DOCUMENTED BRIEFING

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Metrics for the Quadrennial Defense Review's Operational Goals

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PREFACE

The Department of Defense has adopted a capabilities-based approach to defense planning for transforming the U.S. military to meet newly emerging national security challenges. Capabilities-based planning focuses on developing the general wherewithal to fight successfully in a wide range of circumstances rather than only in stereotyped scenarios. The 2001 Quadrennial Defense Review highlighted what it called six specific operational goals for the focus of the transformation. It then sought metrics for evaluating, advancing, and monitoring progress in attaining those goals.

This documented briefing contains the slides and text of a briefing that describes a first cut at identifying such metrics. The research reported here was conducted within the Acquisition and Technology Policy Center (ATPC) as part of RAND's "Metrics for the QDR Transformation Operational Goals" project, a cross-cutting effort sponsored by the advisory board of RAND's National Defense Research Institute (NDRI), a federally funded research and development center supported by the Office of the Secretary of Defense, the Joint Staff, the unified commands, and the defense agencies.

The research reported here was conducted in early 2002, and results were presented to NDRI's advisory board in April 2002. This documented briefing should be of interest to those involved in defense planning, particularly as it relates to transforming the U.S. armed forces.

CONTENTS

1. INTRODUCTION

Metrics for the Quadrennial Defense Review's Operational Goals

The 2001 Quadrennial Defense Review (QDR)[1] promulgated a new defense strategy that is grounded in "capabilities-based" planning rather than in "threat-based" planning. Capabilities-based planning focuses on developing the general wherewithal to fight successfully in a wide range of circumstances rather than only in stereotyped scenarios. In particular, capabilities-based planning considers potential asymmetrical strategies by the opponent.

To meet the emerging security challenges, the QDR put forward a persuasive argument that the U.S. military must transform itself. The QDR postulated what it called operational goals, which the services should pursue as the focus of their transformation efforts. The QDR report stated that the attainment of the operational goals would result in a change in U.S. military capabilities that would "maintain or improve U.S. military preeminence in the face of disproportionate discontinuous changes in the strategic environment."

An essential element for managing the transformation is the identification and institutionalization of a set of metrics for evaluating, advancing, and monitoring progress in attaining the operational goals. This documented briefing contains the slides and text of a briefing that describes an initial effort to identify such metrics.

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[1]Donald H. Rumsfeld, *Quadrennial Defense Review Report*, Washington, D.C.: Department of Defense, September 30, 2001.

Current QDR Contains Six Operational Goals to Focus Transformation

Enhancing capability and survivability of space systems

Developing joint C4ISR

Assuring information systems and conducting information operations

Quadrennial Defense Review

Projecting/ sustaining U.S. forces in distant anti-access environments

Protecting critical bases of operation at home and abroad

Denying enemy sanctuary

• Some are mission-oriented

• Some are enablers

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The operational goals set by the QDR for the focus of the Department of Defense's (DoD's) transformation efforts are

- Project and sustain U.S. forces in distant anti-access and area-denial environments

- Deny enemies sanctuary by providing persistent surveillance, tracking, and rapid engagement

- Protect bases of operation at home and abroad and defeat the threat of CBRNE weapons[2]

- Assure information systems in the face of attack and conduct effective information operations

- Enhance the capability and survivability of space systems

- Leverage information technology and innovative concepts to develop interoperable joint command, control, communications, and computer intelligence, surveillance, and reconnaissance (C4ISR).

The operational goals are not all of the same character. Some (the first three) can be considered as missions that must be accomplished; the others might be called "enablers"—i.e., their attainment can help U.S. forces achieve their missions. The varied nature of the operational goals influenced our choice of a research approach for identifying metrics for evaluating progress in attaining the goals.

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[2]*CBRNE weapons* are chemical, biological, radiological, nuclear, and enhanced high explosives.
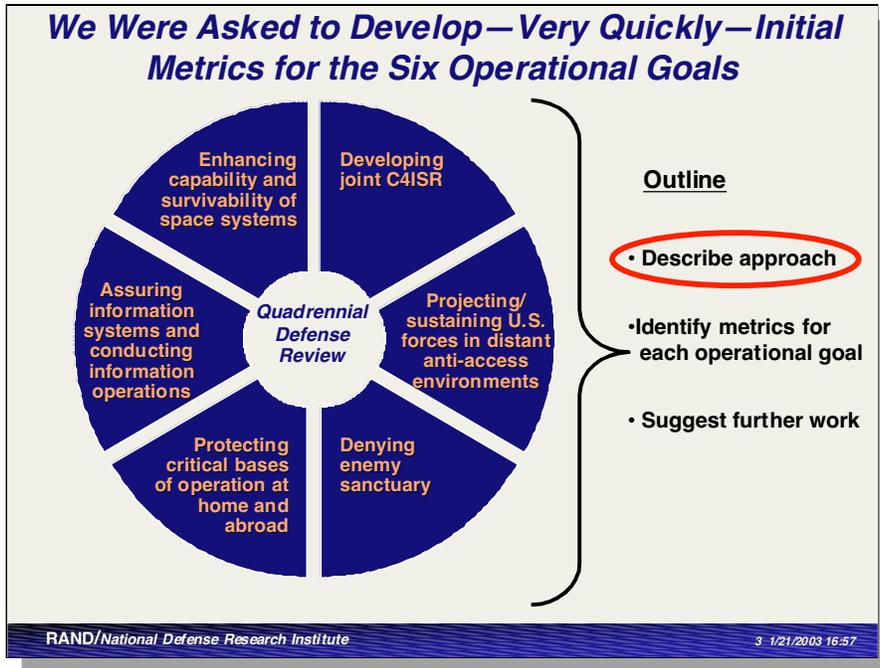
This slide serves as an outline for the briefing. We first describe our analytic approach. Next, we discuss the metrics that we identified for evaluating progress on attaining the QDR operational goals.[3] Finally, we close with some suggestions for follow-on research.

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[3]This project had a duration of only eight weeks. The time constraint on completing the project was driven by the Office of the Secretary of Defense's (OSD's) desire to list metrics for identifying progress on attaining the QDR operational goals in the *Defense Planning Guidance*, which was scheduled to be published in spring 2002. The short timeline meant that the results of this project should be considered as a first cut at such an identification.

2. DESCRIBE APPROACH

We Used Two Complementary Research Approaches to Identify Metrics

- **Framed SecDef-level challenges corresponding to new security environment**
  - **Identified key future large-scale operations that**
    - **will be essential**
    - **are infeasible today**
    - **could be feasible in the future**
  - **Decomposed challenges, identifying critical components of capability (transcending individual scenarios)**
  - **Observed logical metrics from the campaign analysis and related them back to the QDR operational goals**

- **Conducted quick survey of subject-matter experts**
  - **Requested experts to identify critical components**

We used two complementary approaches to identify metrics for evaluating progress toward achieving the six operational goals as described by the QDR report. For the first approach, we identified military challenges that are relevant to the new security environment.

A *challenge* is a future, militarily significant campaign or large-scale operation. It is at a level of importance that warrants Secretary of Defense (SecDef) attention. Moreover, it is an operation whose mission objectives would be infeasible or extremely difficult to accomplish with today's military forces but that might be achievable in the future with new or enhanced capabilities. An example of a significant military challenge is the destruction of a terrorist organization in a country similar to Afghanistan, but lacking a Northern Alliance–like indigenous ground force with which U.S. forces can operate. Another example is the securing of nuclear weapons in a country in which civil war has broken out and for which the central government's control of the weapons is in doubt.

After identifying representative challenges, we then decomposed the challenges into their critical components and subcomponents. One of the military challenges that we examined was "Quickly Defeating or Precluding Large Enemy Maneuvers." Using it as an example, we identified such possible components as (1) deploy forces and logistics; (2) establish high-effectiveness command and control (C2) and intelligence, surveillance, and reconnaissance (ISR) capabilities; (3) negate air defenses; and (4) attack maneuver forces.[4] Each of these components is critical because if an individual

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[4]For a more complete discussion of challenges and their decomposition, see Paul K. Davis, *Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation*, Santa Monica, Calif.: RAND, MR-1513-OSD, 2002.

mission cannot be achieved, the overall challenge cannot be met. Each critical component can, in turn, be decomposed into its sub-missions, or tasks. For example, the component "negate air defenses" has as a subcomponent the attack of the integrated air defenses or the avoidance of those defenses by the use of stealth or other means. In theory, each subcomponent can be decomposed further into its subtasks, which, in turn, can be decomposed, and so on, in a cascading, tree-like structure. However, as the air defense example illustrates, tasks do not have to be decomposed down many branches in practice before too low a level of detail is reached or alternatives to required ways are found for accomplishing a mission or task. Thus, air defenses can be negated by either avoiding or suppressing them. However, both methods are not required, although in reality both will probably be used to some extent.

Having decomposed the challenges into critical components and their subcomponents (which may or may not be individually critical), we then need to identify metrics indicative of accomplishing the components and subcomponents. The metrics come from a campaign analysis of the challenge. The final step is to relate the metrics to the appropriate QDR operational goal or goals. For example, continuing with our air defense illustration, if the campaign analysis determined that the time that it took to negate air defenses was an appropriate metric for that component, then that would be a candidate metric for the first operational goal. The Appendix details how this approach was used to identify metrics for the first two QDR operational goals (see p. 2 for a listing of the QDR operational goals).

The second approach that we undertook was to conduct surveys of RAND colleagues who were experts on the various subjects covered by the operational goals. Designed to assist in identifying critical components of the specific subjects, the surveys were conducted as structured interviews.

