Attacking the Mobile Ballistic Missile Threat in the Post–Cold War Environment

New Rules to an Old Game

ROBERT W. STANLEY II, Major, USAF
School of Advanced Air and Space Studies

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Abstract

The threat to US national security from mobile ballistic missiles is at least as great today as at any time in history to include the heights of the Cold War. Proliferation of missile technology and associated weapons of mass destruction already jeopardize America's ability to project power to any corner of the globe. The 1991 Persian Gulf War opened our eyes to the significant potential of this threat. Our decision makers realized that if just one of the missiles launched against Israel had been armed with a weapon of mass destruction (WMD), the outcome of that conflict may have been far different.

In response, the US defense establishment spent billions of dollars to research and field greatly improved precision munitions; more elaborate surveillance systems; and perhaps most importantly, more persistent reconnaissance platforms. But has this reaction in the years since the Gulf War been adequate? Has the United States prepared for proper integration of these individual examples of advanced technology? Indeed, terms such as *precision engagement* and *time-sensitive targeting* have come into vogue, but have we covered all of the necessary bases to turn these drawing board concepts into a reality on the battlefield? Finally, the strategist must ask who, if anyone, will serve as the advocate for the counterforce mission against ground-mobile ballistic missiles. Does a specific community need to be created for this task?

While investigating these topics, my research centered on an interview with one of the former Soviet Union's top missile engineers, the vice commander of Air Combat Command, discussions with the USAF Air Armament Center's chief of advanced concepts, and on recently declassified CIA documents regarding the US reconnaissance program and National Intelligence Estimates. Also important to this work are Russian language sources documenting the Soviet need to develop mobile missiles. Although many other sources within the media and academia were tapped for information, these were the most prominent. As a result, this study highlights many of the great technological leaps America has made toward being able to attack mobile missiles, but it also underscores the need for improved coordination. Perhaps most importantly, the necessity for a more responsive post–Cold War strategic mind-set and doctrine for attacking these mobile menaces was underscored. As such, this study offers the following six recommendations:

1. Develop those capabilities that allow persistent surveillance and reconnaissance coupled with the ability to discriminate between potential targets before conducting precision strike operations.
2. Augment the concept of deterrence with that of preemption in joint military planning and doctrine.
3. Develop a focused, counterforce-minded, joint community responsible for hunting and destroying ground-mobile ballistic missile launchers.

It is vital that this team include elements of the national intelligence community to ensure information stovepipes are broken down.

4. Create a formal joint school and specific identity for those involved in the defense against mobile missiles.
5. Implement the RAND mobile ballistic missile counterforce concept.
6. Conduct regular formal training, exercises, and evaluations for the units specifically responsible for the battle against ground-mobile ballistic missiles.

About the Author

Maj Robert W. Stanley II was commissioned through the Reserve Officer Training Corps, Purdue University in 1988. Graduating from undergraduate missile training in 1989, he went on to serve as a combat crew member in the USAF Ground Launched Cruise Missile (GLCM) program in United States Air Forces in Europe (USAFE). Following assignment to Comiso Air Station in Sicily, he underwent intercontinental ballistic missile (ICBM) operations training and was assigned as a combat crew member to Strategic Air Command's Minuteman III fleet in Wyoming. Following the integration of space and missile operations, he was certified as a launch controller for the Delta II spacelift program at Cape Canaveral Air Force Station, Florida. Major Stanley is a senior space and missile operator with numerous GLCM and ICBM alerts as well as 17 DOD, NASA, or commercial spacelift missions. He has a bachelor's degree from the Knoy School of Technology at Purdue University, a master's degree in management from Lesley University, a master's degree in national security and strategic studies from the US Naval War College, and a master's degree in airpower art and science from Air University's School of Advanced Air and Space Studies (SAASS). In July 2003, Major Stanley was assigned to the HQ USAF Space Operations staff as chief, Launch Vehicle Branch.

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The vice commander of Air Combat Command, Lt Gen Bruce Wright, was instrumental in providing this work with a top-level, inside view of what had been done in the past to combat the threat from mobile ballistic missiles and what needs to be done in the future. General Wright's candid, professional insight and contributions make this thesis far more complete than it would have been otherwise. Likewise, Dr. Sergei Khrushchev's willingness to contribute to this work and kindness in allowing me to interview him regarding his participation in the Soviet missile program was a highlight of my research efforts. It was truly an honor to speak with someone so close to events that shaped the Cold War and, subsequently, our world. Additionally, I would like to thank Col John Ward, USAF; Col Tim Roberts, USAF, retired; Lt Col Mark Dowhan, USAF, retired; and Lt Col Dave Nuckles, USAF, for being living examples of what I consider ideal leaders.

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Chapter 1

Introduction

When the spread of chemical and biological and nuclear weapons, along with ballistic missile technology . . . occurs, even weak states and small groups could attain a catastrophic power to strike great nations.

—Pres. George W. Bush

As a result of the 11 September 2001 (9/11) attacks on New York City and Washington, D.C., American eyes have been opened to a new and deadly kind of nonstate enemy who will stop at nothing to accomplish their political aims. Recognizing this threat, the Bush administration recently published the *National Security Strategy* (NSS) that argues the case for preemptive strikes against those who seek to blackmail America, alter our foreign policies, and potentially even destroy our way of life.[1] Consequently, as our nation scans the horizon with this new perspective, the propagation of weapons of mass destruction (WMD) weighs heavily on our minds. Moreover, the increasing availability to our enemies of a vast array of delivery systems creates grave concerns. Yet, out of the myriad combinations through which this threat could manifest itself, scarce resources dictate that we must focus our efforts. One threat stands out from the rest—the lethal combination of mobile ballistic missiles armed with WMD.

The capability to move ballistic missiles from one launch point to another is one that America has repeatedly proven itself either unable or unwilling to counter. From the recognition of this US vulnerability to strikes by the Soviet Union in the early decades of the Cold War to successful deployment of mobile Scud missiles by Iraq in 1991, enemy actors have identified what may indeed be our country's Achilles' heel.

Unlike previous studies, which focused primarily on the technological aspects of defeating the mobile missile threat, this study explores the issue from a doctrinal perspective.[2] To accomplish this, it compares differences in hardware and strategy between the Cold War and post–Cold War eras. Between these two very different periods, the historical record reveals that while the technological part of this equation has received much-needed attention, the approach and doctrine for employment has lagged. But, before continuing, it is necessary to provide some context regarding the reality of the mobile missile threat.

The Mobile Ballistic Missile Threat in Context

For a successful treatment of this topic, any analysis must first address why the issue of mobile ballistic missiles should concern us at all. It has been over a decade since the last warhead from a Scud missile struck Israel or Saudi Arabia during the Persian Gulf War. It was not the destructiveness of Saddam Hussein's Scud force that mattered, it was how it affected the strategic calculations of those directing the war.

It would be even more frightening to contemplate those same Scud attacks if they had contained WMD. Had just one of the Iraqi ballistic missiles fired into friendly territory in 1991 been armed with such a weapon, Operation Desert Storm would not be remembered as a victory for the anti-Iraq coalition. Along with the terrifying destruction wrought, the detonation of a nuclear, biological, and chemical (NBC) weapon would also have changed the political complexion of the conflict in ways that are difficult to fathom. The anti-Iraq coalition never successfully deterred or interdicted those archaic yet strategically effective mobile missiles. This point is explored in more detail in chapters 4 and 5.

America's adversaries undoubtedly learned these lessons too. To get a taste of what other nations learned from the Gulf War, a quote from the Indian Army chief of staff was probably most chilling. He concluded that the great lessons of the 1991 Gulf War were, "Don't fight the United States unless you have nuclear weapons"; and especially disconcerting, "The next conflict with the United States would involve weapons of mass destruction."[3]

Assumptions

To refine the intent of this study, we must review its assumptions. First, the proliferation of WMD will continue. Even if severely hampered, it is naive to think it is possible to halt the global spread of chemical agents, weaponized biotoxins, and (to a lesser extent) fissile material. Second, ballistic missile technology will continue to improve and proliferate. Next, the concept of deterrence will continue to be a viable strategy against the only two nations that can truly threaten America's survival: the Russian Federation and the People's Republic of China. With that said, in the post-9/11 environment, we must also assume that deterrence may not work against rogue nations such as North Korea or organizations such as al-Qaeda. Finally, the United States will continue to pursue coalition warfare in spite of recent problems obtaining United Nations support for action against Iraq. The last assumption, coupled with the US government's sensitivity to public opinion, naturally leads to the imperative for limiting collateral damage.[4] Thus, precision-guided munitions will continue to prevail, as will the complex command and control architectures that govern their use. Weapon systems fielded by the United States in the next several decades must be designed to limit collateral damage.

Methodology and Scope

This study will examine how technology and doctrine have responded to the mobile ballistic missile threat over time. As this work reviews the changes that occurred over the last 60 years, it will seek to highlight the differences in context between the Cold War and post–Cold War periods. To achieve this goal, current studies by the government and independent research agencies, as well as those done in academic circles were consulted. Additionally, this thesis explores the application of military technology and decision-making structures over the past several decades. News articles, recently declassified Central Intelligence Agency (CIA) historical documents, and other government surveys were also tapped. Personal interviews with former Soviet missile design engineer, Dr. Sergei Khrushchev, and vice commander of Air Combat Command, Lt Gen Bruce Wright, were also central to this work. Efforts made by allied governments will not be specifically addressed other than to underscore the added complexity in decision making that is endemic to coalition operations.

Road Map of the Argument

Chapter 2 begins the analysis by outlining the evolution of the mobile ballistic missile from its genesis in World War II through the height of the Cold War. Specifically, it concentrates on the reasons why certain nations deploy these deadly weapons. The chapter ends by foreshadowing the dramatic increase in the global mobile ballistic missile threat caused by proliferation among Third World nations and rising world powers (such as China) after the decline of the Soviet Union.

In chapter 3, the study shifts gears to address America's technological and doctrinal stance against the Soviet mobile ballistic missile threat during the Cold War. From blind guesswork and extrapolation on the part of the US intelligence community at the start of the Cold War, to the unveiling of a sophisticated collection capability that is still in place today, the change in US posture as it related to the Soviet mobile missile threat holds some lessons as we confront a new and very dangerous kind of mobile missile threat.

In chapter 4, against the backdrop of a "new world order," the study will describe the current status of the American counterforce (specifically prelaunch) battle against mobile ballistic missiles. New strategies and concepts such as preemption and "time-sensitive targeting" are addressed. Likewise, the chapter studies some of the weapon systems and technologies that will turn these concepts into reality. The primary intent of chapter 4 is to illustrate the ways in which American forces have reequipped themselves and redefined strategy to combat mobile ballistic missiles in the post–Cold War environment. Ground launched cruise missile (GLCM) ballistic missiles are growing consistently over time and have the potential to make the post–Cold War era the most dangerous in American history.

Finally, chapter 5 offers practical recommendations to improve America's ability to counter the deadly threat posed by mobile ballistic missiles over the next several decades. All recommendations stress the need to think differently than we did during the Cold War. While many of the Cold

War's concepts and practices retain some relevance, the rules of the game have changed.

As late as 1991 in Operation Desert Storm, there was evidence that the rules used to govern potential conflict with the Soviets were still being applied by the United States. Recent conflicts in Afghanistan and a new war against Iraq indicate some mind-set changes, but there is much work to be done. It has been said that the United States is often guilty of relying so heavily on technology that success on the battlefield suffers. The recommendations offered in this study are meant to offset this tendency by ensuring the tough doctrinal and organizational issues are addressed as well.

Notes

1. George W. Bush, *The National Security Strategy of the United States of America* (Washington, D.C.: The White House, September 2002), 13.

2. Two prominent School of Advanced Air and Space Studies (SAASS) theses to addressing this topic are dealt with in detail in chapter 4. Several other works pertaining to the mobile ballistic missile threat were also used as resources. See also, Mark E. Kipphut, "CROSSBOW and Gulf War Counter Scud Efforts: Lessons from History," research report (Maxwell AFB, Ala.: Air War College, 1996); Scott M. Reynolds, "Needle in a Haystack: Hunting Mobile Theater Missiles on the Battlefield," monograph (Fort Leavenworth, Kans.: US Army Command and General Staff College, School of Advanced Military Studies, 22 May 1997); Kenneth P. Werrell, *Evolution of the Cruise Missile* (Maxwell AFB, Ala.: Air University Press, 1985); and James J. Wirtz, "Counterforce and Theater Missile Defense: Can the Army use an ASW Approach to the Scud Hunt?" monograph (Carlisle Barracks, Penn.: US Army War College, 1995).

3. Rex R. Kiziah, "Assessment of the Emerging Biocruise Threat," in *Counterproliferation Papers: Future warfare series no. 6* (Maxwell AFB, Ala.: USAF Counterproliferation Center, Air War College, Air University, 2000), 198, http://www.au.af.mil/au/awc/awcgate/cpc-pubs/biostorm/kiziah.doc.

4. Charles K. Hyde, "Casualty Aversion: Implications for Policy Makers and Senior Military Officers," *Aerospace Power Journal* (Summer 2000): 18.

Chapter 2

The Evolution and Spread of Mobile Ballistic Missiles

If we had these rockets in 1939, we should never have had this war.

—Adolph Hitler on the V-2

Why do countries find mobile ballistic missiles attractive? One answer is that these weapons introduce a profound amount of uncertainty to enemy planners. To fight against a nation armed with mobile missiles (especially if they could be armed with WMD) means the costs of war might be prohibitive. In 1991 Saddam Hussein's Iraq changed the tempo of the coalition air campaign by firing relatively obsolete Scud missiles into Israel and Saudi Arabia. More importantly, America's haphazard and unsuccessful efforts to locate and destroy this mobile threat did not go unnoticed. According to Mark Kipphut, who conducted an in-depth study of mobile missile proliferation, potential adversaries who cannot afford to match the US military dollar for dollar could greatly complicate and even deter American intervention in their sphere of influence by obtaining a credible mobile ballistic missile force and equipping it with any type of mass destruction warhead.[1]

By learning more about the history of mobile missiles, we can better understand their rise in popularity among our potential adversaries. Moreover, the strategist may then be able to develop effective defenses or incentives to minimize the threat posed by proliferation of these weapons. It is important to go back to the initial development and use of mobile ballistic missiles. The context in which mobile ballistic missiles were developed sheds light on the decision processes driving the proliferation of these weapons today.

As is the case for so much of modern weaponry, this journey takes us back to the last days of Hitler's Third Reich. It was out of Germany's desperation that the mobile ballistic missile was first deployed.

The V-2: An Asymmetric Solution for Germany

As his empire began to crumble around him, Hitler became desperate for a wonder weapon. He had to punish the Allies and disrupt their plans for prosecuting the war against the German homeland. By mid-1944 he could no longer count on Hermann Göring's debilitated Luftwaffe, as the Allied bomber offensive had progressively decimated it. Not only had it fallen from grace by allowing American and British bombers to ravage Germany, but attrition had irreparably reduced the number of veteran pilots.

Furthermore, Germany had not devoted the necessary resources to produce the type and quantity of aircraft that could strike deep in the heart of Allied territory. All that was left for the Führer was the prospect for vengeance and the fleeting hope for a devastating psychological blow that would alter the course of the war.[2]

To exact his revenge, Hitler turned to long-neglected, yet brilliant scientists who had been toiling at the Reich's secret weapons research center in Peenemünde on the Baltic Coast.[3] Peenemünde was divided into an eastern section, where the Army worked on ballistic missiles, and a western section, where the Luftwaffe was devoted to early cruise missile technology. These pioneering scientific communities had developed and initially tested the world's first cruise missile by 1941 and its first intermediate-range ballistic missile (IRBM) by 1942. These weapons were dubbed the Fi-103, and the A-4, respectively. Later, they were renamed by Hitler to more accurately describe the role they were to play. The Fi-103 became the V-1, and the A-4 the V-2. The "V" stood for "Vergeltungswaffen," or revenge.[4] As pointed out by noted historian Michael Neufeld in his work on Germany's rocket development program, the real genesis of the program was the severe limitation on conventional military development imposed by the Versailles Treaty. Since rockets were not specifically prohibited, they presented a point of least resistance through which Germany might rearm its depleted armed forces.[5] In short the development, eventual deployment, and use were driven out of a dire need for an asymmetric counter to the militarily superior Allied powers.

