Capability-Based Acquisition: Key Factor in Meeting 21st Century Threats

Restructured Missile Defense Agency Steps up to the Challenge

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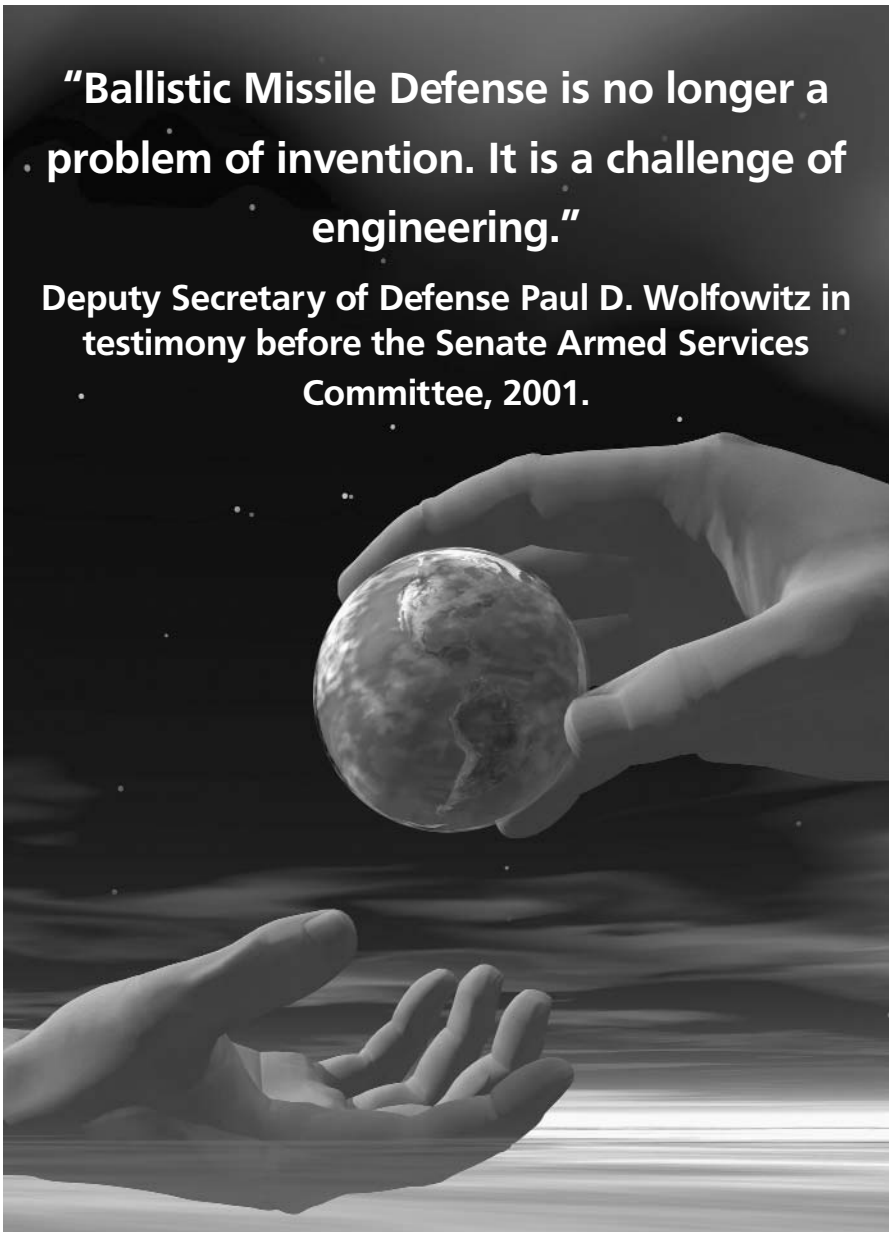
Despite the continued proliferation of intercontinental medium- and short-range ballistic missiles, the missile defense program was hampered in the past by political constraints and an unwieldy management structure. Since former President Reagan first declared his vision for a Strategic Defense Initiative (SDI), changes in the perceived threat have outpaced the development of an operational system to protect the homeland and our military troops in combat. Recent media accounts indicate that China is transitioning silo-based ICBMs to mobile launch capability; North Korea possesses a nuclear weapons development program and may be planning flight testing of the Taepo Dong 2 missile, which is capable of reaching the west coast of the United States.