Metrics for Transformation Need Certain Characteristics

Should

- Evaluate capabilities that are of high-level concern
  - Suitable for *Defense Planning Guidance*
- Distinguish among multiple levels of capability
- Focus on outcomes
- Encourage innovation

Should not

- Dictate solutions
- Be service-specific
- Encourage non-effective solutions

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Before we attempted to identify metrics for the QDR operational goals, we considered those characteristics the metrics should have.

First, metrics should evaluate capabilities that are of concern to the senior DoD leadership. By that, we mean capabilities for attaining the objectives at an operationally significant level, such as a campaign. Additionally, the metrics should be suitable for inclusion in the *Defense Planning Guidance*, which means that there should be a fairly small number of them. A large number of metrics would tend to disperse rather than focus the services' energies. Second, the metrics should be defined so that they can be used to compare proposed alternatives, thereby improving the services' capability to meet the operational goals. Third, for the metrics to be most useful, they should focus on outputs in capability rather than on inputs, such as the amount of resources required. Finally, the metrics should be phrased so that they encourage innovative solutions, a subject that we cover in the next slide.

We also considered a number of characteristics that metrics should *not* have. They should not be so specific that they dictate the type of solution; rather, they should be stated in a way that encourages putting forward a variety of solutions that would compete against each other. As a corollary, they should not be service-specific; all services should be encouraged to put forward their candidate solutions. Finally, they should not be phrased in a way that inadvertently encourages ineffective solutions and creates counterproductive incentives.

We now return to the issue of phrasing metrics to encourage innovation.

Metrics for Encouraging Innovation

- Metrics for the transformation should be phrased so that they encourage innovation

- However, standard metrics may encourage business-as-usual solutions

- We worked backwards from the new war-fighting paradigm emerging in Afghanistan to identify metrics that might have led to that operational shift

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To transform the U.S. military requires innovative approaches to developing new operational concepts (CONOPS) for the conduct of warfare and the exploitation of new technologies and organizational structures. A key question for this project was: How should metrics be phrased in order to encourage innovation?

Metrics are already used extensively in defense planning. For example, million ton-miles per day is widely used for measuring strategic lift capability. However, there was some apprehension that using such standards to measure progress toward attaining the QDR operational goals might lead to proposals of business-as-usual solutions rather than innovative solutions.

A new paradigm, an innovative concept of operation, has emerged and has been used successfully in Afghanistan. We decided to investigate that innovative concept in some detail as an example of what we could learn about the phrasing of metrics to encourage innovation, hoping to apply those lessons to the current project.

Essence of War-Fighting Paradigm That Emerged in Afghanistan

- **Rapid, Precise Remote Fires Team**
  - <u>Ground-based targeting teams</u>, generating GPS target coordinates on enemy units in line-of-sight contact
  - <u>A ground-attack combat air patrol</u>, performed by remotely based, long-range, large-payload, long-endurance aircraft
  - <u>Precision-guided weapons</u>, using GPS (day/night, all-weather) guidance
  - <u>UAVs</u>, performing target detection and designation, and (sometimes) precision-guided weapon-delivery functions
- **Remote Fires war-fighting paradigm should be applicable to many other combat situations:**
  - **Given air superiority**
  - **When conditions permit insertion of the ground-based targeting teams**
- **In certain situations, Remote Fires Teams could replace heavy mechanized units**
  - **Vastly expanding the combat role and utility of light infantry**

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To review, the essence of the new war-fighting paradigm (which we have called Rapid, Precise Remote Fires Teams) has four principal elements. Ground-based teams, in line-of-sight contact with enemy units, determined the coordinates of the enemy units using the Global Positioning System (GPS). The target coordinates were passed to aircraft on combat air patrol (CAP). Mainly bombers that could be based remotely from the theater, the CAP aircraft had large payload-carrying capacity and long endurance over the target area. These aircraft were equipped with precision-guided weapons, many of them GPS-guided, which permitted day or night and all-weather attacks. The ground-based teams and CAP aircraft were supplemented by unmanned aerial vehicles (UAVs), which performed target-detection and target-designation functions and, in some cases, the weapon-delivery function. In Afghanistan, this concept resulted in precise (tens of feet) and rapid (tens of minutes between target detection/designation and attack) remote fires. These characteristics were precise and rapid enough to knock out convoys of moving vehicles.

This new war-fighting paradigm should be applicable to other combat situations, given air superiority (to permit the CAP aircraft to operate without coming under attack) and conditions that permit the safe insertion of the ground-based targeting teams.

Throughout the Afghanistan campaign, working in conjunction with the Northern Alliance, the Rapid, Precise Remote Fires Teams played roles usually performed by artillery and tank units. For those situations in the future for which the new war-fighting paradigm is applicable, Remote Fires Teams could replace heavy mechanized units and vastly expand the combat role and utility of light (preferably mobile) infantry.

Metrics Were Standard Ones

Metric

- **Weapon-delivery accuracy**
- **Response time**
  - **From time of target designation to bombs on target**
- **Firepower**
  - **Number of shots per hour**
- **Begin operations quickly**
  - **Base availability and survivability**

We reviewed the new war-fighting paradigm in an attempt to identify the metrics that might have provided the catalyst to the conceivers of the innovative paradigm. To RAND analysts, the metrics were ones that had been used frequently to characterize this type of operation.

We Believe Coupling a Metric to a Desired Goal Can Encourage Innovation

Metric	Desired Goal
Weapon-delivery accuracy	Few 10s of feet
Response time • From time of target designation to bombs on target	Few 10s of minutes
Firepower • Number of shots per hour	Many 10s to 100s
Begin operations quickly • Base availability and survivability	Within a few days/ near invulnerable

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However, we came to the conclusion that coupling a metric to a desired goal can encourage innovation if the goal is challenging enough—i.e., if it requires a stretch to achieve. For our Afghanistan example, if the goal for weapon-delivery accuracy was set at a few tens of feet, the goal for response time was set at a few tens of minutes, the goal for firepower was set at many tens to hundreds of shots per hour, and operations had to begin within a few days after the decision was made, then we believe that the combination of metrics and desired goals would have been enough to encourage the innovative solution.

Consequently, each metric that we describe for the QDR operational goals will have a desired goal, or value, associated with it.

Transformation Requires Metrics in Three Interrelated Areas

Establish objectives, processes, leadership
- Promulgate missions and goals
- Set up organizations
- Set aside $s

Ensure that programs are on track
- Develop new doctrine
- Design new force structures
- Modify contingency OPLANS
- Ensure that funding/deliverables are on schedule

Ensure that appropriate capabilities emerge
- Encourage innovation
- Select programs on basis of
  - cost-effectiveness
  - robustness
  - flexibility
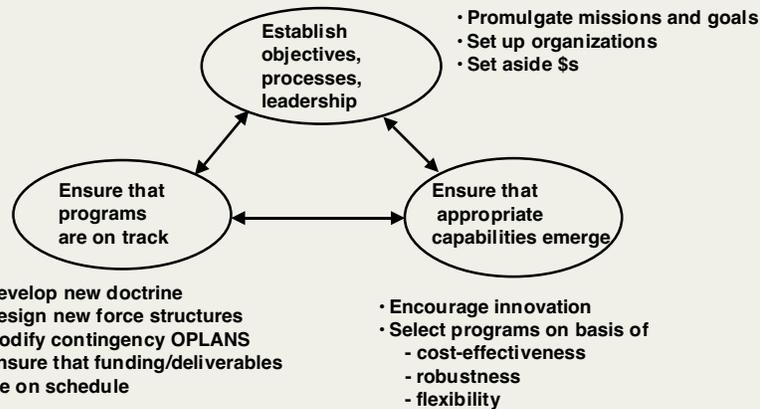
Different types of metrics are needed for the transformation. Metrics can be divided into three interrelated areas as shown on the slide. For a transformation to succeed, first and foremost, objectives must be established, processes must be defined, and leadership must be chosen. Many of these steps have already been accomplished. The QDR report explicitly laid out the new defense strategy and identified the operational goals as the focus for transforming the U.S. military. The office of Director, Force Transformation, has been established. And funds have been set aside to underwrite transformational activities.

Next, appropriate capabilities for meeting the established objectives need to emerge. As discussed in the last few slides, innovative solutions, both in programs and operational concepts, need to be encouraged, and programs and concepts that are cost-effective and that lead to robust and flexible capabilities need to be selected.

Finally, after transformational programs and concepts have been selected, steps need to be taken to ensure that their development remains on track and adequately funded. For programs, attention must be paid to maintaining development and production schedules. In order for innovative solutions to have maximum benefits for force capabilities, new doctrine will need to be developed and new force structures designed. Ultimately, operational plans (OPLANs) must be modified to take advantage of the transformational programs and concepts.

In Two of These Areas, Metrics Involve Next Steps

- **Establish objectives, processes, leadership**
  - Promulgate missions and goals
  - Set up organizations
  - Set aside $s

Sometimes called "next steps"

- **Ensure that programs are on track**
  - Develop new doctrine
  - Design new force structures
  - Modify contingency OPLANS
  - Ensure that funding/deliverables are on schedule

- **Ensure that appropriate capabilities emerge**
  - Encourage innovation
  - Select CONOPS and systems on the basis of
    - cost-effectiveness
    - robustness
    - flexibility

Traditional quantitative metrics

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The primary focus of our study was identifying metrics for encouraging innovation and for selecting CONOPS and systems from among competing innovative proposals ("Ensure that appropriate capabilities emerge"). We call metrics for the other two areas "next steps," because they follow from the traditional quantitative metrics that we identify.

