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14. ABSTRACT

The U.S. Department of Defense is currently shifting funding from future investment programs to cover urgent war needs, accepting some increase in future risk in order to reduce risk in the near term, and this tension between current and future operational priorities is likely to worsen. To effectively manage risk across possible missions and between today and tomorrow, senior Air Force leaders must make difficult decisions. This monograph seeks to provide the Air Force with a framework to structure their deliberations, connect them to supporting staff and expert inputs, and communicate their decisions to a broader audience. It describes a risk-management process that would help senior Air Force leaders to (1) focus planning on the most salient threats, (2) gain greater clarity on the risks associated with alternative courses of action across multiple futures, (3) maintain a sense of the persistent uncertainties associated with any policy choice, and (4) effectively communicate their judgments about risk to key audiences.

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Managing Risk in USAF Force Planning

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Prepared for the United States Air Force

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Preface

The U.S. Department of Defense (DoD) and the military services face a range of challenges in 2008 unlike any in previous history. During the Cold War, only the Soviet Union could threaten fundamental U.S. interests. Today, global terrorism; insurgencies in Iraq and Afghanistan; continuing unrest elsewhere in the Middle East; nuclear proliferation in Korea and Iraq; an unstable, nuclear-armed Pakistan; and uncertainties about Chinese military ambitions and Russia's future path all present significant threats to U.S. interests. Other threats—yet to be identified—likely lurk over the horizon. Resources to address these threats are limited, requiring national and DoD leaders to make judgments about relative risks and allocate resources accordingly.

To address these and related policy issues, RAND Project AIR FORCE conducted a fiscal year 2007 study titled "Managing Risk in the Future Air Force." The study sought to develop a risk-management process that would help senior U.S. Air Force (USAF) leaders (1) focus planning on the most salient threats, (2) gain greater clarity on the risks associated with alternative courses of action (COAs) across multiple futures, (3) maintain a sense of the persistent uncertainties associated with any policy choice, and (4) effectively communicate their necessarily subjective judgments about risk to key audiences: USAF personnel, the Office of the Secretary of Defense (OSD), and Congress.

This research should be of interest to planners and leaders in the services, combatant commands, and DoD, as well as the broader defense community.

The research reported here was sponsored by the Associate Director of Strategic Planning, Headquarters United States Air Force, and conducted within the Strategy and Doctrine Program of RAND Project AIR FORCE.

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Summary

DoD is currently shifting funding from future investment programs to cover urgent war needs, accepting some increase in future risk in order to reduce risk in the near term. The tension between current and future operational priorities is likely to worsen as the costs of ongoing operations in Iraq and Afghanistan, global operations against radical Islamists, and looming recapitalization needs across the armed forces constrain resources available to meet the challenges posed by nuclear-armed regional adversaries, the emergence of China as a great power, and continued unrest in the Middle East. In such a complicated and stressful environment, managing risk across possible missions and between today and tomorrow is of preeminent importance. This requires that difficult judgments and choices be made.

This monograph seeks to help Air Force leaders manage risk across multiple futures. It explains a transparent method to guide senior leaders as they make necessarily subjective judgments about the relative probabilities and potential harm associated with alternative policy options across multiple futures. In particular, it seeks to give the USAF three capabilities to which the study's sponsor gave high priority early in the analysis:

- Give decisionmakers a more visceral sense of the persistent presence of uncertainty and its implications for policy decisions.
- Filter the "parade of terribles"—the seemingly endless list of potential threats and challenges—so that decisionmakers can focus planning on the most salient threats.

- Help decisionmakers better understand and communicate to the broader Air Force, OSD, and Congress the policy-relevant *consequences* of "taking risk" when resource shortages occur.

A Framework for Integrating Risk into Force Planning

This document offers an orderly framework in which senior Air Force leaders and their planning staffs can sharpen their understanding of their subjective beliefs about the future and the policy implications of these beliefs. It seeks to improve transparency about the assumptions, implicit and explicit, that shape policy decisions. This document describes a simple scorecard for reporting the findings derived from the application of this framework. Senior Air Force leaders and their planners could use the scorecard described here to build consensus on beliefs about the future and risks associated with it and then communicate these consensus beliefs to relevant audiences inside and outside the Air Force.