Using the traditional weapons acquisition processes, the military services were tasked with developing missile defense systems peculiar to their own missions (sea, land, air, and space) and were responsible for developing operational requirements documents (ORDs) in coordination with the Ballistic Missile Defense Organization (BMDO), now the Missile Defense Agency (MDA). The current administration, the secretary of defense (SECDEF), and leadership in the MDA recognized that only a departure from the status quo will accelerate development of a missile defense system



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and provide an operational system in the near term.

Platform-Centric to Network-Centric: Building the System of Systems

The MDA has embarked on one of the most complicated and demanding systems engineering and program management tasks ever undertaken: to provide a capability to defeat ballistic missiles in all stages of flight using a single architecture of fully integrated elements and components. The MDA's approach is a radical departure from past Department of Defense acquisition programs. It is, however, the only path that can successfully bring together disparate Air Force, Navy, and Army ballistic missile defense elements and components to achieve the coordinated and sophisticated layered defenses necessary to meet the short engagement time lines of ballistic missile flight.

As a corollary to MDA's embrace of a capabilities-based acquisition approach, the agency has also reorganized its program to reflect the framework of network-centric warfare (NCW). NCW principles, such as sensor fusion and self-synchronization, will serve as underlying precepts for designing a ballistic missile defense (BMD) system of systems. In the past, missile defense development relied on a platform-centric approach in which sensors, shooters, and decision makers are logistically and physically linked. The new direction, however, emphasizes building not specific platforms, but rather missile defense capabilities in which a military service's weapons systems are single elements in a larger organic whole. For missile defense to be successful, it requires the fusion of sensor data from space, airborne, sea, and ground elements. Only the NCW concept of networking sensors, decision makers, and shooters into a collaborative synchronized effort will allow this to be successful. And only the capabilities-based acquisition approach now being undertaken by MDA can provide the programmatic framework for NCW concepts to be put into place. If the MDA approach proves successful, it could provide an impetus for change in the way the DoD develops, procures, and supports military forces and capabilities.

Rather than discussing the formidable technological issues that face missile defense, our goal in this article is to explore the management and organizational approaches that MDA is taking. It is our belief that the progress made in hit-to-kill technology has reached such a stage of maturity that the management and organizational issues are becoming just as important as the technological ones. Hindsight, we believe, will show that the redirection of MDA towards a capabilities-based approach in January 2002 was the turning point in achieving a missile defense system with a fully netted capability.

Shortcomings of the Requirements Generation Process

Although seen by many today as cumbersome and paperwork-intensive, the traditional requirements process worked fairly well for single-service, stand-alone systems. However, the success of a system like missile defense depends on a multitude of sensors from a variety of air, sea, and ground platforms. It was, therefore, necessary to move away from the traditional requirements generation system, which did not emphasize the possible benefits of fully netted systems. While the requirements-based approach emphasized building a system to discrete standards to defeat known adversary capabilities, the capabilities-based approach recognizes that the pace, as well as the utility and extent of the capability itself, is not known. This is not the next generation fighter, but an entirely new system of systems architecture from the ground up.

The traditional requirements generation approach rested on the premise that the operational community could identify—years out—a needed capability and that a system could be built to defeat a specific, predictable, and identifiable threat. A very formalized structure was in place to describe the threat, justify the mission need, and describe the shortcomings of the existing systems. Specific performance levels had to be established against specific threats.