Consequently, in addition to identifying metrics and their associated desired goals, or values, we also link some "next steps" to the metrics and their associated goals.

3. IDENTIFY METRICS FOR EACH OPERATIONAL GOAL
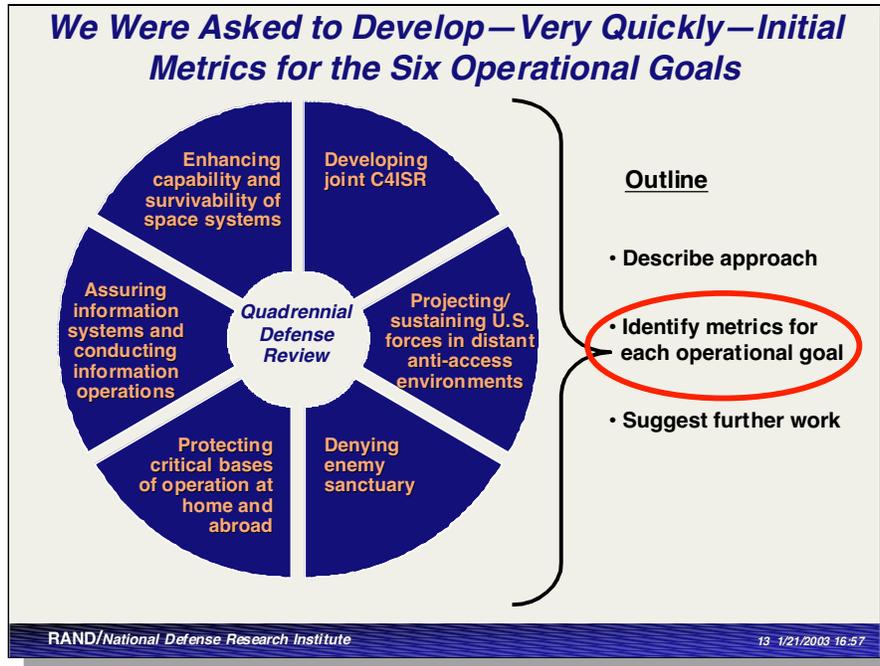
We now turn to the next section of the briefing: identification of metrics for each of the QDR operational goals. During the course of this project, we presented briefings on metrics for each of the six operational goals. The briefings went into considerable detail on our rationale for the metric identification, associated desired goals, and key next steps. This section of the current briefing summarizes the material from those more-detailed briefings.

We Posed Four Challenges Related to Projecting U.S. Power and Denying Enemies Sanctuary

- **Halt an invading army under conditions of early anti-access**
- **Preclude enemy maneuver (e.g., while U.S. or allied forces attack in a regime-change operation)**
- **Stop ethnic cleansing ("next Kosovo")**
- **Deploy and fight in a WMD environment**
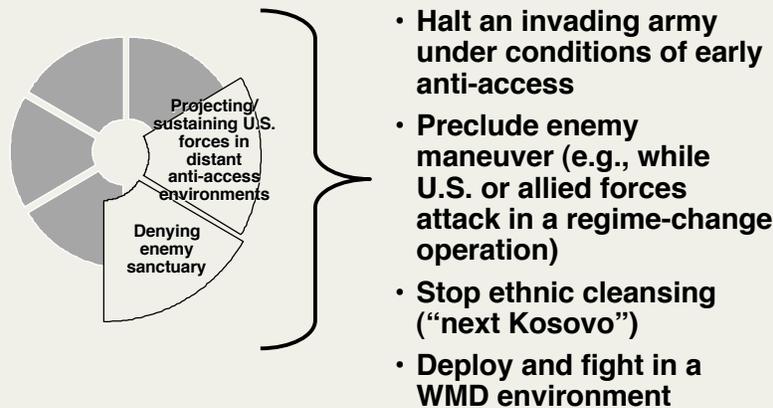
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We considered the first two operational goals ("Projecting/sustaining U.S. forces in distant anti-access environments" and "Denying enemy sanctuary") together because, in many large-scale military contingencies that could be envisioned, these two operations would be conducted simultaneously and would reinforce each other.

We formulated the four challenges listed on the slide by defining a "spanning set" of operational challenges. Consequently, a fairly abstract QDR operational goal can be given concrete meaning while ensuring that a potential package of capabilities will be quite flexible.

This approach requires addressing both offense and defense, different classes of targets, and so on (see Appendix). It is different from choosing an allegedly bounding scenario. The level of analysis, operations rather than wars, is a notch down and recognizes that no single war scenario generates all the necessary stresses. Further, it recognizes that *component operations* (and their subcomponents) are the modules, or building blocks, that establish flexible capability, whereas designing for a particular war can lead to inflexible capabilities.

As we described in Section 2, for each such operational challenge the procedure is to decompose the challenge into critical components. Many decompositions are possible, but the critical-component decomposition is intended specifically for higher-level DoD management (and related analysis). The U.S. military is often considering operations that would fail unless *each* of several component operations proves successful. That is, the net capability is limited by the weakest link.

The decompositions should relate logically to both real-world military operations and to analytic constructs for assessing a capability rigorously. Such a relationship should lead directly to logical metrics—i.e., to common-sense measures of capability. Having decomposed the challenges, we next identified metrics for accomplishing the critical components. These metrics follow from extensive campaign analyses of the challenges, which were conducted in this and earlier studies. The final step was to relate the metrics to the appropriate QDR operational goal.

We Identified Five Metrics for These Two Operational Goals (1 of 2)

Metric	Desired Goal	Key Next Steps
Distance to halt invading army under conditions of early anti-access	100 kilometers	*Set up decision processes that facilitate "leaning forward" upon strategic warning, preemptive attack, and surprise*
Distance to halt maneuvering division	0 kilometers	*Lay groundwork for permanent redlines in Iraq and North Korea--providing fair notice of preemption*
Time to stop ethnic cleansing	A few days	*Assemble fully operational "brigade-size" JTF for immediate operations and rapid insertion*
Fraction of critical enemy fixed and mobile targets that can be held at risk from D-Day (earlier, if preemption permitted)	Value that is consistent with level of long-range strike capability deployed to theater on D-Day (or earlier) as part of OPLAN	

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This slide displays the metric–desired goal–next steps format for the remainder of this section. Although there is a one-to-one correspondence between an individual metric and an individual desired goal as delineated by the dotted line, the key next steps that are listed on this particular slide apply to all of the listed metrics.

The first metric is the penetration distance that an invading army can achieve when U.S. forces are subjected to early-on anti-access attacks. The corresponding desired goal is 100 kilometers (km). (We comment on the practicality of achieving this and other goals shortly.) The choice of the desired goal is not completely arbitrary. The distance between the Iraq-Kuwait border and Kuwait City is about 100 km, and the United States would certainly desire to stop a second attack on Kuwait before the invader reached the capital city. And, of course, the distance between the Korean demilitarized zone (DMZ) and Seoul is much shorter. Achieving this capability has been seen by many in recent years as a tangible example of a *major*, transformational, capability exploiting technology and new concepts of operations—a capability that would render obsolete the massive Soviet-style mechanized forces with which rogue states can threaten their neighbors. This capability was highlighted in the 1996 and 1998 summer studies of the Defense Science Board.[5,6] The second metric relates to halting a smaller-scale (division rather than army) enemy maneuver. It deals with the challenge of precluding enemy maneuver while U.S. and friendly forces maneuver, or being able to protect friendly ground forces, which might apply if the United States were conducting a regime-change operation in Iraq. Here, the goal should be to utterly

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[5]Office of the Secretary of Defense, *Defense Science Board 1996 Summer Study Task Force on Tactics and Technology for 21st Century Military Superiority*, Vol. 2, Part 1, *Supporting Materials*, Washington, D.C., October 1996.

[6] Office of the Secretary of Defense, *Defense Science Board 1998 Summer Study Task Force, Joint Operations Superiority in the 21st Century: Integrating Capabilities Underwriting Joint Vision 2010 and Beyond*, Vol. 2, *Supporting Reports*, Washington, D.C., October 1998.

preclude maneuver, so that the desired goal is 0 km. This would be a plausible goal, but might require new concepts, such as long-endurance, high-capacity, survivable hovering bombers or Unmanned Combat Air Vehicles (UCAVs), or responsive longer-range missiles.

The third metric is the time needed to stop ethnic cleansing. The desired goal is a few days rather than the several weeks or months as in Kosovo.

The fourth metric is the fraction of critical enemy targets, fixed and mobile, that can be held at risk on D-Day, or earlier if preemption is allowed. The desired goal is the value of that fraction of targets that is consistent with the amount of long-range strike capability deployed to the theater on D-Day as part of the OPLAN. Essentially, the U.S. ability to locate and track enemy targets should be roughly in balance with its ability to attack the targets.

There is no doubt that the desired goals are stringent. Several appear at first blush to be impossible to meet with today's or near-to-mid-term's projected capabilities. However, the desired goals are deliberately set to be difficult to accomplish in order to encourage innovative thinking on how they might be met or, if not met, at least approached.

We believe that the desired goals will remain out of reach unless the United States begins to make good use of available strategic warning. This belief prompted us to identify the key next steps displayed on the right side of the slide. The United States should set up a force deployment and employment process that facilitates leaning forward based upon strategic warning. This process would include the use of preemptive attack and surprise, when and where warranted.

A related key step is to lay the groundwork for specifying permanent redlines providing fair notice of possible preemption. These lines would be similar to the no-drive zone that U.S. forces have established in Iraq.

