COUNTERFORCE: LOCATING AND DESTROYING WEAPONS OF MASS DESTRUCTION

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FOREWORD

We are pleased to publish this twenty-first volume in the *Occasional Paper* series of the US Air Force Institute for National Security Studies (INSS). This paper is particularly timely as it addresses a critical situation that United States military forces face in deploying to forward locations and in confronting rogue states and asymmetrical challenges. Colonel Chandler explores the protection of U.S. forces from weapons of mass destruction (WMD) threats enroute to and during deployed operations. He develops a system-of-systems capability package using existing or nearly operational systems to provide early-conflict or pre-conflict dominance, enabling the introduction of traditional force packages into theater and their protection from WMD threats. He adds a detailed development of how such operations fit into the regional combatant commander's concept of operations, and a discussion of planning factors to implement the system for the CINC. The threat is real, and these ideas are worthy of full study and consideration by military planners at all levels of operations.

This paper was not written under INSS sponsorship, but was brought to our attention by the Air Staff's Policy Division, Nuclear and Counterproliferation Directorate, INSS' primary sponsor. This is only the second Occasional Paper that was not originally an INSS research project, and we believe that the timeliness of the topic, the relevance of the paper, and the originality and detailed development of its ideas fully warrant its publication for wider distribution and review.

About the Institute

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INSS coordinates and focuses outside thinking in various disciplines and across the military services to develop new ideas for defense policy making. To that end, the Institute develops topics, selects researchers from within the military academic community, and administers sponsored research. It also hosts conferences and workshops and facilitates the dissemination of information to a wide range of private and government organizations. INSS is in its fifth year of providing valuable, cost-effective research to meet the needs of our sponsors. We appreciate your continued interest in INSS and our research products.

JAMES M. SMITH
Director

EXECUTIVE SUMMARY

The global technological transformation of warfare has been underway since the end of the Cold War. Proliferation of weapons of mass destruction (WMD)—nuclear, biological, and chemical weapons—and advanced conventional weapons and technology are offering potential regional adversaries new operational concepts for countering American power projection. The Air Force has been responding to these evolving challenges with its own continuous process of renewal and global situational awareness that charts a course for the first quarter of the twenty-first century. The 1998 Presidential Panel to Review Long-Range Air Power added a new element to the process of reshaping Air Force strategic concepts and capabilities to meet the exigencies of a quickly evolving threat.

The proliferation of WMD and advanced conventional weapons has placed the U.S. power projection strategy under attack in several regions of the world. Asymmetric threats pose significant challenges to the U.S. military strategy. The United States, on the other hand, possesses significant strengths, including the potential to increase the tempo of warfare through long-range precision counterstrikes early in a conflict. Counterforce operations at the outset of a conflict can be effective in preventing the use of WMD and at the same time confuse, disorient, and disorganize an adversary's forces.

In order to defeat a WMD-armed adversary's asymmetric attacks, the United States needs to have in place balanced CINC concepts of operation and robust counterforce operational concepts for locating and destroying WMD early in a conflict. A system-of-systems architecture is useful in identifying the military capabilities or building blocks necessary to underwrite such a counter-WMD approach: intelligence,

surveillance, and reconnaissance (ISR); command, control, communications, computing, and intelligence (C4I); long-range precision strike forces; precision strike weapons; theater enabling forces; distributed ground combat cells; and carrier-based aircraft. The synergies among these seven building blocks make possible prompt counterforce attacks against an enemy's WMD and other military capabilities that could impede U.S. power projection operations.

When these capabilities are placed in the hands of the combatant commanders with global and regional responsibilities, new concepts of operation can be fashioned to locate and destroy WMD "before they can be used" against U.S. forces and friendly populations. New targeting models and planning tools make it possible for a combatant commander to chose from an ever-expanding number of military strike options. The creative use of intelligence in peacetime can result in workable operations plans for conflict and lay the groundwork for providing the CINC full-scope battlespace knowledge in the earliest hours of a crisis.

In regional conflicts involving adversaries armed with WMD and advanced conventional weapons, the U.S. should turn to its revolutionary advantages based on battlespace knowledge, sensors and rapid computing, stealth, precision, and aerial strike. The United States needs to create an air dominance in the earliest hours and days of a conflict. Non-linear, asymmetric U.S. long-range precision strike operations offer the best opportunity to neutralize the new found operational concepts by WMD-armed adversaries.

Counterforce: Locating and Destroying Weapons of Mass Destruction

> The Panel to Review Long-Range Air Power...provided several far-reaching recommendations for fully exploiting the potential of the current B-1, B-2, and B-52 bomber force, and for upgrading and sustaining the bomber force for the longer term. These longer term recommendations warrant careful review as the Department of Defense prepares its Fiscal Year 2000-2006 Future Years Defense Program.
>
> President William J. Clinton
> March 31, 1998[1]

Anticipating change in regional threats worldwide following the enormously successful air attacks in the 1991 Persian Gulf War, the Air Force developed a vision for restructuring and modernization in *Global Reach—Global Power* that would guide it into the 21st century. Building upon this forward-looking Air Force vision, the senior leadership recognized early that any new aerospace concept in the mandatory and continuous process of renewal must satisfy the demands of America's national security and operate more from a reservoir of U.S.-based contingency forces.

Global Engagement: A Vision for the 21st Century Air Force presents a strategic vision that charts a course for the Air Force during the first quarter of the next century. Centered on the ability to obtain timely global situational awareness, orchestrate military operations throughout a theater of conflict, and project intense firepower over great distances within hours to days, the vision is poised on the capacity to strike an adversary's centers of gravity directly and to prevail at the operational and tactical levels of warfare.

These two vision statements tapped into the mainstream of the global technological transformation that is creating new instruments for shaping international security. The rapid spread of military technology and knowledge is strongly influencing the way people think about war, its conduct, and its consequences. Gone are the modern versions of Napoleonic warfare where clashes of military strength against military strength would continue until attrition on one side compelled the other to quit the battle out of sheer exhaustion. New operational strategies made possible by technology are asymmetric where each side uses its strengths against an adversary's weaknesses and, as is the case in the martial arts, turns the enemy's strengths against himself. A continuous renewal of Air Force strategic concepts and aerospace capabilities will be required in this new threat environment to maintain a powerful and superior global force.

One such renewal of Air Force concepts and capabilities was initiated in March 1998 by the report of the Panel to Review Long-Range Air Power.[2]

> The Panel believes that long-range air power is an increasingly important element of US military capability.... The potential of the bomber force is multiplied by the addition of precision-guided munitions, both direct delivery and stand-off.... The Panel believes that more attention is needed to exploit this expanded capability of the bomber force.... In addition to their own attack capability, stealth aircraft can be employed to leverage the success of the rest of the bomber force and fighter fleets.[3]

The Long-Range Air Power Panel's recommendations made it crystal clear that the bomber force should not be allowed to wither and die. "As these emerging long-range high payload attack systems are integrated into the force structure, there will be increasing demand for them," the panel chairman, General Larry Welch, former Air Force Chief-of-Staff, expressed confidently, "the DoD needs a plan for maintaining the bomber force over the years through 2030."[4]

The purpose of *Counterforce: Locating and Destroying Weapons of Mass Destruction* is to integrate the key insights of previous Air Force vision statements with the findings of the 1998 Long-Range Air Power Panel and address one of the most demanding practical issues that will impact America's next first battle. The proliferation of weapons of mass destruction (WMD) changes the context and conduct of future warfare. For starters, America's military strategy, operations concepts, and doctrine for the early 21st century should be based on the very real possibility that the armed forces will be pitted against adversaries armed with biological and chemical weapons and the ballistic and cruise missiles needed to deliver them accurately across great distances.[5]

After the astounding American-led victory over Iraq in the Persian Gulf War, several countries have been studying U.S. military operations in search of vulnerabilities that might be effectively exploited in future conflicts. Their approach is the one recommended by Sun Tzu, the Chinese military philosopher in the fourth century B.C.: "To subdue the enemy without fighting is the acme of skill. Thus, what is of supreme importance in war is to attack the enemy's strategy."[6]

Drawing upon lessons learned from the Gulf War and taking advantage of the bustling international arms market, weapons of mass destruction offer disaffected non-Western countries new opportunities for posing severe asymmetric threats against the U.S. global power projection strategy. North Korea, Iraq, and other non-Western countries possess the means and the motivation to engage the United States militarily with WMD as the twentieth century comes to a close. Meanwhile, several other regional powers are growing in wealth, technology, and knowledge that will give them more deadly military capabilities and greater influence in the years immediately ahead. Some may attempt to dominate a region by intimidating U.S. allies and friends, pursue interests inimical to the United States, and develop WMD and

other weapons necessary to challenge American power and influence. Regional adversaries unable to confront American power directly may attempt to counter the U.S. strategy through asymmetric means by (1) confronting the United States in ways that it cannot match, (2) circumventing U.S. strengths through inexpensive or unconventional approaches, or (3) carefully exploiting military vulnerabilities associated with the deployment and operations of American expeditionary forces.

