge or a factory.[4]

The progressive introduction of precision guided munitions into the inventory has allowed the U.S. military to substitute precision for sheer tonnage and has reduced the numbers of sorties required dramatically. Precision weapons have given a new meaning to the concept of *mass*. As Lieutenant General (Ret) Buster Glosson has noted, "what we historically achieved with volume we now can accomplish with precision."[5] General Deptula estimates that whereas 1,000 B-17 sorties dropping 2,000 pound bombs were required to destroy one target in WWII, only 20 F-4 sorties, dropping 176 of the first laser-guided bombs, were needed in Vietnam to accomplish the same task.[6] By 1991, only one F-117 dropping two precision guided munitions could destroy two targets. By 1998, in the air war against Serbia, a B-2 bomber was capable of destroying 16 individual targets with bombs launched in a single sortie.[7]

The circular error of probability (CEP) of such weapons had shrunk from 3,200 feet in 1943 to 20 feet by 1998. This increased accuracy made precision guided munitions the weapons of choice as they became available. By the time of Desert Storm in 1991, as one commander noted, "of the 85,000 tons of bombs used in the Gulf War, only 8,000 tons…were

PGMs, yet they accounted for nearly 75 percent of the damage."[8] Note the evolution of precision guided munitions use from Desert Storm to the Kosovo air war in Table 1 below. By the time of Operation Iraqi Freedom in 2003, precision guided munitions were used most of the time.

Table 1: U.S. Airpower in Recent Regional Conflicts[9]

	Desert Storm	Serbia/ Kosovo	Afghanistan
Precision Guided Bombs Delivered	20,450	8,050	12,500
Percentage of total Munitions that are Precision Guided	7-8%	35%	56%
Percentage of Precision Guided Weapons delivered by the United States (versus others in coalition)	89%	80%	99%

Precision guided munitions make up the majority of the overall U.S. munitions budget. As one report states, "dozens of smart-munitions programs are in development or production today by the Army, Navy, and Air Force. About 60 percent of the munitions budget is spent on precision guided weapons, and that 60-40[10] breakdown is expected to continue in the foreseeable future."[11]

Precision guided munitions can provide a number of battlefield advantages over less accurate arms. First, precision guided munitions can reduce collateral damage, allowing commanders to strike enemy targets that are near the civilian population or near sensitive cultural assets such as churches, mosques, cultural symbols, hospitals, schools, and businesses, while minimizing noncombatant casualties and avoiding destruction of valued non-military facilities.

Second, precision guided munitions can more rapidly quiet enemy firepower by employing more effective targeting and less ordnance. Precision guided munitions allow more stand-off target kills, responsive kills, and one-shot kills. They also allow commanders to send missiles

and guided bombs rather than men and women aviators against targets, thus reducing allied casualties while accelerating the engagement and defeat of enemy forces. As General Glosson has written, "each (WWII) Schweinfurt raid placed 3,000 airmen in harm's way. Today, we can do the same job with just two airmen."[12]

Third, the widespread use of precision guided munitions reduces the logistics tail of friendly forces. Accurate "smart" weapons can inflict damage equivalent to that of much larger numbers of "dumb" munitions.

Smart bombs also reduce the inventory of bombs needed to destroy a given set of targets. General Glosson noted that, "according to the Gulf War Air Power Survey Data Base, we used approximately 180 tons of precision munitions a day in Desert Storm. Our airlift capacity from the continental United States to Southwest Asia was 6,500 tons a day. Nine C-141s (of the 234 available) a day could supply the daily precision guided munitions expenditures of Desert Storm."[13] Precision guided munitions provide orders of magnitude increases in per-weapon-lethality and far fewer weapons are needed to accomplish the same objectives. In summary, precision guided munitions reduce collateral damage, improve lethality, enhance survivability, reduce logistical demands, and accelerate enemy defeat.

One such precision guided munition, the Joint Direct Attack Munition (JDAM), has had a particularly dramatic impact on targeting effectiveness. As General Glosson summarizes, the JDAM "will allow a single B-2 to precisely destroy 16 separate targets on a single pass."[14] The JDAM guidance kit converts existing unguided bombs (dumb bombs) in the inventory into precision guided "smart" munitions. The tail section of JDAMs contains GPS and inertial navigational systems that can guide either the 2,000-pound MK 84 or the 1,000-pound MK 83 warheads to target when air launched against ground targets by an F/A-18 aircraft. Testing of JDAMs indicates they have a 95 percent system reliability and are accurate to within nine meters in all kinds of weather.[15]

Between 1997 and 2003, the United States had acquired 87,000 JDAMs in its inventory and it became a weapon of choice against many targets in Operation Iraqi Freedom in 2003, dropped by B-52s, B1-Bs, B-2s, F-15s, F-16s and F/A-18s.

However, the JDAM is just one of a large family of new U.S. smart weapons or precision guided munitions employed in the U.S. inventory

and improved in the past decade to provide greater accuracy and lethality with far fewer weapons employed.[16] General Glosson noted that, "the Joint Standoff Weapon (JSOW), coupled with the Sensor-Fuzed Weapon (SFW), would leave destroyed the armor of the Iraqi Hammurabi and Medinah divisions, if they had been available in Desert Storm. This would have prevented their use in quelling the Shiite rebellion after the 1991 Gulf War."[17] These Iraqi Republican Guard Armor Divisions were destroyed by such precision guided munitions in Operation Iraqi Freedom 12 years later.

Further, in the past decade, the United States also has developed and acquired over 60,000 precision guided munitions.[18]

This PGM revolution, in sum, means that the U.S. and allied militaries will be able to achieve targeting objectives utilizing far fewer flights while achieving more targets killed per delivery.

IV. Implications of Stealth for Counterforce Targeting

This revolution in accuracy and accompanying lethality has also been coupled with a significant improvement in the ability of air forces to penetrate unscathed to target through the introduction of new stealth technology. As General Deptula has stated, stealthy aircraft like the F-117 flew only two percent of the combat sorties in Desert Storm, yet accounted for forty-three percent of the targets stuck, since they were all but invisible to Iraqi air defense radars.[19] Stealth allows full penetration to optimal launch points and helps ensure survivability of the aircraft and crew during the mission. Thus, the combination of weapons lethality gained by accuracy, and bomber survivability gained by stealthiness, maximizes the counterforce capabilities of U.S. air forces, a revolution augmented by robust acquisition programs in the dozen years since Desert Storm (in 1991).

V. Solving the Challenge of Hardened Deeply Buried Targets

As the United States improves its counterforce weapons by drastic improvements in stealth and accuracy, adversaries are countering U.S.

capabilities by placing their own weapons, production facilities, storage facilities, and command and control assets inside hardened and, at times, deeply buried facilities. U.S. precision guided munitions and air superiority have sparked a "mole" response as adversaries have taken to tunnels, caverns, deep underground bunkers, and cut-and-cover facilities.

These underground facilities are likely to be shielding high-value time-sensitive enemy assets like their:

- leaders and top staff
- command, control, and communications centers
- weapons of mass destruction
- nuclear enrichment assets
- WMD munitions storage
- Transporter-Erector-Launchers (TELs)
- CBRN production facilities

As one Department of Defense report states, "the limitations of weapons capabilities during the (1991) Gulf War, as well as the increasing availability of advanced tunneling technologies, have brought about a clear world-wide trend in tunneling to protect facilities. Hardened cut-and-cover facilities may be vulnerable to current air-to-surface conventional penetrations but remain a substantial challenge when standoff attack is desired. Some facilities housed in tunnels or deep underground shelters, however, are nearly invulnerable to direct attack by conventional means."[20]

Potential military adversaries such as North Korea have turned to tunnels and hard and deeply buried facilities to shield their military forces from the ever more lethal precision guided munitions of the United States.

Reportedly, "more than 70 countries now use underground facilities (UGFs) for military purposes. In June 1998, the Defense Science Board Task Force on Underground Facilities states that there are now over 10,000 underground facilities worldwide. Approximately 1,100 underground facilities were known or suspected strategic (WMD, ballistic missile basing, leadership or top echelon command and control) sites. Updated estimates [from the] Defense Intelligence Agency reveal this

number has now grown to over 1,400. A majority of the strategic facilities are deep underground facilities."[21]

During World War II, the German high command shielded itself from allied bombing by building a series of leadership bunkers. Indeed, Adolph Hitler died in his bunker as allied forces closed in around him in the Spring of 1945. During the Vietnam War, the Viet Minh and Viet Cong made frequent use of tunnels to hide forces, weapons caches, and to provide secure transportation routes. During the Cold War, Soviet leaders and forces attempted to protect themselves from possible attack by building thousands of hardened bunkers and underground facilities to try to place themselves in safe positions. Similarly, the U.S. leadership, beginning with the Eisenhower administration in the 1950s, built a network of leadership and critical asset shelters in a Federal Relocation Arc, around Washington, D.C., 50 or more miles outside the city, scattered throughout the countryside in an area including North Carolina, West Virginia, Virginia, Maryland, Pennsylvania, and the District of Columbia, to protect against a possible Soviet attack.[22]

ICBM forces on both sides were placed in hardened silos in an attempt to protect them against possible attacks, ranging all the way from those that could withstand a few hundred pounds per square inch (psi) of overpressure to some that would remain intact and withstand up to 100,000 psi of overpressure.