The Luftwaffe's V-1, or "buzz bomb" as it was known to the English, was a pilotless cruise missile resembling a monoplane. It was powered by a pulse-jet motor and carried a one-ton high-explosive warhead. The V-1 was 25-feet long with a 16-foot wingspan; it could be launched from a simple ramp. It traveled at about 350 miles per hour (mph) and could climb to an altitude of 4,000 feet. The range of these rudimentary cruise missiles was approximately 150 miles.[6] The first buzz bombs were launched toward England on 12 June 1944 from Pas de Calais on the northern coast of France. However, the first wave of the assault was plagued by confusion and the operators' unfamiliarity with launch equipment; none of the V-1 weapons reached English soil. Subsequent launches resulted in the first impact of a cruise missile on England in the early morning hours of 13 June 1944.[7] Of the first 19 launched toward England, only four made it. However, by 18 June Germany had launched over 5,000 V-1s.[8] These attacks initially caused panic in Britain reminiscent of the first German bombing attacks during World War I. As a consequence, between the middle of June and the end of July around one and one-half million people evacuated London.[9] The political ramifications of a militarily insignificant weapon forcing the evacuation of so many civilians were very significant. Pressure was immediately applied to the British government to stop the V-1 attacks even if it meant diverting assets from the strategic bombing campaign.[10]

While England became relatively proficient at defending itself against the slow, low-flying V-1, there was no defense against the German army's V-2. This missile represented a quantum leap in technology. It was a single-stage ballistic missile fueled by alcohol and liquid oxygen (LOX). This 46.1-foot-tall rocket had a thrust of 56,000 pounds and could carry a 2,200-pound warhead that reached a velocity of 3,500 mph.[11] The first V-2 rocket struck London on 7 September 1944. As in the case of the V-1, the destruction caused by the V-2 was relatively minor, but the political impact was enormous.[12] To ease the political crisis (and protect Overlord operations), the Allies dedicated significant resources to finding and destroying the development centers and launch sites of these new and terrifying weapons by accelerating Operation Crossbow.[13] Air Marshal Arthur W. Tedder's words on 16 June 1944 reflect the concern given to the mission, "Crossbow targets are to take first priority over everything except the urgent requirements of the battle; this priority to obtain until we can be certain that we have definitely gotten the upper hand in this particular business."[14]

The Allies began Operation Crossbow in May 1943 when they became aware of the special weapons. Crossbow aircrews were assigned the mission of destroying both rocket production and launch sites. But targeting the launch sites would not prove as easy as hitting production facilities. From the outset the German armed forces pursued mobile or hardened sites for the V-1 or V-2 and in so doing, made them a difficult target for Allied airpower.[15] The V-2 (funded by the army) was conceived as an extension of artillery and was thus planned to be a mobile weapon for field use. Not coincidentally, its size was the largest that would pass through a railway tunnel. It was to be carried on a *Meillerwagen*, a wheeled transporter/erector, which used a hydraulic ram to elevate it to 90 degrees on a rotating table over a small launchpad. About 30 other vehicles carried liquid oxygen, alcohol, command and control gear, electric power, and other equipment. The elapsed time from its arrival on the unprepared site to full launch capability was about four hours.[16] Yet, as hard as it was for the Allies to find and destroy the mobile V-2 launchers, its smaller cousin, the V-1 cruise missile, proved just as troublesome.

In spite of intensive training conducted by the Allied air forces in Florida against full-scale mock-ups of the V-1 launch sites, success did not come easy.[17] The initial Crossbow strikes forced the Germans to build prefabricated launchpads that could be assembled quickly, yet were small enough to fit in the various civilian buildings that dotted northern France. The V-1 launch ramps (deemed "ski sites" by Allied airmen) were not hard to hide from prying aerial eyes.[18] As a result, considerable Allied resources were dedicated to the task of eliminating the launch sites and logistical support bases. In the end, historian Dr. Kenneth Werrell estimated that the movable V-1 rocket imposed a cost on the British and American war effort that was nearly four times higher than the cost of the weapon to Germany.[19]

Unfortunately for the Third Reich, the Allies could afford their portion while Germany could not.

Despite Crossbow, by February 1944 the RAF had only destroyed 73 of the 96 V-1 and V-2 launch sites.[20] While V-weapon launches decreased due to constant harassment, it was not until the Allied ground forces overran the launch areas that the threat truly came to an end.[21] By becoming mobile, the Germans had exploited a weakness in airpower that would give them the asymmetric edge they required to deflect the Allied strategic bombing strategy. This was a lesson the Soviets would take to heart during the Cold War while developing their own mobile missile capability.

Russian Reliance on Rockets

Soon after the end of World War II, the alliance arrayed against the Axis powers crumbled. England was but a shadow of its former self, leaving the United States and the Soviet Union as the world's only existing "superpowers." Conflicting ideology, divergent political goals, and extremely powerful military machines backed by nuclear weapons caused these two giants to settle into a high-stakes game of brinkmanship. As the two sides stared at each other across the iron curtain, each tried to gain the upper hand. It was in this environment of distrust, secrecy, technological advance, and political unrest that mobile missiles would make the next great leap forward. Indeed, the descendents of Nazi Germany's V-weapons would dramatically influence the history of the Cold War.

With the atomic bomb and the means to deliver it, the United States initially had what seemed to be an insurmountable edge. Even after the Soviets detonated their first atomic bomb on 29 August 1949, they lacked a viable means to deliver it in sufficient numbers. For the Soviets, neither possession of "the bomb" nor massive conventional forces poised to stream into Western Europe could guarantee strategic success. The Soviets knew that a nuclear attack would mean certain annihilation. Thus, with her superior atomic weaponry and means of delivery, America and her allies relied to a substantial degree on the specter of nuclear war to deter the Soviet Union in the early years of the Cold War.

The Soviets knew that if they were to compete with America, they would have to find a reliable way to deliver atomic weapons. While they worked hard to duplicate the US strategic bomber capability, the ballistic missile soon emerged as the Russian delivery system of choice. The capture of several prominent German rocket scientists after the war provided a treasure trove of technological information that greatly accelerated the Soviet rocket program. Foremost among the Soviet-controlled Germans was the left-wing engineer named Helmut Gröttrup, who was soon at work for the Soviets as head of a rocket institute near the rebuilt Mittelwerk missile plant in the German Democratic Republic.[22]

Communist distrust of the German scientific community produced a failure to integrate them fully into the Soviet engineering hierarchy as the

Americans had done with Wehrner von Braun's team. In fact, the USSR began returning German scientists to their homeland in 1951 after they felt all useful information had been obtained from them.[23] In the end, it was Russian engineer Sergei Pavlovich Korolev who became the key to the Soviet effort. Combining his own expertise with that obtained from the Germans, Korolev acted as the catalyst for the embryonic Soviet space and missile program. His tenacious drive to build a viable space booster led to Russian reliance on missiles over bombers throughout the Cold War.

Evolution of the Soviet Design Team

Born in Zhitomir, a small village near Kiev, in 1906, Korolev received his education in aeronautical engineering from the Kiev Polytechnic Institute.[24] In 1931, at the age of 25, this future father of the Soviet space and missile program cofounded the Gruppa Isutcheniya Reaktivnovo Dvisheniya (Group for Investigation of Reactive Motion).[25] Combined with the Leningrad Gas Dynamics Laboratory (GDL) in 1933, the new organization was called the Reaction Propulsion Scientific Research Institute. Korolev and fellow engineer Valentin Glushko worked on a series of projects resulting in various missiles and gliders throughout the 1930s. However, it was Korolev's RP-318 rocket-propelled aircraft that pushed him to the forefront of the Soviet military technological community. Unfortunately for Korolev, before he could see the fruits of his labor, he and Glushko were thrown in prison during Stalin's 1938 purge. But as the threat of war with Nazi Germany loomed, Stalin knew he would need the finest Soviet minds at work on advanced weapons development. Korolev was soon back in aircraft development under noted Russian engineer Sergei Tupolev.[26] During the 1942 evacuation of Tupolev's team from Moscow due to the Nazi invasion, Korolev found himself serving as deputy director for flight-testing in Glushko's design bureau in Omsk. Then in 1944 both men were assigned to Vladimir Chelomei's bureau to work on a variant of the V-1 cruise missile.[27]

Korolev's most significant discovery occurred in August 1946. A Soviet scientific research institute known as NII-88 was established, and Korolev was named its chief constructor for long-range ballistic missiles. His colleague Glushko, who was now serving as chief of the Leningrad GDL (now called GDL-OKB), developed the engines to be used in Korolev's missiles. In early 1953 Korolev received approval from the USSR's Council of Ministers for work on the world's first intercontinental ballistic missile (ICBM)—the R-7. The R-7 was known to the West as the SS-6 "Sapwood."[28] Korolev's RD-105/RD-106 propulsion concept for this missile involved a total of five engines—a simple design based on German research. Difficulty in working out the technical intricacies of these engines, along with politically-driven changes (such as a need for increased payload capacity), eventually led the government to select Glushko's concept of engine "clustering" over Korolev's design. With the additional engines called for by Glushko, the R-7 became a monster with 20 main engines and 16 vernier engines firing at liftoff. Korolev was very dissatisfied and knew that the program's planned initial launch date of 1956 was highly unlikely.[29] Moreover, basing concepts for such a large and complex missile would be very limited. The heated dispute that resulted between Korolev and Glushko led to a return to prominence for their old mentor—Vladimir Chelomei.

Based on his cruise missile work, Chelomei had become one of the Soviet Union's most prominent engineers. His notoriety, coupled with Korolev's R-7 difficulties, opened a door for Chelomei to become more involved with his true passion, the Soviet long-range space and missile program. Consequently, he requested the opportunity to lead development of the R-7, which in Soviet eyes was a higher priority than cruise missile technology.[30] A key decision in moving toward this goal was the hiring of Prime Minister Nikita Khrushchev's son, Sergei, to his bureau as a design engineer. Along with the contributions he would receive from this very capable young engineer, Sergei's presence provided Chelomei with access to the highest levels of government. In 1959, his proven capabilities and newfound political connections resulted in the formation of his own missile design bureau, *NPO Mashinostroenia*. Chelomei's design bureau was also known as *OKB-52* or Union Experimental Design Bureau no. 52.[31]

As the deputy department chief of *OKB-52* from 1958 to 1968, Dr. Khrushchev's contributions to the Soviet missile program were both varied and extensive. While his primary focus was on the development of the P-5 submarine-launched cruise missile, he also had a hand in such major projects as the SS-11 ICBM and Proton space launch vehicles. Along with the numerous responsibilities he held in these programs, the close relationship he enjoyed with his father put Dr. Khrushchev in a unique position to observe the complex inner workings of both technical missile development and politics.[32]

The Soviet Decision to Go Mobile

The groundbreaking work Dr. Khrushchev performed on the P-5 led to a cruise missile that could be launched from a canister with its wings unfolding shortly after launch. This development allowed for ease of transport. As a result, unlike its fixed-wing American cousin (the Matador), the P-5 could be deployed in a much wider variety of transporters.[33] However, as Dr. Khrushchev noted in an exclusive interview, "this missile did not receive enough support and was cancelled after father was out of power. It was thought that the ground-launched ballistic missiles would be more effective."[34]

He went on to say that the shift in emphasis toward mobile ballistic missiles in Soviet defense strategy might have had its beginnings in the successful deployment of mobile surface-to-air assets. As described by Dr. Khrushchev:

> We made our surface-to-air missiles mobile because we had a big area to defend. Our stationary surface-to-air missile sites were primarily around Moscow and others were under construction around Leningrad. But, there were not enough of these fixed launchers to cover all the areas we had to defend. The SA-2 was developed in response. We had also developed a missile similar to the American "Honest John" surface-to-surface rocket. It was called the "Luna" missile and was also mobile. Then the R-11 surface-to-surface missile (Scud-A) was deployed in 1955.[35]

From this, we can deduce that the enormous land area of the Soviet Union coupled with the high cost of deploying complex missile systems played a key role in the decision to develop mobile assets. By going mobile, the Soviets could deploy fewer missiles and achieve the same operational effectiveness at lower cost.

But according to Dr. Khrushchev, there also were important bureaucratic motivations behind the decision to deploy mobile missiles that came from within the Soviet military-industrial complex:

> The military-industrial complex told the government that it would enhance their capabilities if they combined the fixed ICBMs with mobile missiles. The military-industrial complex drove the development decision. They wanted to just go ahead and build these and deploy them, then come up with the reason why later. The Kremlin would have had to have a strong leader to say "no" to these people in the military-industrial complex. Father told them "no" many times, but [Leonid] Brezhnev (Khrushchev's successor) was weak. Brezhnev had a good relationship with Ustinov who strongly supported the military-industrial complex and nominated him as Minister of Defense. Ustinov strongly supported the military-industrial complex desire for these mobile missiles along with the fixed ICBMs. Under father, the Soviet Union only had tactical mobile missiles; mobile strategic missiles came under Brezhnev.[36]

From Dr. Khrushchev's recollections, we can see the importance not only of sheer bureaucratic inertia, but also of the vital importance of a patron at the highest levels in Soviet government. Deploying a mobile strategic missile capability simply was not a priority for Premier Khrushchev, but it became one when the leadership changed. Nevertheless, despite pressure from the Soviet military-industrial complex to develop and deploy mobile ICBMs, it would have to wait—technical limitations were playing a key role. Specifically, the lack of a reliable and easily transportable propellant held back the USSR's long-range mobile missile development.

Developing the Right Fuel

The lack of a practical fuel for mobile missiles meant that for the time being, intermediate-range missiles (which needed far less fuel than their intercontinental siblings) were the only missiles in the Soviet inventory that could reliably be made mobile. The drive for more robust propellants coincided with an ongoing battle between Korolev and Glushko over which type would be most effective. Glushko no longer wanted to use liquid oxygen as the oxidizer. He felt that hypergolic, or self-igniting, fuels held many advantages over those using cryogenic fuel.[37] Glushko's designs maximized military utility. By using self-igniting fuel and a storable oxidizer, the missile became much more operationally useful and flexible. Unlike their cryogenic counterparts which quickly boiled off after loading, these hypergolic fuels could be stored in the missile's own fuel cells for extended periods. Liquid oxygen rockets could only be fueled immediately prior to launch. However, when loaded with hypergolic fuel, a missile could be ready for launch at virtually any time. On the downside, these hypergolic fuels were deadly to human beings (even in small concentrations) and quite corrosive. Spills of these fuels were catastrophic.

Due to these significant safety concerns and his true focus on space travel, Korolev disagreed with this development and pursued use of liquid oxygen and kerosene. In the end, Glushko's concepts convinced the Russian military establishment.[38] But even loaded with hypergolic fuels, mobile ICBMs were technologically problematic at best. An even more stable and easily transportable fuel was necessary for so large a rocket. Solid fuels would solve both the safety problems posed by hypergolic fuels and the operational limitations imposed by cryogenics.

This last piece of the technological puzzle appears to have been solved primarily by Soviet aerospace engineer Aleksandr Nadiradze. According to Dr. Khrushchev, it was Nadiradze's discovery of a method for preventing cracking in large solid fuel castings that kicked open the last technological door preventing development of a Soviet mobile strategic missile.

> Cracks in solid fuel had kept them from building bigger mobile missiles. You see, it is much easier to move missiles if they have solid fuel. Aleksandr Nadiradze was the developer of solid fuel ballistic missiles. He solved the problem of cracks in the solid fuel. Soviet missiles were liquid fueled until the late 70s and early 80s when they deployed the Topol, or SS-25.[39]

Unlike their Soviet rivals, the United States had worked on solid rocket propellants since 1940, and enthusiasm for ship-launched (especially submarine-launched) ballistic missiles meant solid fuels were becoming available to US designers as early as 1951.[40] An extensive ICBM-type solid fuels program started in 1955 and became a priority in late 1957.[41] However, even without the solid fuel dilemma faced by the Soviets, the United States moved toward fixed ground-based launchers for their solid-fueled ICBMs such as Minuteman. The question then becomes: why were mobile ground-based ballistic missiles more attractive to the Russians than to the Americans?