The approach described here develops, maintains, and updates a basic scorecard like that shown in Table S.1. Each column contains information for a different policy package. Column 0 shows information for the currently programmed force, appropriately extended to cover any relevant planning horizon. To reflect our sponsor's interests, the analysis reported here focuses on a horizon of 10 to 15 years, but the scorecard can address any horizon. Each of the remaining columns presents information on some alternative policy package applied over the same horizon. Each row provides information about outcomes associated with these policy packages in a different future. For convenience, we define the futures used in this table in terms of the type of generic threat expected to dominate this future during the period covered by the planning horizon (the text explains alternative approaches). The contents of the table report subjective values of the probability that each future will occur if the Air Force adopts each policy package, as well as the magnitude of damage to U.S. national security interests that would occur in each future for each policy package.

Table S.1
Structure of the Basic Scorecard, with Notional Contents

		Alternative Policy Package					
		0	1	2	3	4	5
Future Dominated by Threat Listed	**Risk Measure**	**Current Force**	**Operate from FOB Against Anti-Access Threat**	**Large-Scale COIN with U.S. Forces**	**Partners for Irregular Warfare in Many Countries**	**Conduct Air Operations Exclusively from Long Range**	**Operate from FOBs Under Nuclear Attack**
Natural disaster	Magnitude	2	2	2	2	2	2
	Probability (%)	15	15	15	15	15	15
State failure	Magnitude	4	4	2	4	3	4
	Probability (%)	7	7	7	6	7	7
High-loss terrorism	Magnitude	7	6	6	5	6	6
	Probability (%)	15	15	15	13	13	15
Major insurgency	Magnitude	3	3	2	1	3	3
	Probability (%)	45	45	45	30	45	45
Traditional conventional conflict	Magnitude	4	4	4	4	3	4
	Probability (%)	4	4	4	4	4	4
High-tech conventional conflict	Magnitude	8	4	8	8	5	4
	Probability (%)	7	5	7	7	5	5

Table S.1—Continued

		Alternative Policy Package					
		0	1	2	3	4	5
Future Dominated by Threat Listed	Risk Measure	Current Force	Operate from FOB Against Anti-Access Threat	Large-Scale COIN with U.S. Forces	Partners for Irregular Warfare in Many Countries	Conduct Air Operations Exclusively from Long Range	Operate from FOBs Under Nuclear Attack
State nuclear use/threat	Magnitude	20	16	20	20	13	10
	Probability (%)	7	6	7	7	6	5
Low-risk future	Magnitude	2	2	2	2	2	2
	Probability (%)	0	3	0	18	5	3

NOTES: FOB = forward operating base; COIN = counterinsurgency.

The subjective values presented in the table are notional and offered here for illustration only.[1] For a scorecard of this kind to be useful, it must reflect consensus subjective beliefs of the senior leadership of the Air Force.

The document explains methods that senior leaders and their planning staffs can use to identify such beliefs. To implement such a scorecard, Air Force planners must work with senior leaders to develop information about three things: (1) what futures senior leaders should focus on during a planning cycle, (2) what policy packages deserve the attention of senior leaders during a planning cycle, and (3) how senior leaders can identify and validate the likely probability and magnitude of damage to U.S. national security interests for each future and policy package. The remainder of this summary briefly reviews each of these key elements of the scorecard and closes with a brief description of the benefits that such a scorecard should provide to senior Air Force leaders and their planners.

Choosing Relevant Futures

Each future in Table S.1 reflects one generic threat type that could dominate the environment in which the Air Force operates over the planning horizon. Generic threat types are a basic building block of our risk assessment. Even when comparing the performance of offensive and other proactive capabilities, we assess them in terms of their ability to mitigate the risks associated with a mix of threats by reducing the probabilities and/or magnitudes of damage to U.S. interests in alternative futures where these threats exist. The framework can be applied to any planning horizon.