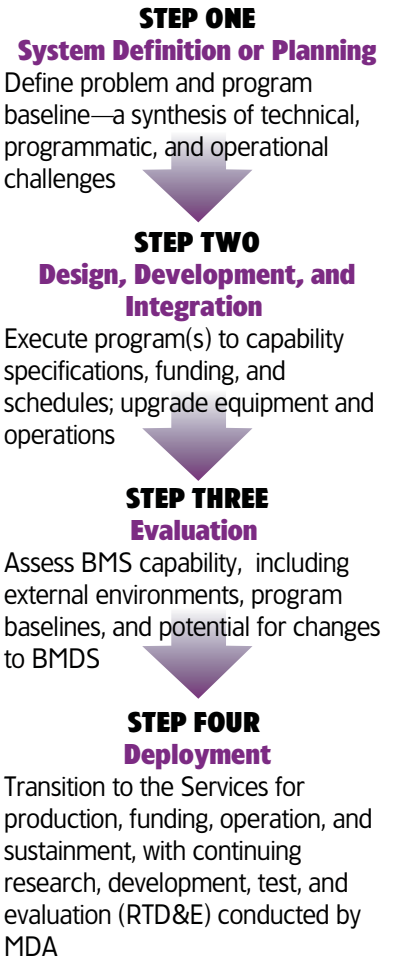

FIGURE 1. **The Four-Step Approach to Building a Capabilities-Based Program**

Reality was, however, that it was very difficult to arrive at adequate knowledge of adversaries' intentions and programs. The North Korean Taepo Dong-1 is the best example. On August 31, 1998, North Korea surprised the U.S. intelligence community when it launched a Taepo Dong-1 ballistic missile over Japan and demonstrated the apparent ability to achieve intercontinental range. The event itself was anticipated, but the sophistication of the missile—a three-stage solid fuel rocket that could be modified to reach Alaska and Hawaii—was not. The intelligence community had judged that this missile would have medium-range capability and that its follow-on, the Taepo Dong-2, would be the one to provide North Korea with the inter-

continental range it sought. The launch of the Taepo Dong-1, however, demonstrated the potential of North Korea to deliver a lethal chemical or biological warhead to a target outside Asia. This was in direct contradiction to intelligence estimates that North Korea could not threaten the United States for another 15 years and illustrates the limits and potential dangers of relying on very finite and predictable measures to build weapon systems.

The MDA now relies instead on an adversary capabilities document (ACD) as a guide to building the system. The ACD describes the threat using overall technical parameters and does not adhere to a single-point design threat assessment as used in the past.

Technology and Timeframes Impede Development

Rapidly evolving technology and uncertain deployment timeframes were also an impediment. When the traditionally developed system was finally delivered, technology had frequently advanced beyond the system design, leaving the original requirements and solution outdated. In addition, the process of review and coordination was long, and even after requirements were approved, they were often frozen for many years before the system was actually deployed. Through this long period, the threat might have changed and certainly the technology had become more advanced.

The MDA program addresses these issues by relying on a set of two-year reviews and block upgrades that will build upon core capabilities to meet rapidly emerging and evolving threats. To address the dilemma of changing threats, MDA has adopted a more physics-based approach that looks at what is physically possible. This links with the evolutionary acquisition approach of aiming to deploy an initial operational capability as soon as possible and upgrading it at two-year intervals with integrated block improvements. The block upgrade approach should allow the operational community a more immediate stake in the system being deployed than was possible in the past.

The Case for Capability-Based Acquisition

A capabilities-based approach is necessary because the ballistic missile threat is not nearly as predictable now as in the past, and our current knowledge of ballistic missile proliferation intentions among our adversaries is inadequate. In addition, the operating forces lack the expertise to develop operational requirements in an emerging field like missile defense. The attacks of September 11, 2001, showed that the current environment is—as some have dubbed it—one of "unknown unknowns." We can no longer forecast with certainty what combinations of nations or nonstate organizations might pose a threat to U.S. interests. The MDA is responding to this dynamic and unpredictable strategic atmosphere by developing a single BMD program. The goal is to deploy an initial capability as soon as technologically practical and then build and improve upon this baseline through incremental enhancements.

In traditional acquisition programs, one of the military services typically investigates a concept or idea for a new weapons system to address an emerging threat and develops an ORD to define system requirements and top-level performance parameters. The process can be lengthy and unwieldy, and in some cases it delays system acquisition to the point where the threat overtakes the ORD. Further, the ORD often envisions an "end-state" requirement that is far ahead of existing technological capability and that fails to recognize the evolution of technology and the changing nature of warfare.