Decision to Go Mobile Also Driven by Necessity

The previous discussion suggests the Soviets developed mobile missiles for internal bureaucratic reasons. However, there was another key reason for the Soviet drive toward mobile ground-based missiles—they had to counter a demonstrated US ability to locate and destroy their fixed-missile sites. Using U-2 reconnaissance aircraft since 1956, America had demonstrated a viable capability to locate and target fixed missile sites well within Soviet borders. This capability could not have gone unnoticed by the Kremlin. As evidence of the desire to counter this threat, Decree 708-336 of the Soviet Ministers was issued on 2 July 1958. This decree directed several design bureaus to begin work on a system that "would allow the missiles to be moved continuously." By continuous movement, Soviet missiles would be safe from prying American eyes.[42] This would negate America's ability to locate and target fixed missile launch sites. As a result, the Soviet Union would obtain some degree of safety from a knockout first-strike by Strategic Air Command (SAC). To further corroborate this statement, recently declassified CIA documents also point to a change in Soviet missile deployment concepts as early as 1959. The NIE "11-5-59" of September 1959, describes the USSR's move toward mobile ballistic missiles as follows:

> There is no firm evidence to indicate the Soviet concept of ICBM deployment or the nature of operational launching sites. From other ballistic missile systems it appears that mobility is a basic design consideration. As opposed to the advantages of hard or soft fixed site systems, a mobile system can reduce vulnerability by making site location and identification more difficult.[43]

Putting all of this information together, the Soviet Union's decision to make mobile ballistic missiles the mainstay of its strategic arsenal appears to have been born out of two primary causes. First, as described by Dr. Khrushchev, there was a strong desire by the military industrial complex to protect precious research dollars allocated to mobile ballistic missile research and development programs. But a second, perhaps even more compelling factor was the need for the Soviet government to protect its ballistic missiles from the prying eyes of advanced American reconnaissance programs. When this operational requirement was combined with the change in leadership from Khrushchev to Brezhnev, the move toward reliance on mobile ballistic missiles for deterrence was reinforced.[44]

The American Dimension of the Soviet Decision to Go Mobile

With the enormous landmass within which the Soviets could transport and hide mobile ballistic missiles and a form of government that could largely ignore the domestic problems inherent in roaming nuclear weapons, the decision to deploy ground-based mobile ballistic missiles may have been foreordained for America's Cold War antagonist. In comparison, US decision makers considered the idea of a mobile *ground-based* strategic missile concept several times only to find that other alternatives were more politically feasible. Specifically, the United States could afford to base its land-based ballistic missiles in fixed sites because it had a viable strategic bomber force along with a rapidly improving submarine-launched ballistic missile capability to provide for stable deterrence. Moreover, when the initial ICBM deployment decisions were being made in the late 1950s and early 1960s, there was no Soviet equivalent to the U-2 or American satellites that could locate our fixed-site missiles. For the ground-based American ICBM force, a quick response and hardness were deemed more important than the ability to hide.[45] However, the eventual decision to base ICBMs in fixed silos did not come without controversy.

When the United States obtained the services of Wehrner von Braun, he worked closely with the US Army in the development of such missile-age milestones as the Redstone and Jupiter rockets. Jupiter was a mobile intermediate-range ballistic missile designed for deployment in Europe, as was the Air Force's fixed-launcher missile known as Thor.[46] Eventually, fixed-site launchers for ground-based ballistic missiles dominated over those dependent on ground mobility.[47] Army chief of staff at the time, Gen Maxwell Taylor criticized the Air Force's basing concept:

> Although the Jupiter was specifically designed for field mobility, in November 1958, the Air Staff directed the Army to remove this feature completely as if it were something unholy. The reason for the attitude is hard to determine. Perhaps it is also the fact that a mobile missile needs Army-type troops to move, emplace, protect, and fire it. . . . Thus, a decision to organize mobile ballistic missile units would in logic have led to transferring the operational use of the weapon back to the Army—where it should have been all the time.[48]

While Taylor's point makes sense, it ignores America's unique circumstances at the time the basing decision was made. One should look not only at interservice rivalry as Taylor apparently did, but factors such as America's geographic position, her political situation, financial capacity, technological prowess, and her potential adversaries' military capabilities before condemning the decision to field a stationary system. Additionally, consideration must be given to the fact that both Jupiter and Thor were intermediate-range missiles meant for deployment in Western Europe. At the time the decision was made, fixed launchers might have been the best option for the political climate and state of technological maturity.

Consider how America's geography influenced the decision to deploy fixed-base ICBMs. First, while America is a large continental power, it is situated between two rather benign neighbors and two expansive oceans that provide a formidable barrier to invaders. It is also these two oceans that provide America with a tremendously effective hiding place for submarine-launched ballistic missiles (SLBM). From the Atlantic and Pacific Oceans, the United States can hide and launch ballistic missiles at virtually any target in the world with impunity. There is no need to get permission for basing rights in these two bodies of water, and there is no restriction to cold-water ports and the corresponding need to launch missiles through the polar ice as the Soviets had to do. So geography explains in large part why the Soviet SLBM capability always paled in comparison with that of the United States.

In addition to the flexibility American geography afforded it in comparison with the relatively landlocked Soviet Union, the United States has generally been able to field more advanced, albeit more expensive, launch platforms in the form of strategic bombers and ballistic missile submarines. As a result of our experience in World War II, the United States relied upon its aircraft and submarine industries. Americans simply had to cross over different mediums than did the Soviets to get to the battlefront. The issue of differences in political landscape must also be considered.

The American decision to deploy mobile IRBMs and cruise missiles in Europe in the 1980s caused storms of protest. Even America's staunchest NATO allies were less than enthusiastic about receiving another country's nuclear weapons onto their homelands. The deployment of American GLCM throughout Western Europe in 1982 touched off events captured in the following vivid account:

> Noisy protesters came early for the arrival of the wing's first batch of Ground Launched Cruise Missiles. However, US troops brought them in late at night, as the protesters slept. Greenham Common on that day was besieged by thousands of women anti-nuclear activists. They were chanting, singing, and blowing trumpets in protest of the presence of the nuclear-tipped cruise missiles. These anti-nuclear zealots even briefly penetrated a perimeter fence protecting the base against intruders.[49]

The pandemonium described above was experienced within the territory of America's closest ally, England. Certainly, this speaks to the immense political clout spent in getting our allies to receive the new, mobile nuclear weapons. But these political costs exist when deploying weapons systems inside the continental United States as well; fielding a mobile ICBM system inside America would be only somewhat less troublesome.[50] Protests erupted throughout large portions of the American Southwest when it was announced that the MX mobile missile basing would require vast tracts of land throughout that region, and it is safe to assume any future mobile basing concept would draw the attention of large numbers of protestors.[51] Obviously, US government officials simply could not ignore these voices of protest, as might their Russian counterparts—especially not when they had other means at their disposal that were somewhat more expensive in terms of money, but not political capital. But, perhaps more important to basing considerations is an assessment of enemy capabilities.

As mentioned previously, in the late '50s and '60s, the Soviet reconnaissance capability was not much of a concern. Additionally, even if they could locate our sites, they simply did not have the capability to destroy all of the nuclear weapons we deployed on land, sea, and in the air. In short, we had what the venerable Cold War strategist Thomas C. Schelling describes as a relatively invulnerable deterrent force.[52] Even after a devastating Soviet attack on our fixed-launch sites (which was unlikely), the United States would continue to threaten Russia with unacceptable damage. As we discovered, the Soviets could not boast such a capability by relying solely on their fixed-base ICBMs. Together with a rudimentary SLBM force and a limited strategic bomber capability, mobile ICBMs gave them exactly what they needed in the face of superior US reconnaissance and long-range strike capabilities—the ability to threaten future damage to America after a first strike.[53] As summed up by CIA analysts in 1983, "mobile ICBMs provide a highly survivable force element. We believe the Soviets will apply extensive camouflage, concealment, and deception measures to make the probability of accounting for or detecting their mobile ICBM units on a timely basis more difficult."[54]

The same CIA report suggested the SS-X-25 and SS-20 would form the backbone of the USSR's offensive mobile ballistic missile threat throughout the 1990s. Unfortunately for the West, the fall of the Soviet Union would not eliminate this threat—it would disperse it, arguably making the danger greater than ever.

Post–Cold War Proliferation of Mobile Ballistic Missiles

As we look at nations deploying mobile missile systems, such as Pakistan, India, China, Iraq, North Korea, and Iran, we can understand some of the determinants of their decision-making process. Table 1 lists potential adversarial nations that have deployed mobile ballistic missiles. Our potential adversaries' choices will likely include factors such as geography, political environment, and enemy capability.

Table 1. Selected World Ground-Mobile Missile Systems

Country	System	Type	Range (km)	Payload (kg)	Status
Afghanistan	Scud B	BM	300	1,000	In Service
Algeria	Scud B	BM	300	1,000	In Service
Argentina	Alacran	BM	200	500	In Service
Egypt	Otomat Mk 2	ASCM	180	210	In Service
India	Prithvi-150	BM	150	1,000	In Service
Iran	HY-1 Silkworm	ASCM	85	400	In Service
	C-802	ASCM	120	165	Imported
	Scud C	BM	550	500	In Service
	M-11	BM	300	500	Development ?
	Nodong 1	BM	1,000	1,000	Imported ?
Iraq	Sakr 200	BM	150	500	In Service
North Korea	HY-2 Seersucker	ASCM	95	500	In Service
	Nodong 1	BM	1,000	1,000	In Service ?
Libya	Otomat Mk 2	ASCM	180	210	In Service
	Scud B	BM	300	1,000	In Service
Pakistan	M-11	BM	300	500	In Service ?
	Hatf 3	BM	600	500	Development
Serbia	Scud B Variant	BM	400	700	Development
Syria	SSC-1 Sepal	ASCM	450	1,000	In Service
	Scud C	BM	550	500	In Service

BM = Ballistic Missile ASCM = Antiship Cruise Missile

Adapted from Dennis M. Gormley and K. Scott McMahon, "Counterforce: A Response to Deficiencies in US Counterforce Operations," *Global Defence Review 1997*, www.global-defence.com/1997/Counterforce.html.

But one new element must be considered especially important since the fall of the Soviet Union: the technology for mobile ballistic missiles is now quite easy to obtain. Russia and former Soviet client states have become willing suppliers of the weapons that America feared during the Cold War. Nations looking at our dismal performance against Iraqi Scuds in 1991 (discussed in chapters 3 and 4) cannot help but see mobile ballistic missiles as a possible way to mute America's ability to project power and influence. Without having to do the tedious research that consumed Germany, the United States, and the Soviet Union, a Third World nation with nothing more than money and some organic technical competence (probably gained in American universities) can acquire the same weaponry as a former superpower. With this realization, the stage is certainly set for a dangerous future.

The threat posed by proliferation has grown so great that Congress commissioned a study of the ballistic missile threat to the United States in 1998. This commission, chaired by Donald Rumsfeld, came to the conclusion that the danger posed to the United States is far greater than originally reported by the intelligence community:

> Concerted efforts by a number of overtly or potentially hostile nations to acquire ballistic missiles with biological or nuclear payloads pose a growing threat to the United States, its deployed forces and its friends and allies. These newer, developing threats in North Korea, Iran and Iraq are in addition to those still posed by the existing ballistic missile arsenals of Russia and China, nations with which we are not now in conflict but which remain in uncertain transitions. The newer ballistic missile-equipped nations' capabilities will not match those of US systems for accuracy or reliability. However, they would be able to inflict major destruction on the US within about five years of a decision to acquire such a capability (10 years in the case of Iraq). During several of those years, the US might not be aware that such a decision had been made.[55]

Particularly disturbing to the commission were the following three differences between the present and the period we characterized as the Cold War:

> 1. Newer ballistic missile and weapons of mass destruction (WMD) development programs no longer follow the patterns initially set by the US and the Soviet Union. These programs require neither high standards of missile accuracy, reliability and safety nor large numbers of missiles and therefore can move ahead more rapidly.
> 2. A nation that wants to develop ballistic missiles and weapons of mass destruction can now obtain extensive technical assistance from outside sources. Foreign assistance is not a wild card. It is a fact.
> 3. Nations are increasingly able to conceal important elements of their ballistic missile and associated WMD programs and are highly motivated to do so.[56]

Unfortunately, the commission set out to recommend a way to respond to the threat from ballistic missiles but ended up only being able to identify it. Equally vexing is the thought that America may no longer be able to call upon a Schellingesque concept of deterrence to defend against ballistic missiles as it did throughout the Cold War.

The United States is being pushed into a corner in which preemption may be the only sure defense against an enemy that has nothing to lose.

Considering rogue nations such as Iran and North Korea, which are now equipped with mobile ballistic missiles, it is not hard to imagine the dire consequences should they obtain the ability to launch long-range strikes against the continental United States with WMD-tipped missiles. Moreover, since these nations do not follow the regimented test and evaluation programs associated with the US and USSR during the Cold War, our warning time before an operational strategic ballistic missile is fielded erodes significantly.[57]

To understand how America might defend against this threat in today's more volatile world, let us first look at how America responded to the challenge posed by mobile ballistic missiles during the now-nostalgic days of the Cold War—the subject of the next chapter.

Notes

1. Mark E. Kipphut, "CROSSBOW and the Counter-Scud Efforts: Lessons from History" (Maxwell AFB, Ala.: Air War College Research Report, Air University, 1996), 50.
2. Michael J. Neufeld, *The Rocket and the Reich: Peenemünde and the Coming of the Ballistic Missile Era* (New York: Free Press, 1995), 275.
3. Ibid., 2, 34, 49, 55–56.
4. Paul Schons, "Wernher von Braun Dreams of Space," *Germanic American Institute*, 1 June 2001, http://courseweb.stthomas.edu/paschons/language_http/essays/vonBraun.html (accessed 22 December 2002).
5. Neufeld, *The Rocket and the Reich*, 6.
6. Kenneth Werrell, *Evolution of the Cruise Missile* (Maxwell AFB, Ala.: Air University Press, 1985), 45.
7. Ibid.
8. Ibid., 46.
9. Martin Gilbert, *Second World War* (London: Weidenfeld Publishing, 1989), 626.
10. Kipphut, "CROSSBOW and the Counter-Scud Efforts," 16, 20–21.
11. Neufeld, *The Rocket and the Reich*, 51–52.
12. Werrell, *Evolution of the Cruise Missile,* 47.
13. Kipphut, "CROSSBOW and the Counter-Scud Efforts," 16.
14. Joseph W. Angell, "CROSSBOW—Second Phase," in Wesley F. Craven and James L. Cate, eds., *The Army Air Forces in World War II*, vol. 2, *Europe: Argument to V-E Day, January 1944 to May 1945* (1949; Chicago, Ill.: University of Chicago Press, 1951), 527.
15. Bill Gunston, *Rockets & Missiles* (New York: Crescent Books, 1979), 15.
16. Ibid., 48.
17. Angell, "CROSSBOW—Second Phase," 97–104.
18. Werrell, *Evolution of the Cruise Missile,* 44–50.
19. Ibid., 61.
20. Gilbert, *Second World War*, 626.
21. Peter G. Cooksley, *Flying Bomb: The Story of Hitler's V-Weapons in World War II* (New York: Charles Scribner's Sons, 1979), 162.
22. Neufeld, *The Rocket and the Reich*, 268–69.
23. Ibid., 272.
24. James Harford, *Korolev: How One Man Masterminded the Soviet Drive to Beat America to the Moon* (Hoboken, N.J.: John Wiley and Sons, 1997), 16–19.
25. Ibid., 36.

26. Working aircraft development under Tupolev was much better than his alternative. Korolev had been sentenced to hard labor in the gold mines of Kolyma. Harford, *Korolev*, 33–34, 57–59.

27. Ibid., 62, 100–101.

28. Anatoly Zak, "Rockets: ICBMs," *Russian Space Web*, 16 February 2001, table, http://www.russianspaceweb.com/rockets_icbm.html (accessed 26 December 2002).

29. Mark Wade, "Russian Rocket Scientists," *Encyclopedia Astronautica*, 12 August 2002, http://www.geocities.com/duppim/VB05.html (accessed 26 December 2002).

30. Dr. Sergei Khrushchev, telephone interview with author, 9 December 2002.

31. Ibid.

32. Ibid.

33. The Martin Matador was one of three cruise missiles under development for the USAF in the 1940s and 1950s. The Matador was about the same size as a modern jet fighter and weighed 12,000 pounds. It could carry a 3,000-pound warhead at 650 mph over a range of 620 miles. The Matador's shortcoming was a very limited ground-controlled guidance range of 250 miles. Werrell, *Evolution of the Cruise Missile*, 108–12.

34. Dr. Khrushchev, interview.

35. Ibid.

36. Ibid.

37. Cryogenic propellants are liquid oxygen (LOX), which serves as an oxidizer, and liquid hydrogen (LH2), which is a fuel. The word cryogenic is a derivative of the Greek kyros, meaning "ice cold." The distressing tendency of cryogenics to return to gaseous form unless kept supercool makes them difficult to store over long periods of time, and hence less satisfactory as propellants for military rockets, which must be kept launch-ready for months at a time. Hypergolic propellants are fuels and oxidizers which ignite on contact with each other and need no ignition source. This easy start and restart capability makes them attractive for both manned and unmanned spacecraft maneuvering systems. Another plus is their storability—they do not have the extreme temperature requirements of cryogenics. NASA, "Propellants," *NASA Facts Online-John F. Kennedy Space Center*, 28 August 2002, http://www-pao.ksc.nasa.gov/kscpao/nasafact/count2.htm (accessed 20 March 2003).

38. Wade, "Russian Rocket Scientists."

39. Dr. Khrushchev, interview.

40. Michael H. Armacost, *The Politics of Weapons Innovation: The Thor-Jupiter Controversy* (New York: Columbia University Press, 1969), 64–65.