The proliferation of WMD changes the strategic conditions for U.S. forces overseas. First, in a world where a potential enemy is armed with biological and chemical weapons, forward-based American forces are within range of these mass destruction capabilities, whether delivered by strike aircraft, ballistic and cruise missiles or terrorists. Overseas-based U.S. military forces, therefore, must be recognized as both an inherent strength and a potential vulnerability—the June 1996 terrorist attack against U.S. forces at the Khobar Towers in Saudi Arabia drove home the point in a bloody way. Another weakness is centered on the strategic movement of U.S. forces from North America to Northeast Asia, the Persian Gulf and Middle East, and Europe—interruption of the orderly flow of these forces, whether events occur inside the United States, en route, or near their overseas destination, is an important potential vulnerability. Third, United States military strategy is dependent upon foreign governments making timely decisions to grant access to their reception facilities—if a candidate host government is asked to pay a high price in terms of the consequences from enemy use of WMD or terrorist attacks and the U.S. cannot assure its protection, political access to vital ports and airfields may not be readily forthcoming. Fourth, the U.S. dependence on a small number of seaports and air bases for reception and resupply of land-based air and ground forces opens the door to enemy anti-access operations, including biological and chemical warfare attacks. Fifth, deployed American forces are vulnerable to WMD attacks when

operating from fixed-sites such as airfields and logistics centers, as well as carrier-based air operations from the littoral waters within range of the adversary's weapons of mass destruction and missiles. Finally, WMD-armed adversaries may try to exploit potential U.S. vulnerabilities by threatening or inflicting massive American casualties.

These observations make it clear that the dimensions of America's next first battle are already emerging. One thing is certain: technological surprises will challenge U.S. military commanders on the future battlefield. They will be confronted by new uses and interactions of known weapons, new weapons with expected effects, new weapons with unexpected effects because they are used in innovative ways, and "old" weapons not anticipated and for which no defenses have been retained. The spread of lethal technologies, old and new, to rogue regimes[7] and others in the non-Western world is accelerating. This means that the United States must prepare for surprises at the outset of the next conflict.

The United States has the opportunity to turn an adversary's potential asymmetric attacks against itself through superior knowledge of enemy military dispositions and strategically incisive counterattacks with precision-guided weapons delivered from aerial platforms early in a conflict. Situational awareness provided by an array of sensors, rapid fusion through superior computing, and real-time communications can be linked directly to strike aircraft and unmanned systems to the point that the United States could increase the tempo of warfare to confuse, disorient, and disorganize a regional adversary's forces in spite of their geographic advantage of proximity to the battle zone.

In the final analysis, it is quite clear that no less than the longstanding U.S. national military strategy—based on strategic agility, overseas presence, power projection, and decisive force—is under attack by the ever increasing numbers of theater-range strike systems and

weapons of mass destruction available to regional powers. In the past, forward-based and positioned forces, whether stationed there permanently or temporarily deployed, were judged to deter adversaries while reassuring allies and friends. The future, however, will behold an entirely new picture since forward positioned U.S. forces will be held at risk of destruction by theater-based systems. Even with air and missile defenses, in-theater air bases used by American military forces will be highly vulnerable to determined biological and chemical weapons attacks, especially during the critical early stages of a conflict. The strategic concept of "fighting our way into a denied theater or creating and protecting forward operating bases" promises to become more onerous over time as adversaries build arsenals of WMD and theater ballistic and cruise missiles.

The single most distinguishing feature of counterforce operations against WMD, as compared with existing missions of battlefield area interdiction, offensive counterair, and deep interdiction, lies in the targets themselves: chemical and biological weapons and ballistic and cruise missiles. These targets may already be earmarked for attack under an existing mission area but counterforce operations against WMD should be considered a specialized subset of these other missions and whose neutralization or destruction is of immense importance to the success of the overall campaign. Many of the WMD targets should be destroyed early in a conflict to prevent their use against friendly populations and forces. Locating these targets can be difficult, including, for example, the specific site of WMD facilities within the confines of a larger fixed target. Some targets may be relocatable; they may be vulnerable to attack for a short period of time (hours) at the outset of conflict. Mobile targets, such as missile transporter-erector-launchers (TEL), present an especially difficult bombing task due to an enemy's use of ruses, decoys, rapid shoot-and-scoot operations, and other tactics. Another consideration is

the depth of the target from political borders. Generally speaking, the deeper the target location, the more onerous is the counterforce strike operation. Finally, linking sensors-to-shooters can help significantly in striking the WMD target within the enemy's decision-making cycle. Such operations will require exquisite intelligence in peacetime to obtain the knowledge necessary to characterize WMD and WMD-related targets, plan counter-WMD operations ahead of time, and conduct informed and effective operations during conflict.

System-of-Systems Architecture

A system-of-systems architecture is more than a collection of individual system elements. The systems are building blocks used to construct an architecture that will support and provide inputs to the CINC's concept of operations and counterforce operational concepts. The force structure elements in this architecture use existing systems to the extent practicable. A concentrated effort is made to avoid redesigning or creating new system elements. Rather, emphasis is placed on discovering more effective ways to defeat the WMD-armed adversary's asymmetric strategy by using those U.S. military forces and technologies that have already been developed and that are either in or near being in production. The key is taking advantage of the operational synergies of the systems elements resulting from the integrated architecture.

The system elements necessary to support the counterforce architecture are divided into seven building blocks: intelligence, surveillance, and reconnaissance (ISR) systems and processes; enhanced command, control, communications, computing, and intelligence (C4I); long-range precision strike forces; precision strike weapons; theater enabling forces; distributed ground combat cells; and carrier-based aircraft.

Intelligence, Surveillance, and Reconnaissance (ISR)

The system-of-systems architecture for counterforce operations is based on the ability of the United States to apply military forces to impose far greater risks against a WMD-armed antagonist than the adversary can place against U.S. forces. A key system element of the capacity is "battlefield awareness" or the timely knowledge about events before and during the battles. For the first time in the history of humankind, the commander can "see" the battlefield in depth and breadth. No other country is able to bring to the battlefield the integrated array of sensors positioned in space, air, ground, and at sea.

The Air Force has already taken the initial steps to enhance battlefield awareness by development of the Information Superiority/Air Expeditionary Force (IS/AEF) concept in which an "electronic triad" is built around the long-range sensors such as the Joint STARS—Joint Surveillance Target Attack Radar System (radar tracking of vehicle movement), AWACS—Airborne Warning and Control System (air superiority aircraft control), and Rivet Joint (electronic signals). While all three members of the ISR "troika" are important, the Joint STARS aircraft provide a key component of the ability to "see" the enemy's disposition over a wide area and to choose the time and place to attack them before they engage U.S. and friendly forces. The Joint STARS combines moving target indicators with synthetic aperture radars, which produce images that allow U.S. strike platforms to single out individual vehicles. The radar can even distinguish between wheeled and tracked vehicles such as trucks and tanks. The potential interdiction of enemy armored columns before they engage allied forces is a key synergism of the sensor-to-shooter linkage.

The IS/AEF is an important development in overcoming the growing WMD threat to America's power projection strategy. First, it is organized as expeditionary force that makes it immediately available for worldwide deployment. Second, it has a small footprint in or near the

theater that minimizes its exposure. And, third, the IS/AEF has both flexibility and versatility; it offers a readily adaptable resource for countering asymmetric threats. The three aircraft (Joint STARS, AWACS, and Rivet Joint), for instance, offer shooters different battlefield pictures that can be fused into a single, multispectral image of the battlespace. The fusion could be enriched easily by "plugging-in" to U-2 reconnaissance aircraft, reconnaissance unmanned aerial vehicles (UAV), and space surveillance and communications systems. The Navy's E-2C Hawkeye air surveillance and P-3 Orion maritime surveillance could also tap in. Other potential future components of IS/AEF could be the Airborne Laser with its surveillance and battle management systems; the Global Hawk and Dark Star high altitude, high endurance UAVs; and the highly advanced sensing systems of the F-22 stealth fighter. Unattended ground sensors used to monitor an enemy's underground weapons storage facilities could also become members.