When the U.S. Peacekeeper (MX) missile was in development, over 30 different basing modes were explored, most of which looked at some form of protected basing such as in hardened silos, tunnels drilled into hillsides, or deeply buried facilities inside a butte or mountain. Survivability, in many of the basing modes explored, used a combination of hardening, mobility, and location deception.

Muammar Qadhafi in Libya has built a huge underground facility at Tarjunah and has since admitted that this was one of two chemical weapons manufacturing and storage sites. (Qadhafi has shown a willingness in 2004 to roll back his weapons of mass destruction programs, cooperating in their dismantlement.) North Korea has built many thousands of hardened tunnels and hardened underground shelters for its artillery, missiles, and leadership. Saddam Hussein's regime also went underground into bunkers beneath buildings to escape the potential wrath of a U.S. adversary, and such facilities became important targets of

General Franks and his targeteers from U.S. Central Command in Operation Iraqi Freedom.

In the past decade, the U.S. Department of Defense has initiated the Hard and Deeply Buried Target Capability (HDBTC) program "to develop conventional (non-nuclear) weapons systems capable of denying access to, disrupting operations of, or destroying defended, hard and deeply buried facilities."[23]

One of the counterforce achievements of the past decade, since the inception of the U.S. Counterproliferation Initiative in late 1993, has been the initiation of the DoD Tunnel Defeat Demonstration Program that "seeks to develop, assess, and demonstrate end-to-end targeting capabilities (from detecting, identifying, and characterizing facilities to targeting, attacking, and performing damage assessment) across all warfighting options."[24]

Detection of deeply buried hardened facilities can be done by access to human intelligence, by remote sensors that record construction or operations, or by close-in inspections that uncover the presence of power lines, sewage systems, water pipes, camouflaged antennas, air vents, entrances, exits, and tell-tale heat, acoustical, electromagnetic, or other emissions. Details of underground layouts might be acquired by getting blueprints from the foreign contractors originally involved in constructing the facility, or by educated guesses based on the standard layout done by the relevant contractor in previous projects.

Hiding the existence of tunnels, cut-and-cover[25] facilities, and deeply buried bunkers can become a cat and mouse game as rival "hiders" are pitted against the intelligence, surveillance, and reconnaissance (ISR) "seekers" of the United States. Adversaries, for example, become aware of the times when U.S. reconnaissance and surveillance satellites will pass overhead and may do their construction work or operations only when they believe they will be unobserved.

In this contest of hiders and seekers, U.S. intelligence, surveillance, and reconnaissance technologies have improved significantly over the past decade since Secretary of Defense Aspin announced the U.S. Counterproliferation Initiative in December 1993. First, satellite sensors have been improved as multi-spectral sensors have been developed and deployed since 1993. The view from above high altitudes has come into increasingly sharp relief.

The U.S. Department of Defense, over the past decade, has made improvements in the ability to measure hot spots (thermal sensors), gravitational fields, electrical fields, magnetic fields, seismic tremors, radioactive emissions, sonar pings, ground shock movements, biological and chemical agent presence, and other indicators. Moreover, ground penetrating radars can give indications of underground structures and voids, and multi-spectral sensors can detect an array of smells, emissions, noises, and vibrations that help to locate and characterize subsurface operations and structures.

Further, the United States has now developed an improved and very capable group of unmanned aerial vehicles (UAVs) such as Predator and satellites like Global Hawk to loiter over suspect sites and provide constant coverage of activities on the surface and near entrances to underground facilities. This increased overhead presence on a 24/7/365 basis makes it increasingly difficult for an adversary to build and operate from tunnels and underground facilities without detection.

Characterizing the nature of the hidden site is still problematic for the seeker, although a mixture of technologies can help solve the puzzle, including improved seismometers, gravimeters, instruments that map the electromagnetic field of a site, and other remote types of sensors. In the past decade, progress has been made in the technologies employed to characterize underground facilities from either the surface or the atmosphere, although this is far from an exact science and hiders have great advantages over seekers in this arena. Hiders can make the opponent's (e.g., the United States) job even more difficult by use of masking, camouflage, decoys, deception, insulating hot areas, covering sharp edges, and painting surface equipment in earth hues.

Even if a hardened tunnel or underground facility has been identified, located, and accurately characterized, it may still be difficult to defeat. Any deeply buried facility with 2,000 feet or more of overburden may be invulnerable to a direct attack even if nuclear weapons were employed.

The U.S. counterforce attack may attempt either a direct attack aimed at destroying the facility altogether or a functional defeat attack aimed at causing "a militarily significant reduction in its capacity to perform its function for a militarily significant period of time."[26]

A functional defeat may be achieved by various means: closing ingress/egress portals, destroying external umbilicals such as electrical power lines, phone line and radio antennas, or by denying life-support systems relating to air and water supplies. Internal equipment might be caused to malfunction due to blast vibrations that were too weak to destroy the structure but which, nevertheless, can disable the technology within it. Also, entombment can inflict a functional defeat as effectively as crushing the facility through blast overpressure.

A good deal of original thought has gone into an analysis of ways to defeat buried hardened facilities in wartime. In addition to use of earth penetrators or other explosive means to penetrate the overburden and crack or shatter the structure, counterforce analysts have examined ways of sealing vents and exits, cutting off the power, water, air, and sewage flows and of entombing the complex. Thought has been given to the use of insulation foam to seal openings and tunnels. Fuel air explosives might be used to suck up the oxygen within a complex and mobile robotic probes and sensors could allow invaders to pre-explore tunnels and openings. Were it not prohibited by the Chemical Weapons Convention or the Biological Weapons Convention, incapacitating agents, choking gas, narcotics, sleep agents, and other toxins might be forced deep into the underground voids via air vents. Other vent weapons might include use of acoustical arms, tear gas, smoke, molds, allergens, mildews, or fungi. Further, the underground or tunnel facilities might be shorn of electrical power by use of electromagnetic pulses, cutting power lines, destroying electrical nodes, or by microwave attacks. Computer systems within the protected shelters could be neutralized by either destroying their antennas, cutting power, or introducing computer viruses.

Unfortunately, once a hardened tunnel or underground complex has been struck, our battle damage assessment (BDA) is still relatively primitive and inadequate for discerning what the effect was inside the targeted tunnel or underground shelter. Yet, battle damage assessments need to be accurate if the U.S. and its allies are to continue to disable the enemy site through timely restrikes and stay ahead of the enemy by blocking his efforts to dig out after the facility's portals have been closed.

The longer the United States has had to identify, characterize, and plan either a functional or destructive strike on a given hardened buried target, in most cases the greater its probability of wartime success against it. The

past decade has seen an arms race of sorts between the moles in states of concern and the growth of U.S. precision guided munition and intelligence, surveillance, and reconnaissance capacity. At this juncture it is not clear whether, in a net assessment, the defense or the offense has made a significant gain. Identifying, characterizing, and killing a hard target set, especially one drilled into the side of mountains or constructed deep underground is still a very difficult problem just as it was in 1993, and much counterforce research and development work still needs to be done to change that fact.

In short, while the United States has come a considerable distance in the past decade in its ability to identify, locate, characterize, attack, and assess damage, it still has far to go since adversaries continue to respond asymmetrically to great U.S. advantages in airpower, intelligence, surveillance and reconnaissance, and to U.S. precision guided munitions by going underground and hardening their facilities to protect their weapons, leadership, and industry.