41. Neufeld, *The Rocket and the Reich*, 122, 147, 182.

42. Mikhail Pervov, *Raketnoye Oruzhiye RVSN* [*Special-purpose Rocket Weapons*] (Moscow: Violanta, 1999) and A. V. Karpenko, A. F. Utkin, and A. D. Popov, *Otechestvenniye Strategischeskiye Raketnoye Kompleks* (Sankt Peterburg, Gangut, 1999). The Marshall Institute's Russian language specialists in Garmisch, Germany, validated references to Soviet Ministers Decree 708-336 in these Russian language sources for the author on 2 April 2003. Mark Wade, "Gnom," *Astronautix*, 26 August 2002, http://www.astronautix.com/lvs/gnom.htm (accessed 26 December 2002).

43. National Intelligence Estimate (NIE) 11-5-59, *Soviet Capabilities in Guided Missiles and Space Vehicles*, 3 November 1959. Document is now declassified.

44. The model that perhaps best describes the process that led the Soviet Union to become increasingly reliant on ground-mobile ballistic missiles was developed by University of Michigan political scientist John W. Kingdon. In his work, Kingdon describes a policy-making process known as "coupling." In a so-called policy stream, proposals, alternatives, and solutions float about being continually updated, revised, and discussed. Once a pressing need or problem appears that elevates a specific proposal into a potential solution, the two can be coupled. Additionally, the opening of a window of opportunity for acceptance of this idea is needed to complete the coupling transaction. In the case of the Soviet decision to become more reliant on ground-mobile ballistic missiles, the proposal to develop and deploy the mobile systems apparently came from the Russian military-industrial complex.

The idea was on the shelf until the problem of defeating American overhead surveillance capabilities became critical. The fall of Nikita Khrushchev and subsequent rise of Leonid Brezhnev, as well as the introduction of reliable solid fuels, completed the transaction by opening a window of opportunity. For a more detailed treatment of this thought-provoking concept, see John W. Kingdon, *Agendas, Alternatives, and Public Policies* (New York: Longman Press, 1995), 172–73.

45. Armacost, *The Politics of Weapons Innovation*, 147.

46. Ibid.

47. Ibid., 146–53.

48. Maxwell Taylor, *The Uncertain Trumpet* (New York: Harper and Brothers, 1958), 141.

49. Peter Grier, "The short, happy life of the glick-em," *Air Force Magazine* 85, no. 7 (July 2002): 70.

50. Lauren H. Holland and Robert A. Hoover, *The MX Decision: A New Direction in US Weapons Procurement Policy* (Boulder, Colo.: Westview Press, 1985), 95–120.

51. Paul J. Culhane, "Heading 'Em Off at the Pass: MX and the Public Lands Subgovernment," *Federal Lands Policy*, 1987, 9–110. See also *Office of Technology Assessment, Annual Report to Congress for 1981* (Washington, D.C.: GPO, 1982), 17.

52. Thomas C. Schelling, *Arms and Influence* (New Haven: Yale University Press, 1966), 233.

53. Ibid., 3.

54. NIE 11-3/8-82, *Soviet Capabilities for Strategic Nuclear Conflict, 1982–1992*, 15 February 1983. Document is now declassified.

55. House, *Commission to Assess the Ballistic Missile Threat to the United States*, 105th Cong., 2d sess., 16 July 1998, 4–5.

56. Ibid.

57. Ibid., 18.

Chapter 3

The American Cold War Response

SDI, Star Wars, Patriot Shield, or whatever one wants to call it will now be built to protect us. By the end of the 1990 decade, the naked threat of ballistic missile attacks will only be a memory.

—G. H. Stine

Prolific science fact-and-fiction author G. Harry Stine anticipated the end of the threat from ballistic missiles in an ambitious prediction from his history of the ICBM. Yet as we contemplate such a naively hopeful prediction, it is arguable that Americans sometimes fall into a "technological trap." That is, Americans place so much reliance on the ability to develop new technological wonders that frequently the nontechnical aspects of the solution elude us. However, while mindful of this admonition, some detailed attention must be given to the topic of technology's role in responding to the threat from mobile ballistic missiles.

Technological advances are critical in addressing the mobile ballistic missile threat. The key technological hurdle remains the ability to provide persistent surveillance that can find, fix, target, and track mobile missiles. Along with these advances, an appropriate strategy for their employment is necessary. This chapter is devoted primarily to a discussion of advances made in persistent surveillance through the height of the Cold War. It also touches on the preconceptions and strategies employed by each of the superpowers during that era.

However, no study of military capability would be complete without an accurate characterization of the technological maturity of key operational components and where they seem to be heading in the near future. Analysis of the move toward even more flexible and persistent surveillance and reconnaissance capability will end the chapter. The discussion starts with a key milestone in Cold War reconnaissance, development of the U-2.

Project Aquatone

Cold War security needs drove the requirement for greatly increased reconnaissance and surveillance capabilities. The advent of the ICBM put the continental United States at risk of a devastating, possibly fatal, surprise attack for the first time in its history. The successful launch of the world's first orbiting satellite, *Sputnik*, in October 1957 reinforced the nation's sense of vulnerability. A quip from then-Senate Majority Leader Lyndon B. Johnson summed up the outlook of stunned Americans everywhere, "Soon, they will be dropping bombs on us from space like kids dropping rocks onto cars from freeway overpasses."[1]

Dwight D. Eisenhower provided the nation's response to Sputnik in a November 1957 presidential address titled, *Science in National Security*. In this speech, Eisenhower observed, "one of our greatest and most glaring deficiencies is the failure in this country to give high enough priority to scientific education and to the place of science in our national life." Furthermore, he lamented the lack of workers in highly technical career fields as "the most critical problem of all."[2] Eisenhower's solution was the National Defense Education Act (NDEA). This act generated almost a billion dollars for higher education initiatives that directly benefited national defense. The result was a dramatic increase in the number of professionals in the United States who could contribute to scientific and mathematical disciplines. But even while attempting to downplay the degree to which the United States had fallen behind the Soviets in missile technology, he knew a breakthrough was required to allow America to more closely observe developments in the USSR. Eisenhower had come to the same conclusion as German army commander-in-chief Gen Werner von Fritsch in 1938, who stated, "The nation with the best aerial reconnaissance facilities will win the next war."[3] To achieve superiority in reconnaissance over a giant landmass on the other side of the globe, Eisenhower had to mobilize the best minds and full resources of America's technological base.

Before the Cold War, reconnaissance flights over foreign countries only took place during active hostilities.[4] However, the speed and destructiveness of a ballistic missile strike no longer allowed for such gentlemanly statesmanship. This new threat and the intensive security measures being implemented by the Warsaw Pact made it clear to the American defense establishment that overhead reconnaissance would play a starring role. Initially, this effort centered on the RB-47, a reconnaissance adaptation of the B-47 strategic bomber.[5] Equipped with cameras and electronic eavesdropping gear, the RB-47 crews worked at penetrating the Soviet Union's Pacific borders. On one occasion, the crew of an RB-47 managed to squeak through a gap in Russian radar coverage and penetrated over 450 miles inland to the Siberian city of Igarka.[6] However, the Soviet Union soon took steps to prevent such intrusions.

In 1950 the Kremlin's policy toward foreign interlopers became much more aggressive. On 8 April 1950 a US Navy privateer patrol aircraft was shot down over the Baltic Sea.[7] The more active Russian stance soon extended to their European borders, and all US and NATO aircraft flying too close to the Iron Curtain were now at risk. The downing of an American RB-29 by Soviet fighters over the Japanese island of Hokkaido on 7 October 1952 attested to the increased danger.[8] The United States quickly turned to technology that could bypass the Soviets' capability to spill blood to guard its secrets. The product became "Project Aquatone"—what we now know as the U-2.[9]

Richard S. Leghorn, commander of the 67th Reconnaissance Group during World War II, went on to work for the Eastman Kodak Company after the war. He became a leading advocate for the new type of reconnaissance platform that formed the foundation of Aquatone. In Leghorn's concept, the combination of high-resolution photography and high-altitude aircraft was vital to our intelligence efforts against the Communist bloc. Given the service ceiling of 45,000 feet for the best Soviet fighter of the day, the MiG-17, Leghorn reasoned that any capable US reconnaissance platform should be able to fly at least to 60,000 feet. This capability was the foundation upon which everything else had to be built. Recalled to active duty for the Korean War, Leghorn took command of the Reconnaissance Systems Branch at Wright-Patterson AFB in early 1951.[10] His concepts would soon come to fruition as he moved up in the reconnaissance establishment.

After being transferred to Washington, D.C., Leghorn began working with an old acquaintance from Wright Field named Charles F. (Bud) Wienberg; an aeronautical engineer by the name of Eugene P. Kiefer; and the future father of America's ICBM program, Col Bernard A. Schriever. These men would form the core group that had responsibility for America's long-range reconnaissance needs. All three agreed on the need for the highest ceiling possible for the next reconnaissance aircraft. Interest in the concept for a high-altitude platform began to grow throughout the Air Force's development community as well as within the CIA. Several companies submitted competing designs, but Lockheed won out with its proposal for an aircraft initially known as the CL-282. The CL-282 later gained fame as the vaunted U-2.[11]

Ironically, the Air Force strongly protested the pursuit of the U-2 project. It favored a Bell design called the X-16. However, supporters of the U-2 (including the CIA) were able to make the case that an unarmed, lighter aircraft that specialized in high-altitude reconnaissance—such as the Lockheed design—better met the requirements of national security. The Air Force's preferred plan that called for an armored, multipurpose platform was far more complex than the U-2 and already behind schedule. Moreover, Lockheed and the CIA were able to make the case that the earlier delivery date for the CL-282 made it more useful from the start than its Bell counterpart. Lockheed's arguments won the support of CIA director, Allen Dulles, and President Eisenhower. The Air Force soon followed suit.

After surviving a multitude of spirited disputes over design concepts as well as which agency would operate the new aircraft, the United States finally had the capability to observe even the most closely guarded Soviet military and engineering facilities. On 20 June 1956, Carl Overstreet flew the first operational U-2 flight from Wiesbaden, Federal Republic of Germany, over the German Democratic Republic and Poland.[12] In all U-2 pilots conducted 24 deep-penetration flights over the Soviet Union in the four years leading up to the Francis Gary Powers shoot-down on 1 May 1960.[13]

The Soviet Union did not take long to respond to the threat from America's new reconnaissance capabilities. In the previous chapter, we learned that Soviet Ministers' Decree 708-336 of 2 July 1958 led to a mobile missile concept that would largely confound Washington's ability to provide consistent, reliable targeting information to the strategic air command. This new basing mode and an aggressive air defense scheme worked together to deny accurate information on Soviet missile locations, thus denying the United States any possible benefit from a first strike against Russian ballistic missile forces. American planners now knew that the ability to observe significant military developments in the Soviet Union was going to require an evolutionary process that might span decades. It was thus vital that American technologists discover ways to overcome the continuously improving Russian countermeasures and strategies. Along with intensive efforts to match the Soviet KGB in infiltrating foreign defense establishments, incredible air-breathing systems such as the SR-71 Blackbird resulted from this call to action. However, the capability to observe adversaries from the ultimate high ground proved to be the next great technological leap of the Cold War.

The Eye in the Sky

Project Corona was the first attempt to exploit outer space for reconnaissance and surveillance purposes. Started in the late '50s, Corona was to be the next leap forward for observing the USSR's military machine. In particular, this constellation of photoreconnaissance satellites would provide valuable targeting information to the staff responsible for building the Single Integrated Operational Plan (SIOP). Without continuous information on the whereabouts of Soviet ballistic missile and bomber forces, the United States could not effectively deter either a massive conventional plunge by the Warsaw Pact or a surprise "bolt from the blue" strategic nuclear attack. The seriousness with which the Eisenhower administration viewed this situation is evident in the text of NIE 11-6-54. This product contained the seeds for all future US space reconnaissance programs:

> In preparing this estimate, we have had available conclusive evidence of a great post-war Soviet interest in guided missiles and indications that the USSR has a large and active research and development program. However, we have no firm current intelligence on what particular guided missiles the USSR is presently developing or may now have in operational use. . . . Therefore, our estimates of missile characteristics and dates of missile availability must be considered as only tentative, and as representing our best assessment in the light of inadequate evidence and in a new and largely unexplored field.[14]

Clearly, it was unacceptable that our intelligence apparatus could only seem to make informed guesses as to the state of the Soviet missile program. After the cessation of U-2 overflights in 1960, Corona seemed to solve this problem. The first images provided by Corona were analyzed on 18 August 1960 and showed a military airfield near Mys Schmidta on the Chukchi Sea in northeastern Russia. The resolution of this first image was only seven meters, but it fundamentally changed the way America looked at the Soviet Union.[15] Consider the contrast between the two following NIE statements. The first was given to the president in mid-1960, "Since there is insufficient direct evidence to establish the scale and pace of the present Soviet ICBM production and deployment program, we have based our estimate in part on various indirect forms of evidence and on argument and analysis deduced from more general considerations."[16] Certainly, this report would not make for a sense of confidence in America's strategic decision-making circles. However, in the autumn of 1961, President Kennedy received the following, much more detailed analysis:

> 1. New information, providing a much firmer base for estimates on Soviet long-range ballistic missiles, has caused a sharp downward revision in our estimate of present Soviet ICBM strength.
> 2. We now estimate that the present Soviet ICBM strength is in the range of 10–25 launchers from which missiles can be fired against the United States, and that this force level will not increase markedly during the months immediately ahead.[17]

Obviously, something had changed the way of thinking and tone of the American intelligence community to produce such a confident document. That something was the Corona satellite program. The imagery produced by these very early generation satellites was rudimentary by today's standards and provided even less granularity than photos from its U-2 counterpart. However, a key advantage offered by space-based reconnaissance was that it covered a much wider area. In fact, the first Corona mission covered more of the Soviet Union than all previous 24 U-2 flights combined.[18] An even more important political benefit was the fact that Corona could not be shot down.

The End of U-2 Overflights of the USSR

In early 1960 increasingly accurate Soviet radar tracking and surface-to-air missile capabilities caused concern in the Eisenhower administration that one of the U-2s could be brought down over Russian territory and thus ruin the president's valuable reputation for honesty. This reputation was particularly important to him due to the planned Paris Summit with Khrushchev on 16 May 1960. Unnamed CIA sources reported the following to the agency's director of plans Richard Bissell on 14 March 1960, "We can assume, with a 90 percent probability of being correct, that we will be detected on entry, tracked accurately throughout the period in denied territory (approximately four hours), and will evoke a strong PVO (Soviet Air Defense) reaction."[19]

In spite of this warning, the final U-2 overflight of the Soviet Union, "Operation Grand Slam," was approved for execution on 28 April 1960. Unfortunately, bad weather caused a delay of this mission until 1 May 1960. On that Sunday morning, already 30 minutes behind schedule (due to secure communications problems), the final "in the clear approval for launch was given to pilot Francis Gary Powers."[20] In addition to the ominous delay and communications failure that preceded the mission, the May Day holiday turned out to be a bad time to attempt a secret transit of the USSR. Greatly reduced Russian air traffic allowed their tracking facilities to concentrate on the odd signature they received from Powers' U-2 before it entered Soviet airspace.

While scrambled Soviet jet interceptors failed to shoot down the U-2, a salvo of missiles was launched at it, with one SA-2 surface-to-air missile exploding to the rear of the aircraft at 70,500-feet altitude just short of Sverdlovsk. The explosion disabled Powers' plane, and forced him to eject before activating the self-destruct ordnance. Khrushchev's ensuing embarrassment of America and the Eisenhower administration at the Paris Summit effectively ended U-2 overflights of the Soviet Union.[21] Eisenhower left the door open to other means of overhead intelligence collection, however.

The High Ground Comes of Age

Because of the failure of Operation Grand Slam, the investment in Corona continued and the technology dramatically improved to the point that its imagery rivaled that previously obtained from the U-2. A June 1967 Corona presentation showed all 24 known Soviet ICBM installations. This presentation provided an astonishingly accurate count of between 893 and 898 deployed Russian ICBMs.[22] America's "Eye in the Sky" had come of age.