New families of in-close sensors are being developed for precision attacks against weapons of mass destruction and missiles. Even more advanced technologies available over the long-term will allow detection of camouflaged targets. Advances in bringing data together from multiple sources and assembling the inputs into useable forms for support of military operations are making progress. Net-centric operations linking sensors with weapons are evolving rapidly through the integration of pre-conflict characterization of WMD and WMD-related targets with the wartime sensor data that will make it possible to target, deny, interdict, or destroy WMD forces and supporting infrastructure.

Sensors based on satellites and UAVs can be used in mutually reinforcing ways. Satellites, for instance, can provide twenty-four hour surveillance of a specific target. They can perform this function from a predictable location. The potential to have almost constant images from satellites of specific trouble spots in the world would give the United

States a tremendous advantage. UAVs, on the other hand, are mobile and can respond to rapidly changing events on the ground. On the flip side, UAVs can also offer non-Western states a ready reconnaissance capability very cheaply to supplement the more sophisticated one-meter square satellite images available from commercial companies. While UAVs appear to offer WMD-armed adversaries and other smaller countries an equalizing capacity in surveillance and reconnaissance capability, it is an enormously complex and challenging task to integrate UAVs and the ISR data available from other sources. While the U.S. and its allies can be expected to maintain their lead in these capabilities for some time in providing real-time targeting information, WMD-armed adversaries may achieve systems that are "good enough" to target U.S. forces deploying to the theater.

Another U.S. sensor platform of potential value is the Cobra Ball RC-135 aircraft that has been revamped to detect the launch of ballistic missiles and analyze their capabilities. Its advanced sensor suite can accurately locate a missile launch more than 260 miles away, mark the engine's cutoff, and then quickly calculate its trajectory and impact point. Valuable information about its stability and accuracy can be gleaned from the reentry vehicle's speed of rotation and any signals it receives from ground controllers can tell more about the missile's mission. These are valuable components of a theater ballistic missile defense system. Cobra Ball is expected to provide a sound anti-Scud capability by using proven technology.

The intelligence, surveillance and reconnaissance assets that provide a heightened battlefield awareness of the location of weapons, troops, and armored columns are important components of a combatant commander's concept of operations. The U.S. commander is also offered the ability to achieve dominant battlespace knowledge based on (1) an awareness of where things are, (2) an understanding of the relationships

and related significance of the enemy's force elements, (3) how the units and weapons fit into the terrain and are constrained by it, (4) what the forces are trying to achieve, and (5) how the various military objectives relate to each other. The ability to quickly comprehend how the enemy's units and weapons relate to each other will provide the United States a tremendous leverage in locating and destroying WMD that can be exploited by precision munitions. The United States will be able to select the highest payoff targets and develop an attack plan that goes after the enemy's asymmetric strategy by turning his strengths against himself.

The ability of the United States to collect and process data rapidly from a relatively large area (about 40,000 square miles) will permit the identification and location, with minimal processing delay, of virtually all friendly, neutral and opposing forces, military facilities, machinery, weapons, vehicles, and militarily significant units. Processing the data to provide an integrated fusion provides a battlespace picture in great detail. This dominant battlespace knowledge is an enormously important exploitable advantage. Over time, one should anticipate adversaries will adjust by taking actions to deny the United States such knowledge to the extent that might be possible. Yet, even a grand "cat-and-mouse" game of a competition between "hiders" and "finders" promises to disrupt an adversary's invasion forces against neighbors and the flow of asymmetric attacks against U.S. deployments. As the adversary becomes better at "hiding," the U.S. can be expected to become better at "finding." The regional competition will favor the side that is most creative in understanding the other.

Command, Control, Communications, Computing, and Intelligence (C4I)

A second crucial architecture element is the enhanced C4I communications and data links that are growing apace with dominant battlespace understanding and allow the transmission of the information

to where it is most needed, whether to the strike operations command posts or the top of the chain of command. The Global Command and Control System links the various military command centers of the United States and provides the warfighter with a fused picture of the battlespace. The commander can also talk to and coordinate a vast number of military assets at the same time. Rapid fusion and dissemination of surveillance and targeting data can ensure greater battlefield awareness in the cockpit or other firing platform. Integrating Global Positioning System data into the overall C4I system gives strike platforms even greater visualization of the battlefield and opportunities to locate and destroy WMD.

The C4I system element is important to targeting strike platforms, including those attacking on the fly. In the rapidly changing environment on the ground anticipated when WMD-adversaries take counter-actions against U.S. attacks, military commanders will need to be able to "read" the other side quickly and adapt rapidly to the newly emerging circumstances. This leads us to the conclusion that the synergy between ISR and C4I is a special attribute that must be fully exploited.

The C4ISR systems elements are fused into one. These capabilities are based on more than a collection of hardware and software systems. Dominant battlespace understanding can only be achieved by integration of concepts, operational methods, people, training, and supporting systems and processes. C4ISR provides a usable picture of the battlespace to support targeting and strike operations as well as the knowledge base for the commanders making informed decisions. Integrating C4ISR into the CINC concept of operations is a key to enhancing U.S. counter-WMD capabilities and the basis for attacking the enemy's asymmetric strategy.

Long-Range Precision Strike Forces

The third element of the system-of-systems architecture is use of long-range aircraft armed with precision weapons to execute anti-armor,

counter-WMD, and other counter-military operations. The C4ISR and precision-munitions are essential components in applying airpower's inherent characteristics of speed, range, flexibility, and versatility to attack enemy targets directly. With a zero delay in sensor-to-shooter information, manned aircraft can be re-directed when attacking targets not only in the close-in battle between land forces but deep into the enemy's rear areas. In many cases, air strikes will be able to reduce the enemy's WMD significantly and destroy combat capabilities essential to his asymmetrical strategy designed to slow, disrupt, and block U.S. deployments to the theater.

With C4ISR providing a near-real-time global awareness, the U.S. will be able to dominate the dimension of time by carefully selecting targets and integrating the campaign to strike the enemy throughout his territory. This U.S. asymmetric strategy of using long-range precision-strike aircraft (B-52, B-1B, and B-2) to enable the introduction of tactical fighters to a theater earlier and in greater numbers invokes parallel warfare in which the enemy is attacked in depth and breadth with overwhelming force. The centers of gravity of the enemy's anti-access asymmetric strategy are the primary targets, including the critical points in the adversary's order of battle and infrastructure that underwrite his WMD threats to deny the U.S. access to regional seaports and airfields. The U.S. operations would be designed to give the enemy no time to adjust, adapt, or mount a counteroffensive. The objective is to attack all of the enemy's centers of gravity at once—in parallel or "parallel warfare"—rather than serially where the enemy is given a chance to adapt to strikes against facilities low on the attack plan. Four operational objectives can be expected to guide U.S. strike operations at the outset of a conflict: disrupt the enemy command and control, halt the invading forces, locate and destroy WMD, and maintain access to the region's ports and airfields.

Long-range bombers have "virtual presence" in overseas regions resulting from their capability to strike any target anywhere on earth with the assistance of aerial refueling. Saddam Hussein, as we have seen, has shown himself to be very sensitive to time and how much he can accomplish before the Americans can respond in force. Other foreign leaders with political objectives inimical to U.S. interest are also keenly aware of America's lengthy response times. A "virtual presence" of ready, quick responding long-range bombers armed with precision-guided munitions could alter their strategic calculations and perhaps dissuade actions by Saddam and other leaders hostile toward the United States. Moreover, stealth enhances the capability for survivable attack against defended targets. To hedge against the lack of strategic warning and surprise, the initial bomber strikes can occur directly from the United States, but this is not the preferred solution. Forward bases just outside the reach of a WMD-armed adversary's ballistic and cruise missiles and attack aircraft are needed to ensure rapid recycling of the bombers so that the highest possible sortie rates can be maintained over extended periods.