Another key step is the establishment of a fully operational brigade-size Joint Task Force (JTF) for rapid insertion and immediate operation. The Joint Forces Command (JFCOM) has already been tasked to establish a prototype for a Standing Joint Task Force (SJTF) headquarters. We recommend adding forces to the SJTF headquarters as a key next step.

Continuing the list of key next steps from the previous slide, we recommend OPLANs that account for attack of enemy ground forces and critical mobile targets (CMTs) without a lengthy preparation or defense-suppression phase. Methods for quickly suppressing or avoiding enemy air defenses would be key here, as would long-endurance, high-capacity survivable platforms for combat air patrol (CAP) and munitions to provide improvements in aircraft and fleet ballistic missile submarine (SSBN) effective payloads.

The final metric for these two QDR operational goals is the probability of achieving OPLAN objectives *in spite of WMD threats*. The desired goal is to achieve the same probability of success with or without weapons-of-mass-destruction (WMD) threats. (Obviously, the OPLAN will need to be adjusted when WMD threats are present as opposed to when they are not present if the same probability of success is to be achieved.) The key next step is to identify potential failure modes in the OPLAN, assess the consequences, and identify measures to mitigate those consequences.

Our Search for Critical Base-Protection Metrics Focused on Four Homeland Security Missions

- Sovereignty
- Missile defense
- WMD terrorism
- Continuity of military operations

Protecting critical bases of operation at home and abroad

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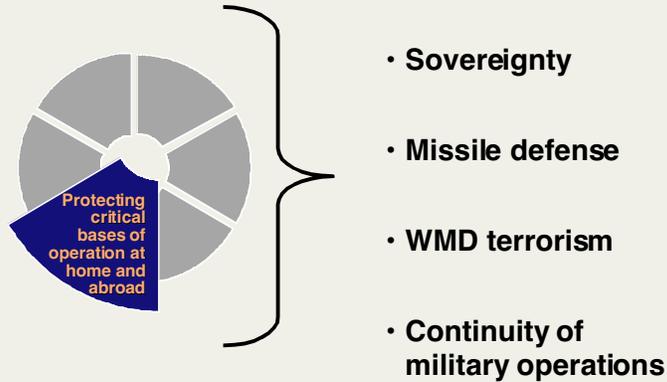
The next operational goal is the protection of critical bases of operation at home and abroad. We have already discussed operating overseas in a WMD environment; here, we confine our remarks to protecting critical bases at home. We focused on the areas shown on the slide: defense of U.S. territory against attacks originating outside the United States, missile defense (although part of the sovereignty mission, missile defense is treated separately because of its prominence in current defense planning), coping with the consequences of WMD terrorism attacks, and continuity of military operations.

The sovereignty mission includes border and coastal defense of the United States.[7] Of primary importance from the perspective of the military is preventing WMD from being launched at or smuggled into the United States.[8] Obviously, the United States would like to intercept WMD as far away from U.S. borders as possible. However, a minimum distance is needed for such interception, and that minimum distance depends upon the nature of the threat.

A ship capable of launching a cruise missile with a 500-km range needs to be intercepted farther away from U.S. shores than does a ship carrying a WMD bomb in a container. Consequently, our metric is the offshore distance at which the United States can determine the intent of and, if necessary, interdict, potentially threatening carriers of WMD. A key next step is to make the goal explicit according to the threat type.

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[7]The material on sovereignty, WMD terrorism, and continuity of military operations is based largely on Eric V. Larson and John E. Peters, _Preparing the U.S. Army for Homeland Security: Concepts, Issues, and Options_, Santa Monica, Calif.: RAND, MR-1251-A, 2001.
[8]Defense against missiles armed with WMD is considered on the next slide.

Missile-Defense Issues Lead to Two Metrics and Desired Goals

Issue	Metric	Desired Goal	Key Next Steps
Missile Defense	Fraction of population that falls within potential reach of deployed defenses	100 percent (effectively)	Develop high-level strategy • Role of deterrence • Space versus terrestrial systems • Preemption and defense
	Probability of zero threat warhead leakage	95 percent	• Boost, midcourse and terminal defense • Local defenses for remote regions and high-value targets Develop new doctrine for use of strategic warning

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For missile defense, we focused on relatively unsophisticated threats of modest size, the so-called rogue nations threats, rather than on defense against a massive, sophisticated attack. If we had considered more-sophisticated and larger threats, our choice of metrics and their associated goals would have been different.

There are two fundamental missile-defense questions: What is to be protected? and What level of protection is desired? A rogue nation armed with a few ballistic missiles equipped with WMD warheads would not be able to cripple U.S. military power or, in the extreme, to destroy the nation itself. However, it could inflict or threaten to inflict substantial misery by killing large numbers of U.S. citizens. Consequently, our first metric is the fraction of the U.S. population that falls within the potential reach of the deployed defenses. The desired goal is 100-percent coverage. We cannot leave significant gaps in defense coverage that would result in substantial numbers of citizens being left unprotected. Otherwise, we would have to assume that those gaps would be discovered and exploited. Further, it would be politically unacceptable to leave significant gaps in coverage.

The second metric is the probability of zero threat warhead leakage—i.e., the probability that not even a single warhead can successfully penetrate the defenses—and the associated goal is 95 percent.

This metric and its associated goal were selected because the United States will desire to *eliminate* damage, not *limit* it. There would be little satisfaction in shooting down one of two incoming warheads that are launched at a U.S. metropolitan area. To be sure, such a stringent objective would be deemed to be impossible to achieve for a large threat. But we are talking about small threats here.

A key next step is the development of an overarching strategy for developing, producing, and deploying missile defenses. That strategy would include the role of the U.S. nuclear and conventional retaliatory capability; the role, if any, of space-based weapons; the complementary roles of preemption and defense; layered defenses; and

consideration of supplemental local defenses for providing coverage to remote regions, such as Hawaii and Alaska, and additional coverage for especially high-value targets, such as Washington D.C.

Another key step is developing doctrine for use of strategic warning. It makes no sense to wait to defend against an anticipated attack if warning would allow preemption, especially since missile defense is difficult and its effectiveness so uncertain.

Our Metrics for Protecting Critical Bases at Home Also Consider the Consequences of WMD Terrorism Attacks

Issue	Metric	Desired Goal	*Key Next Steps*
WMD Terrorism	**Percentage of shortfall in local/state/federal consequence-management-response capabilities met by at-home military units**	**100 percent**	*Determine, from a planning perspective, which organization has responsibility to close shortfall* *If DoD, establish threat, magnitude of effects, desired performance levels, and estimate DoD capabilities to fill shortfall*

Defeating WMD terrorism has two main components: consequence management and crisis management. The Federal Bureau of Investigation (FBI) is the lead agency for all federal crisis-management activities. Our analysis focused on the consequence-management part of WMD terrorism attacks because of the potential for a prominent DoD role.

The Federal Emergency Management Agency (FEMA) is the lead agency for federal consequence-management-response activities. In addition to FEMA, state and local resources would also be available to respond to a terrorist WMD attack. It is prudent to anticipate that FEMA/state/local resources would be insufficient to deal with all WMD emergencies. In those circumstances, if not before, the U.S. military would be pressed into service to provide the resources to close the gaps. Thus, our metric is the percentage of shortfall in FEMA/state/local consequence-management-response capabilities that can be met by at-home military units. We explicitly mention at-home military units because a unit that has already deployed overseas would be useless in dealing with a terrorist incident that occurs at home. The desired goal is 100 percent—i.e., all of the shortfall should be covered.

The choice of the metric and its associated goal assumes that DoD has the responsibility to plan for closing the consequence-management-response shortfalls, after netting out what local, state, and federal civilian agencies and private-sector actors can provide. The first key step is to ascertain the nature and magnitude of potential shortfalls in local and state civilian and military capabilities. The next step is to determine the federal agencies that have responsibility for making up remaining specific shortfalls.

If DoD has the responsibility to make up the shortfall—or to provide support to another actor that has primary responsibility—then the next key steps would follow: (1) For different types of WMD threats, estimate the maximum magnitude of the potential resulting harm (e.g., deaths or injuries that might be prevented) that will be used for planning, and the desired response performance levels; (2) estimate the

capabilities that would be needed to provide these performance levels; (3) identify which capabilities DoD might need to provide; and (4) estimate DoD's current ability to make up for the shortfall, and take steps to correct any deficiencies.[9] However, the responsibility for making up for the shortfall may be assigned to some other federal agency. Therefore, the first key step is to determine the organization that has the responsibility for remedying the shortfall.[10]

While our focus here is on *protecting* critical bases at home that are subject to WMD attacks, it is also important to be able to identify the perpetrators of the WMD attacks so that the United States could undertake retaliatory attacks promptly.

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[9]This study was completed before the Bush administration announced plans to create the Department of Homeland Security.

[10]In an emergency, the DoD will always be called upon for whatever assistance it can provide. There is a difference between an ad hoc response and a planned response. We are talking here about DoD's planning responsibilities.

Additionally, Our Metrics for Protecting Critical Bases Consider Continuity of Military Operations

Issue	Metric	Desired Goal	Key Next Steps
Continuity of military operations	Time to restore mission-critical facilities and networks following an attack	Minimum time necessary so that OPLAN objectives can still be achieved with high confidence	Establish criteria for identifying "mission-critical" bases, installations, etc. Determine the level of acceptable delays Identify workarounds and fixes so that the acceptable delays are not exceeded

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The final component of protecting critical bases was continuity of military operations. To slow deployment of U.S. forces or impede their effectiveness once deployed, any nation or group subject to being pursued overseas by U.S. military forces might attack U.S. forces and the civilian infrastructure those forces rely on. The identified metric is the time that it would take to restore mission-critical facilities and infrastructure networks following an attack. The desired goal is the minimum time necessary so that the OPLAN objectives can be achieved with high confidence. Short delays in deployment or small amounts of degradation in force-employment capability may be acceptable. What those delays are needs to be determined.