Another often-heard criticism is that program managers (PMs) fail to stay in touch with the operational community and lose touch with changes in operational concepts. In a speech given at the U.S. Naval Institute/Armed Forces Communications and Electronics Association Western Conference 2002, Adm. Dennis C. Blair, commander-in-chief, Pacific Command, said, "Many individual pockets in the armed forces do connect developers and operators closely. Generally they are the smaller specialized communities like special operations, or some of the smaller aircraft communities, or individual commanders with initiative.

"However, the big, big money in acquisition goes to the long-term replacement programs that are detached at a very early stage from the dynamic reality of operations and warfare. They emerge decades later with new generations of systems. Yes, these new systems are better than what they replace. But they are not as good as they could be in meeting the needs of the warrior, which will

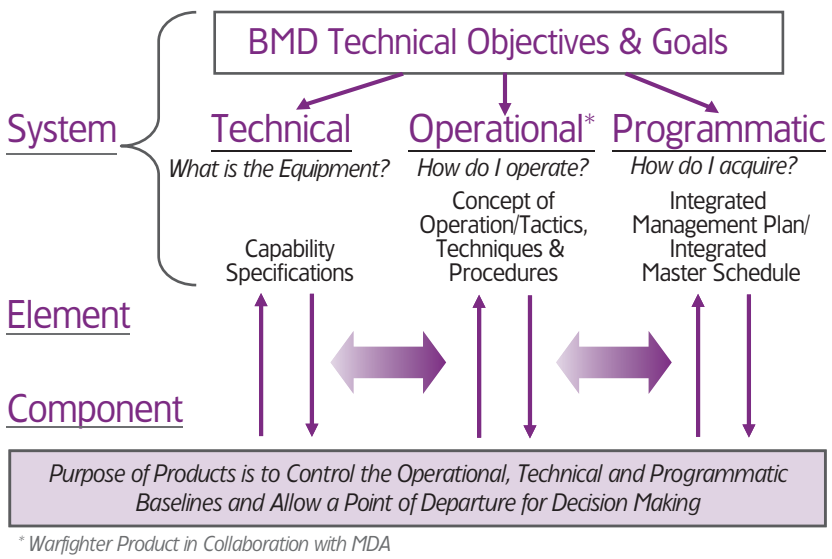

FIGURE 2. **Implementation of Capability-Based Acquisition**

have changed significantly since the original requirements for the program were established."

The key to a capabilities-based approach lies in viewing a threat not as coming from a specific weapon system or from a specific geographic region, but rather as emanating from the capabilities that an adversary might develop or deploy. Using a capabilities-based approach, a joint DoD agency would not be organizationally and programmatically centered around specific Service weapons platforms, but rather it would be organized to focus on the ability to integrate the effective military capability of those platforms into a larger whole.

Structure of Former Agency Precluded Holistic View of BMD

In pre-MDA days, the BMD mission was hampered by a number of issues. The MDA's predecessor, the Ballistic Missile Defense Organization (BMDO), was not structured in a way that allowed it to take a holistic view of BMD. The BMDO was organized under a family-of-systems framework of an upper- and lower-tier theater missile defense (TMD) system and a separate and distinct national missile defense (NMD) program. The lower tier, made up of the Army PAC-3 and the Navy Area Defense System, was designed to defeat short-range ballistic missiles; the upper tier, made up of the Theater High Altitude Area Defense (THAAD) and the Navy Theater Wide (NTW) programs, was designed to defeat the mid- to long-range threat. Although these four programs had certain commonalities in mission and performance, each was separately managed by its respective military service PM. Although they were managing BMD programs, the service PMs for PAC-3, Navy Area Defense, THAAD, and NTW did not report through the BMDO chain of command; their military responsibilities (and perceived success) were thus more tied to the success and advocacy of their Service-sponsored BMD platforms than to achieving a fully interoperable family of BMD systems.

Additionally, these TMD programs were not organizationally or programmatically connected to BMDO's NMD program. While the lower- and upper-tier programs aimed to defeat short- to long-range ballistic missiles, the NMD program was aimed at the ICBM threat. Although the constraints of the 1972 Anti-Ballistic Missile (ABM) Treaty were the major reason for this disconnect between TMD and NMD, there was no concentrated effort to see BMD as a whole.