Currently, the United States has a mixed bomber force of cruise missile equipped non-stealthy bombers; direct attack, precision equipped non-stealthy bombers; and direct attack, precision equipped stealthy bombers. A host of operationally-based measures and investments will give the bombers greater capability:

- Non-nuclear operational support for B-52, B-1B, and B-2 bombers;
- All bombers capable of carrying the maximum practical number of the most effective munitions;
- Capability to attack multiple high leverage targets per sortie by increasing the responsiveness of the mission planning system;
- Assured C4ISR connectivity for battlefield awareness;

- Better delivery accuracy for the B-1B and B-52 by improving the attack radar systems; and

- Increased sortie rates through upgrading improved B-2 stealth maintenance and performance, mission planning, and additional support resources, especially at forward bases.[8]

Precision Strike Weapons

Precision-guided munitions (PGMs), a fourth element of the system-of-systems architecture, are capable of striking any military-related target that can be located precisely and characterized in sufficient detail any place in the world. Three main streams of technology assure precision guidance. Human-guided weapons include fiber-optic- and laser-guided bombs; signature-guided weapons use infrared radar reflection and acoustic homing; and location-directed weapons or those that know precisely where the target is and where the delivery bomb is located. The reason for attacking with precision-munitions is the efficiency obtained in strike operations. There are other important logistics benefits as well. According to the Defense Science Board, one ton of PGMs is equivalent to 12-20 tons of unguided munitions on a tonnage per target basis. With fewer misses, it stands to reason that fewer bombs are needed to destroy the target. In addition, when taken in the totality of operations during the Gulf War, the use of PGMs, on a per target basis, saved as much as 35-40 tons of fuel.[9]

Since precision weapons make it possible to hit what we aim at, it means we can strike biological and chemical weapons and ballistic and cruise missiles more effectively. These targets will be vulnerable to small-scale as well as large raids. The precision weapons allow a significant increase in efficiency of the resources expended for such missions with fewer misses or bombs scattered across the landscape. In addition, precision accuracy means less collateral damage will be experienced which is always an important consideration, especially when

counterforce operations are conducted in situations with a high political context.

Strikes against biological and chemical weapons manufacturing plants, main storage facilities, forward depots, and committed assets in transit to launch locations present special considerations in how best to destroy the weapons while limiting collateral damage to civilian populations and friendly forces. Traditional high-explosive bombs could destroy the intended target but also produce the possible release of deadly biological and chemical warfare agents into the atmosphere and their dispersal over a vast area. Needed are special "agent defeat" weapons that will limit such collateral effects while destroying the WMD target.

Three criteria help to assess the consequences of precision munitions: (1) the direct, first-order effects on the destruction of various classes of targets; (2) indirect effects such as delays and confusion; and (3) the direct and indirect effects after allowing for countermeasures and other adaptive responses by enemies, including virtual attrition resulting from inducing a diversion of enemy resources to provide active or passive defenses against the American weapons.

The ability to make highly accurate attacks on locatable targets at any range has major implications for attacks against fixed facilities. These include WMD and WMD-related installations, such as storage and garrison locations, command and control facilities, and other critical targets. No less important is the target acquisition of wheeled and armored vehicles on the move that can be provided by Joint STARS and other ISR platforms.

Concentrations of vehicles will be subject to accurate fires delivered by precision-strike platforms, especially if the enemy's routes of advance—restricted by terrain and a scarcity of roads—are known and monitored. The enemy can be expected to use counters, including attacks against surveillance sensors or control systems, active defenses, decoys,

camouflage in innovative uses of natural cover, and wider spacing of vehicles to reduce the chances of multiple kills by a single precision munition. Yet, the aggressor must be on the move to seize the territory of others, which means his forces will be more visible and sometimes in road-march formation. This will enhance the regional defender's efforts to halt the enemy's invasion short of his objectives. It will also lessen the chances of an adversary successfully presenting the United States with a fait accompli.

Two kinds of U.S. weapons are of particular interest in developing counterforce operations. One set is the right weapons suite for halting the aggressor's armored invasion forces, including the enemy's ground firepower weapons such as rockets and artillery for delivery of biological and chemical warfare agents. The second set of munitions important for counterforce attacks are those necessary to destroy an adversary's weapons of mass destruction and theater missiles at fixed sites (including WMD relocated to new sites).[10]

- *Wind-Corrected Munitions Dispenser (WCMD)*. This is an Air Force guidance system designed to get dispensers with submunitions close enough to their targets, including moving vehicles, so that terminal-guidance sensors will take over to produce a high probability of kill. At a 40,000 feet release, for example, the WCMD will be able to steer to a target area nine miles away and about two or three miles cross-range. Release at 20,000 feet gives it a down-range distance of four to five miles and a cross-range of one to two miles. The WCMD will be able to dispense CBU-97 Sensor Fuzed Weapons, CBU-87 Combined Effects Munitions (anti-armor/anti-personnel), and CBU-89 Gator air-delivered mines.[11]

- *Sensor Fuzed Weapon (SFW)*. The CBU-97 munition dispenser was specifically designed to attack moving vehicles. It dispenses smaller projectiles that fire *discriminately* at targets on the ground—under best-case conditions, a single SFW could disable about ten tanks. Each SFW contains ten BLU-108 submunitions and each submunition houses four Skeet projectiles. Each of Skeet projectile forms and fires an

explosively-formed penetration warhead at a target using infrared sensors to locate hot targets such as tanks or armored vehicles.

• *Brilliant Antiarmor Submunition (BAT)*. This Army-developed submunition is a self-guided, anti-armor, top attack system that employs acoustic and infrared sensors. The BAT works autonomously to acquire, track, home on to moving armored vehicles. An analysis by RAND's Glenn C. Buchan and David R. Frelinger shows that BAT, because it has a larger footprint or area of coverage than the Skeet submunition, would improve the effectiveness of long-range bombers by a factor of two or three by reducing the number of aircraft needed to halt an invading force. The larger footprint makes BAT far less sensitive to enemy dispersal and vehicle interspersal than Skeet.[12]

• *Conventional Air-Launched Cruise Missile (CALCM)*. The AGM-86C delivers a 1,000-pound warhead more than 1,000 nautical miles with an accuracy of about 40 feet. Each B-52 can carry 20 CALCMs. On the opening night of Operation Desert Storm 35 CALCMs were launched for defense suppression; 13 were launched in September 1996 in Operation Desert Strike.

• *Joint Standoff Weapon (JSOW)*. This aerodynamically efficient, stealthy system is an INS/GPS guided glide weapon capable of a 15-40 mile range. It can disperse submunitions to attack fixed area and relocatable targets or dive onto the target with a 500-pound unitary warhead. The JSOW can be delivered by B-52, B-1B, and B-2 bombers as well as F-15E, F-16, and F/A-18 fighter aircraft.

• *Joint Air-to-Surface Standoff Missile (JASSM)*. The JASSM is a conventionally armed, low observable cruise missile designed to destroy the enemy's high-value targets from aircraft that launch from outside the area defenses. The missile has automatic target recognition, autonomous guidance, precision accuracy, and a J-1000 warhead optimized for penetration and carrying a new high-yield explosive. These characteristics give JASSM capabilities against heavily defended hard targets such as aircraft shelters and underground command posts as well as soft targets such as rail yards.

• *Joint Direct Attack Munition (JDAM)*. The JDAM is a tail kit providing INS/GPS guidance to general purpose and

penetrator warheads to achieve an accuracy of less than 40 feet. This all-weather weapon solves the problem of weather-obscured targets that deny high precision from laser-guided weapons. Tactical fighters can carry from two to five of the 2,000-pound version while the bomber fleet can deliver 16 on the B-2, 12 on the B-52, and 24 on the B-1B. The new F-22 stealth fighter will be able to deliver two of the 1,000-pound JDAMs. The JDAM (BLU-109) version will have penetration capability.

Theater Enabling Forces

Future air defenses, at least for the first decade or two of the 21st century are unlikely to be fielded in the numbers and density of the former Soviet Union, except in a couple of areas. Even then the adversary's air interceptors and ground-based surface-to-air missiles and anti-aircraft guns probably will not be well integrated, making attacks aimed at breaking air-ground coordination more successful. The stealth F-22 Raptor is the next generation air superiority fighter that will soon join the Air Force inventory. The aircraft can cruise at supersonic speeds while using only slightly more fuel than used by a conventional tactical fighter to cruise at subsonic speeds. It has a low radar cross-section—on the order of an insect to a small bird—that allows it to penetrate an enemy's integrated air defense systems; the aircraft's low drag gives it exceptional range and minimal refueling needs. Heat and other emissions from the aircraft are carefully managed. Using the latest computer technology, the F-22 has an integrated avionics suite that allows the pilot to manage information instead of operating complicated sensors. With the onboard computers handling more of the sensor tasking, the pilot is freed to fly the airplane and fire its eight anti-aircraft missiles or deliver its two 1,000-pound GPS-guided Joint Direct Attack Missiles.

To the extent that long-range precision strike aircraft are used to locate and destroy the enemy's weapons of mass destruction, the F-22 could be instrumental in establishing the air dominance necessary for non-stealth bomber operations and B-2 daylight strikes. Even when

armed with standoff missiles such as JSOW and JASSM, B-52s and B-1Bs may need to push up to area defenses in order to reach deep targets—F-22 protection may be needed. If anti-radiation missiles of a size to fit the F-22's internal bomb carriage were developed, the aircraft could provide a comprehensive suppression of enemy air defenses (SEAD). A combination of stealth and speed should compensate for what presumably would be shorter-range anti-radiation missiles.