Key next steps include establishing criteria for identifying "mission-critical" bases and infrastructure, determining the magnitude of delays that is acceptable, and identifying workarounds and fixes that would ensure that delays are not longer than the acceptable delays.

For Information-Assurance Metrics, We Focused on Computer Network Operations

Assuring information systems and conducting information operations
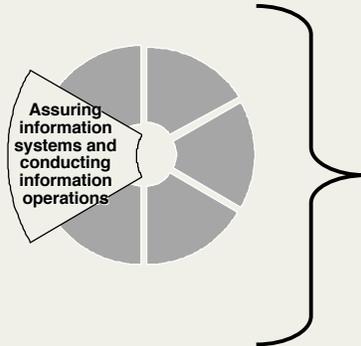
- **Metrics attempt to capture emerging information-age issues and opportunities**

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We now turn to the information-assurance operational goal. Our focus is on identifying metrics that capture emerging information-age issues and opportunities, such as computer network defense and attack missions.

We Concentrated on Offensive and Defensive Elements of Computer Network Operations

Information Operations (IO)

Information Operations Supporting National Security Needs Day-to-Day

Information Warfare (IW)
· Attack
· Defend

Offensive
· PSYOPS
· Electronic Warfare
· Military Deception
· Physical Attack
✓Information Attack

Defensive
✓Information Assurance
· OPSEC
· Counterintelligence
· Counter-PSYOPS
· Electronic Protection
· Counterdeception

· C4/ISR
· Weather
· Precision navigation & positioning

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Information operations covers a wide gamut of activities, ranging from electronic warfare and psychological operations (PSYOPS) to operations security (OPSEC) and electronic protection. The QDR report emphasized the growing dependency of U.S. society and military forces on advanced information networks, which creates potential new vulnerabilities as well as opportunities. Because of this emphasis, we focused on two information-warfare components: information assurance and information attack. We believe that, of the two components, information assurance should receive more attention because of the high dependency of the U.S. society, generally, and the U.S. military, specifically, on information systems and networks relative to other countries. Therefore, we address the information-assurance component first.

Issue	Metric	Desired Goal	Key Next Steps
Information Assurance	Percentage of critical DoD information-technology systems certified as secure—i.e., with vulnerabilities identified and eliminated	100 percent	Provide national-level guidance on legal issues, national security/law enforcement boundaries and authorities, and "active defense" ROEs and procedures—e.g., - monitoring domestic networks - FOIA: willingness of commercial entities to share information - stopping attacks vs. collecting evidence - hot pursuit crossing international borders Influence commercial providers on infrastructure security protection

The metric we identified for information assurance was the percentage of critical DoD information-technology systems that are certified as being secure. By *secure*, we mean that if vulnerabilities exist, they have been identified and adequately eliminated. The desired goal is 100 percent, which is a logical goal if the systems are deemed to be critical to operations. By *critical information systems*, we mean those systems that are indispensable for the successful conduct of operations.

A key next step is providing national-level guidance on a whole host of issues, including (1) legal issues, such as the monitoring of domestic networks to see if they have been breached and the willingness of commercial entities to share security information with the government when that information may become widely available through the Freedom of Information Act (FOIA), (2) delineating national security and law enforcement boundaries and authorities when those organizations may be in conflict—for example, when law enforcement authorities desire the attacks to continue so that they can gather evidence and the military wants the attacks to cease, and (3) rules of engagement (ROEs) for regulating active defense measures such as hot pursuit across international borders.

Another key step relates to DoD dependence on commercial information-infrastructure providers. In this step, we urge DoD to participate effectively in critical-infrastructure forums in order to influence how the commercial community provides security.

| Issue	Metric	Desired Goal	Key Next Steps
Information Attack	Percentage of critical adversary information-technology systems that can be and are held at risk	Double-digit SAM defenses: ensure that minimal aircraft attrition (<< 1 %) occurs	*Provide national-level guidance on legal issues and ROEs* *- attacks may affect civilians or U.S. entities*
		Critical C2 systems: ensure that U.S. C2 loop operates inside adversary's loop	*Coordinate/adjudicate DoD and IC responsibilities and authorities* *- attack vs. exploit*
			Synchronize, deconflict, and integrate service and joint doctrine

For offensive information warfare, the metric is the percentage of critical adversary information-technology systems that can be and are held at risk. There can be numerous systems, and we believe it is important to focus on the critical systems and not dissipate DoD efforts. The two critical systems are those that control the surface-to-air missiles (SAMs), particularly the most modern, or "double-digit," SAMs, and the overall C2 systems, including related ISR systems.

The importance of negating SAM defenses, especially double-digit SAMs, cannot be overemphasized. If enemy SAM defenses are rendered ineffective, all sorts of operational opportunities become available to the joint commander that would not otherwise be feasible. Thus, the desired goal is to perform information operations so that aircraft attrition is very low or non-existent. With regard to the enemy's overall C2 system, the desired goal is to have the time for U.S. military leaders to make command decisions and to execute them be shorter and, it is hoped, considerably shorter than the corresponding time for the enemy.

A key next step is to provide national-level guidance on legal issues and on ROEs when information operations might involve inadvertent attacks on enemy civilians or on U.S. entities located overseas. Another key step is to coordinate and adjudicate DoD and intelligence community (IC) responsibilities and authorities. For example, DoD may want to attack and destroy a network, whereas the IC may want to exploit the network.

Finally, service and joint doctrine should be integrated. As of now, each organization is pursuing its own goals and is often not aware of what other organizations are doing, in part because of security compartmentalization. Effective information attack requires centralized control with decentralized execution. Effective use of information operations will require service/joint/interagency cooperation and collaboration, with appropriate management authority, visibility into classified programs and funding, and programmatic discipline.

In Our Search for Space Capability and Survivability Metrics, We Focused on the Space Control Mission

Enhancing capability and survivability of space systems

✓ **Space control**

· **Force enhancement**

· **Force support**

· **Force application**
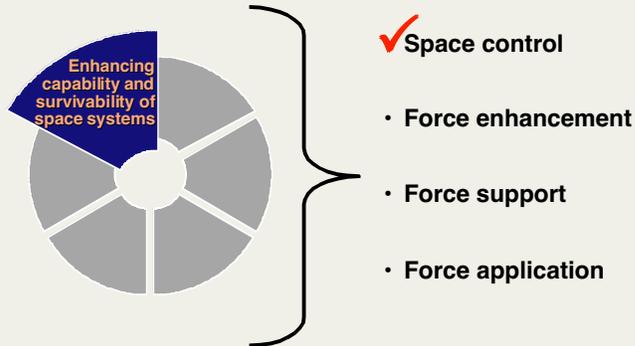
The space mission can be divided into four parts: (1) space control, which involves the ability of the United States to access and utilize space, protect U.S. space assets from attack, and, when directed, deny the enemy access to space, (2) force enhancement, such as providing navigation and missile warning information, (3) force support, which includes space lift and satellite control, and (4) force application, which involves weapons transiting through or based in space. The QDR emphasized the importance of space control. Consequently, that was the focus of our deliberations.

We Derived Three Metrics for Space Control

Metric	Desired Goal	Key Next Steps
Time to restore minimum-acceptable U.S. space capability	Hours or days	*Establish minimum-acceptable capability for nav, comm, ISR, weather, and missile-warning space capabilities* *Evaluate range of options: satellite hardening, supplemental terrestrial backups, rapid launch capability, deep-space and on-orbit spares, etc.*
Number of enemy anti-satellite salvos before U.S. destroys ASAT capability	One	*Determine space surveillance requirements and countermeasures for attacks by nanosats*
Number of non-U.S. space systems that can be prevented from providing important information to adversary	All critical systems	*Determine which space systems can be denied through cooperative means* *If cooperative measures infeasible, consider both non-lethal and lethal means for denying access*

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We derived three metrics for space control; the first two relate to ensuring freedom of access to space for the United States and its allies.

The first metric is the time that it would take to restore minimum-acceptable U.S. space capability after that capability had been degraded either by enemy action or for some other reason. The *minimum-acceptable U.S. space capability* is that capability that would still allow U.S. military forces to execute its OPLANs successfully. The desired goal is that the minimum-acceptable capability be restored in hours or days rather than several weeks or months, which is the case now. Key next steps are the determination of the minimum-acceptable capability for navigation, communications, ISR, and other space force enhancement activities. Next, evaluate a range of options, including hardening (to make it more difficult to degrade U.S. space capability), supplemental airborne or ground-based backup systems, rapid launch capability, deep-space and on-orbit spares, and other means for restoring the minimum-desired level of capability.

The second metric is the number of enemy anti-satellite (ASAT) salvos that are fired before the United States can destroy the enemy's ASAT capability. The desired goal is one salvo. Short of preemption, the United States cannot prohibit an adversary from taking the first shot; however, the United States cannot afford to let it attack U.S. space assets at will after it has taken the first shot. A particularly difficult ASAT capability to defend against is attacks by so-called nanosats, small satellites that can be launched in peacetime and that orbit close or attach themselves to U.S. satellites and then explode or otherwise degrade the performance of the satellites when they receive a signal, once hostilities have commenced. Accordingly, the key next step is to determine the space-surveillance requirements and countermeasures for attacks by nanosats.