We used a three-step process to identify a small number of threat types that we could use to frame the analysis described below and the most salient threat within each type against which the Air Force can plan. Air Force planners could apply these steps with different assump-

[1] Probabilities sum to unity across futures for each policy package. Magnitudes reflect subjective judgments about relative levels of damage scaled to a score of 1 to 20, with 20 reflecting the highest value of damage. For more information about how each future and policy package shown in this notional table is defined, see Appendix F.

tions to develop alternative sets of threat types and most salient threats that they might prefer.

In the first step, we surveyed the unclassified literature on threats identified in recent years; Air Force strategic planning would, of course, examine classified sources as well. This survey generated the expected "parade of terribles"—a bewildering and depressing catalog of everything that might go wrong over the next decade or so.

In the second step, we used characteristics that these potential threats shared to develop a taxonomy that grouped the vast majority of them into what ultimately became the seven categories of threats that dominate the first seven futures shown in Table S.1.[2] The threats included in each of these categories tended to share similar causes and effects and to exhibit similar dynamics over time after they became active and not just potential threats. These commonalities suggested that defense planners could often use similar strategies and forces to mitigate the risks associated with threats grouped in each category.

The final step identified a set of detailed scenarios associated with each threat type and asked which would require the greatest U.S. effort to mitigate the threats associated with it. This most stressful scenario became the most salient threat, which we would use to represent other threats that might arise in this category. In this analysis, we qualitatively considered factors that could affect the likelihood and magnitude of damage to U.S. interests relevant to each threat and the adequacy of Air Force capabilities and capacities to address each threat, particularly the capacity to react effectively to potential surprises that might emerge if each threat occurred.

Choosing Relevant Policy Packages

Policy packages must be matched to the planning horizon and level of planning. As we considered risks relevant to Air Force–wide strategic force planning over the next 15 years, we found that alternative packages are most meaningful when each emphasizes a distinctly different major capability. They should also be designed to "span the policy

[2] The last future—the so-called "low-risk future"—is an analytic construct explained in Appendix C.

space" implied by the set of futures chosen above. That is, they should offer concrete, qualitative alternatives potentially available to the Air Force with which to mitigate risks identified in relevant futures. To sustain the engagement of senior leaders and to allow in-depth analysis of each package seriously considered, planners should limit the number of packages examined in this approach. Within any planning cycle, we would expect the definition of such packages to evolve as leaders and planners identify hybrid packages that better match their beliefs and priorities about the future. Policy Packages 1 through 5 in Table S.1 are examples of packages that the Air Force might implement with an increment in resources above the programmed force in Policy Package 0.

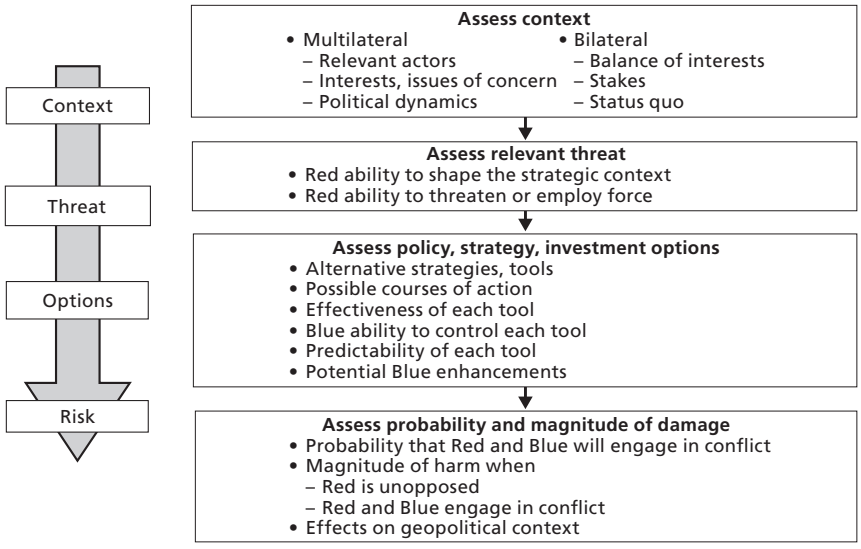
Assessing Probabilities and Magnitudes of Damage

As noted above, futures comprise sets of posited threats. Given any threat in a future and a chosen policy package, what is the likelihood that the threat will actually manifest itself over the planning period? How can the United States affect that likelihood? If the threat manifests itself, how likely is open conflict? What would be the consequences of conflict or a U.S. decision not to respond to a manifest threat? We provide a disciplined way to ask these questions and build answers to them that culminates in a subjective assessment of the probability and magnitude of damage relevant to the scorecard in Table S.1.[3] Figure S.1 summarizes how we do this in four steps.