Distributed Ground Combat Cells

Situations will arise in the future where air power alone may be unable to deal with all aspects of potent military challenges. In these cases, compelling roles for U.S. ground forces in the theater may be beneficial including (1) integrating with coalition forces, (2) filling in gaps and resolving ambiguities associated with remote sensors, (3) identifying noncombatants and fixing their locations to the extent possible, (4) securing points of debarkation for follow-on forces, (5) controlling territory for the time necessary to satisfy the CINC's concept of operations, (6) locating and neutralizing WMD or designating them for aerial strike, and (7) exploiting the gains achieved by long-range precision-strike operations. To satisfy these roles, the rapid insertion of ground forces would be required. The new expeditionary force concept designed by the U.S. Defense Science Board in 1996 envisions light, agile, potent, and rapidly deployable ground forces.[13] This is an enabling force in that it prepares the groundwork, together with long-range and carrier-based airpower, for the deployment of large numbers of U.S. tactical fighters and land warfare units. Key elements of this concept include a ground force that is distributed and disaggregated into ten to twenty man "combat cells." These "cells" would be empowered by battle dominant knowledge, supported by precision logistics, connected by robust communications, and dependent on remote fires that are effective against a variety of targets. By deploying the right suite of weapons, the

enemy can be attacked when he presents the most lucrative targets and when they are most vulnerable.

The expeditionary force would contribute to halting the enemy's armored assaults, destroying his WMD, and securing the in-theater ports of debarkation essential to deployment of U.S. forces. When necessary, the combat cells would coalesce into larger units. The concept is more about "massing fires, not forces" and extensive use of unmanned vehicles and robotics. Low profile, responsive logistics provides the essential force sustaining consummables.

C4ISR capabilities that are focused on enabling land warfare can provide a comprehensive combat identification of the ground environment. This perspective can be created by fusing high resolution, multispectral, and geometrically diverse data from multiple sensors on a variety of platforms from satellites, aircraft, and UAVs to unattended ground sensors and micro air vehicles.

Wide-band communication networks will enable the CINC to maintain centralized control and stay in the loop of the combat cell activities and, at the same time, give the on-the-scene freedom of action necessary to exploit enemy vulnerabilities. The command relationships that will permit the requisite freedom on the ground while giving the CINC enough information to direct long-range, precision-strike air operations to halt invading forces and destroy WMD need to be examined in great detail to strike just the right balance.

Carrier-Based Aircraft

Long-range precision strike bombers and carrier-based aircraft—used in tandem against a WMD-armed adversary early in a conflict—could well begin to deny the enemy the anticipated benefits of asymmetric WMD missile and terrorist attacks against U.S. forces deploying to an overseas theater. The cross-service synergies and complementarities could be essential in delivering the remote fires upon which distributed combat

cells would be dependent. Air power debates of the past over the role of land-based air versus carrier-based air need to be delivered precisely into the trash can of "old think."

The United States faces adversaries with growing capabilities to attack the longstanding U.S. power projection strategy. To adapt appropriately and deliver America's own asymmetric blows to defeat the enemy's strategy, joint operations are essential. The operational synergies between land-based and carrier-based tactical fighters are important qualities of the emerging 21st century force posture. These aircraft can execute counterforce operations autonomously or in tandem. The operational synergies possible range across the conflict spectrum. Carrier-based aircraft can also conduct escort missions and SEAD for B-52 and B-1B missions pushing up against enemy defenses and support land-based surveillance and target acquisition aircraft (AWACS, Joint STARS, and Rivet Joint).[14]

CINC's Concept of Operations

The commanders-in-chief or "CINCs"—the combatant commanders responsible for the employment of American forces in support of U.S. military objectives—deal with new realities like the emergence of the WMD and missile threats through the development of concepts of operations. Whatever the specifics of the U.S. policy and strategy at the time, the CINCs will first look to the adversary's military capabilities and infrastructure. If the CINC is asked to use military force, his first steps will encompass actions against a set of high-value (to the enemy) and high-threat (to the United States) targets.

Supporting the CINC’s concept of operations is an analytic process based on the interaction at the strategic, operational, and tactical levels of warfare between intelligence (the target locaters and characterizers) and operations (the shooters). Forces, including people and equipment, carry

out military or operational tasks as specified by a combatant commander in a concept of operations that ties together the weapons systems, support elements, and organizations assigned to the commander and judged necessary to do an assigned mission. When this analytic process is completed, a single adaptive plan can be put into place to achieve the CINC's concept of operations which also can be seen as a roadmap for decisions on what needs to be done first and how best to do it when conflict begins or if directed to take military action in response to warning. In peacetime, the concept of operations is also a tool for target analysis, employment planning, and force requirements validation. There are four steps to development of a combatant commander's concept of operations: (1) find and characterize the targets, (2) task resources, (2) attack and destroy enemy targets, and (4) assess and report the results of the attacks.

Find and Characterize the WMD Targets

Intense intelligence preparation focused on anti-armor and WMD counterforce operations will greatly improve the possibility of identifying high priority targets in peacetime and their detection, location, and tracking, and, if necessary, destruction during crisis and conflict. Peacetime intelligence, surveillance, and reconnaissance offers clues about the enemy's intentions, provides vital inputs to planning, helps to determine when and where to attack, indicates how best to minimize collateral damage, and facilitates long-range precision strike.

The Counterproliferation Analysis and Planning System (CAPS) is an extremely valuable tool for evaluating options for denying or reversing proliferation. Developed by the Lawrence Livermore National Laboratory, the CAPS modeling system can generate models of a specific country's proliferation activities by drawing upon information from many sources, both government and private sector. CAPS features include (1) models of chemical biological, and metallurgical processes that can be

used to build WMD; (2) integration of information from diverse sources to create country-specific models of proliferation, identifying the specific function and location of major production sites and creating details of the layout of each site; (3) nodal analyses on each country-specific model to identify critical nodes in the country's proliferation production facilities; and (4) completed analyses in a logical and easy-to-use format, utilizing the latest advancements in commercial computer software development. CAPS is presently serving the U.S. Strategic Command, U.S. Special Operations Command, the Joint Staff, and the Air Staff. In addition it has been endorsed by all of the combatant commanders.[15]

Characterizing the potential adversary's advanced weapons and WMD accurately is key to determining how best to deal with them. Special attention is focused on WMD from initial and basic research to launch and execution. Especially important is the identification of proliferation pathway characteristics that will cue reconnaissance, surveillance, and target acquisition systems in counterforce attacks. The target analysis should also be sufficiently rigorous so that it aids in aim point selection and battle damage assessment.

Each WMD target must be classified according to its function, mobility, physical structures, and environmental attributes. These elements, taken together, provide important insights for use in tasking the right resources and assigning the most effective strike platforms.

Function

- *Infrastructure*: Targets that comprise the WMD research, development, manufacture, importation, and support base, as well as the recruitment, training, and education processes.

- *Operational*: Deployable and non-deployable targets, generally associated with military field organizations, that are organized and equipped to execute WMD attacks.

- *Support*: Deployable and non-deployable targets that are organized and equipped for the support of the full range of the enemy's WMD operations.

Mobility

- *Fixed*: Relocation and replication is not possible without the expenditure of considerable time and resources.

- *Relocatable*: The target can be moved and easily reassembled at another location. Examples include forward facilities for warhead mating with missiles, WMD storage depots relocated for proximity to potential launch areas, and ballistic and cruise missiles for survival.

- *Mobile*: The target has inherent ability (i.e., does not require added resources) to move at will; may be able to remain fully functional while on the move.

Structure

- *Physics*: The nature of a target's design, construction function, size, weight and design such that can mitigate the effects of one or more weapons effects directed against it.

- *Elements*: The principal components of a multiple functions target and their interrelationship in contributing to the successful operation of the target. Detailed characterization of the key components will be required to identify potential weak-links in the target's internal processes.

Environment

- *Defenses*: Whether the target is located within a regional or local air defense envelope or protected by other forces. Defenses increase the risk of attacking the target and, depending upon the U.S. attack platform used, may require added effort for defense suppression prior to, or in conjunction with, an attack.

- *Accessibility*: The degree to which the geographic location influences target attack options, e.g., targets located deep within a country or region may require extended surface ingress and egress or overflight across neutral, hostile or other third party territory.

- *Geography*: Those aspects of the target's location—climate, weather, elevation, soil, vegetation, topography, land use, civilian and military populations—that may enhance or mitigate the potential for collateral damage and complicate or simplify attack options. Potential for collateral damage is defined as the

> probability of damage to "innocent" or friendly and neutral facilities and people as a direct result of weapons effects or as a result of the secondary effects of damage to the target. Corollary effects include such events as secondary explosions and release of chemical or biological agents, or other hazardous materials.