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A further hindrance to the BMD mission was the unclear management responsibility for meeting the air breather (aircraft and cruise missile) threat. While BMDO had the systems engineering lead against the theater air and missile defense (TAMD) threat, and the Services' BMD systems had an air defense role in addition to their BMD role, BMDO's concentration was—rightly—on the formidable task of single-handedly defeating ballistic missiles.

All these factors resulted in a BMD management and programmatic structure that was platform-centric with clear organizational divisions between various Service-managed sensor and interceptor systems. Numerous boards were commissioned, and various documents were drafted dealing with the key issue of ensuring that each Service-managed missile defense system was interoperable with the others. However, because of BMDO's unclear management role over Service functions, the concentration of these efforts was on merely documenting deficiencies and not on building a battle management framework that would see Service missile defense systems and sensors as one large systems of systems.

MDA Has Flexibility for Restructured Missile Defense Program

On January 2, 2002, Secretary of Defense Donald H. Rumsfeld refocused and reorganized the BMD program to emphasize the need to see the BMD battle as a synergistic whole. While the former BMDO lacked the necessary authority to manage BMD platforms as elements of a larger system, the newly formed MDA was given that broad mandate and authority (as other DoD organizations, such as the Strategic Systems Program and National Reconnaissance Office, had been in the past).

BMD was restructured not into platform elements but into capabilities to defeat ballistic missiles in all three stages of flight (boost, midcourse, and terminal). Funding lines now correspond to the systems that will defeat the threat in these stages of flight—a dramatic difference from the previous practice of funding individual Service BMD weapon systems. The number of BMDO research and development program elements (the major DoD budgetary element) was reduced from 20 individual segments to nine. This gave MDA more flexibility to transfer resources between systems, to maximize capabilities, and to reduce time delays. MDA is currently pursuing implementation of a single Program Element (PE) in the fiscal 2004 budget enactment.

Even more significantly, Service BMD ORDs were cancelled and all the Service programs came under the direct management control of MDA. All BMD programs, including the airborne laser program and the sensor program SBIRS-Low, are now treated as a single unit. No longer is there unclear management responsibility for missile defense: all programs, whether sensor or weapon system, have one ultimate PM. It is of paramount importance to this effort that government and industry work together as one entity to assure disciplined engineering and decision making. The bottom line is always to buy and evolve what is executable.

Deliver What is Possible

The basis of capability-based acquisition is to identify what is possible; determine if development is executable; then plan, design, develop, and integrate the concept into the BMDS system when it is ready for production and transition to the military services (Figure 1, p. 23). This is an iterative process that is designed to provide a defensive system in the short term based on available, militarily useful capability; and to concurrently evolve systems, elements, and components over a period of years, enhancing capability and performance as new technologies emerge. The benefit of the approach is that we don't get to the end of development and then identify all that is wrong with the product. Rather, we assess and correct as we go. The new operational test and evaluation mantra is to be able to characterize just what capability is being fielded (and to agree that it is useful).

Implementation of capability-based acquisition is based on BMD technical objectives and goals (TOGs) (Figure 2, p. 24). The TOG has three sections at the system level: technical (*what*); operational (*how employed*); and programmatic (*how acquired*). At the element and component levels, technical capability specifications, concepts of operations and tactics, and integrated master plan and schedules are required to develop products. Assessment metrics are then designed to monitor progress of development against cost, schedule, and performance requirements. Potential adversarial capabilities (threat) are defined along with a characterization of the current programs in place to meet these threats. Over time, the capability-based approach should make us less susceptible to "surprises" from intelligence and should demonstrate that our knowledge of what is achievable will always be greater than the ability of intelligence to predict potential threats.

Real World Considerations

Another advantage of the capabilities-based approach is that it recognizes an uncomfortable reality: although formal requirements based on threat and mission needs may be established, weapon systems are often acquired based on more intangible and changeable factors, such as politics, budgetary constraints, and the public's perception of the nature and level of the threat. With missile defense technology still under development, it is not practical to build to a certain set of finite numbers established through the traditional requirements approach. So MDA's capability-based program has resulted in a movement away from major inventory objectives to an approach that emphasizes research, development, test and evaluation (RDT&E) activity and shorter-term block buys; that concentrates on continuous systems enhancement by applying spiral development techniques; and that maximizes yearly buys rather than concentrating on a long-term objective.