VI. Solving the Challenge of Targeting Mobile Missile Launchers

During Desert Storm the United States' military capability to counter the Iraqi missile threat was very limited. Iraq launched 88 Scud-type ballistic missiles, 42 of which were aimed at Israel. According to the Gulf War Air Power Survey (GWAPS), coalition forces directed 1,500 air sorties against Iraqi missile launchers. Despite these numerous air strikes, GWAPS concluded that not a single Scud launcher kill could be confirmed.[27] This finding was disputed by General Wayne Downing, commander of U.S. Special Operations Forces (SOF) in Desert Storm, who asserts that SOF "took out six to eight Scuds, including a couple destroyed by anti-tank missiles launched by the teams."[28]

Nevertheless, the Gulf War Air Power Survey indicated that: "The actual destruction of any Iraqi mobile launchers by fixed-wing coalition aircraft remains impossible to confirm. Coalition aircrews reported destroying about eighty mobile launchers. Special operations forces claimed another score or so. Most of these reports undoubtedly stemmed from attacks that did destroy objects in the Scud launcher area. But most, if not all, of the objects involved now appear to have been decoys,

vehicles such as tanker trucks that had infrared and radar signatures impossible to distinguish from those of mobile launchers and their associated support vehicles, and other objects unfortunate enough to provide 'Scud-like' signatures."[29]

The best that could be said about the intensive allied Scud Hunt of Desert Storm, even if it resulted in few or zero kills, is that the operation at least kept the Iraqi Scud-launch teams continually moving, hiding, and taking evasive actions. It almost surely reduced Iraq fire rates and the number of salvos.

During the 1991 war with Iraq, allied forces allocated about five percent of all aircraft sorties in the counter-Scud offensive. However, several factors accounted for the meager results.

First, Iraq abandoned fixed-site Scud launchings and instead opted to adopt "shoot and scoot" tactics using mobile transporter-erector-launchers (TELs) to fire their missiles. The Iraqi Scud-launching teams utilized decoys to draw coalition fire while shielding their TELs through constant movement and camouflage, concealment, and deception techniques.

Mobile TEL survival strategies thus include:

- shoot and scoot tactics;
- use of decoys and other camouflage, concealment, and deception techniques;
- hide sites (under bridges, inside buildings, in tunnels);
- use of fixed sites as target magnets to draw off enemy resources otherwise devoted to destroying mobile missile launchers;
- rapid launch sequences to limit "dwell time."

Second, the allied forces in Desert Storm hindered their own efforts by not taking the Scud threat seriously at the inception of the planning process, by not deploying maximum Special Forces into the Iraqi desert at the beginning to ferret out Scud transporter-erector-launcher locations, and by a sensor-to-shooter time lag of 60 minutes. The present goal is to try to reduce this sensor-to-shooter time to 15 minutes or less in order to get within the enemy firing cycle and to destroy the mobile missile launchers once pinpointed, before they can move and relocate.

Third, the Scud hunt against mobile missile launchers in 1991 ignored the use of some of the available sensor/platform technology that had proven effective in tests but which had not yet been deployed. The officer in charge of the 1991 Scud Hunt air campaign had never previously commanded or participated in exercises designed to destroy mobile missile launchers.

During Desert Storm the primary mission for both the United States' Delta Forces and the United Kingdom's Special Air Service (SAS) was to locate and then designate targets for coalition aircraft such as U.S. Air Force A-10s, F-15s, F-16s, Air Force Special Operations Command (AFSOC) C-130 gunships, and MH-53J Pave Lows. Delta Forces on the ground were also equipped with 50-caliber sniper rifles to target Iraqi missiles, launchers, and their teams. Unfortunately, allied special forces could rarely get within rifle range and the aircraft response times averaged an hour, permitting the Iraqi mobile launch teams to fire and move away before coalition land and air forces could close in and destroy them.

VII. U.S. Scud Hunt Needs and Shortfalls

Considerable technical progress can be reported in developing new U.S. technologies and concepts of operation to be successful in future engagements against an enemy operating with ballistic missiles launched by a mobile transporter-erector-launcher.

To succeed against the mobile "Scud-type" threat the United States needs to be able to:

- improve its persistent and mission-dedicated intelligence, surveillance, and reconnaissance capabilities to locate enemy mobile missile launchers in a timely, targetable way;
- preemptively destroy suspected enemy hide sites or potential hide sites in the expected launch zone;
- shorten the sensor-to-shooter handoff time to 15 minutes or less;
- prioritize Scud Hunt missions in the Air Tasking Order (ATO); and

- organize, train, and equip joint air assets, intelligence, surveillance, and reconnaissance assets, and special operations forces (SOF) ground assets for this role.

There are certain deficiencies in the Scud Hunt capabilities that need to be developed to provide nuclear, biological, chemical, and missile (NBC/M) counterforce against such time-sensitive, time-critical targets. As Lt Col Tim Lindemann has summarized in a study of U.S. counterforce capabilities, "Warfighting commands and service planners have done a thorough job of identifying and analyzing capability gaps – or unfulfilled needs – of NBC/M mobile targeting. With regard to intelligence, reconnaissance, and surveillance these needs consistently include:

- intelligence preparation that supports pre-launch operations;
- wide area surveillance;
- rapid sensor retasking;
- precise target location;
- tracking, classification, and identification;
- data exchange and cross-cueing between sensors; and
- foliage penetration."[30]

With regard to battle management and command, control, and communications, he indicates that the needs include:

- "rapid data exchange between platforms;
- automated battle management tools for data fusion;
- target tracking; and
- tasking (dynamic battle management);
- a common view of the battlespace (i.e., a common operational/ tactical picture); and
- integrated fire control of service platforms."[31]

Still a challenge is the job of finding and fixing the Scud transporter-erector-launcher targets or the infrastructure that supports such systems (e.g., roads, hide sites, command and control, maintenance, logistics, etc.). The current buzzword to improve battle management and targeting is "horizontal fusion" or integration of all sources of data and from all sensor suites to facilitate the intelligence preparation of the battlespace, intelligence, surveillance, and reconnaissance collection planning, dynamic cueing, target data fusion, target data identification, and target data validation. This data must be synthesized and made operational for the shooters.

To provide more persistent overhead intelligence, surveillance, and reconnaissance capabilities it is suggested that more airborne platforms, including attack aircraft and tankers, carry sensors. Likewise, some assets designed for intelligence, surveillance, and reconnaissance purposes might be equipped as shooters as well (e.g., Predator). All airborne platforms would become multipurpose to facilitate the Scud Hunts of the future.

The intelligence challenge will be to provide the warfighter with a global situation awareness and persistent surveillance of the battlespace. Finally, as Lindemann has suggested regarding weapon systems, the needs consistently include:

- "Having sufficient [and] numerous theater air assets assigned to the Scud Hunt mission;
- ability to acquire, identify, and engage targets in an adverse weather environment;
- having enough attack aircraft to cover all the "kill boxes" on the map;
- having enough intelligence, surveillance, and reconnaissance assets to discover the presence of Scud transporter-erector-launchers in "kill boxes" on a continuous basis;
- having highly responsive shooters with available weapons accepting in-flight target updates;
- employment of automatic target recognition capabilities;
- having shooters in close proximity to targets when needed; and

- weapons must be capable of neutralizing nuclear, biological, and chemical agents without excessive collateral damage."[32]

During Operation Iraqi Freedom, U.S. forces practiced against mobile transporter-erector-launcher targets at a CONUS airbase location to perfect teamwork and attack operations against possible Iraqi transporter-erector-launchers. This practice and certain practices led U.S. commanders to believe they would do significantly better in Scud Hunting in Operation Iraqi Freedom than was the case in Operation Desert Storm. The possible outcome will never be known because no Iraqi Scuds surfaced to fight in Operation Iraqi Freedom.

Nevertheless, unlike Operation Desert Storm, in Operation Iraqi Freedom numerous special operations forces teams were deployed forward at the outset of hostilities, U.S. attack aircraft were better trained to engage mobile missile launchers, U.S. intelligence, surveillance, and reconnaissance assets were improved and more persistently in place over the target zones, and the intelligence team assembled before and during the operation better prepared the battlespace, fused the various collections of intelligence data, and better prepared the target characteristics for the Air Tasking Orders that followed.

During the Operation Iraqi Freedom Scud Hunt operation, the Time-Sensitive Targeting cell of the Combined Air Operations Center did, indeed, become such a potential force multiplier that it could be considered a weapons system in its own right. A tactical ballistic missile intelligence federation made up of fifteen different intelligence agencies and operational commands combined to do the intelligence preparation of the battlespace for Operation Iraqi Freedom. Potential launch areas or "Scud baskets" were identified. Geospatial data and analysis was generated to identify roads and paths Scud transporter-erector-launchers might traverse or potential hide sites. Intelligence on the potential Iraqi missile order of battle were combined with named areas of interest, coordinates were assigned, and "kill boxes" were identified and plotted. Then, had an engagement with Iraqi Scud transporter-erector-launchers taken place in Operation Iraqi Freedom (OIF), the triad of intelligence, surveillance, and reconnaissance, special operations forces, and attack platforms would have combined to attempt to destroy the Scud threat.