As the years passed and satellite reconnaissance capabilities for both the West and the Eastern bloc improved markedly, each side poured significant resources into creating and maintaining the very best surveillance and reconnaissance capability possible. However, it is important to note that each side continued to target these rather inflexible surveillance assets against stationary targets. Moreover, throughout this period, each state was able to operate under fairly well understood rules of engagement. Foremost among these unspoken rules was the fact that the opposing ballistic missiles were for deterrent purposes only—to use them appeared to be utter madness. For both the Soviet Union and the United States, nuclear weapons held the adversary's civilization hostage. To damage the hostage in any way with these weapons negated the threat of future damage.[23]

Because of this mutual understanding, managing the immense amounts of intelligence and targeting data became a highly classified exercise managed at the top levels of the US defense establishment. US nuclear weapons had to cover as many Soviet nuclear weapons as possible. Because only a select few had a "need to know" concerning strategic targeting, little thought was given to more tactically useful reconnaissance. In this regard, not much in the way of resources or thought was devoted to the purpose of providing information directly from the "sensor" to the "shooter." Furthermore, because the primary object of the Cold War nuclear standoff was deterrence, very little effort was put into reconnaissance of mobile ballistic missiles until the last decade of the Cold War.

Ensuring the location of fixed targets had always been the priority of overhead assets. Only at the end of the Cold War did the Soviet's mobile missile technology mature. Pres. Ronald Reagan's buildup of the 1980s focused in part on that threat. Col Thomas P. Ehrhard, professor at the US Air Force's School of Advanced Air and Space Studies, addressed the causes for this change in approach and strategy as part of his PhD dissertation on the increasing relevance of unmanned aerial vehicles (UAV):

> With the emergence of mobile nuclear ballistic missile systems, the weaknesses inherent in fast reconnaissance rapidly became a national security liability. The Soviet Union destabilized the European theater in 1977 by introducing hundreds of accurate, mobile, multiple-warhead SS-20 intermediate-range nuclear missiles that threatened key North Atlantic Treaty Organization (NATO) military sites. Mobile air defense radars and launchers made getting to those missile sites a lethal proposition. Soviet nuclear missile submarines could flush out of their ports in between satellite overflights and be missed. Because the new, road-mobile missiles presented a vast array of moving targets that available reconnaissance assets could not track, NATO planners had no way of addressing the threat except by using fighter aircraft on suicidal hunter-killer missions deep behind enemy lines. . . . The only militarily useful way to deal with the proliferation of critical mobile systems was to find and track them in real time. Satellites provided only episodic coverage, so only a stealthy, data linked overhead system—an airborne system—could accomplish the "find and track" mission by filling the gaps between satellite overflights.[24]

Colonel Ehrhard goes on to describe in detail the Reagan administration's drive for persistent, unmanned, airborne reconnaissance assets to assist strike platforms (such as the B-2 bomber) in the hunt for mobile ballistic missiles. The need for persistence in reconnaissance became even more acute when the Soviets deployed the deadly SS-25 mobile ICBM in 1985. The US homeland was suddenly under direct threat from a highly accurate and nearly undetectable mobile ballistic missile system with intercontinental range. However, US progress in fielding the needed reconnaissance and strike systems and the deployment of Pershing II IRBMs and GLCMs throughout Western Europe contributed to the unexpected downfall of the Soviet Union. These successful demonstrations of allied resolve, combined with a crumbling Soviet economic and political infrastructure, soon reduced America's Cold War nemesis to a shadow of its former self.

While the unexpected end of the Cold War and fall of the Soviet Union provided an apparent respite from having to address the mobile missile problem, the US armed forces soon discovered the relief was more apparent than real.

Exposing a Weakness in Spite of Overwhelming Victory

America's first real taste of large-scale war since the end of the Vietnam War occurred in 1991 in the Persian Gulf. US conventional forces had been postured for a significant conventional conflict ever since the great face-off against the Soviet Union began. However, there was a catch that underscored the Pentagon's vulnerability to weaker adversaries equipped with archaic Soviet mobile missiles.

Iraq could not hope to match the overwhelming superiority of American arms, tactics, and training in battle. Saddam Hussein probably understood this stark reality after sustaining only a few hours of precision attacks from the American air armada. While his solution to this dilemma was carried out clumsily, inconsistently, and sometimes incoherently, it would significantly alter the way the United States looks at warfare. Moreover, it would provide enemies of freedom all over the globe a lesson in how to counter American military superiority. Saddam's only effective weapon was his al-Hussein (Scud) mobile ballistic missiles. For Iraq to survive the full might of the United States, Saddam knew he must find a way to weaken, and possibly even shatter, the fragile coalition formed by Pres. George H. W. Bush.

By simply using a limited number of these obsolete Soviet-made missiles to strike Israel and Saudi Arabia, he almost accomplished that goal.[25] Gen Charles Horner described the influence of Saddam's Scud strikes against Israel and the coalition as follows:

> The ballistic missile had a profound impact on the coalition nations in Desert Storm, on our forces, and on our understanding of the ballistic missile's own utility. The ballistic missile was the only advantage that Saddam Hussein had in that war. That's the lesson Saddam taught us, that ballistic missiles may have little military value but do have great terror potential.[26]

The terror potential mentioned by General Horner was apparently put to use by Saddam in the hopes of bringing the Israelis into the war. This, he probably reasoned, would highlight to the Arab members of the US-led coalition that the true war they should be fighting was alongside his forces against the United States and Israel. His machinations so worried President Bush that in addition to deployment of Patriot antimissile batteries to Israel, Air Force and Navy pilots flew nearly 2,500 sorties in a vain attempt to locate and destroy Iraq's mobile launcher inventory.[27] Much as the diversions from the combined bomber offensive (CBO) created by Hitler's V-weapons, the coalition forces found themselves caught up in a Crossbow-like campaign that altered the Desert Storm air strategy. Daily sorties allocated to the Scud hunt eventually accounted for approximately 5 percent of all planned missions. Within this force package, the effort was broken down into three primary functions that included: (1) attacks on fixed launchers, production, and storage facilities, (2) around-the-clock patrols to disrupt launch actions, and (3) around-the-clock patrols to attack recovering launch sites.[28]

Fortunately for the American-led coalition, the Scud gambit failed to lure Israel into the war against Iraq, but the essential point had already been made. Mobile ballistic missiles allowed an inferior nation to play on the same field as a superpower. Had Saddam armed just one of the Scuds fired into Israel with a chemical, biological, or nuclear warhead, Israel would not have been able to ignore it.

Moreover, had a volley of conventionally armed or a single chemical-equipped Scud struck the coalition's key logistics staging areas, such as the one at al-Jubayl, the results could have been catastrophic. Even a very accurate conventional explosive could have shut down al Jubayl. Noted Gulf War analyst Adam Siegel vividly describes the possibility:

> Among the forces deployed to the theater, the ships of Maritime Prepositioning Squadrons 2 and 3 (five and four ships, respectively) carried the equipment and 45 days of supplies for 30,000 Marines. The first three of these ships from Diego Garcia arrived at Al Jubayl on 15 August 1990. These ships carry significant amounts of supplies. Each squadron carries about 2,000 containers, 800 of which contain ammunition. The ammunition and other combustibles such as fuels have an explosive arc of about 4,500 feet. In other words, if just one ship had exploded at the Al Jubayl commercial pier, the blast would have likely destroyed all ships at the pier and everything on it. In August 1990, this included thousands of US Marines.[29]

One near-miss by a Scud landed just 150 meters from the pier at Al Jubayl.[30] This potential tragedy along with the 25 February 1991 Scud strike on US barracks in Dharan that killed 28 American soldiers and wounded 98 more, made it clear that no matter how obsolete, the Scud mobile launchers had to be destroyed.

One drawback to this effort was that US Central Command (USCENTCOM) would have to coax Cold War weapons, organizations, and doctrine into fighting a new kind of enemy against which they were ill-prepared. The new type of enemy, personified by Saddam, was one not satisfied to use his missiles as a "threat of future violence," but one who actually had to use them to have any hope of survival.

Anxiously watching Cable News Network (CNN) in early 1991, Americans anticipated that Iraq might conduct a ballistic missile attack using WMD. This attack would likely result in a massive US, British, or Israeli response in kind, which might end any prospect of holding the fragile allied coalition together. With this as the backdrop, American and British forces feverishly began the hunt for the mobile Scud launchers to prevent just that scenario. The tools they used were not meant for that purpose, nor were the forces doctrinally prepared for this new kind of battle.

Bringing a Knife to a Gunfight?

US forces facing Iraq in 1991 were armed with virtually every conceivable reconnaissance platform available for fighting a war against a peer competitor such as the Soviet Union. Yet despite a massive effort, they failed to kill even a single mobile Scud launcher.[31] From Defense Support Program missile launch warning satellites and airborne warning and control system (AWACS) aircraft, to the venerable U-2, to the still-developing joint surveillance target attack radar system (JSTARS), the coalition seemed to have everything necessary to track and kill mobile targets. Was it a lack of technology that led to the alleged failure?[32] Let us briefly look at the capabilities that were available to American forces to determine if there were any glaring technological deficiencies that limited coalition effectiveness in hunting Scuds.

As stated above, for reconnaissance purposes, the United States employed a variety of advanced sensor platforms to collect information on enemy forces. As a sample of opinion of the performance of the new JSTARS platform, the following glowing report was submitted to Congress:

> The Air Force-JSTARS proved its worth beyond the shadow of a doubt during Desert Storm, despite the fact that the system was still in development and was therefore deployed with entire components left out. The airborne JSTARS provided combat commanders with near real-time information on various targets, including moving targets, in all weather conditions. As one CENTCOM intelligence officer stated, JSTARS turned out to be our most valuable platform. JSTARS and other moving target indicator (MTI) platforms, such as the Army's OV-1D Mohawk, tracked the movement of Iraqi logistics/supply units throughout the war and tracked other mobile tactical targets. This information was passed, sometimes in near real time, to strike aircraft for targeting and destroying these Iraqi forces. That was the benefit for the Air Force. For the Army, JSTARS showed that the Iraqi forces arrayed on the front lines were not dug in and about to attack. The Army liked the downlink which showed in real time what was in front of it, while the Air Force used it for target acquisition, chiefly of moving targets.[33]

Along with those positive words specifically for JSTARS, former chairman of the Joint Chiefs of Staff, Gen Colin Powell testified to Congress on the overall intelligence picture available during Desert Shield/Desert Storm when he stated that "no combat commander has ever had as full and complete a view of his adversary as did our field commander. Intelligence support to Operations Desert Shield and Desert Storm was a success story."[34]

The commander of USCENTCOM during the Gulf War, Gen H. Norman Schwarzkopf agreed with Powell's assessment when he added his own positive words to the accolades given the intelligence community. "The great military victory we achieved in Desert Storm and the minimal losses sustained by US and Coalition forces can be directly attributed to the excellent intelligence picture we had on the Iraqis."[35]

From these testimonials, it is difficult to imagine that technological shortcomings in reconnaissance played a major role in attacking the mobile launcher threat. But, keeping in mind the strategic and operational-level positions held by both generals cited above, compare their statements with that of the commander of the 2d Marine Division, Lt Gen William M. Keys, who voiced the concerns of commanders who led troops at the tactical level: "At the strategic level, [intelligence] was fine. But, we did not get enough tactical intelligence—frontline battle intelligence."[36] If his criticism is justified, something had to have happened to intelligence data as it filtered down from the highest echelons to the tactical level. To track, target, and strike elusive mobile targets such as Iraq's Scud missile force, the ability to pass instantaneous intelligence efficiently from strategic to tactical level is paramount. Therefore, the question must be asked—what was it that happened to the flow of intelligence, and at what level did the problem exist?

General Keys's criticism of the intelligence reporting provided to lower echelons received credence in the words of the current vice commander of Air Combat Command, Lt Gen Bruce Wright. General Wright recalls that as a wing commander in Desert Storm, he received "no COMINT [communications intelligence] at all." He went on to say, "The Cold War intelligence system was sequential and, thus, very slow. It was based almost entirely on providing strategic-level information to senior decision-makers."[37] A House Armed Services Committee report also served to highlight the United States' continued orientation toward "strategic" reconnaissance.[38] The committee criticized national authorities because the investment in tactical collection assets had not kept pace with national strategic reconnaissance assets. Specifically, there was no system to provide wide-area imagery with necessary granularity or to make maps and provide terrain data for the US Air Force's F-117 and F-15E, or for the US Navy's Tomahawk land-attack missile. Limitations in tactical collection assets also hindered the ability to locate and count enemy weapons systems and provide adequate battle damage assessments (BDA), or to locate and target Iraqi mobile missiles. The committee labeled as "short-sighted" the fact that follow-on systems were not available before the SR-71 and an unnamed wide-area imagery satellite had been retired from service.[39] In short, Congress accused the US intelligence community of not preparing itself technologically to face a conventional enemy such as Iraq. America was still fighting the Cold War.

Finding and destroying *fixed* Scud sites using national reconnaissance assets (in combination with F-15Es or other highly capable strike platforms) was accomplished with ease during the first hours of the war. However, success in finding Saddam's mobile launchers was another story. Still, the House of Representatives subcommittee findings did not point to a lack of technological capability in the failure to locate and destroy the mobile Scuds. Rather, panel members pointed to two main reasons the Scud hunt failed to achieve any confirmed kills. First, analysts incorrectly predicted that the Iraqis would take several hours to erect, calibrate, and aim their ballistic missiles, just as the Soviets had done during exercises. The Iraqis, though probably less accurate than their Russian counterparts, could set up, launch, and move to another location within 10 minutes. Second, US pilots simply had not practiced hunting mobile missiles. Without actual wartime experience in this task or realistic exercises simulating the environment, success would prove elusive to even the best-equipped force in the world. As a result, new tactics had to be created on-the-fly. A continuous air patrol was created using an Advanced Synthetic Aperture Radar System (ASARS)–equipped U-2 and an F-15E Strike Eagle. The U-2 would notify the Strike Eagle crew as soon as it located what it thought was a transporter-erector-launcher (TEL), and the F-15E would attack it.

While Scud launches decreased dramatically after employment of this ad hoc procedure, decoys and other more benign mobile targets proved to be the only likely kills. According to the subcommittee report, even if the location of a TEL was known exactly, the attacking aircraft still had significant difficulty spotting and destroying it. General Wright flew during one of the Scud missions and recalled, "It was frustrating to go out there and look all day for something and not find it. Sometimes you wondered if it was really there or not."[40] The words of the 9th Reconnaissance Wing historian point to a Cold War mind-set as a key culprit in American shortcomings at hunting mobile ballistic missiles, "The Strategic Air Command always considered the U-2 as a 'strategic' asset for gathering intelligence data against the Soviet Union."[41] Unfortunately, for the tactical-level commander in Desert Storm, this attitude meant there would be a lack of photo imagery with which to plan and conduct tactical strikes—and photo imagery is exactly what was needed.

The failure of Cold War mentalities during Desert Storm meant longstanding organizational structures needed to be reconstructed shortly after the Gulf War. General Wright gives credit to then USAF chief of staff, Gen John Jumper for fighting to transform the Cold War information stovepipes when he served as the Air Force deputy chief of staff for Plans and Operations:

> General Jumper's efforts to fight stovepipes resulted in a transformational change with the integration of the Air Intelligence Agency into Air Combat Command. This is exactly what we needed to build the right kind of relationship between the intelligence community and the combat air force. He knew that if we could team them, we could fuse relevant information for rapid combat targeting.[42]

Additionally, the perceived intolerance for collateral damage and the success of precision-guided munitions meant the United States would never go to war the same way again after 1991. Nevertheless, other major changes also occurred.

Continuous reduction of the armed forces and the operational use of stealthy platforms, such as the B-2 bomber (designed to kill Soviet mobile ballistic missiles), and the outstanding loiter capabilities of UAVs would also dramatically shape the post–Gulf War US defense establishment.[43] However, technologically speaking, where did America invest most of its resources in the search for weapon systems better suited for use against mobile ballistic missiles? In testimony before the Senate Armed Services Subcommittee on Strategic Forces, the principal deputy assistant secretary of the Air Force for acquisition, Lt Gen Gregory S. Martin, articulated the issue quite nicely:

> Once combat operations are underway, Joint Surveillance Target Attack Radar System (Joint STARS), U-2, Rivet Joint, Unmanned Aerial Vehicles (UAV), Defense Support Program (DSP), and, in the near future, Space Based Infrared System (SBIRS), provide near real time information to a Joint Air Operations Center to rapidly initiate attack operations against enemy theater missile systems and to cue active defense systems. The DSP has been a vital ISR system for many years. As the DSP nears the end of its service, the Air Force will gradually replace it with the more capable SBIRS, adding significant capability to our TMD architecture. SBIRS will provide the nation with new and improved warning and sensing capabilities for the next century, allowing the accomplishment of a greater number of missions from space.[44]

Table 2 shows other potential ISR programs that the United States will rely heavily upon for defense against mobile ballistic missiles. When teamed with future systems such as the airborne laser (ABL), or hypersonic weaponry, the United States could very well revolutionize its antimobile missile capability.