The PAC-3, the most developed of the BMD systems, is also most representative of this practice. Though the system is already fielded in limited numbers, the MDA has hesitated to make a decision on full-rate production. The Army objective is 1,159 missiles; however, MDA has questioned firm decisions to acquire that quantity. The MDA strategy is to concentrate on acquiring inventory numbers in a serial procurement method and to emphasize achieving a capability, however limited, without making a firm commitment to a long period of procurement and acquisition.

The advantages of achieving an integrated air picture among BMD systems have been recognized and codified in appropriate BMD requirements and acquisition documents. The Joint Theater Air and Missile Defense (JTAMD) Operational Concept for 2010 envisions a sophisticated sensor and information-sharing construct that would enable such advanced firing concepts as "engage on remote" and "precision cue." These concepts would provide significant improvements in several important areas: they extend the range of weapons platforms beyond the range of individual sensors, decrease weapons wastage, increase probability of kill, and allow multiple shot opportunities.

The BMD battle can be won only by using the NCW-derived integrated fire control techniques found in the 2010 JTAMD Operational Concept. Precision cue allows an external sensor to detect and track a ballistic missile, enabling an organic fire control sensor to perform a more focused search than it could in an autonomous mode. Engage on remote uses an external sensor to detect and track a threat ballistic missile and additionally enables a BMD element to launch its interceptor before its own organic fire control sensor detects the target.

Need for Psychological Adjustment

While the technical challenges of achieving these concepts are daunting, there are also significant doctrinal and even psychological obstacles to accomplishing the advanced operational concepts. For example, it would take a high degree of confidence in another Service's sensor for a battery commander to engage a target that he cannot see with his own sensor; however, this confidence is core to the engage on remote concept. One could understand the reluctance of a PAC-3 commander to act on tracking data from Navy SPY-1 radar or an airborne sensor. In the opposite scenario, will that same battery commander be confident enough in the netted air picture to withhold fire when the target TBM is in his range in order to allow another platform the first shot opportu-

nity? Even if that level of confidence is achieved, will it survive the first friendly fire incident?

The concept of engage on remote brings into play legal and doctrinal questions that have yet to be addressed. Will any commander have enough confidence in a netted air picture to allow integrated joint fire control with other Services' platforms? There are some scenarios where the commander will have no choice. Only through strict adherence to joint doctrine and to robust, repeated joint exercise opportunities will a commander be able to achieve the degree of confidence necessary to fully use these concepts.

Figure 3 depicts an ICBM missile attack scenario from North Korea to the continental United States, showing the complexity required for a successful engagement. The first indication of a launch would be from a space-based sensor. The missile, if pre-stationed in the Sea of Japan, could be tracked by an AEGIS vessel, and under some scenarios, the AEGIS could attempt a boost or ascent phase intercept. An airborne laser operating in the same area would also have an opportunity for a boost phase engagement. If these systems are unavailable or their operations unsuccessful, the missile would enter its midcourse trajectory, and the ground-based midcourse system would engage. This engagement scenario would last only a few minutes. In order for an intercept to be successful, close command and control relationships and operational handoff concepts would need to exist between the U.S. Forces Korea, U.S. Forces Japan, Pacific Command, Northern Command, and Strategic Command.

1950s Provide Precedent for New Approach to BMD

The missile defense reprogramming approach is not totally unprecedented. There are striking similarities between the MDA program of 2001-2002 and the ICBM program of the mid-1950s. Gen. Bernard Schriever was given exceptional latitude to manage the extremely challenging role of devising a systems engineering and management structure capable of developing an ICBM program. Schriever realized early on that he had to manage outside the established Air Force reporting chains. In *Rescuing Prometheus*, Thomas P. Hughes writes that Schriever found "Air Force and Pentagon bureaucracy could overwhelm and delay his project with endless complications introduced at many tiered approval levels of bureaucratic compliance for each special interest in the system and by a maze of budgetary review requirements." A situation much like that was created by the management structure of the BMDO in the late 1990s.