Despite some significant advances over the first Gulf War Scud Hunt operations, OIF success still would have been limited by such problems as:

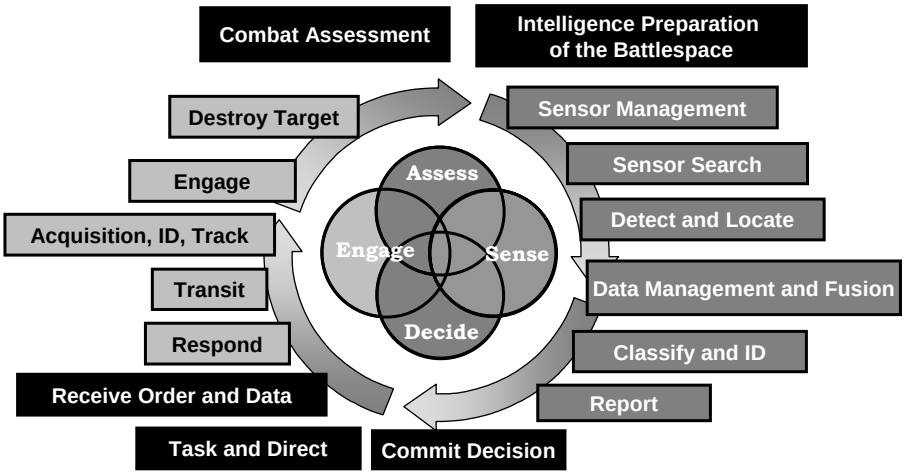
- night-time surveillance,
- limited sensor capabilities,
- great limits in the ability to deliver persistent 24/7 ISR coverage, and
- the fact that the coalition lacked enough attack aircraft to cover all the "kill boxes" assigned to the counter-Scud mission.[33]

At present, the United States is making a number of upgrades to its Scud hunting/mobile targeting capabilities. One such very recent program upgrade is the Predator unmanned aerial vehicle equipped with two Hellfire Thermobaric Blast/Frag warhead upgrades to target and defeat highly mobile or relocatable targets.[34] Another such program is the USAF Low Cost Autonomous Attack System (LOCASS), an affordable precision-attack guided munitions capable of broad area search for transporter-erector-launchers and a system that can execute both the location and destruction missions.

As currently envisioned, LOCASS is a turbojet powered, Global Positioning System navigated, and Laser Detection and Ranging (LADAR) guided munition. It has a 90-100^{+} nautical mile range and has 30 minutes of powered flight. It can be used as a standoff weapon, can be launched from an aircraft or missile, and can use its Automatic Target Recognition feature to engage in target search and close to destroy the targets located and identified.[35]

To improve the nation's "Scud Hunting" capabilities, the United States needs to improve in four operational areas of the so-called "kill chain": target sensing, attack decisions, target engagement, and post-strike assessment. Note these elements in Figure 1[36] that go into the attack operations (AO) "kill chain" steps to be taken when targeting an enemy asset such as a mobile ballistic missile transporter-erector-launcher. Strengthening all is the path to real effectiveness.

Figure 1. Attack Operations: Joint Operational Elements



As Dr. George W. Ullrich, Director, Weapons Systems Office in the Office of the Secretary Defense has stated, mobile targets demand a wide-to-spot area search capability; rapid target cueing and fingerprinting; the presence of overhead weapons platforms, unmanned, mobile sensor platforms, and prompt sensor-to-shooter linkages, likely integrating both sensors and weapons delivery on platforms like the Predator that carries two Hellfire AGM-114M enhanced lethality warheads.[37] Persistence is one way to address the engagement portion of the kill chain. Another would be through development of high-speed weapons to reduce the time of flight portion of the kill chain, especially in anti-access scenarios where 'persistence' solutions would be vulnerable to integrated air defenses.

Some of the more important new technologies being developed to improve U.S. attack operations versus enemy mobile transporter-erector-launchers are the following:[38]

- Automatic Target Recognition (ATR) Technology in U.S. synthetic aperture radars combined with a wide-area search capability on U.S. overhead sensors, as may be placed on platforms like the U-2 aircraft, the JSTARS aircraft, or the Global Hawk satellite;
- Semi-Automated Imagery Intelligence Processing (SAIP) System to more rapidly assist image analysts in locating and identifying targets and help in transmitting targeting data to the tactical commander faster and more accurately;
- Affordable Moving Surface Target Engagement (AMSTE) System to integrate sensors with precision standoff weapons to attack moving targets in all weather scenarios without visual confirmation; and
- Targets-Under-Trees (TUT) Program uses synthetic aperture radars to find, identify, and destroy enemy hide sites for ballistic missile launchers despite his use of camouflage foliage, or other deceptive and denial practices.

This list is suggestive, not exhaustive. Interesting research and development projects that could improve future U.S. scud-hunting capabilities are:

- Mobile Killer Units;
- Improved Synthetic Aperture Radars;
- Improved Technology for Measurement and Signature Intelligence (MASINT);
- Multi-Spectral Scene Generation for Critical Mobile Missiles;
- Advanced Remote Unattended Ground Sensors;
- National Imagery and Mapping Agency Support to Targeting;
- Overhead Specific Emitter Identification;
- Counter-Camouflage, Concealment, and Deception (C-CC&D) projects;

- Polarimetric Measurement and Signature Intelligence (MASINT) Collection Capability;
- Advanced Remote Ground Unattended Sensors (ARGUS);
- Red Time Synthetic Aperture Radar Battle Damage Assessment;
- Fusion of Electro-Optical and Radar Sensor Data;
- Intelligence Preparation of the Battlespace Support vis-à-vis Critical Mobile Missile Targets.

In order to take advantage of these developing new counterforce weapons, ISR and targeting decision technologies, the U.S. is going to have to increase its acquisition of low density/high demand assets like the U-2 and Joint Surveillance and Target Attack Radar System (JSTARS) aircraft and satellites like Global Hawk. The technologies to improve elements of the kill chain must be incorporated into one or all of these overhead platforms.

Even with such improvements in place, the burden of proof will still be upon the U.S. military to prove it has solved the challenge of tracking, targeting, and destroying mobile missile launchers in combat. During 1991's Operation Desert Storm, the official tally was 0 for 88 in our confirmed ability to destroy Scuds and Scud-variants before launch. In the 2003 Operation Iraqi Freedom no missiles appear to have been fired from mobile transporter-erector-launchers. It appears, that Iraqi forces relied on fixed launchers only, which should have been far easier to identify, locate, and destroy. However, 22 ballistic and cruise missiles were fired at U.S. and allied forces, without being detected before launch.

Thus, no country, not even the United States, has yet demonstrated the capability to conduct successful attack operations against rival ballistic missile mobile launchers, and the jury is still out on our ability find and target all fixed missile launchers prior to launch. The United States is gaining on the solution to this counterforce problem, but will have to lean most heavily on its active and passive defenses until attack operations reach a much higher level of capability.

Within the U.S. Government for some years there was no single office or agency exclusively dedicated and empowered to develop technology and concepts of operation to conduct a "Scud Hunt." The effort now falls in numerous domains, including the individual U.S. armed services, the

Joint Theater Air and Missile Defense Organization (JTAMDO), and the combatant commanders (e.g., such as the Special Operations Command, SOCOM).

Prior to 1997, theater air and missile defense (TAMD) systems were developed by the individual services to satisfy the unique requirements of each, and this was not a joint coordinated program. Rather, each service went its own way.

Finally, because theater air and missile defense was deemed increasingly important due to the proliferation of weapons of mass destruction in the hands of potential adversaries and the wastefulness and inefficiency of parallel go-it-alone theater air and missile defense service programs, JTAMDO was created to "define system interoperabilities and operational architectures and to validate the developing joint theater air and missile defense capabilities."[39]

There are three areas within theater air and missile defense that JTAMDO is responsible for developing requirements, including:

- active defense;
- passive defense; and
- attack operations.

Thus, if an enemy aircraft or missile threatens a U.S. or allied force or asset in wartime, it can either be destroyed on the ground prior to launch (attack ops), intercepted while in flight toward the target (active defense), or those in the targeted area can be protected from harm via passive defensive measures like dispersion, using shelters, wearing protective gear, and making advance medical preparations. JTAMDO was directed to (1) develop joint U.S. theater and missile defense capabilities requirement for the armed services, (2) design the joint mission architecture, and (3) plan a joint theater air and missile defense capabilities roadmap. The organization was to become the U.S. Defense Department's operational proponent for theater air and missile defense (including attack operations) with oversight over Defense Department planning coordination, and oversight over theater air and missile defense operational requirements. In short, oversight over U.S. "Scud Hunt" enabling programs is JTAMDO's responsibility, a job that it has failed to

accomplish due to limited resources and a focus on other elements of its tasks.