The approach begins by placing any "most salient threat" of the type described above in a regional as well as a global context that identifies players relevant to the threat and their primary interests. It assesses the balance of interests relevant to the threat to determine what, broadly writ, the benefits and costs of any potential conflict might be for the primary players. This is an initial scoping step.

[3] This process is detailed in Chapter Four. Appendixes D and E illustrate the approach with applications to salient threats associated with a confrontation with China in the Taiwan Strait and an insurgency in the Solomon Islands, respectively.

Figure S.1
Summary of Method for Assessing Probabilities and Magnitudes of Damage to U.S. National Interests



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Based on information from this first step, the approach then assesses what actions "Red"—any potential opponent—might take. This depends on Red's capability to act and what it might gain from acting. Action can take many forms, from, at one extreme, efforts to persuade other relevant players to change their positions to, at another extreme, direct use of force to secure Red's interests, including use of force against "Blue"—the United States and its allies. These actions make up the threat space that we might associate with any most salient threat.

The third step considers the options available to the United States to counter any Red action. Like Red, Blue has a broad set of available actions, ranging from persuasive to coercive, with which to shape the environment relevant to any threat, deter Red from acting if possible, and apply military force if necessary. This step considers alternatives as COAs and asks how effective each COA is, how predictable its effects are, how much control Blue has over it, how changes in Blue capabil-

ity or capacity might change the answers to these questions, and so on. This step characterizes the risk-mitigation space available to Blue.

The information developed in the first steps provides the basis for assessing the likely interaction between Red and Blue, each with specified options available, in the context of a particular most salient threat. This analysis works through these Red and Blue options using a simple tree diagram that considers, for each option, a Red action, a Blue decision to respond or not in a particular way, and the consequences for Red and Blue of each sequence. This analysis provides a basis for ultimately assessing the likelihood that Red will act in a particular way and the consequences for Blue. These likelihoods and consequences provide the basis for a consensus subjective assessment of the probability that the most salient threat will become active during the planning period and, if it does, what damage it would do to U.S. interests.

The sequences of decisions assessed in this step are too complex to examine in any but a subjective way. We seek to improve such subjective assessments by documenting the judgments underlying any final assessment. We seek to make any assessment more transparent and to simplify the application of sensitivity analysis to assess the implications of alternative beliefs about the future.

Working together, senior Air Force leaders and their planning staffs can apply this approach to fill the contents of a scorecard like that in Figure S.1 and adjust these contents as circumstances change. Doing this will be challenging and will take time and resources, both to develop the capabilities and specific processes to do this within the Air Force and to apply these capabilities and processes to fill out any scorecard for an actual set of futures and policy packages. We envision this approach as an integral part of planning that continues over a series of planning cycles. If this occurs, each planning cycle can build on assessments completed in earlier cycles and thereby limit the difficulty of keeping the scorecard current.

Expected Benefits of the Scorecard

The scorecard described here can enhance the USAF's force-planning and resource-allocation efforts in the following ways.

Give Decisionmakers a More Visceral Sense of the Persistent Presence of Uncertainty and Its Implications for Policy Decisions

The approach described above seeks to do this in two ways. First and most directly, it highlights the range of risks that remain active after senior leaders have committed themselves to a preferred package of policies and resources to apply over the planning horizon. Many futures can occur over that planning horizon; a final decision on a plan cannot wash away much of the uncertainty that will affect the success of that plan. (See pp. 103–107, 112–113.)

Second, the approach draws on an active, structured interaction between decisionmakers and their support staffs to elucidate the leaders' subjective beliefs about key uncertainties (p. 114). The approach recognizes the primacy of the subjective beliefs of Air Force decisionmakers (pp. 106–107). That said, it gives them a language that should help them express their intuitive beliefs more precisely (pp. 107–110). In particular, it encourages them, throughout the planning process, to think more clearly about how much they really "know" about the future.