In 1954, the management structure was streamlined. A Defense Ballistic Missiles Committee led by the deputy secretary of defense (DEPSECDEF) and including assistant Service secretaries was formed and served as the single review authority for the ICBM program. Schriever instituted concurrent development and parallel development to reduce risk and to enhance competition. Like Air Force Lt. Gen. Ron Kadish in 2002, Schriever could have done this only with the active support of the SECDEF, and it could have been done only during a time of what was seen as immediate crisis. In 1955, in an observation that could prove particularly relevant to the missile defense program, Schriever said that "major operating commands are strongly oriented toward

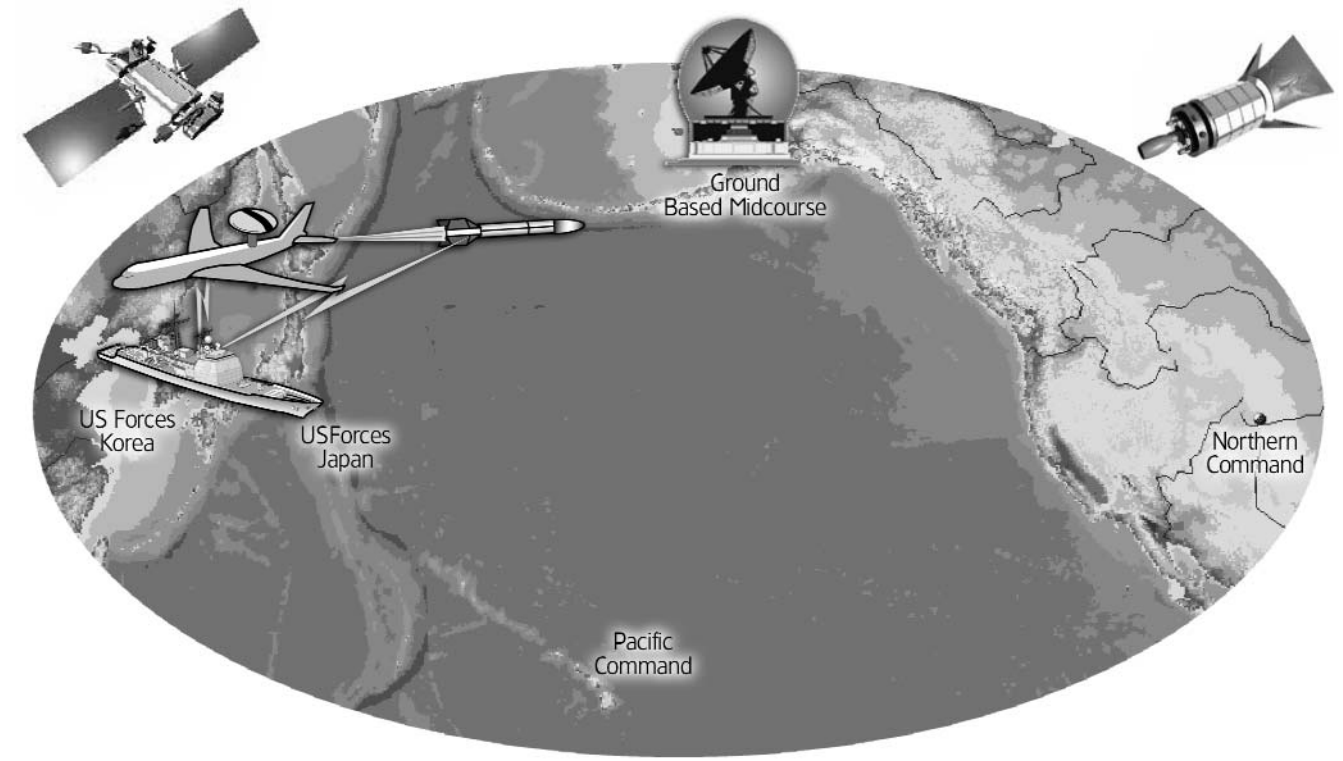

FIGURE 3. **North Korean ICBM Attack Scenario**

DoD Missile Defense Agency photograph

near-term programs … [and] the action levels in the Air Staff and in Commands will not (despite priorities and directives) be inclined to volunteer first attention to difficult problems of intercommand coordination" (quoted by Edmund Beard in *Developing the ICBM*).