VIII. Solving the Challenge of Targeting WMD Assets: Thermobaric (TB) and Agent Defeat Weapons (ADWs)

The threat posed in Operation Desert Storm by Iraqi chemical and biological weapons brought home to U.S. defense officials the need to develop weapons that could destroy, disable, or deny such production facilities and stockpiles to remove that chemical and biological menace.

At present, the United States military is mostly limited to conventional warheads as the tools to eliminate adversary chemical and biological weapons capabilities. Unfortunately, conventional explosives directed against an enemy bunker, storage facility, or production plant may cause the scattering of lethal agents over substantial adjacent areas that may be inhabited by civilians and friendly forces. This could also contaminate the local environment. If infectious diseases were released, such targeting could result in even more widespread infections.

The U.S. Thermobaric and Agent Defeat Weapons programs were accelerated and upgraded to meet special warfighting needs after the September 11, 2001, attacks on the World Trade Center and the Pentagon sparked the U.S. declaration of a global war on terrorism, including the state sponsors of terrorist groups. Two counterforce thermobaric programs were put on the fast track. One was the Bomb Live Unit (BLU)-118B Thermobaric Penetrator which was rushed into the hands of the warfighter after a 90-day transition period of tunnel and open air tests of weapon effectiveness that preceded delivery of this agent defeat weapon complete with warheads, guidance kit, and fuzes to theater. The BLU-118B Thermobaric Penetrator can be used for defeating hard and deeply buried targets housing chemical and biological weapons.[40]

The second post - 9/11 thermobaric weapons delivery to the theater, Predator unmanned aerial vehicles equipped with Hellfire Thermobaric Blast and Fragmentary warheads (AGM-114M), took eleven months to get into the possession of relevant commands.[41] Thermobaric weapons are optimized, or tailored, blast weapons. Generally speaking, less blast is better when detonating in the vicinity of weapons of mass destruction.

The Defense Threat Reduction Agency sponsored two quick reaction programs: the AGM-86D Conventional Air Launched Cruise Missile (CALCM) Penetrator and the BLU-119 Crash Prompt Agent Defeat (CrashPAD) gravity bomb. The CALCM-P was developed, demonstrated, and fielded as part of the DTRA-led Counterproliferation II Advanced Concept Technology Demonstration (ACTD). CrashPAD was sponsored by the Defense Threat Reduction Agency, in collaboration with the Air Force Research Laboratory, and was fielded in nine months as the first weapon designed specifically to defeat biological agents.

In addition to these quick-reaction thermobaric and agent defeat weapons (ADWs) programs, the U.S. Defense Department has in the last decade also begun work on a number of other new classes of ADWs that could be air-delivered to deny an adversary the use of its chemical and biological stockpiles and facilities with minimal collateral damage.

Put another way, as Thomas A. Ricks reported in the *Wall Street Journal*, the agent defeat weapons program is unique. "Its mission is to produce the first truly new weapon of the post-Cold War era, a bomb whose effectiveness is to be measured by how many people it doesn't kill– while it destroys stockpiles of horror weapons."[42]

While the details of such agent defeat weapons are classified, suffice it to say that at least eight agent defeat weapons programs are in progress and are designed to neutralize enemy chemical and biological assets by:

- high temperature incendiary (HIT) weapons attack utilizing so-called "thermobarics" to burn the enemy chemical or biological munitions and materials in place;[43]
- fragmentary weapons attacks designed to puncture chemical or biological containers within facilities without major explosions because major explosions might blow the agents outside the walls of those bunkers or laboratories;
- keep-out weapons attacks that so contaminate the chemical or biological assets that enemy personnel could not retrieve them in a timely manner;
- blast weapons coupled with hard target smart fuzes and penetrating warheads that are designed to collapse or implode bunkers rather than explode them so that the structures struck collapse onto and

cover the chemical or biological munitions and agents, denying easy access to enemy personnel;

- other means of sealing off or rendering hardened tunnels or deeply burial facilities non-functional, denying opponents entry or exit from such chemical or biological locations and destroying facility umbilicals.

The agent defeat weapons coming into the U.S. arsenal have been tested in three Advanced Concept and Technology Development (ACTD) programs:

- The Counterproliferation II Advanced Concept and Technology Development program administered by the Technology Division of the Defense Threat Reduction Agency;
- The Agent Defeat Weapons Advanced Concept and Technology Development program begun in 2002 administered by the U.S. Navy; and
- The Thermobaric Advanced Concept and Technology Development program was begun in 2002. The thermobaric operational sponsor is the U.S. Forces Korea command, with the Defense Threat Reduction Agency as the technical manager.[44]

In addition, the Air Force Research Laboratory (AFRL) at Tyndall AFB began work on air-delivered agent defeat weapons in 1999. The overall agent defeat weapons program is designed to be compatible with U.S. arms control commitments and the agent defeat weapons Advanced Concept and Technology Development program is developing analysis tools to predict agent release plumes, internal dispersion and venting outcomes, and agent defeat weapons lethality against weapons of mass destruction targets.

The agent defeat weapons that are being designed are to be compatible with insertion into or to replace the 2000-lb BLU-109 warhead and will be compatible with USAF guidance kits for a number of other U.S. bombs and warheads including the GBU-31, Joint Direct Attack Munition or JDAM.[45]

During Operation Enduring Freedom in Afghanistan, the BLU-118B thermobaric warhead was employed against Al-Qaeda and Taliban forces entrenched in caves and tunnels at Gardez.[46]

According to a report by the Jane's Information Group, although the official goal of the Agent Defeat Weapons advanced concept technology demonstration project was "to fabricate eight weapons by fiscal year 2004 for flight tests and validation and to have another 20 to leave for operational use,"…nevertheless there was a push to get the weapons ready in time for a U.S. war with Iraq.[47] Luckily, such agent defeat weapons were not needed in Operation Iraqi Freedom.

Of the 58 original ideas considered for research and development by the U.S. Government, only eight agent defeat weapons programs have been seriously pursued, but it is still certain on which ones might be worth full-scale acquisition and deployment. The problem is that some enemy chemical and biological weapons storage facilities may be so deeply buried and hardened as to require a nuclear weapon on an earth penetrating warhead to have any reasonable chance of destroying that kind of target. Thus, the agent defeat weapons R&D process goes on, still in search of a more effective agent defeat weapon that remains a conventional weapon. This is a problem still awaiting a solution.

IX. Counterforce Science and Technology Support

Much of the progress in U.S. counterforce programs in the past decade is the product of work done at the Defense Threat Reduction Agency which conducts and supports R&D programs in such areas as:

- The Counterproliferation I and II ACTDs;
- WMD Combat Assessment Systems;
- Agent Defeat, Deny, and Disrupt Technologies;
- Hard Target Defeat;
- WMD Database Maintenance;

- Target Planning and Assessment tools (e.g., Hazard Prediction Assessment Capability - HPAC, Munitions Effects Assessment - MEA, and Integrated Munitions Effects Assessment - IMEA);
- Weather Modeling;
- Survivability Assessments;
- Hazard Prediction;
- Force Protection Assessments;
- Structural Response Technology;
- Weapons Effects Phenomenology;
- Nevada Test Site Operations;
- Counterproliferation Analysis Planning System (CAPS);
- Test and Simulator Operations; and
- Nuclear Stockpile Stewardship.

The Defense Threat Reduction Agency is an amalgam of diverse parts. Its directorates focus on such programs as counterforce development, chemical and biological warfare defense, nuclear technology, combat support, weapons elimination, counter-terrorism science and technology, on-site inspections to verify arms control compliance, as well as management of the U.S. Defense Department's participation in the Cooperative Threat Reduction program in partnership with the states of the former Soviet Union. The Defense Threat Reduction Agency's predecessor was the Defense Nuclear Agency (DNA), which temporarily was named the Defense Special Weapons Agency (DSWA), before it morphed into its present Defense Threat Reduction Agency form in 1998.