Targets associated with biological and chemical weapons and missiles include fixed sites such as manufacturing and system assembly facilities; relocatable targets such as weapons storage and garrison sites, forward storage depots, and final assembly and refueling areas; and mobile targets that are in transit to areas for dispersal or concealment as well as the recycling of TELs after launch for reload and refiring. In addition, operational support mechanisms are priority targets including missile launch crews and support personnel, training and exercise facilities, weapons support systems (trucks, TELs, etc.), fixed launch sites, relocatable command centers, choke points along lines of communication, decoys, and other infrastructure, committed (in transit), and post-execution targets.

Counter-WMD operations can be expected to be highly complex and very risky since the proliferator will undoubtedly know that America viewed his development of WMD and missile delivery systems as highly threatening. American counterforce attacks could come after a prolonged period of rising political tensions, during which the enemy's suspected WMD program will likely have received concentrated U.S. and international attention. Fearing military action, the proliferator would likely step up defensive preparations, such as concealing and dispersing critical WMD assets and placing air defenses in a much higher state of readiness. Many of the most critical facilities could very well be located in hardened and/or deeply-buried bunkers resistant to all but the most advanced penetrating weapons and virtually invulnerable to current-generation cruise missiles. Many facilities would probably be guarded by an overlapping system of sophisticated local-area and terminal air

defenses. Moreover, many could be located in, or indeed relocated to, heavily populated urban areas. "Hugging" civilians with WMD plays against the well-known Western aversion to collateral damage, especially when played back by on-the-scene television reports to the court of world opinion.

Fine-grained intelligence is necessary to identify and characterize hard and deeply buried targets. Details on these targets are essential for weapon penetration and fuzing purposes and to define the appropriate physical or functional kill criteria. Some hardened structures will be simple surface facilities with a berm of concrete and soil for protection—these facilities can be easily breached with gravity bombs. Others will be below ground at a limited depth and can be breached with penetrator weapons. A third category, tunneled or deeply buried targets, can be underground at an unlimited depth where only portal areas, adits, vents, and supporting functions are visible on the surface. The enemy should be expected to house his most critical functions in the deep tunnels, including those associated with WMD and their use against U.S. forces.

Since intelligence may be insufficient to characterize the deep tunnels in enough detail to destroy them, functional kill—when the facility can no longer perform its mission—may be a viable option. Attacks against surface level communications and electrical power, for instance, might shut down operations for hours to days to weeks. Damaging WMD production equipment or denying access via portals and roads could be sufficient to interrupt operations for days to weeks to months. Other essential elements above ground might be damaged to score a functional kill: commercial power vaults, hardened antennas, air intake and exhaust vents, microwave towers, and many other small pieces of equipment vital to the underground operations. If the enemy makes repairs or uses work-around solutions, additional functional kill attacks may be required.

If one assumes that one military task assigned to U.S. counterforce operations would include neutralizing a proliferator's WMD capabilities, the Gulf War air campaign sets a rather weak precedent. Iraq's chemical and biological programs had fully matured prior to Desert Storm, and large quantities of weaponized biological and chemical assets survived the allied bombardment. Indeed, the real setbacks to the Iraqi WMD program occurred only *after the war*, when U.N. and IAEA inspectors uncovered the extensive Iraqi WMD programs (albeit with many details hidden forever by the Iraqis).

In short, we can expect future WMD target sets to be large, extremely difficult to find, hardened, well-protected, and located next to things or people we do not want to damage or injure. Counter-WMD operations therefore could likely be large in scale, extraordinarily challenging from both operational and logistical standpoints, and politically controversial.

Task Resources

The interface between intelligence and operations is essential for bridging the peacetime functions of target identification and characterization with the wartime attack and kill functions. The operations-intelligence interface is the analytic process that (1) integrates intelligence considerations (target characteristics) with operational factors (operational tasks), (2) determines the degree of relevance the military tasks have to each target, and (3) compares relevant target characteristics with their operational attributes in order to provide an operations plan that supports the CINC's concept of operations. Military action against WMD targets requires substantially more planning and evaluation because of moral and political sensitivities surrounding such an attack and the potential consequences of unintended collateral damage. The potential lethality of WMD when used against friendly forces and populations is a sobering calculation when assessing the impact if we do

not take timely and effective military action. Besides their operational impact, these tasks also hold important force structure implications as seen by the combatant commander. These warfighting needs drive the force requirements to be satisfied by the military services.

When making judgments about the attack platforms and precision munitions to be used in strikes against WMD and WMD-related facilities, five criteria guide decision-making. These criteria are expressed in terms of the weapons-target interaction that must be satisfied for successful counterforce operations against WMD and WMD-related targets:

Vulnerability

Target Damage Assessment. Assess the weapons-target interaction by evaluating weapon effectiveness in achieving the desired level of damage. Then other important questions are asked. Can the target be located and defined well enough to conduct military operations? To what degree does lack of target detail hamper operations? What is the degree of physical security and its threat to attacking systems?

Time Sensitivity

Target Kill Window. Assess the weapons-target interaction by gauging the ability to achieve desired levels of damage within the time lines available. Key questions are: To what extent is the target an immediate threat to U.S. interests? What are the time factors in locating and attacking the target? Are there target perishability windows?

Military Value

Relative Target Importance. Assess the weapons-target interaction in achieving the desired level of damage within the strategic interest of the United States objectives. What is the relative value of the target given the CINC's concept of operations? What is the target's relationship to non-military targets?

Political Significance

National Political Imperatives. Assess the weapons-target interaction after making adjustments for political guidance and instructions form senior civilian authorities that constrain military operations. Other questions to be answered include: What might be the political significance of U.S. operations against the target? What might be the significance of not taking military action against this target?

Collateral Damage

Civil Deaths and Destruction. Damage both from the weapons and the agent under attack are important considerations. Assess the weapons-target interaction with a view toward minimizing damage to civilian populations, structures, and environment—including the dispersal of hazardous agents/toxins. What is the potential for release of hazardous agents due to military operations against this target? What are the dispersal patterns for this agent and how will they be affected by predicted weather at the time of the strike? What may be the effects on rural and urban areas? What will be the effects of blowback on U.S. and friendly forces?

Attack and Kill (With Limited Collateral Damage)

The Gulf War air campaign was one of the most intensive in history. For forty-three days between January 17 and February 28, 1991 the United States and its coalition partners conducted around-the-clock air strikes against Iraq. Approximately 40,000 air-to-ground and 50,000 support sorties were flown. By the end of war, approximately 1,600 U.S. combat aircraft, mostly Air Force, had been deployed.

The Persian Gulf War was a wake-up call. A revolutionary change in warfare occurred during the 1990-91 Persian Gulf conflict. For the first time, the United States and other members of the coalition arrayed against Iraq would fight an adversary armed to the teeth with biological and chemical weapons and missiles to deliver them—an adversary who was also just months away from possessing a limited number of crude nuclear devices. Since then, other countries have found it in their interest to pursue alternative paths toward obtaining weapons of mass

destruction, some via indigenous programs and others through direct purchase of the requisite components from willing international sellers.

Thanks to the United Nations inspections of Iraq's weapons-making complex following the Gulf War, Americans are offered a rare glimpse into an unfolding future filled with deadly new threats and grave risks as the up-gunning of the non-Western world continues around the globe. For the countries in search of chemical, biological, and nuclear weapons, Iraq's successful development of weapons of mass destruction and missiles offers a virtual "how-to" book on alternative proliferation pathways.

While the size of the WMD target base will determine the ultimate scale of the operation, the need to suppress enemy air defenses rapidly will also drive the attacking force size and composition as well as influence its technical difficulty and overall complexity. The use of long-range precision-strike forces—including B-2 stealth bombers and launch of CALCMs and JASSMs by B-52s and B-1Bs, respectively—can attack ahead of traditional strike packages of fighter-bombers, combat air patrol, and airborne suppression of enemy air defenses.

To prevent dispersal of critical WMD assets and possible WMD retaliation, the initial strikes in long-distance counterforce operations must be decisive. While many types of military forces may be required, land- and sea-based airpower will no doubt comprise the main strike force. Planners will want to destroy as many targets as they can as quickly as possible. This places a premium on surprise, lethality and payload.