An adversary can gain access to space by paying to use commercially available systems or by orbiting its own space systems. Denying an adversary's access to space must take into account both types of systems. The third metric of U.S. ability to limit an adversary's access to space is the number of non–U.S. space systems that can be prevented from providing important information. The associated desired goal is

denying all systems that could provide information that is critical to the conduct of the war. The first key next step is to determine which space systems can be denied to an adversary through cooperative means between the United States and the nation or commercial entity that owns the system. During a conflict, the United States may simply be able to buy the provided service, thereby denying that service to its adversary.

For those systems for which denying the service through cooperative means is not feasible, both nonlethal and lethal means need to be considered. Nonlethal means would come into play when a satellite system belongs to an ally or third party. Destroying a satellite could be considered an act of war, and, unless the United States is in a desperate situation, that is an act that it would probably want to avoid. Nonlethal means for temporarily degrading the functioning of a satellite, perhaps through jamming of communications satellites or temporarily blinding the sensors of imaging satellites, would be preferable to either not stopping an adversary from having access or destroying the satellite. The same nonlethal techniques could also be used to degrade an adversary's satellites, although there would be no prohibition to destroying them outright.

We Focused on Two Metrics Related to Joint C4ISR

Developing joint C4ISR

Metric	Desired Goal	Key Next Steps
Percentage of C4ISR elements that should be interoperable, and are interoperable	100 percent	Establish C4ISR architect/engineer with appropriate authority to influence acquisition process and budget for C4ISR systems
Time to establish fully integrated C4ISR system in an AOR distant from CONUS that can provide responsive C2, BM, and timely ISR TPED	C4ISR: earlier than 48–96 hours C2/BM: hours for planning; near real-time for execution ISR/TPED: near real-time for CMTs	Field additional manned/unmanned airborne sensor systems and/or space-based sensor systems, if needed Integrate information and communications systems into a global network

The final operational goal relates to developing joint C4ISR.   The QDR report argues that information technology will provide a key foundation for transforming the U.S. military and that interoperable information systems are a key element in all DoD operational and system architectures. Interoperable systems in which information can be shared offer the promise of conducting operations more efficiently and with fewer forces than current systems.

When the current study was under way, another NDRI study was just beginning whose purpose was to develop a framework with analytic methods and metrics for informing DoD decisions about C4ISR investments.[11] We used its framework and the Decision Support Center's review of over 40 studies as our point of departure in developing C4ISR metrics.[12]

Our first metric is the percentage of C4ISR elements that should be interoperable, and that in fact are interoperable. The associated desired goal is *all*. No one within DoD has the authority now to accomplish this goal. Authority is spread across the services and C3I. Therefore, our recommended key next step is that a C4ISR architect/engineer be designated and given the appropriate authority to influence the acquisition process and, importantly, the budget for C4ISR systems.

The second metric is the time necessary to establish an integrated C4ISR system in the theater of operation distant from the United States that can provide responsive C2; battle management (BM); and timely ISR tasking, processing, exploitation, and dissemination (TPED) of intelligence products. The goal has three components. The goal for establishing the C4ISR system in an Area of Responsibility (AOR) is earlier than 48–96 hours. The Air Force has a bombs-on-target goal for its Air Expeditionary Force of 48 hours after receiving the order to begin operations, and the Army has a

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[11] The other study, *Toward an NCW Focused Investment Strategy for DoD Transformation,* is being led by our RAND colleague David Signori.
[12] Department of Defense, *2001 C4ISR Study Review*, Washington, D.C.: Joint C4ISR Decision Support Center (DSC), 2001.

deployment goal of 96 hours for its Stryker Brigade Combat Team (SBCT). Therefore, an integrated C4ISR system needs to be established in the theater prior to the arrival of those forces. The goal for conducting command and control and battle management is hours for planning, such as development of the Air Tasking Order (ATO), and near real-time for execution. The goal for timely ISR/TPED is near real-time for critical mobile targets (CMTs), a time that is necessary to engage those targets effectively.

The key next steps are to develop and field a rapidly deployable sensor architecture to provide persistent surveillance, and to integrate information and communications systems into a global network to enable rapid access to information anywhere within DoD and the IC, subject to security considerations.

4. SUGGEST FURTHER WORK
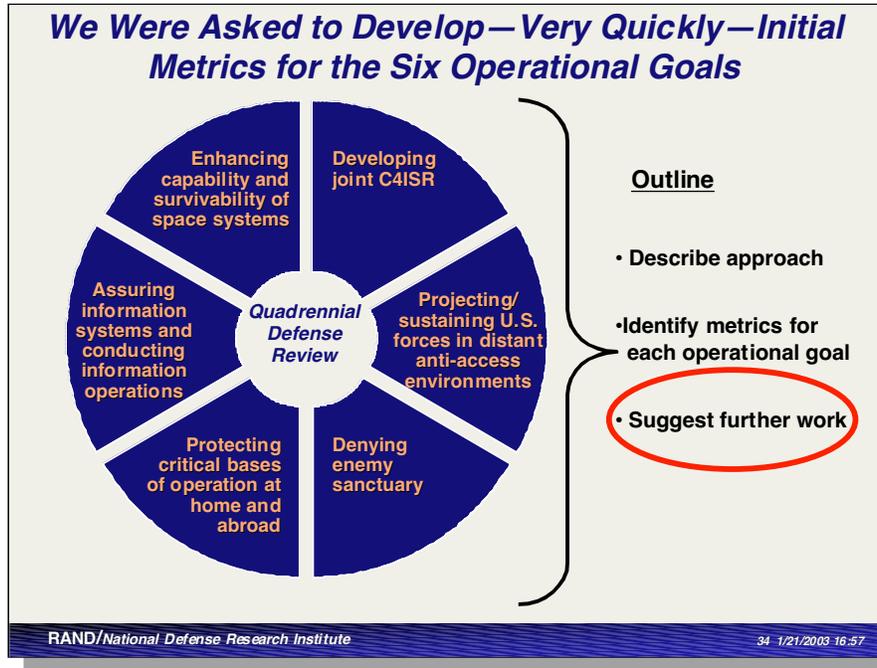
Our work on the development of metrics to measure DoD's progress in attaining the QDR operational goals has led us to suggestions for further work.

Suggested Next Steps

- **Test the metrics as a basis for decisionmaking**
  - **Establish baseline**
  - **Identify and evaluate alternatives**
- **Balance short- and long-term risks**
  - **Construct alternative defense programs that emphasize short- and long-term national security demands**
  - **Identify alternatives to mitigate risk**
  - **Assess short-term risk versus long-term risk**
- **Understand how to ameliorate institutional factors that could impede transformation—for example**
  - **The current acquisition system's unresponsiveness to innovation**
  - **DoD's difficulty in competing for skilled personnel**

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We recommend that DoD pursue three initiatives to advance the transformation of the U.S. armed forces.

Having developed a set of 17 metrics and associated goals for measuring progress in attaining the QDR operational goals, we recommend that the metrics be used as a tool for building a program to attain the associated goal or goals for each metric. The first step would be to establish the baseline—i.e., the value of the metric that is attainable with current or near-term capabilities. The next step would be to identify alternative transformational activities for addressing the shortfall, or difference, between the baseline value of the metric and the desired goal. Finally, the identified alternatives would be analyzed using the methods of capabilities-based planning and the metrics here to determine which alternatives show the most promise.

The second initiative involves assessing and balancing near- and long-term risks, or "operational and future challenge risks" as the QDR report defines them. At the same time that DoD is pursuing transformational activities, it needs to support to some extent its legacy systems, including recapitalizing those systems until new capabilities are introduced into the force. Given a fixed defense budget, trade-offs can be made between developing future capabilities and sustaining current and near-term capabilities. However, such trade-offs are not without risks.

Attempting to balance near-term risks and long-term risks in concert with transforming U.S. armed forces raises some fundamental questions that need to be answered:

- What near-term capabilities might DoD be able to forgo if the near- to mid-term security environment is fairly benign?

- What hedging strategies might DoD employ to lessen the effect of reductions in near-term capabilities?

- What risks are associated with cutting near-term capabilities if the forecast of a benign near- to mid-term security environment is in error?

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- What would be the costs, in time and dollars, that would be required to procure additional weapon systems or to retrain or reactivate units if the need arises?

The final initiative would identify and suggest ways to ameliorate institutional factors within DoD that could limit or otherwise impede transformation efforts. Two sample factors that *might* limit or impede transformation efforts are a system-acquisition process that is unresponsive to innovative system concepts and DoD's difficulty in competing with the civilian sector for skilled personnel.

This Appendix focuses on operational goals 1 and 2 (see p. 2), which relate to projecting forces in the presence of anti-access strategies and to denying the enemy sanctuary. "Denying sanctuary" is treated here only in the context of force projection—not, for example, in the context of finding and attacking terrorist groups deep within some nation that harbors them.

Approach Outline

Identify spanning set of operational challenges to give concrete meaning to goals

For given operational challenge,

- **Decompose problem into critical components**
- **Relate top and lower nodes to analytic constructs and resulting metrics**
- **Establish desired goals**
  - **Goals stressful enough to dramatically alter nature or extent of capability**
  - **Goals that will typically require new CONOPS, force units, etc.**

The approach taken in this part of our work was to define a "spanning set" of operational challenges so that an abstract QDR transformation goal (QTG) can be given concrete meaning and military planners can be given a way to ensure that a potential package of capabilities will be quite flexible.

For each such operational challenge, the procedure is to decompose the challenge into critical components. Military planners are often dealing with capabilities for military operations that would fail unless *each* of several component operations proves successful. That is, the net capability is limited by the weakest link. The decompositions should relate logically to both real-world military operations and to analytic constructs for assessing the capability rigorously. If so, they should lead directly to measures of capability.