Table 2. A Survey of Today's Intelligence, Surveillance, and Reconnaissance Platforms

E-3C Airborne Warning and Control System (AWACS): Can keep track of hundreds of aircraft flying in an area equivalent to the New York City–Boston air traffic control region.

E-8C Joint Surveillance Target Attack Radar System (Joint STARS): A joint program with the Army that provides detection of moving and stationary targets on the ground in an area as large as southern Iraq, as well as slow-moving rotary and fixed-wing aircraft and theater missile defense targets.

EA-6B: A joint Navy–Air Force electronic warfare aircraft that not only can jam enemy radars but can collect information about their location and operating parameters.

EP-3: A Navy P-3 Orion specially modified to collect electronic intelligence.

RC-12 Guardrail: An Army turboprop aircraft configured for collecting battlefield electronic and communications intelligence.

RC-135 Rivet Joint: Collects electronic intelligence on an adversary's radars, communications, and other systems.

RQ-1A Predator: An unmanned aerial vehicle remotely piloted at medium altitudes to obtain detailed video imagery of enemy vehicles. At least one Predator was modified during Operation Allied Force to carry a laser target designator.

RQ-4A Global Hawk: Now in development, Global Hawk is a large UAV that will be able to provide image collection while maintaining station over an area of interest for many hours at a time.

Satellites: Several classified spacecraft can provide detailed imagery, in many wavelengths, of ground targets. The Lacrosse satellite, for example, can generate detailed images of the ground through cloud cover with its synthetic aperture radar.

U-2: An Air Force high-flying reconnaissance aircraft that collects digital imagery in several wavelengths. The imagery can be transmitted to Beale AFB and analyzed while the mission is still under way.

Adapted from John A. Tirpak, "Find, Fix, Track, Target, Engage, Assess," *Air Force Magazine* (July 2000): 24–29, http://www.afa.org/magazine/July2000/0700find.html (accessed 30 December 2002).

Nevertheless, two key questions remain in spite of all the promise of such fantastic technologies. First, is the Cold War decision-making mentality truly dead, or is it simply residing in a new and improved body? Second, should we think about targeting in a completely new light? The next chapter seeks answers to those questions.

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Chapter 4

Responding to Mobile Ballistic Missiles in the Post–Cold War Environment

It is not necessary to change. Survival is not mandatory.

—W. Edwards Deming

Throughout the Cold War, mobile ballistic missiles provided a highly survivable deterrent force for each superpower. Each side understood that these weapons were intended to provide an insurance policy against a first-strike nuclear attack. In theory, mobile ICBMs would survive such a first strike in large enough numbers to destroy the society of the nation that initiated the attack. A balance and understanding had been reached that would govern the Cold War period. The anxiety of having the mobile missile "Sword of Damocles" hanging over each nation's head was somewhat balanced by the fact that the rules of deterrence were fairly well understood. As a preeminent strategist of the period, it is doubtful Thomas Schelling foresaw the end of bipolarity when he wrote that "deterrence will go on being our main business, compellence the exception."[1]

The end of the Cold War was met with relief tempered by a great deal of trepidation in the United States. The peer competitor America had faced since the end of World War II no longer existed in a form that was well understood. In the place of the Soviet Union, a collection of newly independent states came to the fore. Some of these new nations were home to the scientists, engineers, resources, and facilities employed by the USSR to produce and operate nuclear, chemical, and biological weaponry. Moreover, some of these new states possessed the weapons themselves. What had been a monolithic, closed, and tightly controlled international system was now splintered and chaotic. Its people were hungry, poor, and infested by organized crime. As a result, what had been centrally controlled weapons technology and expertise was now a means to raise much-needed cash.

Out of all the military capabilities being made available to the highest bidder in this new market, none was more sought after than mobile ballistic missiles that could be armed with WMD.[2] These weapons were readily available from suppliers ranging from the former Soviet Union to North Korea and Pakistan. Even for countries with very weak technological bases and a lack of developmental infrastructure, mobile missile technology could be in reach within a frighteningly short period of time. As mentioned in the Rumsfeld Commission report on the ballistic missile threat to the United States:

> The warning times the United States can expect of new, threatening ballistic missile deployments are being reduced. Under some plausible scenarios including rebasing or transfer of operational missiles, sea- and air-launch options, shortened development programs that might include testing in a third country, or some combination of these—the United States might well have little or no warning before operational deployment. Therefore, we unanimously recommend that US analyses, practices and policies that depend on expectations of extended warning of deployment be reviewed and, as appropriate, revised to reflect the reality of an environment in which there may be little or no warning.[3]

For many of the same reasons that drove Germany to the concept of mobile missile delivery systems, Third World nations seek them as an asymmetric balance against conventionally superior Americans. No longer do Arab nations have a superpower sponsor to counter the US-Israeli alliance. Likewise, in the Far East, North Korea no longer has the Kremlin as its benefactor; and it too must find a viable means to curb American influence on that tiny peninsula. It must also be remembered that with the increasing number of smaller, hostile nations armed with mobile ballistic missile systems, the Russian Federation and Peoples' Republic of China still remain the most formidable threats to the survival of the United States. To overlook the threat still posed by these two powers would be folly. However, the likelihood that deterrence will continue to work against them has, for the time being, turned the focus to smaller, perhaps "undeterrable" nations and organizations.[4]

The surprise attacks on New York City and Washington, D.C., in September 2001 served to put one more key change from the Cold War mind-set in bold print—our enemies are not afraid to strike us in spite of our overwhelming military and economic superiority. It is this devaluation of deterrence that led the current Bush administration to adopt preemption as a prime theme in the most recent *National Security Strategy*:

> The traditional concepts of deterrence will not work against a terrorist enemy whose avowed tactics are wanton destruction and the targeting of innocents; whose so-called soldiers seek martyrdom in death and whose most potent protection is statelessness. The overlap between states that sponsor terror and those that pursue weapons of mass destruction (WMD) compels us to action. . . . The United States will, if necessary, act preemptively.[5]

In short, the rules many of our enemies play by have changed—and an increasingly effective weapon in their arsenal is the mobile ballistic missile.

Given a new strategy against the threats facing the United States, the armed forces must obtain the capability to successfully implement it. Against something as deadly as a nuclear-tipped ballistic missile launched from a mobile platform, a layered defensive approach that attacks enemy missiles in each phase of their flight seems appropriate and is exactly what the US Missile Defense Agency has in mind.[6] But given the counterforce perspective of this work, we will concentrate specifically on the offensive technologies and systems that must be deployed to preempt the launch of mobile ballistic missiles.

Longer Loiter Time and Shorter Kill Chains

The technology needed to combat the mobile missile threat is emerging. To achieve the ability to identify, track, and kill a relatively small and elusive target such as a mobile ballistic missile launcher requires the United States to be more agile and accurate in its targeting than ever before. The attempts to target and destroy Iraq's mobile Scud missile force using Cold War assets and channels of communication met with rather disappointing results. Fortunately, the armed forces took those lessons to heart. As a result, our latest actions in Afghanistan and the recent war in Iraq have unveiled a new, more responsive and adaptive targeting capability than many thought possible. This new capability rests on two key components—compressing the "kill chain" and the ability to loiter over potential launch areas for extended periods before attacking with precision-guided munitions.

Reducing the time it takes to strike a mobile target (or compressing the kill chain) has become the Holy Grail for American airpower. The following account from Afghanistan, written during Operation Enduring Freedom, alludes to the importance of this new attitude:

> The air war over Afghanistan, while neither big nor particularly dangerous, has been a laboratory for some of the most important airpower innovations in 20 years. And unlike the 1991 Persian Gulf War or the 1999 Kosovo war, the big breakthroughs haven't been the debut of new combat jets like the stealthy F-117 or the B-2, or the unveiling of new "smart" weapons. Airpower experts are jazzed over something more mundane, yet potent: improvements in the information flow that compress the "kill chain," allowing pilots to pounce on targets more quickly once they are detected.[7]

As former Air Force chief of staff Gen Ronald Fogleman first said in the mid-1990s and former chief of staff, Gen John Jumper continually reminds his audiences today, to attack a target successfully the system must "find, fix, track, target, engage, and assess"(F2T2EA).[8] Reducing the time necessary to plan a strike and do all of the things listed by General Jumper in F2T2EA is the goal of the time-sensitive targeting process. While the senior-level support for this capability is encouraging, much work remains. To get to the point where the kill chain is confidently reduced to the point that hitting a mobile ballistic missile before it launches can be considered routine will require extensive research, training, and equipping.

Affordable Moving Surface Target Engagement

The Defense Advanced Research Projects Agency (DARPA) is working to reduce the time needed to attack targets such as mobile ballistic missiles. Currently, its star project is referred to as Affordable Moving Surface Target Engagement or AMSTE. AMSTE is a system designed to bring together new targeting algorithms, data links, two long-range radars, and global positioning system (GPS) navigational capability. The purpose of combining all this technology with approximately 300 different types of munitions is to enable shooters to track mobile ground targets as they "maneuver aggressively among other vehicles, foliage, and obscuring terrain features."[9]

One of the most positive developments in compressing the kill chain is that the AMSTE project researchers are also looking for ways to make command and control structures more efficient and relevant for each situation, regardless of the branch of service in control. Comments like the following from AMSTE project manager William McCall underscore this new way of thinking, "This is a multiple-weapon, multiple platform, multiple-BMC2 [a type of command and control network] concept. It can be used in many ways to hit moving targets. Whoever is fielded to a theater of war can move in and use the capability immediately."[10] DARPA points out that while significant materiel and technology investment have enabled American forces to hold fixed and stationary targets at risk, AMSTE will extend US battlefield dominance to moving threats.[11]

AMSTE is designed to improve moving target engagement by simplifying the process, beginning with identification and ending in attack. To make this possible, DARPA is developing layered GMTI sensors feeding a continuous plot of the moving object to weapons capable of receiving continuous fire control updates.[12] The sensors compress the kill chain by eliminating several segments from the procedures used to hunt Scuds during Desert Storm. The Desert Storm targeting procedures failed to get data collected from strategic assets (such as space-based sensors) to tactical units in a sufficiently short period to make the information relevant. The deployment of a large number of GMTI sensors would produce direct information from sensors to shooters. In most cases (if not all) the goal of AMSTE is to move the data from the sensor directly into the very weapon tasked to strike the target. While this raises concerns about leaving human judgment out of the decision loop, it undoubtedly would compress the kill chain significantly.[13]

RAND's Proposal for Attacking Mobile Missiles

Another promising project that seeks to shorten the time required to activate the kill chain is the proposal from RAND briefly mentioned in chapter 3. The RAND report highlights ideas for defeating mobile missile threats from foes such as Serbia to a near-peer competitor such as China. The study describes a "detect-classify-recognize-defeat cycle" that would take place in a matter of minutes, rather than hours or days. This capability depends on three key pillars: "finders," "controllers," and "strike assets." The finders identify and track enemy forces. Controllers direct the actions of both the finders and strike platforms, select worthwhile targets, and make decisions to engage. Strike assets attack the target.[14]

As RAND points out, while new technologies are key to their concept, they alone cannot solve this complex problem. A comprehensive solution will require blending prebattle analysis, new technologies, and streamlined control to shorten the kill chain and successfully strike elusive targets such as mobile ballistic missile launchers. Moreover, RAND points out the importance of understanding the enemy's tactics, techniques, and procedures (TTP) and constraints such as geography. Nevertheless, even with the attention given to streamlining processes, their emphasis is on new technology.

RAND suggests two potential technological approaches to locate moving enemy targets. The first involves high altitude UAVs using radar in GMTI mode. This would provide a virtual catalog of every vehicle moving at a specific speed. Automatic target recognition (ATR) equipment on the UAV would then filter out irrelevant radar returns (such as civilian vehicles) from the virtual catalog. The returns left in the catalog would then be imaged with synthetic aperture radar (SAR) if they are stationary or by inverse SAR (ISAR) if they are moving. ATR could then further reduce the potential target list to simplify the task of the controllers and strike platforms. On board an airborne command post, controllers could then validate the provided catalog by comparing what was submitted by the finder with known battlefield conditions or suspected locations for enemy activity (such as known launch areas for ballistic missiles). Once narrowed down, the catalog of targets could then be passed to combat aircraft for further clarification and validation. Perhaps by deploying a "small UAV," the verifying combat aircraft would then relay higher-resolution images of the potential targets back to controllers. Permission to strike the final target could then be granted or denied based on real-time tactical data.

The second approach is meant to counter mobile ballistic missiles deployed by a country such as China. In this approach, the problem of accurate and timely targeting is much more problematic and would differ depending on whether or not a missile launch had already occurred. Compared with the relatively small geographic area and fewer numbers of radar returns from irrelevant moving objects in a country such as Serbia, targeting in a China scenario would involve several complex steps and begin with the use of space-based assets.

For a missile launch scenario, US forces would depend on data from space-based infrared detection satellites such as SBIRS. The SBIRS would pass to the airborne controller the general vicinity of the missile launch. The controller would order a combat asset to proceed at high speed to the area in question, but this platform would remain outside of enemy airspace. Once in range, the strike asset would launch a hypersonic weapon at the general vicinity identified by SBIRS. While the SBIRS continuously scanned the general launch area, the weapon would maneuver into the kill zone and deploy autonomous smart munitions. These smart munitions would then fly in search patterns and strike the launchers. If a launch has not yet taken place, GMTI radars on satellites and/or loitering UAVs would be tasked to monitor the enemy's roads, looking for vehicles within the specifications set for a mobile missile launcher. As mentioned previously, further refinement by SAR and ISAR would provide the required catalog of targets. Controllers would then be called upon to decide whether or not to order strikes using hypervelocity smart weapons.

In each of the RAND approaches, the kill chain has been reduced by providing intelligence data directly to decision makers in position to employ advanced, autonomous weapons. Unlike Desert Storm, time-critical intelligence is not relayed through various rigid stovepipes for review before the shooter receives it.

RAND is not the only agency with an attractive new concept for attacking mobile missiles. A similar concept is undergoing analysis at the Air Armament Center at Eglin AFB in Florida. It is the brainchild of the chief of advanced concepts at the Air Armament Center, Greg Jenkins. Jenkins' vision for battling the mobile ballistic missile threat is called persistent area dominance (PAD).[15]

Persistent Area Dominance

Through PAD, Jenkins seeks to create an environment from which to attack time-critical targets (TCT) such as mobile ballistic missiles. His concept relies on employing technologies similar to those described in the previous section. But it also depends on redefining the kill chain. Much as in the last RAND scenario, Jenkins hopes to achieve a shorter, more effective decision process.

To describe PAD, Jenkins first defines the current kill chain process as the "responsive model approach" to TCT. Essentially, he characterizes the current kill chain as a reactive, linear process. Moreover, he asserts that this linear process requires the find, fix, track, target, engage, and assess steps be conducted in sequence by a host of different communities. The intelligence, surveillance, and reconnaissance (ISR) community plays the major role in the find, fix, track, and target portion of this approach. The ISR community then passes responsibility to a strike community after proper coordination between their respective organizations. Rather than rely solely on each community's ability to shorten specific response times, PAD calls for a great deal of the ISR community's find, fix, track, and target responsibilities to be transferred directly to the weapons themselves.

Advocates of PAD argue that virtually all other proposed concepts regarding TCT require shortening the process by speeding up each of its components while still retaining a series of sequential actions. Further, they suggest that this serial process will not effectively counter threats such as mobile ballistic missiles. According to proponents of PAD, the basic problem with this approach is that by focusing on continuous reductions in the amount of time needed for each portion of the kill chain, our processes are tied to existing organizational structures, and are too reactive to enemy weapons and tactics. To illustrate this point, Jenkins states that when adversaries eventually deploy directed-energy weapons that can attack with nearly instantaneous results, we will have no time left to reduce within any of the individual components.

To implement a more effective strategy, he suggests significant changes in how we consider the role played by UAVs. In Afghanistan, the United

States demonstrated that a single UAV could serve as both ISR and attack platform.[16] There can be no greater reduction in the kill chain than to make the soldier or machine doing the reconnaissance the same one doing the killing. As Jenkins puts it, "Decision maker connectivity is the key enabler."[17] This thought process is similar to the RAND proposal in that it puts a great deal of responsibility on deployable smart weapons that would seek and destroy enemy mobile missile launchers.

The PAD concept also calls for the war fighter to ignore enemy weapon systems deployed in areas that cannot readily influence the fight. Again, this is somewhat similar to RAND's proposal to thin out the catalog of potential targets through the use of SAR and ISAR "strainers" that would filter out irrelevant or lower-priority radar returns; but it goes one step further. Jenkins describes reducing the potential target areas as follows:

> Effects-based operations (EBO) dictate that the needle in the haystack is only relevant when the needle is close enough to the surface to inflict damage. Therefore, 90% of the inner parts of the haystack do not need to be searched because if the needle were there, it would be of no military use to the adversary (or it is not an imminent threat to us). So why look for it there?[18]

The idea is to focus only on relevant areas and targets. To do this, the war fighter must first determine from where the enemy prefers to (and can) operate. This is referred to as the predictive battlespace awareness (PBA) model.