Senior Executive Council

The current MDA approach has undertaken initiatives similar to the ICBM program of the 1950s. The only real missile defense reporting and decision-making body is the Senior Executive Council (SEC) (analogous to the Defense Ballistic Missiles Committee) made up of the DEPSECDEF, the under secretary of defense for acquisition, technology and logistics, and the individual military service secretaries. The SEC oversees all BMDS activities and is the final decision-making authority for missile defense procurement and fielding recommendations. The Missile Defense Support Group, made up of 13 OSD offices and agencies, provides a DoD review and advisement role. The closely structured contractual arrangement that the ICBM program used is mirrored by MDA's "National Team" approach, whereby two teams will perform the technical management of the BMDS. One team, led by Boeing, performs the systems engineering function, and the other, led by Lockheed Martin, performs the battle management, command, and control (BMC2).

Many Challenges Ahead for MDA

One of the most significant challenges for MDA will be how to define a new relationship with the Joint Chiefs of Staff (JCS), the Office of Test and Evaluation, Congress, and the operational community. In a broad critique of missile defense testing and financial accountability, the Project on Government Oversight indicated that MDA's management of all the elements of BMD is seen by some as a significant threat to normal, established processes for weapons acquisition.

Military Services

Service concerns rest on whether MDA can fully represent a service BMD program and recognize the unique contributions that a particular weapon brings to the battlefield.

JCS

The Office of the JCS has concerns regarding the waiver for MDA to bypass the traditional Defense Acquisition Board and Joint Requirements Oversight Council process.

T&E Community

Some in the T&E community have questioned whether firm testing standards and metrics can be established using a capabilities-based program.

Congress

Congress has expressed concern about its oversight role and is wary of efforts to view weapons as part of larger system capabilities rather than as individual platforms with easily identifiable production facilities and contractors.

Public Interests

And last, convincing the public and such organizations as the Union of Concerned Scientists will require considerable effort and a rigorous testing program.

Coordination with SIAP SE

An additional framework that needs to be further clarified is the MDA relationship with the Single Integrated Air Picture (SIAP) Systems Engineer (SE). This office was established in 1999 through a series of annual Flag Officer TAMD Capstone Requirements Document workshops that identified concerns with progress in addressing deficiencies in DoD's approach to TAMD interoperability. The SIAP SE's purpose is to implement a disciplined systems engineering process that yields recommendations for fielding an SIAP. MDA's goal of establishing a seamless BMC2 network to track missiles in all phases of flight obviously needs to be closely coordinated with the work of the SIAP SE. It is unclear at present whether MDA is fully considering SIAP SE recommendations in the planning for an integrated BMC2 network.

In addition, the new MDA program approach calls into question the utility and relevance of other traditional acquisition initiatives such as the integrated product team (IPT) construct. The tight management and control structure that MDA has established over the BMD elements is not conducive to the consensus-building that underlies the IPT concept. The IPT approach brings users and acquisition communities together into a collaborative process that is, perhaps, suitable for single weapon systems and firm sets of requirements. The current MDA approach of treating various Army, Navy, and Air Force sensors and weapons systems as a single system does not lend itself to an IPT approach. Additionally, a capabilities-based approach, which de-emphasizes firm requirements in favor of fielding achievable block capabilities, will be difficult using an IPT process.

Only Path to Integrated Missile Defense

The path that the MDA is presently following is the only one that can result in the kind of system-of-systems approach that would make a fully integrated missile defense system practical. A capabilities-based acquisition approach using a network-centric systems framework is a prerequisite for achieving success in missile defense. With missile tests becoming more routine, and with the cancellation of the ABM Treaty, the missile defense debate has changed direction. It has moved away from technological arguments regarding the practicality of hit-to-kill technology toward more of a discussion of the DoD management and systems engineering approaches that MDA is undertaking. Although there are still significant managerial and programmatic challenges to meet, MDA is on firm ground in defending its unique and unprecedented approach.

Editor's Note: The authors welcome comments and questions on this article. Biggs can be reached at timothy.biggs-contractor@mda.osd.mil and Stuchell at raymond.stuchell-contractor@mda.osd.mil.