The Defense Threat Reduction Agency's counterforce philosophy is to first develop enabling technologies and then demonstrate those through testing, advanced demonstrations, and ACTDs. The Defense Threat Reduction Agency then transitions such capabilities to the warfighter, procures limited numbers of unique counterforce systems, and then offers the combatant commanders support in the operational use of such counterforce systems.[48]

The Counterproliferation I and Counterproliferation II Advanced Concept and Technology Demonstrations have provided the combatant commanders with some new bunker buster weapons (as well as agent defeat weapons) designed both to destroy hardened targets and to limit downwind fallout of biological, chemical, or nuclear contamination. The Advanced Concept Technology Demonstration program has been utilized to:[49]

- use mature advanced technology integrated into enhanced/new counterforce capability that meets the warfighter's needs, providing early and affordable evaluations;
- perform a military utility assessment of the new technology and associated concepts of operations and tactics, techniques and procedures, usually evaluating this in a combatant commander's military's exercise;
- leave behind new counterforce technology at the bases or other sites when the Advanced Concept and Technology Demonstration is completed; and
- provide a counterforce program transition from Research, Development, Test and Evaluation status to acquisition of new counterforce technologies, weapons, and tools for use by U.S. forces.

The DTRA-managed Counterproliferation Advanced Concept and Technology Demonstrations have been aimed at providing the U.S. warfighter with improved counterforce or direct strike options against possible enemy WMD-related targets. Some of the products tested and provided to field commands via the Counterproliferation I Advanced Concept and Technology Demonstration are the hard target smart fuze, the advanced unitary penetrator, a targeting concept of operations, the low altitude navigation and targeting infrared for night (LANTIRN).

X. Counterforce Targeting Planning Tools

Other Defense Threat Reduction Agency products have aided the warfighting community in its ability to plan counterforce operations and predict outcomes. One such tool is the Integrated Munitions Effects

Assessment (IMEA) which helps targeteers do pre-strike planning and post-strike assessments by using weapons and target characteristics as inputs to predict collateral effects.[50] The IMEA provides an end-to-end capability to analyze results and collateral effects."[51]

Other valuable counterforce targeting planning tools recently developed are the Munitions Effects Assessment (MEA), a WMD planning tool that estimates damage and the amount of agents released, and the Hazard Prediction and Assessment Capacity (HPAC) tool that predicts downwind hazards, collateral effects, and nuclear weapons effects.

Another very significant improvement in counterforce targeting capabilities over the past decade has been the Counterproliferation Analysis Planning System (CAPS), a U.S. Strategic Command and Defense Threat Reduction Agency classified computer-based program based at the Lawrence Livermore National Laboratory where intelligence is collected, analyzed, and displayed on the chemical, biological, radiological, and nuclear weapons programs of states of concern.

CAPS allows targeting analysts to identify key nodes in the infrastructure of chemical, biological, radiological, nuclear and missile programs of such states and supplies a comprehensive fused intelligence picture of their weapons of mass destruction assets.

Thus, the key function of CAPS is "to provide comprehensive and timely counterproliferation target planning information to the combatant commander."[52] CAPS allows U.S. defense specialists to analyze another state's specific approach to weapons production, identifying critical processing steps or production facilities which, if denied, would prevent that country from acquiring weapons of mass destruction.[53]

CAPS can also be useful to guide arms control verification efforts to assist in discerning compliance or noncompliance of other states with various nonproliferation regimes they have agreed to, such as the nuclear Non-Proliferation Treaty, the Chemical Weapons Convention, or the Biological and Toxins Weapons Convention.

XI. Counterforce Employment and Preemption Decisions

As the *U.S. National Strategy to Combat Weapons of Mass Destruction* states, "Because deterrence may not succeed, and because of the potentially

devastating consequences of weapons of mass destruction use against our forces and civilian population, U.S. military forces and appropriate civilian agencies must have the capability to defend against WMD–armed adversaries, including in appropriate cases through preemptive measures. This requires capabilities to detect and destroy an adversary's weapons of mass destruction assets before these weapons are used."[54]

The United States, therefore, in this national strategy, has stated that: "We will not permit the world's most dangerous regimes and terrorists to threaten us with the world's most destructive weapons." Put another way, "we cannot afford to be the unready confronting the unthinkable."[55] To this end, better counter-CBRNE (chemical, biological, radiological, nuclear and high-yield explosives) preparedness, the U.S. Counterproliferation Initiative was dedicated a decade ago in December 1993 when Secretary of Defense Les Aspin announced the beginning of the Counterproliferation Program. An important component of this counterproliferation readiness effort is the capability to launch effective counterforce operations to eliminate the weapons of mass destruction threat posed if that action was deemed necessary.

Since Operation Iraqi Freedom there has been a debate about the wisdom of the United States decision to preempt against what was perceived as a growing weapons of mass destruction threat from Iraq. The overthrow of Saddam Hussein's regime was partially motivated by a sense of growing peril and a desire to extinguish that weapons of mass destruction threat before it was turned full force on the United States or its allies.

The failure to find concrete evidence of the Iraqi weapons of mass destruction arsenal after Operation Iraqi Freedom points out one of the hardest problems of a policy of preemption, namely the need for very accurate actionable intelligence to pinpoint the weapons of mass destruction assets that the U.S. forces would have to destroy, disrupt, disable, deny, interdict, neutralize, or seize in a counterforce operation. It is hard to design an air tasking order or special operations plan without precise target location information.

The hardest case is where a relatively peaceful situation exists, but where the U.S. authorities have evidence that leads them to believe that a malevolent regime is about to acquire a dangerous new weapons of mass destruction capability that U.S. officials believe will be used against the United States or an ally in the not-too-distant future. If the regime

leadership has a history of aggression, is a state sponsor of international terrorist groups, and has an evident and active hatred of the United States, such a new weapons of mass destruction capability is generally seen as especially dangerous. In such scenarios, U.S. authorities may contemplate preemption as a means of removing that threat, if it appears all peaceful approaches have been explored and are unsuccessful and if the threat is viewed as imminent.[56]

Of course, if the United States is already at war with such a heavily armed adversary, the decision to forcibly disarm its weapons of mass destruction assets is relatively noncontroversial. Here, a good offense (i.e., a good series of counterforce targeting operations) is perhaps the best defense. Better to eliminate these chemical, biological, radiological, nuclear, or high-yield explosives rather than have the enemy strike with them. However, even in wartime, such counterforce strikes can backfire if the adversary sees himself forced into a "use or lose" mode. Such wartime or peacetime counterforce strikes need to be decisive in eliminating the threat early in a developing crisis or the United States may face the wrath to come from those enemy WMD-equipped forces missed in the first attacks.

Unfortunately, real world decisions often have to be made when time is short and information is incomplete. Crises are generally marked by high stakes, surprise, and a short time for decision-making. Unfortunately, at the very time when rational decisions are most necessary, the pressure and stress of such situations add an extra difficulty for those in command. However, seeking answers to the questions raised above may be a step toward making a well-considered decision on whether or not to initiate action against enemy weapons of mass destruction. Clearly, such decisions will never be made lightly and preemption is rightly an option of the very last resort, if, it is to be exercised at all.

Such analysts and legal authorities argue that preemption is illegal in international law since it is an act of war against a hitherto peaceful state. The argument is made that all aggressors give some defensive rationale before they invade their neighbors and that a doctrine of preventive war would lead us back to the law of the jungle in international relations where the strong can make the rules to fit their own situation.

Others argue that the spread of weapons of mass destruction presents a new imperative in international relations. These argue that no state can tolerate an enemy weapons of mass destruction strike, due to the enormous

damage and mass casualties such weapons can cause, if it has the means to uncover an impending attack and to neutralize it before it happens.

These argue that the United States has an inherent right of anticipatory self-defense. They argue that in some very few, very special cases the best and perhaps only means of effective defense is a good offense, that it is better to disarm by military action an adversary poised to inflict massive harm on U.S. forces or population rather than to suffer catastrophic losses due to, say, an enemy biological or nuclear attack.[57]

As Elihu Root wrote in 1914, "International Law does not require the threatened state to wait in using force until it is too late to protect itself."[58] Just war theory, if applied to the concept of preemption and anticipatory self-defense, would limit such actions only to occasions where preemptive actions were taken only in situations of evident self-defense, after peaceful remedies were exhausted, where there was a reasonable chance of success, taken, in actions either proportional to or less than the injury or anticipated injury about to be suffered, and executed on the decision of a competent authority.[59]

Another just war theorist, Michael Walzer, concludes that, given compliance with these conditions, "states can rightfully defend themselves against violence that is imminent, but not actual."[60]

Thus, the United States might legally, in certain situations, have the right to preemptively disarm a WMD-armed opponent, if an attack was seen to be very likely.

Perceptions of impending catastrophic attacks by an adversary might, therefore, dictate U.S. preemptive action in an extreme case. Indeed, no U.S. President could likely survive a later impeachment trial if it were proven after such a horrific weapons of mass destruction attack that he had substantial knowledge of an impending weapons of mass destruction strike and failed to take preventive action that was in his power to order.