There is usually nothing transformational about a metric per se (at least, a metric of capability). However, when the goals[13] for those metrics are stringent enough, then the result is transformational. Indeed, achieving such goals usually requires new concepts of operations, force units, weapon systems, and command and control systems. This is not change for the sake of change, but change to enable the achieving of important and stressful goals.

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[13]Here and in much of the briefing, *goal* refers to the value sought for a given metric. This is a different usage than in the context of referring to the QDR's operational, or transformation, goals, usually referred to here as QTGs.

Choosing Operational Challenges

Challenges chosen should:

- **Be modules of future Combatant Commander–level campaigns**
- **Address only issues needing special attention**
- **As a group, give concrete meaning to QDR's transformation goals**
- **Relate to both visionary and current-day military constructs**

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Our approach uses operational challenges to provide context. The concept for doing so has been discussed previously in some depth.[14] This slide summarizes some highlights. A key point is that transformations involve development of new modules (new force units, new concepts of operations, and new technical systems). If chosen to focus only on the special issues demanding attention by the Secretary of Defense (SecDef), the operational challenges should be good modules of future anticipated operations. The SecDef need not worry about the Air Force working on air-to-air superiority, but he *does* need to worry about whether future commanders will be able to conduct various *joint* operations and to do so *quickly and adaptively*.

In this work, the choice of operational challenges should be driven by the QTGs and by other background constructs, such as those of the Joint Vision documents.

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[14]Paul K. Davis, *Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation*, Santa Monica, Calif.: RAND, MR-1513-OSD, 2002.

Our current work on projection-force transformation uses the above operational challenges.

Why These?

Beyond covering QDR transformation goals, we need capability modules for

- **Offense and defense**
- **Mobile, fixed, and maneuver-force targets**
- **MTW, SSC, and anti-terrorist-type conflicts**
- **With good and minimal early access**
- **Standoff and up-close-and-dirty**
- **Joint aerospace, land, and sea operations**
  - **—all in ambitious, transformational context, not easy cases**

These challenges were chosen to help the designer (the force planner) by providing a spanning set of representative stresses. Such a set requires addressing both offense and defense, different classes of targets, and so on, as shown in the slide.

This is a very different approach from that of choosing an allegedly bounding scenario. The level of analysis is a notch down, at the level of operations rather than wars. The approach recognizes that no single war scenario generates all the necessary stresses. Further, it recognizes that *component operations* (and their subcomponents) are the modules, or building blocks, that establish flexible capability for dealing with a variety of contingencies, whereas designing for a particular war can lead to inflexible capabilities.

Projection-Force Challenges Stress All QTGs, but Emphasis Here Is on QTGs 1 and 2

QDR Priority Challenge	1 Project in presence of anti-access	2 Deny sanctuary	3 Protect bases; defeat CBRNE	4 Assure IT and conduct IW	5 Enhance space capability	6 Leverage IT for joint C4ISR
1 Quick counter-maneuver	•••	•	•	•	•	•••
2 Destroy CMTs	•••	•••	•••	•	•••	•••
3 Stop the killing	•••	•	•	•	•	•••
4 On-ground counterforce	•••	•••	•••	•	•	•••
5 Attack terrorist strongholds	•••	•••	•	•	•	•
6 Do early counter-offensive	•••	•	•••	•	•	•••
7 Invade after loss	•••	•	•	•	•	•

• QTG may be important to success in challenge; ••• Challenge provides direct stressful metrics for QTG

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This slide indicates that the projection-force operational challenges provide stresses for *all* of the QTGs. The more bullets in a cell, the more directly a QTG can be given concrete significance in an operational challenge. However, this Appendix focuses on QTGs 1 and 2.

Counter Maneuver Quickly

1 Halt Time

2a **Deploy forces and logistics**
2b **Establish high-effectiveness C2, ISR**
2c **Suppress or avoid air defenses**
2d **Attack maneuver forces**

Use forward-deployed forces

Deploy upon strategic warning

Deploy fast after D-Day

Use standing capabil-ities

Spin up fast after strategic warning

Attack IADS

Use stealth or standoff

Maintain suppression

Delay and disrupt

Attack moving forces

Reinforce allies

Top level: <u>and</u> conditions
Lower level: mix of <u>and</u> and <u>or</u> conditions

<u>Logical Metrics</u>
- Time to deploy
- Time to establish C2, ISR
- Time to defeat defense
- Time to defeat maneuver force

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This slide provides a breakdown of components for the first operational challenge, that dealing with countering maneuver forces quickly, as in an early halt[15] or in a regime-change operation in which the United States wants to tie down enemy forces while, in other operations of the overall campaign, U.S. forces do their own maneuver. The slide highlights getting the forces to the theater; establishing the requisite command and control; suppressing, evading, or bypassing air defenses; and attacking enemy maneuver forces. The operation would fail if *any* of these critical components fails. It leads logically to a systematic set of metrics, as indicated on the slide.

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[15]Achieving this capability has been seen by many in recent years as a tangible example of a *major*, transformational, capability exploiting technology and new concepts of operations—one that would render obsolete the massive Soviet-style mechanized forces with which rogue states can threaten their neighbors. The transformational nature of the capability was highlighted in the 1996 and 1998 summer studies of the Defense Science Board (Office of the Secretary of Defense, 1996, 1998).

Generic Metrics

Top Level
- **Nominal distance and time to halt invading road-bound army (via an agreed-upon calculation)**
- **Nominal ability to counter (preclude) smaller-scale shorter-distance maneuver (e.g., Iraqi division-level maneuver against dissident element) (via an agreed-upon calculation)**

Second Level
- **Buildup curves for employable capability versus time, measured from strategic warning on which action can and should be taken**
- **Time to achieve full capability for high-effectiveness C2, ISR**
- **Delay time for defense suppression adequate to permit large-scale interdiction operations**
- **Potential effectiveness per aircraft-day or missile-launcher day (armored vehicle kills per day, others...)**

> **Goal setting must distinguish cases' varying threat size, warning, forward presence, time of access, enemy tactics with SAMs,...**

At the top level, the obvious metrics for this challenge are relatively scenario-independent measures of countermaneuver capability: the halt distance and halt time as calculated for a stereotyped threat. Using them is akin to measuring the mass or momentum of a collective effort. Such metrics require agreed-upon calculations. This agreed-upon calculation should be simple and more like a rule of thumb than a complex computer simulation that depends on thousands of input data elements. An analogue might be measuring the performance of a new personal computer by asking how long it takes to perform a group of set piece operations (e.g., a spreadsheet calculation and retinting of a photograph).

In this approach, and as suggested by the previous slide, there are logical high-level metrics for each of the critical components. The logical way to display this challenge graphically is with a curve that shows the increase of component capability over time; another way is to estimate ("measure") troublesome delays, such as the time to suppress or evade[16] air defenses well enough to permit attack of maneuver units. And, finally, another high-level metric is the killing power per shooter-day by either aircraft or missile launcher.

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[16]The phrase "suppress or evade" is significant because a transformational approach might involve a concept of operations in which the air defenses can be ignored or bypassed, rather than suppressed. Or the concept might employ a new system of attack that could instantaneously suppress air defenses, rather than requiring a multi-day campaign.

$$T_{halt} \approx \frac{TgtsToKill}{Shooters * Lethality} + T_x - T_{delay}$$

Result of early attacks on choke points

Equivalent D-Day shooters

Kills/day

When tgts can be attacked, which is max of Tsead, Tc3I

Assume: 1,000 targets to kill and that T_x is when effective attacks on maneuver targets can begin

Actual calculations would be a bit more complicated and accomplished with a fast-running exploratory-analysis model.

This slide illustrates schematically a potential agreed-upon calculation. Based on insights from more-detailed analysis,[17] it suggests estimating halt time with a formula dependent on the number of targets that have to be killed (which could be standardized at, say, 1,000), and by various aspects of a capability package:

Shooters: shooters present on D-Day in a standard scenario, assuming, for example, current-day forward presence and 7 days of ambiguous strategic warning, but no full-scale deployment until D-Day.

Lethality: kills per shooter per day achievable after air defenses have been suppressed or evaded, assuming a standard threat moving along three two-column axes of advance with 100 meters between armored vehicles. The calculation would address both per-sortie lethality and sortie rate, which, in turn, would depend on aspects of the capability package, such as its dependence on forward bases and prepositioning of support, and surge-sortie potential from bases or carriers. Long-range bombers and missile-firing ships or ground-force units would be included as equivalent shooters.

T_x: the largest of the time required to spin up command and control sufficiently to prosecute effective attacks on maneuver forces, the wait time before even stealthy shooters could be employed, or the time to suppress air defenses. It would be improved by a standing JTF command and control element, such as that mandated by the QDR.

T_{delay}: the delay that could be imposed on the enemy if permission were granted to attack choke points early (e.g., effects-based preemption after enemy crossing of redlines).

Although the actual calculation would likely be done with a fast-running computer model, the formula could be used for rough work and for highlighting solutions that provide significant increases in capability. Note from the formula that an early halt is infeasible if, for example, a suppression of enemy air defense (SEAD) campaign is required that would take a week (T_x would be at least 7 days

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[17]Paul K. Davis et al., *Measuring Interdiction Capabilties in the Presence of Anti-Access Strategies: Exploratory Analysis to Inform Adaptive Strategy for the Persian Gulf*, Santa Monica, Calif.: RAND, MR-1471-AF, 2002. This documents a model for real-time exploratory analysis across scenario assumptions. A much simpler model can also be used if desired. It is akin to the formula above (Davis and Bigelow, unpublished RAND research).