PBA is composed of intelligence preparation of the battlefield (IPB) inputs, integrated ISR, comparative COA, and targeting. Once the enemy's potential battlespace possibilities have been identified and significantly narrowed down, the ISR assets can more precisely focus. The targeted area must then be "persistently dominated" by the surveillance, reconnaissance, and strike assets available to the war fighter. Vice commander of Air Combat Command, Lt Gen Bruce Wright considers the ability to map potential mobile missile launch zones vital:

> We must never apply our scarce ISR resources on an unplanned basis. These intelligence collection efforts must be planned well in advance. To map mobile missile launch sites we need overhead [satellite] and air-breathing ISR to perform pre-targeting data collection. After building an extensive library of this sort of information, we must develop information technology that can analyze it, and allow a reasonable prediction as to where these mobile missiles will be. Then we can target them.[19]

Obviously, to meet this requirement technology again comes into play.

Long endurance, wide-area search devices (such as UAVs or satellites) with advanced ATR and ISR sensor capabilities with independent target attack capability are both required. UAVs would figure prominently in the ability to suppress enemy forces over such a dominated zone. As UAVs become more integrated into our plans and ways of thinking about force application, they could be adapted into expendable, smart munitions. Again, as in the RAND proposal for combating mobile missile launchers, reducing the kill chain to the degree required may necessitate delegating the track, target, and engage portions of the mission to smart weapons such as these future UAVs. The human interface would exist to direct the initial search for targets and to submit an attack order once the catalog of potential targets was sufficiently narrowed down.

The essential factor of Jenkins' PAD proposal is to attack the enemy's strategy by taking initiative. Using PAD as described, the United States would not wait until missile launch detection to find the launchers and strike. This concept fits in well with the preemptive nature of the National Security Strategy (NSS) outlined earlier in this chapter, but does present some interesting problems for senior government policy makers.

Aside from the expense in developing the technology for PAD, the main concern to this concept is political—at what point would the United States be willing to strike first or penetrate sovereign airspace? This is a very complex question that is dependent on the many intertwining contextual issues. The current Bush administration struggled with this issue before initiating a preemptive war to bring down Saddam Hussein's regime. As administrations, political necessity, and opponents changend the willingness to utilize a preemptive capability such as PAD would also change. However, having such an option would be an invaluable tool against the "undeterrable" enemy. In addition, from a political viewpoint, the idea of violating the airspace of a nation with whom we are not yet at war may cause policy makers pause. Fortunately, air-breathing assets are not all the United States has at its disposal.

The Contribution from Space

The commander of Air Force Space Command, Gen Lance Lord describes the vital role played by space-based assets in the struggle to reduce the kill chain. According to General Lord, "Operation Enduring Freedom (OEF) has proven that beyond-line-of-sight satellite communications (SATCOM), precision navigation and timing, missile warning, weather, and intelligence information are embedded in every combat-related activity and are key enablers to the kill chain."[20] Space ISR assets can be used to find targets in an antiaccess environment. They do not need overflight permission, and they do not violate sovereign airspace. This is a powerful strategic and political advantage for the United States. Furthermore, satellites could make airborne weapons and ISR platforms far more efficient and effective.

General Lord notes that satellites can be very useful in providing information to terrestrial ISR assets (such as UAVs, JSTARS, U-2s, or special forces). Instead of attempting to search for mobile ballistic missile launchers in an immense area, these terrestrial assets can be cued by space assets, saving fuel and time. Additionally, global positioning system signals can aid in virtually all stages of the kill chain, from "finding," to "targeting," to "engaging." However, the integration of space expertise into the proper command relationships is the key to fully appreciating these important capabilities.

In Afghanistan a direct support relationship between the Combined Air and Space Operations Center (CAOC) and the 11th Space Warning Squadron, Schriever AFB, Colorado, resulted in more efficient tasking of satellites and in more timely intelligence for the theater commander. The theater commander had the ability to pass requests directly to the unit at Schriever. The result was a dramatically shorter kill chain than what his predecessors had to work with during Desert Storm.[21]

Common Threads

It may be helpful at this point to step back and ask what common threads exist in the various approaches discussed to shorten the kill chain. First, all recognize the need to deploy sensors that can discern one moving target from another and discriminate relevant targets such as missile transporters and launchers. Second, these sensors must be able to loiter for extended periods over potential mobile missile launch areas. Moreover, unless they are space-based, these loitering assets will likely be flying over enemy airspace and will have to be at a high altitude and/or sufficiently stealthy to avoid the enemy's integrated air defenses (IADS). Third, each concept calls for initial find and fix information to be provided either directly to controllers who will direct platforms for further target refinement, or directly to the striking munitions themselves. Finally, all three concepts rely on close battlespace coordination between various agencies and commands and a baseline of proficiency. Thus, it is now appropriate to examine coordination and proficiency in the battle against mobile ballistic missiles.

Building a Knowledge Base, Proficiency and Continuity

Ballistic missile defense is widely acknowledged to include passive and active defenses as well as counterforce elements. When these components intermingled during the Gulf War, the results were less than spectacular. In fact, so little attention had been paid to the threat from Iraqi mobile ballistic missiles before the conflict started that when the threat arose, the response was described as "improvisation."[22] While CENTCOM and CENTAF planners knew that Iraq had a sizable mobile ballistic missile force, they largely ignored it in their prewar exercises.[23] According to *Gulf War Air Power Survey (GWAPS)* authors Thomas Keaney and Eliot Cohen, commanders so lightly regarded Saddam's Scuds that they were relegated to the category of "nuisance."[24]

> The planners in the Black Hole, like CENTCOM's leaders, regarded Iraqi ballistic missiles (even with chemical warheads) chiefly as nuisance weapons that might cause political difficulties for the alliance (particularly if Israel were to retaliate against the Iraqis.) They viewed the missiles as posing little tactical or operational threat to the Coalition and intended to reduce the offensive threat they represented by attacking fixed launch sites, support bases, production facilities, potential sites of concealment, and support facilities for mobile launchers, but not the launchers themselves.[25]

As a result, coalition forces simply were not prepared to face the political problems posed by the mobile launchers.[26] The flexibility and ingenuity of the American armed forces partially overcame this lack of prior planning and training, but the Scud hunt is still widely regarded as a failure. Perhaps one of the most important lessons learned from this episode was that what is not trained, exercised, and evaluated in peacetime does not happen effectively in wartime. General Wright credits extensive joint training with much of the success in preventing Iraqi ballistic missile launches against Israel during Operation Iraqi Freedom.

> Joint training exercises at Nellis AFB, Nevada allowed special operations personnel to work directly with our F-15E crews in performing TCT. In fact, the special ops folks got to know our aircrews so well that they knew most of their individual tactical call signs. This training also exercised the Joint Force Air Component Commander and the Combat Air Operations Center's ability to integrate the TCT efforts of all the services. We simply could not afford to let Iraq launch a missile at Israel armed with a WMD warhead.[27]

To ensure proper planning, training, and equipping for a unique mission to take place, it is commonplace to assign responsibility to an advocate for that mission. The increasing threat posed by mobile ballistic missiles does indeed suggest that it may be necessary to create an organization responsible for countermissile capability and advocacy, building the continuity of, and training the men and women who will combat this menace in the future.

A move in that direction occurred in January 2002. By renaming the Ballistic Missile Defense Organization the Missile Defense Agency (MDA), a higher priority for missile defense was established by the current Bush administration. However, the mission of the new agency was limited to acquisition of defensive countermeasures against inbound missiles. Moreover, according to the agency's formal mission statement, their focus is purely technological. There is no mention of building up the continuity or proficiency of those who will operate the defensive machinery once it is deployed against the threat.[28] This job will have to fall on another organization, probably more closely associated with the operational units themselves. However, defending against incoming ballistic missiles is a different task than attacking launchers preemptively. For that, another community may have to be created.

It is apparent that building a relevant countermissile community may be simplified somewhat if examples in similar mission areas can be found. The US Navy's Anti-Submarine Warfare (ASW) establishment may provide clues as to how to proceed. When faced with a Cold War threat relatively similar to that posed by mobile ballistic missiles today, the US Navy stood up a formal school in San Diego, California, known as the "Fleet Anti-Submarine Warfare (ASW) Training Center."[29] Many parallels may be drawn between tracking mobile launchers and submarines. The threat posed by each is one of antiaccess; additionally, both mobile missile launcher units and submarines give off limited signatures when hiding. Furthermore, both are inconspicuous when not in motion or in silent operations mode. However, more important than the literal comparisons between elusive submarines and ground-mobile missile launchers is the enormous complexity in coordinating the joint effort to locate and target them.

Key to the idea of modeling an "Anti-Mobile Ballistic Missile School" on the Fleet ASW school model is the essential truth that such a complex and difficult mission cannot be done consistently and reliably without constant training, practice, and adaptation to changing enemy practices and equipment. Similar to the job of hunting enemy submarines, the location and destruction of hidden mobile missile launchers requires the ability to learn in a rigorous, systematic manner.[30] This requires a wealth of experience and knowledge about what has worked in the past and how the enemy has adapted since the last encounter. Without a specific culture to perform this function, continuity is lost and lessons must be continuously relearned at great cost. Additionally, the culture required to combat mobile ballistic missiles must be constantly trained, drilled, and evaluated on how to blend properly a variety of intricate systems in order to perfect the timing so crucial to this mission.

An encouraging sign that the post-1991 Gulf War armed forces understand this reality is the inclusion of mobile missile "hunts" in joint exercises such as the Air Force's Green Flag, and the US Army's Roving Sands.[31] In both exercises, joint forces were required to hunt and destroy mobile Scud missile launchers. For proof of the improved capabilities this joint training facilitated, one needs to look no further than the latest war against Iraq. Under the daring leadership of the combined air component commander, Air Force lieutenant general Gen Michael Moseley, cooperation between air and ground units, and efficient use of ISR assets reached new heights in Operation Iraqi Freedom. As indicated by interviews published in the *Washington Post*, military personnel gave both areas high marks. "Air Force pilots and battlefield commanders described an air campaign significantly different from any the United States had waged before, one that not only featured far greater use of overhead imagery and all-weather precision munitions but that also saw an unprecedented degree of coordination between air and ground forces."[32]

While this sort of teamwork and efficiency is a vast improvement over the first Gulf War, strategists must question whether individual unit participation in annual war games contributes enough to the sense of community that may be necessary to combat the mobile missile threat posed by a more challenging opponent than Iraq. To foster the proper advocacy that the mobile missile counterforce mission deserves may require considerably more investment of America's time, treasure, and talent.

Notes

1. Schelling argues that the distinction between the issues of deterrence and compliance is in timing and initiative. That is, who has to make the first move and whose initiative is put to the test. We cannot afford to give up on the idea of deterrence in the post-Cold War

world. However, we must understand the varied nature of the enemies now arrayed against us. Deterrence may not be the most viable option against an enemy such as al-Qaeda. Forced compliance and preemption may be the only solutions against such a foe.

2. House, *Commission to Assess the Ballistic Missile Threat*, 6–13 (see chap. 2, n. 55).

3. Ibid., 4.

4. The ability of smaller nations hostile toward the United States to obtain mobile ballistic missiles is nearly matched by that of non-state actors such as al-Qaeda. America may soon find that hostile or failed nations simply serve as launching bases for terrorist organizations armed with mobile ballistic missiles. Bush, *National Security Strategy of the United States*, 15.

5. Ibid.

6. For a comprehensive background on the development of defensive measures against ballistic missiles, the US Missile Defense Agency (MDA) recommends the following works: Donald R. Baucom, *The Origins of SDI: 1944–1983* (Lawrence, Kans.: University Press of Kansas, 1992); William J. Broad, *Star Warriors: A Penetrating Look into the Lives of the Young Scientists Behind Our Space Age Weaponry* (New York: Simon and Shuster, 1985); William J. Broad, *Teller's War: The Top-Secret Story behind the Star Wars Deception* (New York: Simon & Schuster, 1992); Frances Fitzgerald, *Way Out There in the Blue: Reagan, Star Wars, and the End of the Cold War* (New York: Simon & Schuster, 2000); Daniel O. Graham, *Confessions of a Cold Warrior* (Fairfax, Va.: Preview Press, 1995); and K. Scott McMahon, *Pursuit of the Shield: The U.S. Quest for Limited Ballistic Missile Defense* (New York: University Press of America, Inc., 1997).

7. Richard J. Newman, *"From up in the sky; Strikes are faster and more accurate—but mistakes still happen," US News & World Report* 132, no. 6 (25 February 2002): 18.

8. John A. Tirpak, "Find, Fix, Track, Target, Engage, Assess," *Air Force Magazine* 83, no. 7 (July 2000): 24–29, http://www.afa.org/magazine/july2000/0700find_print.html.

9. David A. Fulghum, "Moving Targets Vulnerable to Radar/Weapons Mix,"*Aviation Week* 157, no. 23 (December 2002): 66.

10. Ibid.

11. Briefing, DARPA Special Projects Office, subject: Affordable Moving Surface Target Engagement (AMSTE) program, 29 June 2000.

12. Ground moving target indication (GMTI) sensors are capable of automatically detecting ground-based moving targets and extracting other target information such as location, speed, size, and radar cross section (RCS) from these target signatures.

13. The discussion of leaving man out of the loop in the targeting process is beyond the scope of this work, but it is addressed well in the following School of Advanced Air and Space Studies thesis: Keith J. Kosan, "United States Air Force Precision Engagement against Mobile Targets: Is Man In or Out?" (master's thesis, School of Advanced Air and Space Studies, June 2000). Kosan argues that a drive toward autonomous standoff precision-guided munitions which take human decision makers out of the loop is dangerous and could result in unnecessary collateral damage (ibid.).

14. Alan Vick et al., *Aerospace Operations against Elusive Ground Targets*, RAND Report MR-1398-AF (Santa Monica, Calif.: RAND, 2001), 57–81.

15. Briefing, Armament Product Directorate, Plans & Programs, subject: Persistent Area Dominance: An Effects Based Architecture for TCT and Other Target Environments 2010, 16 October 2002.

16. Ramon Lopez, "The Revolution Will Not Be Piloted," *Popular Science* 262, no. 6 (June 2003): 60.

17. Armament Product Directorate, briefing.

18. Ibid.

19. General Wright, interview (see chap. 3, n. 37).

20. Gen Lance W. Lord, "Space in the Kill Chain," *USAF Weapons Review* 50, no. 2 (Summer 2002): 4–6.

21. Ibid., 5.

22. James J. Wirtz, "Counterforce and Theater Missile Defense: Can the Army use an ASW Approach to the Scud Hunt?" (paper presented at the US Army War College, Carlisle Barracks, Pa., 27 March 1995), v.

23. Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Airpower in the Persian Gulf* (Annapolis, Md.: Naval Institute Press, 1995), 25–27.

24. Ibid., 35.

25. Ibid., 36. Both authors back up this contention with target lists from the *GWAPS*, Folder 8. The target lists show targeting against the mobile launchers was not considered until it became a political imperative to the Coalition.

26. David E. Snodgrass, *Attacking the Theater Mobile Ballistic Missile Threat* (Maxwell AFB, Ala.: Air University Press, 1993), 3.

27. General Wright, interview.

28. The Missile Defense Agency's mission is "to develop, test and prepare for deployment a missile defense system. Using complementary interceptors, land-, sea-, air- and space-based sensors, and battle management command and control systems, the planned missile defense system will be able to engage all classes and ranges of ballistic missile threats. Our programmatic strategy is to develop, rigorously test, and continuously evaluate production, deployment and operational alternatives for the ballistic missile defense system. Missile defense systems being developed and tested by MDA are primarily based on hit-to-kill technology. It has been described as hitting a bullet with a bullet—a capability that has been successfully demonstrated in test after test."
Missile Defense Agency, "MDA Mission," *MDALink*, http://www.mda.mil/mdalink/html/aboutus.html (accessed 9 April 2003).

29. The US Navy's Fleet Anti-Submarine Warfare School in San Diego, "Provides tactical, technical, and military training in a safe and stimulating environment to forge skilled Anti-Submarine Warfare Professionals capable of supporting Fleet Requirements," http://dmoz.org/Regional/North_America/United_States/Government/Military/Navy/Education_and_Training/ (accessed 23 June 2003).

30. Owen R. Cote, Jr., *The Third Battle*, Newport Papers (Newport: Center for Naval Warfare Studies, Naval War College, 2003), 82–84.