Thus, the United States will continue to include the preemption option in its repertoire of possible policy responses to those that threaten the United States and its allies with weapons of mass destruction. Counterforce capabilities, if mated with accurate and comprehensive intelligence, could be effective in blunting a weapons of mass destruction attack. Coupled with improved active and passive defenses, a respected deterrent capability, and aggressive non-proliferation diplomacy, perhaps the threat posed by such unconventionally armed rivals can be minimized

or neutralized. In both crises and wartime such counterforce operations may be all too necessary.

XII. Counterforce: The Way Ahead

While weapons of mass destruction targets are, without a doubt, high-priority for combatant commanders, the weapons and assessment systems best suited to address these targets (e.g., agent defeat/disrupt/deny weapons, standoff missiles with penetrating, low yield conventional explosive payloads, UAV-based combat assessment systems, etc.) have not fared well in terms of dedicated service investment in them. This is likely for two reasons. First, the weapons of mass destruction target set, although important, is not large in comparison to the non-WMD target set. Secondly, the services' investment decision-making process tends to favor higher visibility, higher probability of employment systems than 'niche' systems. Additionally, development and fielding of small numbers of specialized weapons/systems, i.e., 'niche' capability, brings with it the requirement to maintain proficiency with the systems and to sustain them in the field. Providing the combatant commander with the tools needed to accomplish the WMD counterforce mission is likely to remain challenging under the current Defense Department investment construct.

Despite funding limitations, the United States armed forces have acquired a significant improvement in their ability to execute successful counterforce strikes against future enemy weapons of mass destruction assets. The revolution in precision guided munitions has dramatically improved the lethality of U.S. forces against such time-critical targets.

Stealth aircraft can also penetrate unscathed to target in a manner not seen prior to Desert Storm. Unmanned aerial vehicles, like Predators equipped with Hellfire Missiles, can provide a continuous overhead and lethal counterforce presence not available when Secretary of Defense Aspin announced the Counterproliferation Initiative in 1993.

U.S. agent defeat weapons, now in research and development, show promise, one day, of successfully destroying, disabling, or denying access to enemy weapons of mass destruction sites without spreading their lethal contamination downwind. Analytical tools for characterizing targets and weapons effects also make life easier for planners given the task of mating

the right weapon to a given enemy weapons of mass destruction target, and predicting effects. Thus, in all of these ways, there have been major technological improvements in accuracy, penetration to target, target area coverage, agent defeat weapons, and analytical tools.

However, the adversaries have not been asleep while all this U.S. technological progress has been achieved. The North Koreas, Irans, and other actual and potential rivals have hidden their weapons of mass destruction assets, using camouflage, concealment, and deception techniques. Unfortunately, as the United States is finding out in Iraq, an adversary may be very successful in concealing weapons of mass destruction programs and finding them may be like finding a needle in the proverbial haystack.

It is close to impossible to execute successful counterforce attacks when the target locations are unknown. Thus, target identification and location is the key to counterforce success or failure. Position location uncertainty also robs the U.S. of its ability to successfully implement a preemptive strategy, so good intelligence on enemy weapons of mass destruction is an absolute requirement.

Nor have adversaries been asleep in other ways. Adversaries like North Korea, for example, have burrowed into hills and mountains and moved their assets into tunnels, cut-and-cover structures, and deeply buried facilities. The "mole" strategy has been adopted to frustrate improved U.S. counterforce strike capabilities and, at present, there is only a partial U.S. capability against adversaries who have taken their weapons of mass destruction maintenance, storage, and production assets underground.

Finally, adversaries have increasingly turned to deploying mobile missile launchers whose shoot and scoot tactics, coupled with numerous decoys, make counterforce targeting extremely perplexing and difficult. After a dismal failure in Desert Storm "Scud Hunting," the United States military still lacks an adequate counterforce capability to find and destroy missiles on transporter-erector-launchers. The mobile or relocatable missile launcher problem is still a good way from being solved despite numerous improvements since 1991.

Thus, in the foreseeable future, despite significant technological and procedural improvements, U.S. counterforce applications can only promise a partial means of diluting and reducing the threat posed by enemy weapons of mass destruction. Much of the burden remains on

nonproliferation means, deterrence, active and passive defense, and the ability to manage consequences after an attack.

Notes

1. See the remarks of George Ullrich, Director, Weapons Systems, Office of the Secretary of Defense, ODUSD (S&T), "Presentation to the 2003 Munitions Executive Summit," Falls Church, Virginia, February 12, 2003.

2. *The United States Strategic Bombing Surveys* (European War) (Pacific War) (Maxwell AFB, Alabama: Air University Press, 1987), 13.

3. David A. Deptula, "Effects-Based Operations: Change in the Nature of Warfare," *Defense and Airpower Series* (Washington, D.C.: Aerospace Education Foundation, 2001), 5-6. On-line, Internet, 1 July 2004, available from http://www.aef.org/pub/psbook.pdf.

4. Ibid., 6. The original source is the United States Strategic Bombing Surveys (European War) (Pacific War) (Maxwell AFB, AL: Air University Press, 1987), 13.

5. Ibid., 5.

6. Ibid.

7. Ibid.

8. Lt Gen Buster C. Glosson, "Impact of Precision Weapons on Air Combat Operations," *Airpower Journal*, Summer 1993, 5. On-line, Internet, 1 July 2004, available from http://www.airpower.maxwell.af.mil/airchronicles/apj/glosson.html.

9. Anthony H. Cordesman, "Instant Lessons of the Iraq War," Washington, *Center for Strategic and International Studies*, April 14, 2003, 88.

10. Sandra I. Erwin, "Precision-guided bombs labeled 'transformational,'" *National Defense*, Arlington, Virginia, October 2001. On-line, Internet, 24 February 2003 available from http://proquest.umi.com/pqdweb?index=0&did=000000082252830&SrchMode=5&Fmt=3&retrieveGroup=0&VInst=PROD&VType=PQD&RQT=309&x=-&VName=PQD&TS=1061406042&clientId=417.

11. Bill Sweetman, "Scratching the Surface: Next Century Air-to-Ground Weapons," *Jane's International Defense Review*, July 1997, 55.

12. Glosson, 5.

13. Ibid.

14. Ibid.

15. "Joint Direct Attack Munition (JDAM)," *United States Navy Fact File*, 18 February 2003. On-line, Internet, 1 July 2004, available from http://www.chinfo.navy.mil/navpalib/factfile/weapons/wep-jdam.html.

16. "Smart Bombs," *Federation of American Scientists (FAS), Military Analysis Network.* On-line, Internet, 1 July 2004, available from http://fas.org/man/dod-101/sys/smart/ index.html. Improved U.S. PGMs include the following: GM-62 Walleye, AGM-65 MAVERICK, AGM-84 HARPOON, SLAM, AGM-86C CALCM, AGM-88 HARM, AGM-130, AGM-142 HAVE NAP, AGM-154 JSOW, AGM-158 JASSM, BGM-109 TOMAHAWK and its variants, LOCASS, FRSW, AARMD, and the HYSTRIKE/FAST HAWK.

17. Glosson, 7.

18. FAS, Op. Cit. The U.S. has acquired, for example, 11,000 GBU-10 and 32,000 GBU-12 guided bombs; 13,000 GBU-24s; 3,200 GBU-27s, and 300 bunker-busting GBU-28s. The U.S. also possesses TV/IR guided bombs like the GBU-15 munition and other GPS-Guided Bombs like the GBU-15, GBU-24 E/B, GBU-29, GBU-32, the GBU-36, GBU-37, and GBU-ADW and other guided bombs like the 40,000 WCMDs acquired since 1998.

19. Deptula, 7.

20. "Proliferation: Threat and Response," *Office of the Secretary of Defense*, (Washington, D.C., U.S., Department of Defense, January 2001), 90.

21. "Nuclear Posture Review [Excerpts]." On-line, Internet, 1 July 2004, available from http://www.globalsecurity.org/wmd/library/policy/dod/npr.htm.

22. Barry R. Schneider, "Invitation to a Nuclear Beheading," *Across The Board*, July/August 1983, 13.

23. Nuclear Posture Review [Excerpts], 90.

24. Ibid., 90-91. The Tunnel Defeat Demonstration Program is jointly sponsored by the Defense Threat Reduction Agency (DTRA) and by the Defense Intelligence Agency (DIA). Currently the Hard Target Defeat Office is housed in the DTRA Technology Development Division, directed by Dr. Anthony Thomas Hopkins.