Assess and Report

Throughout counterforce operations, battle damage assessment (BDA), real-time battlefield surveillance, and battle management are equally critical. The Gulf War illustrated the difficulty of assessing damage done in air attacks. Ironically, precision weapon damage is particularly

difficult to assess—all that may be visible after a direct hit is a "tiny" hole in a structure's roof. In Desert Storm, however, planners had the luxury of "the next day" to make sure the desired damage had been done. Even then the results were mixed. Some hardened aircraft shelters at Iraqi airfields, for instance, were hit several times while others just hundreds of yards away were untouched. Another problem was discovered in Desert Storm when nearly 1,500 sorties were flown against mobile Scud launchers with no confirmed kills. The success of any future theater-based counterforce operation is likely to hinge on the ability of U.S. forces to track and destroy mobile WMD-armed ballistic missiles rapidly.

Counter-WMD Operations Plan

The 1997 *Quadrennial Defense Review* calls on the armed forces to continue to improve capability to locate and destroy biological and chemical weapons "preferably before they can be used."[16] This is a difficult task, one that can never be expected to reach one hundred percent effectiveness. Nevertheless, this central counterforce military task needs to be built into the CINC's concepts of operation. After more than four decades of building targeting plans for deterrence of nuclear warfare and, if necessary, its conduct against the Soviet Union and Communist China, the United States has already developed many of the requisite targeting and campaign planning tools for effective counter-WMD operations. The Counterproliferation Analysis and Planning System developed by Lawrence Livermore National Laboratory provides the basis for building upon the uniformed military's past experience. The initial task—combining modern sensors, communications, and target acquisition systems—is to reduce the enemy's biological and chemical weapons and ballistic and cruise missiles sufficiently to relieve the stress on deploying large numbers of U.S. tactical fighters, ground forces, and maritime elements to the theater.

The creation of operations plans to counter-biological and chemical weapons and missiles would offer theater commanders another option to conduct counterforce strikes against high-priority WMD targets. By identifying targets in peacetime, it would become possible to plan for attacks against WMD, weaponeer the targets, develop and refine tactics necessary to strike them, and train forces for operations against specific targets. Strikes can be rehearsed at unit level and in a wide variety of military exercises. The importance of theater specifics and actual scenarios cannot be underestimated. Yet, peacetime operations plans directed against stationary targets, assuming the intelligence is sufficient to locate and characterize the WMD facilities, is essentially a question of timing, tactics, and weaponeering. The Air Force can perform this task quite well.

Mobile and, to some extent, relocatable targets also present significant challenges. Typically, the timelines available to find the targets, task the resources, and conduct the attacks will be short. To succeed against mobile targets, C4ISR must be exquisite and peacetime preparation must be very thorough. The key attribute is to identify the knowable variables in peacetime such as area limitation modeling that can highlight potential areas that may be used by mobile missile launchers. Assessing an adversary's exercises and training as well as the location of essential support can all help to cue the search for mobile targets in war. These peacetime intelligence efforts can be used to ensure appropriate ISR systems, such as Joint STARS, are in the appropriate area. Upon detection of activity in the predesignated areas during conflict, the data can be passed to attack platforms.

Counter-WMD operations will not succeed unless intelligence and operations functions are fused closely. The CINC’s concept of operations will provide the right analytical framework for selection of the strike platforms and munitions for counterforce attacks against WMD and

WMD-related targets. Planning attack operations against these targets requires an adaptive process that leans heavily on intelligence preparation in peacetime and a workable concept of operations for wartime counterforce strikes. The interface between intelligence analysts and military operations specialists needs to be close and continuing across the pre-war, war, post-war spectrum.

The peacetime collection and processing of intelligence greatly improves the possibility of identification of high-priority WMD targets and their detection and acquisition for strike operations during crisis and conflict. Intelligence about WMD targets offers clues about the enemy's intentions, provides vital input for attack planning, helps determine when and where to attack, facilitates precision strike operations, assists in minimizing collateral damage, and permits initiation of rapid counter-WMD operations. There is much WMD-armed adversaries can do to frustrate and complicate peacetime intelligence preparation. Iraq, for instance, learned from the Soviets how to deny locational cuing for their missile launchers. Some of the Iraqi practices included preparation of ready-hide positions near launch points, rapid deployment, false targets, decoys, camouflage and deception practices, and good operations security, especially radio silence.

Intelligence preparation of the battlefield is vital to the theater commander's concept of operations, especially for high-threat systems like WMD and their delivery systems. Intense scrutiny of a potential enemy’s WMD infrastructure must be undertaken in order to identify high-priority targets. Databases on WMD and ballistic and cruise missiles are essential to identifying the enemy's vulnerabilities from research and development through deployment to the field and launch. Attack plans can be created, awaiting essential updating during a crisis or conflict as the peacetime unknowns are transformed into known facts. As

a crisis unfolds, key targets may be reprioritized as dictated by events and with special attention given to compressed timelines.

The better the intelligence preparation is in peacetime, the more effective will be control of collateral damage, especially when attacking targets in or near enemy urban areas. Intelligence preparation is also important because it provides the support needed for rapid attack and, under some circumstances, preemptive attacks to prevent the launch of WMD-armed missiles against friendly military forces or populations. Finally, intelligence preparation can provide crucial clues about an enemy's intentions. The theater commander usually must rely on inference from various indicators or reports to judge intentions. Intelligence preparation can afford the CINC him clear insight about whether and how the enemy is likely to attack.

The Iraqi WMD facilities in January 1991, as discovered by U.N. on-site inspectors after the war, numbered more than 245 targets. When dual-use (civilian and military use) facilities are included the number runs as high as 335-400 targets.[17] It could be a daunting military task to demilitarize an adversary of so many WMD targets in a brief period of time. On the other hand, stealth and precision strike make it possible to conduct disarming attack operations against key functions to destroy or disable the backbone of the enemy's WMD target system. WMD targeting is a complicated task since destroying or neutralizing the target should be done in a way that does not disperse hazardous materials from the target. This means an extraordinary degree of intelligence analysis is needed to select precision aimpoints. Target characterization and selection of aimpoints should be accomplished to the extent possible during peacetime. Targeting WMD is a scientific-engineering task to achieve an understanding of the target's technological integration and to identify critical nodes for precision strike—it is for this reason that the Lawrence Livermore National Laboratory's CAPS models are so

important to counterproliferation planning. On the basis of this scientific-engineering target analysis, the combatant commander could overlay the enemy's air defense architecture and assess the pros and cons of different ordnance choices. One of the most critical choices occurs when matching aircraft and munitions, especially when long-range precision strike can offer so much to a CINC's campaign plan in the earliest hours and days of a conflict. The faster the United States can respond against a WMD-armed adversary, the more easily U.S. forces can wait until the enemy's attack preparations are unambiguous.

The combination of stealth, long-range, and precision opens the door to potential pre-war operations; not the preventive or preemptive attacks contained in traditional military doctrine, but a wholly new concept of demilitarization strikes where precision-strike conventional weapons, to the extent possible, are used to disarm an adversary of WMD and WMD-related equipment. The idea is destruction of equipment to save lives by taking away the adversary's capability to strike with WMD. Demilitarization attacks would concentrate on weapons and equipment. Extreme efforts would be taken to avoid or minimize human casualties, military as well as civilian. The concept is to destroy the opponent's WMD or so disorganize and reduce it to such a size that the remnants can be easily handled by the active and passive defenses of the United States and its regional partners.

Global counter-military operations in the 21st century will rely on long-range aerial strike packages totally different from those experienced in the past. Peacetime intelligence preparation and comprehensive sensor-to-shooter linkages will be necessary to support a rapid-response, global strike orientation. C4ISR and battle damage assessment capabilities also will be essential components. The keys to obtaining the agility necessary to counter a WMD-armed adversary are range, speed, and lethality of the attack platform and the effectiveness of the C4ISR

that allow U.S. combat crews or teams to "see" the battlefield in depth and breadth to assist in selecting the highest priority targets.

Aerial firepower, including aircraft and cruise missiles, offer a great range of action by reason of speed and mobility. Long-range bombers could satisfy several important missions during the first two or three decades of the 21st century to include posing a rapid initial response capability to overseas crises, hedging against enemy attacks when forward-based forces are fewer, operating from bases well outside the striking range of the enemy's WMD-tipped missiles, delivering large numbers of precision munitions against invading armored forces and WMD and WMD-related targets, holding targets at risk anywhere in a theater of operations, and offering the combatant commander tactical responses by holding at forward orbit areas for on-call strikes against armored forces on the move and vital fixed targets. With a combination of focused battlefield awareness, precision-strike weapons, stealth, speed, and range, aerial firepower has emerged as the dominant warfighting element against WMD-armed adversaries. Aircraft, missiles, and unmanned aerial vehicles offer the capability to intervene on behalf of ground forces held under the gun of the enemy's WMD. Combat support aircraft such as Joint STARS provide essential ground tracking information that make it possible to halt an armored invasion force from the air. Ground maneuver leading to force-on-force, tank-on-tank attrition warfare has lost its decisive character. Encirclements, breakthroughs, and tank concentrations common to Cold War conceptions of warfare are slipping into oblivion as the promise of air power to intervene directly and effectively in ground battles increases.