31. John Pike, "Green Flag,"*Global Security.org*, http://www.globalsecurity.org/military/ops/green-flag.htm and John Pike, "Roving Sands," *Global Security.org*, http://www.globalsecurity.org/space/ops/roving-sands.htm.

32. Bradley Graham and Vernon Loeb, "An Air War of Might, Coordination and Risks," *Washington Post*, Sunday, 27 April 2003, A01.

Chapter 5

Conclusions and Recommendations

One of the tests of leadership is the ability to recognize a problem before it becomes an emergency.

—Arnold Glasgow

Two key aspects of the threat posed by proliferation of mobile ballistic missiles stand out. First, by examining the history of these weapons, it should be clear why countries at a comparative technological disadvantage would want to equip their forces with ground-mobile ballistic missiles. The threat posed by even one such elusive weapon armed with a nuclear warhead is enough to give any opposing nation pause. With the fall of the Soviet Union, the necessary technology and support are readily available to even the weakest of nations (or most shadowy of organizations). Money is all that is required to obtain the weapons once employed only by superpowers. This environment of open-air marketing for mobile ballistic missile technology coupled with the intense desire to retard America's power-projection capabilities will increase proliferation in the foreseeable future.

Second, deterrence is no longer a viable single strategy against the threat of ballistic missile attack. Alongside deterrence, this still operates—more or less—against all adversaries; the concept of preemption must now take a place of prominence. This new concept will drive the future of US efforts against ground-mobile ballistic missiles. Specifically, preemption must become the cornerstone strategy against rogue nations or terrorist organizations deploying ground-mobile ballistic missiles. Along with doctrinal adjustments, this new strategy will force major changes in the kind of weapon systems and tactics employed by America's armed forces. Accordingly, two major components are required to make this strategy viable—applied technology and an efficient decision-making architecture—from sensor to shooter. As indicated by PAD and DARPA theorists, persistent surveillance must be developed that can provide timely, discriminating information directly to the "controllers" or directly into the targeting computers on the munitions themselves.

Finally, in order to field a well-trained, well-equipped, and disciplined countermissile capability that can implement the complex preemption strategy against mobile ballistic missiles, an advocacy community must be formed. At the core of this new community is the need for continuity, training, joint exercises, evaluation, and continual adjustment to enemy TTP. The major findings of this study concludes specific prescriptions and areas for further study.

History of the Threat

For proof of the very real nature of this threat, consider the nations now known to capitalize on Soviet mobile ballistic missile technology. The list includes such troubled countries as Afghanistan, Algeria, Argentina, Egypt, India, Iran, Iraq, North Korea, Libya, Pakistan, Serbia, and Syria.[1] This list is a veritable "who's who" of failed states, sponsors of terrorists, or nations in a state of perpetual war with regional neighbors. An economic collapse in Argentina, successful detonation of a nuclear bomb by Pakistan, a winding-down war against Iraq, a defiant North Korea restarting its nuclear weapons program, and a recently concluded war against Serbia all underscore the danger represented by these countries.

Virtually every country listed above is an actual or potential enemy of the United States with some level of desire to obstruct American power-projection capabilities.[2] Without exception, each knows that to impede overwhelming US military power, it needs a lever. One such lever is the ground-mobile ballistic missile. Competing symmetrically against our rapid power-projection forces—the Air Force, Navy, and Marine Corps, is not possible for most due either to the prohibitive costs of a massive military buildup or the country's lack of a strong technology base. What is more, these states do not look at the rules for use of ballistic missiles in the same way the United States and USSR did throughout the Cold War. Former Air Force director of ISR, Maj Gen John P. Casciano describes the mentality of many of our potential adversaries in the post–Cold War world as follows: "However, today and in future conflicts, the United States and its allies may face opponents who view the possession of WMD not as mere deterrents, as the Soviet Union did, but simply as weapons—potentially first-use weapons to level the playing field against an opponent with an overwhelming conventional advantage or to conduct a terrorist act in order to make a 'political' statement."[3]

The People's Republic of China is also an emerging military threat. Its massive resource potential, opposing political ideology, and improving technological base all send signals that the United States should prepare for potential conflict. As noted in a recent Brookings Institution study, the progress made in deployment of Chinese missiles (some capable of holding North America at risk) speaks for itself.

First tested in 1995, the DF-31 may be deployed in the year 2000 armed with multiple warheads. China is also building the DF-41 missile with a range of 12,000 kilometers (7,500 miles). (The DF-41 will eventually replace the DF-5 ICBM.) If deployed, the DF-31 and the DF-41 will make China as the only country since Russia to deploy mobile long-range missiles.[4]

The first portion of this study painted a detailed portrait of how mobile ballistic missiles have provided an effective politico-military response for weaker nations since the latter days of Hitler's Germany. Moreover, through expansive and costly development programs (courtesy of Germany, the Soviet Union, and America), virtually all of the necessary research and development for these weapons has already been done. Thus, due to their comparatively inexpensive price tags and powerful political impact, proliferation of mobile ballistic missiles will continue.

The Cold War and America's Strategy

America's response to the growing threat posed by the USSR during the early days of the Cold War also informs our view of the problem. As Soviet scientists pressed ahead with a modern ICBM program under Nikita Khrushchev, the United States was forced to develop a robust surveillance and reconnaissance capability. First in the form of the U-2, later in the Corona space surveillance program, the United States was eventually able to determine the actual extent to which the Soviets had deployed nuclear-capable ICBMs. But in doing such a wonderful job at developing virtually untouchable ISR platforms, the United States gave impetus to a Soviet counterstrategy. The mobile ballistic missile allowed Russia to confound the ever-improving US overhead surveillance efforts.

America's response was not only to increase its nuclear strike capabilities, but also to develop new and better ways to conduct surveillance over the Soviet Union. This continuously improving ISR capability provided the United States with vital glimpses behind the Iron Curtain that arguably enhanced deterrence. However, due to the nature of the Cold War, the ISR community that grew up in secrecy and served only a few at the top continued to remain elitist even after the Cold War ended. The ability to get timely information from the sensor to the shooter suffered. This was demonstrated during the unsuccessful Scud hunt of the 1991 Gulf War. The increasing proliferation of chemical, biological, and nuclear weapons and mobile ballistic missile technology forced the United States to reassess how it would fight in a post–Cold War environment.

Post–Cold War Changes

This study also examined efforts to make ISR and the sensor-to-shooter "kill chain" more responsive in the post–Cold War era. Three proposed concepts could significantly enhance America's ability to find, fix, track, target, engage, and assess enemy mobile threats. Faced with an array of failed states and terrorist organizations, the American idea would no longer be to deter the threat, but to destroy it before it launches. Terrorist attacks against the American homeland on 9/11 underlined the fact that for deterrence to work against people armed with ballistic missiles, they must have something to lose—many of our enemies do not.

National ballistic missile defense suddenly gained much-needed attention and resources, but it would not be available in time to protect American lives against the gathering threat. As a result, the George W. Bush administration published the *NSS* highlighting the requirement for preemption. This strategy would allow the United States to attack those enemies deemed to be undeterrable. While deterrence could not be discarded, due to its continued effectiveness against a broad array of foes, different equipment, training, tactics, procedures, and doctrine must be created to breathe life into the new strategy.

Prescriptions and Recommendations

While many advances have occurred since the 1991 Scud hunt in Iraq, much is left to be accomplished. The following five general recommendations address the most prominent shortcomings that became apparent in the course of this research. All are meant to be applied by the US joint military community—not just by one service. There are naturally going to be varying circumstances in which the specialties of one particular military branch will rise to the top, but it (as is the case for all complex endeavors) will require the teamwork of an entire nation to defeat the threat posed by mobile ballistic missiles.

1. *Develop a focused, counterforce-minded joint community responsible for hunting and destroying ground-mobile ballistic missile launchers. It is vital that this team include elements of the national intelligence community to ensure rapid information flow and coordination.*

The equipment, training, and exercises called for in creating a mobile missile hunter capability will be expensive. While most of the equipment and training may well cross boundaries and apply to other TCT missions, it is difficult to imagine a higher priority TCT than a mobile ballistic missile armed with a chemical, biological, or nuclear warhead. Therefore, a community that will advocate this mission at the highest levels must be established. Ad hoc planning, as in the 1991 Scud hunt, was a failure at the tactical level that could have led to a failure at the strategic level had Israel been lured into the war. Establishing a mobile ballistic missile hunter community will underwrite and secure the high priority and advocacy this mission deserves.

2. *Develop those capabilities that allow persistent surveillance coupled with the ability to discriminate between potential targets before conducting precision strike operations.*

Whether America continues to pursue the concept of preemption or deterrence, it is vital to national security that it continue to improve the persistence of surveillance assets. Through a combination of space-based, unmanned aerial, manned aerial, underwater, remote ground, and other sensors, ISR must be able to watch and to discern enemy intentions and capabilities. Furthermore, if the concept of preemption is to succeed, sensors must be able to communicate with controlling platforms such as AWACS and JSTARS and to the strike platforms and munitions themselves. Just as important, GMTI and ATR technology is critical to target discrimination. The political ramifications of striking an incorrect target in a preemptive strike are particularly serious. Likewise, the extreme danger in missing an opportunity to strike a nuclear-tipped missile before it launches is unacceptable. No matter what sort of architecture is implemented, the relevance of these capabilities will be a necessity in the post–Cold War environment.

3. *Augment the concept of deterrence with that of preemption in joint military planning and doctrine.*

Now that the *NSS* has formally embraced preemption, it is important to implement that strategy in doctrine and TTP. It is vital that deterrence not be discarded, for it will likely remain the first option against most aggressive states the United States will face in the coming decades. However, while deterrence seems the right choice against a relatively stable and powerful competitor such as China, preemption should certainly be the strategy of choice when faced with a failed nation such as the Taliban-ruled Afghanistan. Should such a country lay hands on nuclear, chemical, or biological weapons, it must not be trusted to play by the rules. Nonetheless, deterrence may become an even more powerful tool when combined with the acknowledged ability and willingness to preempt. The two concepts can reinforce one another. Further, military doctrine and instructions must recognize and prepare for the possibility of moving from one strategy to the other as situations deteriorate or improve.

4. *Create a formal joint school and specific identity for those involved in the defense against mobile missiles.*

No mission as complex as that of mobile missile defense can be done over long periods of time against a variety of adaptable enemies without continuity, systematic training, and an understanding of changing circumstances. This recommendation meshes closely with the previous one, but is sufficiently important to mention separately. Even if an identifiable mobile missile hunter community is not created, a school for the mission is imperative. Such a school could be modeled after the US Navy's Anti-Submarine Warfare School in San Diego. The ASW school was established for the distinct purpose of creating an environment in which those engaged in the job of hunting enemy submarines could grow and contribute to a complex and critically important mission. The people assigned the mission of neutralizing the mobile ballistic missiles threat deserve the same type of environment.

5. *Implement the RAND mobile ballistic missile counterstrike plan calling for layered sensors feeding real-time targeting information from GMTI and ATR assets to controllers, who will deploy strike assets.*

RAND's proposal calls for ISR and strike platforms to remain just out of an opponent's airspace and from there to employ hypersonic weaponry to neutralize the threat once it becomes imminent and targetable. This plan would be effective against a nation such as China, which the United States would attempt to deter before violating its airspace in an act of war. In contrast, the Eglin Air Armament Center concept of PAD calls for aerial assets to loiter in the opponent's airspace for extended periods to collect targeting information. This concept is also effective, but it is only a politically tenable choice once the decision to go to war has been made or if space-based assets could replace air-breathing ones. Therefore, the PAD concept would be more attractive for a preemptive strategy. DARPA's AMSTE—is a capability for shortening the kill chain as opposed to a tactic or procedure. Therefore, its proposed ability to reduce the kill chain would be welcomed in any time-critical targeting environment.

6. *Conduct regular joint training, exercises, and evaluations for the units specifically responsible for the battle against ground-mobile ballistic missiles.*

Like Green Flag and Roving Sands, a greater emphasis on joint exercises is needed and has already benefited our forces in Afghanistan and the 2003 Iraq War. The sheer complexity of mobile missile strike concepts, such as those outlined in chapter 4 and proposal no. 5, dictates that hands-on training with the forces that will go into the hunt together is necessary. As described earlier, ad hoc mission planning will not work in a critical mission that is dependent on perfect timing—particularly if the United States decides to strike preemptively.

Areas for Further Study

Some questions and concerns surfaced during this work that were beyond its purview. They are offered below in an attempt to prompt further discussion and research.

1. *What factors should US policymakers consider in deciding whether to pursue a policy of deterrence or preemption?*

The concept of employing both the strategies of deterrence and preemption against a varied array of potential enemies is a central theme of this thesis. Perhaps no question for policy makers would be more vexing than trying to apply the correct strategy to each particular situation. Given this potential for confusion, work must be done to understand how the two concepts may strengthen and feed upon each other. Closely related to this is the notion of sliding from one end of the strategy scale to the other as a potential enemy transforms into an imminent threat or vice versa. Warning signs, limits of acceptability, and methods of communicating intent must be defined before a dual-strategy policy can be implemented.

2. *If the United States is successful in neutralizing the threat posed by ground-mobile ballistic missiles mated to chemical, biological, or nuclear warheads, how will the enemy respond? How should the United States best prepare for the eventuality of adaptation? Is it possible that announcing deployment of a superior preemptive capability could make the environment far more dangerous?*

As demonstrated throughout history, the flux between offense and defense leads to episodic supremacy of one over the other. If the United States develops the means to negate the threat from mobile ballistic missiles, opponents will adapt their weapon-delivery systems, doctrines, and practices. Is there a need to keep our true preemptive capabilities highly classified to prevent early adaptation by the enemy, or will knowledge of these preemptive capabilities assist in implementing our complementary deterrence strategy? In any event, just as the Soviet Union signaled its increasing reliance on mobile ballistic missiles in response to US surveillance capabilities in the late 1950s, strategists should anticipate and look for signs of change in enemy deployment techniques as our antimobile ballistic missile capabilities become well known.

3. *Implementing a concept such as PAD calls for invading the airspace of potential enemy nations with UAVs and aircraft in many cases before hostilities break out. While this may be necessary to neutralize an imminent threat, how can space-based capabilities be developed to provide the same effects?*

The United States faces a series of tough choices if it decides to sustain a long-term preemptive strategy against major competitors. In many, if not most, cases, our justification for action may be questionable in the eyes of the world community. Even among staunch allies, there may come a time perhaps following a number of preemptive actions when America loses some international legitimacy. Development of certain space-based surveillance and targeting capabilities could mitigate this potential problem and should be factored into procurement decisions over several decades.

4. *Given the scarce resources and enormous costs associated with developing an effective ground-mobile missile defense, what capabilities can the United States afford to forego? Can the case be made that the capabilities acquired in fielding preemptive mobile ballistic missile defense forces will be worth any cost? If not, what is the limit, and what are the trade-offs?*

5. And finally—*What do we not yet know about the threat posed by mobile ballistic missiles?*

With that last thought, this study closes with a chilling quote describing the gathering danger to the American homeland from the Rumsfeld Commission to Assess the Ballistic Missile Threat to the United States:

> A new strategic environment now gives emerging ballistic missile powers the capacity, through a combination of domestic development and foreign assistance, to acquire the means to strike the U.S. within about five years of a decision to acquire such a capability (10 years in the case of Iraq). During several of those years, the United States might not be aware that such a decision had been made. Available alternative means of delivery can shorten the warning time of deployment nearly to zero.[5]

The United States can no longer afford to depend solely on deterrence and its accompanying structures to protect itself from a new breed of undeterrable entities armed with mobile ballistic missiles. For when these entities become capable of delivering nuclear warheads on their missiles, they may not hesitate to use them. While both American society and government is strong, they may not be able to survive the loss of a major city because defense policies and capabilities were not in tune with a deadly new world.

Notes

1. Dennis M. Gormley and K. Scott McMahon, "Counterforce: A Response to Deficiencies in US Counterforce Operations," *Global Defence Review 1997*, www.global-defence.com/1997/Counterforce.html.

2. As of this writing, the coalition war against Iraq is winding down with US Marines occupying central Baghdad this afternoon. Likewise, the United States and allied countries are still heavily involved with seeking out elements of al-Qaeda as well as remnants of the now-toppled Taliban regime in Afghanistan.

3. John P. Casciano, *Countering the Proliferation and Use of Weapons of Mass Destruction* (New York: McGraw-Hill Companies, Inc., 1998), 283.

4. Ming Zhang, *China's Changing Nuclear Posture* (Washington, D.C.: Brookings Institution Press, 1999), 35.

5. House, *Commission to Assess the Ballistic Missile Threat*, 21 (see chap. 2, n. 55).

Attacking the Mobile Ballistic Missile
Threat in the Post–Cold War Environment

New Rules to an Old Game

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