Metrics of Interdiction Problem

Halt Time (days) — Halt Distance (km)

Realm of incremental gain

Transformational Goal

Today — Better Munitions — + Faster Deployment — +Faster SEAD — + Improved Command and Control Spinup Times — + Early strikes

Mission-system analysis:Transformation requires addressing *all* critical components: mission-system analysis

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This and the next slide provide a preview of cross-cutting considerations that arise in the discussion of all the metrics presented later. This slide illustrates how the metric of halt time (or halt distance) might be used for decision support. Halt time (as computed in the "agreed-upon calculation") is shown as a function of various potential programs, each of which has associated budgets. The message of this illustrative chart is that programs to improve munitions would help—a bit; programs to improve munitions *and* speed up deployment would help—a bit; and so would programs to reduce SEAD time. However, to achieve something transformational—an *early* halt even in difficult scenario—would also require programmed actions to ensure rapid *spin up*, or short time to achieve full capability, of command and control. A similar pattern would apply if the order of the programs just discussed were changed. *The point is that transformational change requires looking at the problem as a system with a number of critical components—all of which must be addressed.*

As suggested by the rightmost bar, if, in addition, the United States were poised to make use of strategic warning and violation of redlines (a function of capabilities, readiness, diplomacy, and strategic doctrine), then D-Day effects-based targeting operations could have a substantial bonus benefit.[18]

[18]Paul K. Davis, *Effects-Based Operations (EBO): A Grand Challenge for the Analytical Community,* Santa Monica, Calif.: RAND, MR-1477-USJFCOM/AF, 2001.

**Special Metric: Time Lines
for Employing New-Capability Ground Forces**

Ground
forces
employable

Desired capability?

Heavier
strike-unit
component

Mobile,
light
strike
units

Regular
forces

Alllied
support

Current capability?

Marine Expeditionary Unit,
Airborne brigade

Time (days)
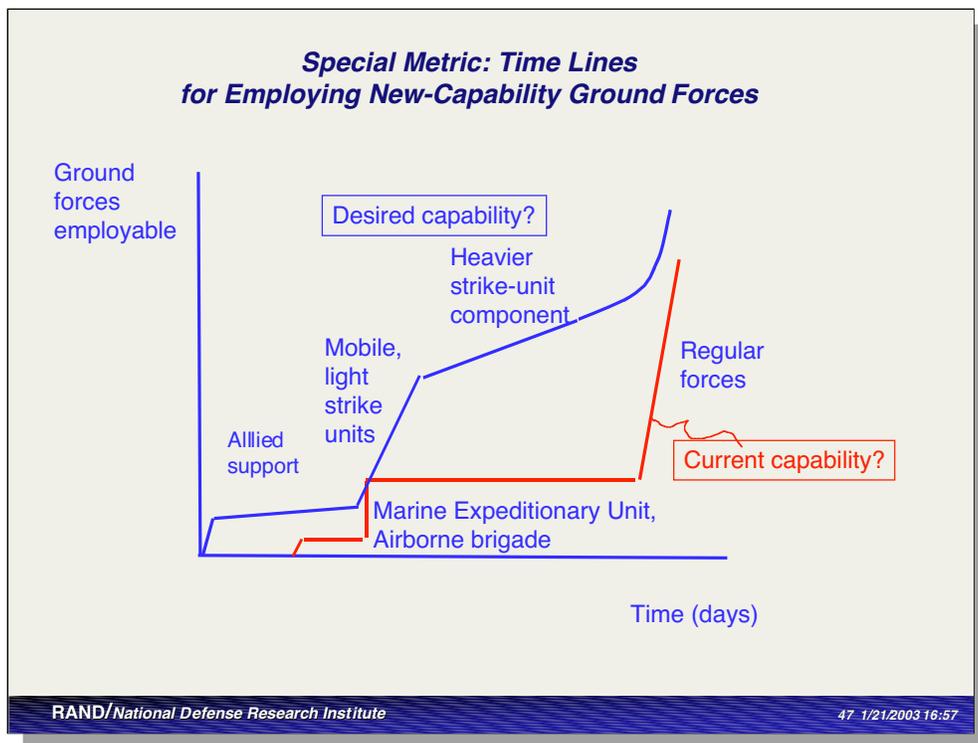
This slide shows another way to depict major, transformational changes in capability for projection forces. Here, the baseline buildup rate for immediately employable ground forces is fairly leisurely—too much so for a quick intervention to stop the killing, as in a future-Kosovo scenario. However, it would be possible to construct a rapidly employable joint strike force with substantial ground forces for the first days and week of operations. When viewed in this way, the change is seen as much more than merely incremental: It would enable new concepts of operations and enhance the ability of the United States to deal effectively with a potentially important class of conflicts.[19]

With this background, let us now look at suggestions for transformational metrics.

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[19]See Gene Gritton, Paul K. Davis, Randall Steeb, and John Matsumura, *Ground Forces for a Rapidly Employable Joint Task Force*: *First-Week Capabilities for Short-Warning Conflicts*, Santa Monica, Calif.: RAND, MR-1152-OSD/A, 2000. An early version of this work was included in Vol. 1 of a 1998 summer-study report of the Defense Science Board (Office of the Secretary of Defense, 1998).

Transformational Metrics for Projection Forces

Metric	Today	Transformational Goal
Halt Distance (km) (invading army)	350 with access	100 with minimum access
Halt Distance (maneuvering division)	Not feasible if maneuver is fast	0 (assuming ability to hover)
Time/Resources to Stop the Killing	Months/Hundreds of thousands, even with allies	1-3 days with "brigade level" forces assisting allies
Deployment Times	Deliberate deployment over many weeks, even with maximum access	100-200 D-Day shooters with minimum access Highly capable joint strike force over 1st week
Spinup Times for C2, ISR...	Weeks from C-Day	Days from strategic warning
Time to Defeat or Bypass Air Defenses	> Week	0
Effectiveness against maneuver forces	1 kill per shooter-day	8 kills per shooter day

This is one of two summary slides listing metrics for transformation. This one addresses the first QTG: projecting forces in the presence of anti-access strategies. At the top of the table are the top-level metrics, which have been alluded to earlier. The lower part of the table shows some of the second-level metrics associated with critical components.

The first two rows deal with counter-maneuver capability. The first addresses the classic halt problem, rendering obsolete the many Soviet-style mechanized divisions owned by potential rogue states that could threaten their neighbors. The metric is the ability to halt such an old-fashioned invasion. The transformational goal might be to be able to halt such an invasion within 100 km. That would be highly stressful—if we consider future circumstances of reduced forward presence on the ground, potential access problems, and so on. However, it is not an impossible goal (see Davis et al., 2002).

The second row deals with the challenge of precluding enemy maneuver of even a few divisions: being able to "tie down" enemy ground forces while U.S. and friendly forces maneuver, or being able to protect friendly ground forces, which might apply if the United States were conducting a regime-change operation in Iraq. Here, the goal should be to utterly preclude maneuver—a plausible goal, but one that might require new concepts such as long-endurance, high-capacity, survivable hovering bombers or UCAVs, or responsive longer-range missiles.

The third row addresses the stop-the-killing scenario. The other rows, the second-level metrics, need not be elaborated here.

Transformational Metrics (partial) for Denying Sanctuary

Metric	Today	Transformational Goal
Strategic doctrine on immediate attack (or preemption)	?	Permanent redlines in Iraq and elsewhere
Timeliness of "Effects-Based Operations"	Eventually	Capability for preemptive or D-Day attack of assembling forces and choke points (despite access problems and air defenses)
Timeliness of ability to attack CMTs in enemy's homeland	Very dependent on access, air defenses, C4ISR, but essentially 0	From D-Day, hold 80% of CMTs at risk of immediate attack
Time and resources to target in or dislodge "killers" from wooded or urban sanctuaries	Months and hundreds of thousands of personnel	1-3 days with "brigade level" forces assisting allies or smaller special-forces units
		1-3 days for new CONOPS that "flush" killers into open for killing

This table summarizes metrics for denying sanctuary in the context of force projection. All rows relate to top-level metrics, but address different operational challenges.

As suggested by the first two rows, the United States has traditionally granted a de facto sanctuary by not being primed for D-Day attack of enemy forces (much less preemption)—even though effects-based attacks at that time could be especially effective. A transformational change would make permanent the concept of enforcing redlines in places such as Iraq. A second such change would be to ensure having—under appropriate circumstances of strategic warning—an instantly ready-to-use preemptive or first-day attack capability. The issues are not so much technology or forces, but rather strategic doctrine, readiness, command and control, and the ability to evade air defenses at the outset without a SEAD campaign (e.g.,with daytime stealthy bombers or hard-to-defend-against standoff missiles).

The third row relates to critical mobile targets (CMTs), which typically operate in the de facto sanctuary of enemy homelands. Mobile Scuds, for example, are highly survivable because of their large operational areas and their short exposure time. This situation can be changed dramatically, but only with major strides in C4ISR and other aspects of the counter-CMT problem. Such issues have been studied by US JFCOM, the Institute for Defense Analyses, and RAND, among others. The transformational goal would be to hold a high percentage of CMTs at risk of immediate destruction.

The fourth and fifth rows pertain to denying sanctuary to dispersed ground forces. Such forces accomplish ethnic cleansing while operating in urban sprawl or foliage—sanctuaries from air attack. One solution might be to employ ground forces quickly or to refine Afghanistan-type operations in which special forces target enemies where they would otherwise be safe, providing the coordinates for precision fires to strike; another solution would be to flush enemies into the open, where they could be seen and attacked. The table suggests metrics and goals for both.