25. This is a method of tunnel construction where a trench is excavated, the tunnel structure built, and then is covered with earth and rock.

26. Michael Giltrud, Briefing, "Emerging Concepts of Counterforce (CF) Weapons," DTRA/TD Slide, presented at Air War College, April 15, 2003.

27. See the *Gulf War Air Power Survey*. See also, Rear Admiral Stephen H. Baker, USN, (Retired), "Iraqi Scuds: A Threat We Have To Respect," CDI Terrorism Project, *Center for Defense Information*, December 3, 2002, Baker summarizes, "on 42 occasions, patrolling aircraft spotted a launch plume, leading to eight attacks. Overall, tactical aircraft reportedly failed to destroy any Scud launchers," 2.

28. Baker, 2.

29. *Gulf War Air Power Survey*. See also, Barry R. Schneider, *Future War and Counterproliferation: U.S. Military Reponses to NBC Proliferation Threats* (Westport, CT.: Praeger Publishers, 1999), 155.

30. Timothy F. Lindemann, "U.S. Nuclear, Biological, Chemical and Missile Counterforce Capabilities," Unpublished Dissertation, USAF National Security Fellows Program, June 2001 draft, 9.

31. Ibid.

32. Ibid.

33. These thoughts are the personal assessment of Mr. Steven Hancock, an intelligence officer from the DIA's Missile and Space Intelligence Center (MSIC) who was a participant in the Combined Air Operations Center for Operation Iraqi Freedom. MSIC itself has taken no official position on the lessons of OIF.

34. Ullrich, 11.

35. Lindemann, 13.

36. Harris, 37.

37. Ullrich, 11.

38. Ullrich, 38-40.

39. Briefing on "JTAMDO 2010 Vision for Attack Operations" by Colonel Rich Harris, USAF, JTAMDO, TCS/J8 to USAF Counterproliferation Center (CPC) Workshop, March 26, 2003. See CPC *Summary Report* submitted to Technology Division, U.S. Defense Threat Reduction Agency, September 30, 2003, 11.

40. Ibid., 10.

41. Ibid., 11.

42. Thomas E. Ricks, "U.S. Military Considers Weapons that Disable Bunkers, Spare People," *Wall Street Journal*, July 1, 1999, 1.

43. Paula R. Kaufman, "Fierce Thermobaric Weapons Readied Against Underground Bunkers," *IEE Spectrum*, 19 November 2002. On-line, Internet, 24 September 2003, available from http://www.spectrum.ieee.org/WEBONLY/wonews/nov02/thermo.html. Thermobaric comes from two Greek words: "therme" for heat and "baros" for pressure. As Dr. Stephen Younger, Director of the Defense Threat Reduction Agency, has stated, "we have several programs…to look at advanced methods for agent defeat, such as generating a high enough temperature for a long enough period to kill biological organisms. This appears to be a promising route, but lacking that ability the best we may be able to do is immobilize the agent until ground forces have arrived." See "Issues and Events: Younger Speaks From the Frontline of Defense," *Physics Today*, February 2003. On-line, Internet, 1 July 2004, available from http://www.aip.org/ pt/vol-56/iss-2/p23.html.

44. "The DTRA Thermobaric ACTD," *Global Security*. On-line, Internet, 1 July 2004, available from http://www.globalsecurity.org/military/library/report/2001/010725-thermobaric.htm.

45. John Pike, "Agent Defeat Weapon, Agent Defeat Warhead (ADW)," *Global Security*, Washington D.C., 22 December 2002. On-line, Internet, 1 July 2004, available from http://www.globalsecurity.org/military/systems/munitions/adw.htm. ADWs are being designed to fit the GBU-15, GBU-24, GBU-27, GBU-28, GB-111B, AGM 130 and GBU-31s.

46. "DoD Readies 'Thermobaric,' Cave-Clearing Bomb For Enduring Freedom," *Inside The Air Force*, vol. 13, No. 1., January 4, 2002. On-line, Internet, 1 July 2004, available from http://www.globalsecurity.org/military/library/news/2002/01/020104-Afws4.htm. See also Kaufman, 1.

47. "U.S. DoD Expedites Anti-Chem-Bio Weapons Development," *Janes Information Group*, 13 September 2002. On-line, Internet, 1 July 2004, available from http://www.janes.com/press/pc020913_1.shtml.

48. Mr. Vayl Oxford, Deputy Director, Technology Division, DTRA/TD, Briefing on "DTRA and Counterforce Operations Against Weapons of Mass Destruction," April 2000, USAF Counterproliferation Conference, Maxwell AFB, Alabama.

49. Ibid.

50. Ibid.

51. Oxford, 62.

52. Ibid., 59. Three major aspects of CAPS program are: (1) Integration of intelligence and production process analyses to create detailed assessments of suspected

proliferating country's WMD assets; (2) identification of critical nodes in each of these country's WMD programs; and (3) consequence management of attack plans.

53. See Counterproliferation Analysis and Targeting System (CAPS) at http://www.llnl.gov/nai/technologies/techinfo2.html. This is the Internet website of NISA, a Lawrence Livermore National Laboratory address.

54. "National Strategy to Combat Weapons of Mass Destruction," *The White House*, Washington, D.C., December 2002, 3.

55. Barry R. Schneider quote that has become the motto of the U.S. Air Force Counterproliferation Center, Maxwell AFB, Alabama.

56. In considering the worth of any preemption decision, policy-makers will be confronted with a number of important questions. (For an earlier discussion of these points see, Barry R. Schneider, "Offensive Action: A Viable Option?" Ch. 7, *Future War and Counterproliferation: U.S. Military Responses to NBC Proliferation Threats* (Westport, CT: Praeger, 1999), 157-182.) For example:

- Should the United States initiate a war to deny a hostile government the use of its weapons of mass destruction? To prevent it from acquiring that capability?
- Or, should the U.S. leadership, in all peacetime cases, abstain from initiating war and take its chances with non-military means of persuasion?
- How immediate is the adversary threat to use WMD? Has the United States exhausted other non-military options first and does it have time to persist in these further?
- How certain is U.S. intelligence about the adversary WMD capabilities and likely timing of future WMD employment? Is the United States and/or its vital interests at immediate risk?
- Are key enemy WMD targets precisely located and vulnerable to U.S. preemptive strikes? Does the United States possess the required counterforce strike capabilities? What levels of damage could the adversary WMD inflict if the U.S. counterforce operation is not completely successful?
- Can the adversary be deterred by U.S. threats and warnings short of war?
- Is surprise achievable? If not, can the counterforce preemptive attack succeed?
- Are the United States and allied states safe from WMD retaliation from the adversary state or its regional allies?
- Is the United States committed to win the conflict once the preemptive strike sparks it? Has it carefully planned the initial campaign, the possible directions such a war might go in, and a reasoned exit strategy and post-war end game?
- Have the U.S. leaders set clear objectives and limits for U.S. military actions and chosen appropriate means?

- Finally, has the U.S. leadership weighed the costs and benefits of preemption as opposed to a non-military set of options backed by the threat of retaliation? Which option holds the greater risk to U.S. national security, counterforce targeting or adopting a wait-and-see diplomatic/deterrence option?

57. Ibid., 162-164. As Daniel Webster, U.S. Secretary of State in 1841, wrote a note to the British Government in the 1837 Caroline Case, "use of force by one nation against another is permissible as a self-defense action only if force is both necessary and proportionate." See Zachary Sr. Davis with Mitchell Reiss, consultant, "U.S. Counterproliferation Doctrine: Issues for Congress," CRS Report, *Library of Congress*, 21 September 1999, CRS-19.

58. Elihu Root, "The Real Monroe Doctrine," *American Journal of International Law*, 35 (1914), 422. For an unsympathetic view of anticipatory self-defense, see Louis Henkin, *How Nations Behave*, 2nd edition (New York: Columbia University Press, 1979), 141-145. For a more supportive view, note Myres S. McDougal and Florentino P. Feliciano, *Law and Minimum World Order: The Legal Regulation of International Coercion* (New Haven, CT: Yale University Press, 1961), 217-244. See also Schneider, "Offensive Action: A Viable Option," 169.

59. Brad Roberts, "Military Strikes Against NBC-Armed Rogue States; Is There a Moral Case for Preemption? Unpublished paper, August 3, 1996.

60. Michael Walzer, *Just and Unjust Wars*, 2nd edition (New York: Basic Books, 1992), 24.

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The USAF Counterproliferation Center was established in 1999 to provide education and research to the present and future leaders of the USAF, to assist them in their activities to counter the threats posed by adversaries equipped with weapons of mass destruction

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