Surprise is best achieved in air operations with stealth attack platforms that can approach their targets without alerting the enemy. Aircraft range will also be critical to achieving surprise. The closer U.S. aircraft are based to the adversary, the more likely he would be to detect

their presence in the region and begin taking evasive and/or military countermeasures (such as retaliation against U.S. air bases and aircraft carriers). Long-range cruise missiles, though not necessarily "stealthy" in terms of radar signature, can also be useful in achieving surprise. Their small size and terrain-following mission profile make them virtually indistinguishable on current radar screens from other "noise" at their altitude; their long range, meanwhile, facilitates delivery from outside enemy detection zones.

Finally, aircraft payload is critical for the simple reason that many WMD targets must be destroyed or neutralized in a very short amount of time. The more weapons per sortie, the fewer the sorties required to destroy a target set. The most valuable airpower assets in counterforce operations will therefore be those possessing stealth, long range, large payload capacities, and precision delivery capabilities (preferably all-weather). The inherent synergy of combined B-52, B-1B, and B-2 operations can provide a useful capability,

A carefully constructed process for adaptive planning will bridge the intelligence and operational plans functions from peace to crisis to war. Potential WMD targets can be identified and characterized in peacetime. Planning for theater WMD target sets should at once embrace the rigor of the Single Integrated Operational Plan (SIOP) and tactical flexibility to respond to a changing array of targets. The highest priority fixed targets should be identified in peacetime and strike plans, within the scope of the CINC's concept of operations, should be developed. Military planners should weaponeer the targets, refine the tactics to be used, assign forces against the targets, and train and certify aircrews in peacetime for attack operations against these highest value targets. A full accounting should be given to the weapons assigned, timelines, rules of engagement, expected collateral damage, and risks. The remaining targets should be made available for CINC-directed daily task order

operations involving both long-range precision strike aircraft and tactical fighters. A built-in flexibility should give the CINC flexibility for rapid reordering of WMD targets in order to integrate attack operations with other theater strikes.

The revolutionary combination of battlespace knowledge, sensors and rapid computing, stealth, precision, and aerial strike are coalescing in a shift of U.S. strategy toward non-linear or asymmetric operations. Future warfare will not be dominated by adversaries threatening or actually using missile-borne biological and chemical weapons to shut down U.S. deployments to overseas theaters. Rather, the United States has the clear and present opportunity to neutralize an adversary's asymmetric strategy by developing a robust global response capability that emphasizes long-range precision strike in locating and destroying WMD.

Long-Range Precision Strike

As General John M. Loh, then-Commander of the Air Combat Command, said in 1994 testimony before the Senate Armed Services Committee:

> Our bomber force is critical to our ability to deal with two major regional conflicts, occurring either back-to-back or overlapping one another.... Within hours, with appropriate munitions and other support, bombers can attack an opponent's most threatening means of destruction—his nuclear, chemical and biological weapons. They can blind him by destroying his command, control and communications facilities. They can begin the process of depleting his war-making might and his military forces. All of these things could occur before American surface forces would be brought into play. As we gain forces and capability in the theater, our bombers would continue to prosecute the air campaign.[18]

The 1998 Long-Range Air Power Panel's recommendations on bomber modernization emphasize the counterforce potential for locating

and destroying WMD in the opening hours and days of a regional conflict. These enhanced capabilities of the bomber force are in line with General Loh's operational vision of their contribution to the nation's security. The key consideration is to match the right precision strike weapon with the right heavy bomber in the creation of an integrated long-range precision strike force where the synergies of B-52, B-1B, and B-2 operations are fully exploited.

A May 1998 House National Security Committee press release fully supported modernization of the current U.S. bomber fleet, including priority upgrades for the B-2:

> The committee...agrees with the Long-Range Airpower Review panel's view that DOD lacks a long-term bomber force structure plan. Therefore, the committee directs the Secretary of the Air Force to report to Congress by March 1, 1999, on planned upgrades to the current bomber fleet, a funding profile for these upgrades, and a timeline for consideration of the acquisition of a follow-on bomber.[19]

Long-range precision strike operations, combining heavy bombers with precision munitions, can be the "first responders" against WMD-armed adversaries. These long distance air strikes can not only disrupt and destroy the enemy's WMD and invading forces, but they can make it far more difficult to conduct anti-access operations designed to slow or block the deployment of ground forces and tactical fighters. This enabling function of making it possible for unhindered tactical fighter deployments to overseas theaters during crises makes the fielding of an appropriate structured long-range precision strike force all the more essential.

ENDNOTES

1. William J. Clinton, President, Letter to the Congress of the United States (The White House, March 31, 1998).

2. The President's Panel to Review Long-Range Air Power was established to recommend how funds appropriated in 1997 for the B-2 might be best spent and to consider the broader issues of long-range air power. Retired Air Force General Larry D. Welch served as chairman. Other members included Samuel D. Adcock, Senator James J. Exon, John S. Foster, Jr., Colonel Frederick L. Frostic, U.S. Air Force (retired), General Merrill A. McPeak, U.S. Air Force (retired), Walter E. Morrow, Jr., Donald B. Rice, and General Robert L. Rutherford, U.S. Air Force (retired). The panel's proceedings took place from late February through March 1998.

3. "Summary of the Principal Findings and Recommendations of the Panel to Review Long-Range Air Power" (March 1998) (Washington, D.C.: Hearings of the House National Committee, Military Procurement Subcommittee, April 1, 1998).

4. U.S., House National Security Committee, Military Procurement Subcommittee, "Hearing on the Report of the Long-Range Airpower Review Panel" (April 1, 1998).

5. These so-called "weapons of mass destruction" or WMD could also include nuclear weapons, which would present the United States with an entirely different set of circumstances and potential responses.

6. Sun Tzu, *The Art of War*, trans by Samuel B. Griffith (New York: Oxford University Press, 1977).

7. The rulers and government of a country that engage in behavior contrary to established international norms, such as developing weapons of mass destruction and supporting terrorism.

8. "Summary of the Principal Findings and Recommendations of the Panel to Review Long-Range Air Power" (March 1998).

9. U.S., Office of the Under Secretary of Defense (Acquisition and Technology), *Report of the Defense Science Board Task Force on Tactical Warfare* (Washington, D.C.: Office of the Secretary of Defense, November 1993), p. 17.

10. "USAF Almanac 1998," *Air Force Magazine* (May 1998), pp. 155-59.

11. *Combined-Effects Munitions (CEM)*. The CBU-87 is a cluster dispenser weapon that includes both anti-materiel and anti-personnel bomblets. *Gator Mine.* The target kill capability of the CBU-89 includes vehicles and light armor as well as soft and relocatable targets.

12. Glenn C. Buchan and David R. Frelinger, *Providing an Effective Bomber Force for the Future*. RAND Congressional Testimony, prepared statement for the Senate Armed Services Committee (May 5, 1994), pp. 26-27.

13. U.S., Defense Science Board, *Tactics and Technology for 21st Century Military Superiority*, Vol. 1 - Final Report (Washington, D.C.: Office of the Secretary of Defense, October 1996).

14. Charles M. Perry, Laurence E. Rothenberg, and Jacquelyn K. Davis, *Airpower Synergies in the New Strategic Era: The Complementary Roles of Long-Range Bombers & Carrier-Based Aircraft* (McLean, Va.: Brassey's, 1997).

15. Details on the Counterproliferation Analysis and Planning System (CAPS) are available from Tom Ramos, Counterproliferation Group Leader in the Nonproliferation, Arms Control, and International Security Directorate, Lawrence Livermore National Laboratory, Livermore, California. E-mail: ramos7@llnl.gov

16. William S. Cohen, Secretary of Defense, *Report of the Quadrennial Defense Review* (Washington, DC: Department of Defense, May 1997), P. 13.

17. Robert W. Chandler, *Tomorrow's War, Today's Decisions: Iraqi Weapons of Mass Destruction and the Implications of WMD-Adversaries for Future U.S. Military Strategy* (McLean, Va.: AMCODA Press, 1996).

18. General John M. Loh, Commander, Air Combat Command, "Bomber Requirements," testimony before the Subcommittee on Nuclear Deterrence, Arms Control and Defense Intelligence, Senate Armed Services Committee (May 5, 1994).

19. U.S., House of Representatives, National Security Committee, press release (May 6, 1998).