Filter and Aggregate the "Parade of Terribles" So That Decisionmakers Can Focus Planning on the Most Salient Threats

A short list of generic threat types, like those discussed above, can capture the most important features of a long list of threats that Air Force planners have had to consider in recent years. As a result, planning against a few generic threats can potentially prepare the Air Force for dealing successfully with most of the "terribles" it might face. (See pp. 47–65, 209–215.)

Help Decisionmakers Better Understand and Communicate the Policy-Relevant Consequences of "Taking Risk" When Resource Shortages Occur

The approach described above highlights the close link between risk and resource constraints; decisionmakers and planners cannot make meaningful statements about risk—the potential for damage to our national interests—without placing their planning activities in a resource-constrained environment (pp. 103–104). That said, the approach is intended to induce decisionmakers and planners to focus more on the risk side of this relationship than on the resource side. It does this on two levels:

1. It asks decisionmakers to assess their beliefs about the probability and magnitude of damage to national interests that they associate with various threat types *when they have specified packages of policies and resources available* (pp. 18–32, 91–102).
2. It asks planners to think about how the various threats that might become active during a planning period compete for the capacities of key capabilities present in the Air Force (pp. 47–65).

When resource shortages exist in this setting, operational commanders must trade off one source of potential damage to the national interest for damage from another source.

As noted above, the approach focuses on giving decisionmakers and planners a more precise language to talk about their subjective beliefs about uncertainty. As they adopt this language, they should also be able to use it to communicate more effectively—decisionmaker to staff, operator to planner, peer to peer, and Air Force advocate to any stakeholder outside the Air Force. (See pp. 108–110, 114.)

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Abbreviations

AETC	Air Education and Training Command
AFMC	Air Force Materiel Command
AO	area of operations
ASBM	antiship ballistic missile
ASW	antisubmarine warfare
BMD	ballistic missile defense
CDR	Committee Defense Review Report
C2	command and control
C3I	command, control, communications, and intelligence
CDR	Committee Defense Review
COA	course of action
COIN	counterinsurgency
CONOPS	concept of operation
CRRA	Capability Review and Risk Assessment
CSG	Carrier Strike Group
DCA	defensive counter-air
DoD	U.S. Department of Defense

EMP	electromagnetic pulse
EW	electronic warfare
FID	foreign internal defense
FOB	forward operating base
GLF	Guadalcanal Liberation Force
HASC	House Armed Services Committee
HQ	headquarters
IFM	Istabu Freedom Movement
IGO	intergovernmental organization
IISS	International Institute for Strategic Studies
IMET	international military education and training
IMP	Integrated Master Plan
IPL	Integrated Priority List
IPMT	International Peace Monitoring Team
ISR	intelligence, surveillance, and reconnaissance
LOC	line of communication
MAJCOM	major command
MEF	Malaitan Eagle Force
MTT	military training team
NGO	nongovernmental organization
NMS	national military strategy
NSS	national security strategy
OCA	offensive counter-air
OSD	Office of the Secretary of Defense

PACAF	Pacific Air Forces
PACFLT	Pacific Fleet
PACOM	Pacific Command
PAF	Project AIR FORCE
PE	program element
POM	program objectives memorandum
PPBS	Planning, Programming, and Budgeting System
PRC	People's Republic of China
QDR	Quadrennial Defense Review
RAMSI	Regional Assistance Mission to Solomon Islands
ROC	Republic of China (Taiwan)
ROCN	Republic of China Navy
RSIP	Royal Solomon Island Police
SAM	surface-to-air missile
SSBN	ballistic missile submarine
SSN	nuclear submarine
TBM	tactical ballistic missile
USAF	U.S. Air Force
USN	U.S. Navy
WMD	weapons of mass destruction

CHAPTER ONE

Introduction

Background

During the Cold War, neither the United States nor its allies ever fielded the conventional forces that would have been required to have high confidence of victory in all planning scenarios; it was deemed fiscally, or at least politically, infeasible to field "minimum risk" forces. The U.S. government responded to this problem in two ways.[1]

First, it developed a national strategy that bound the United States closely to critical countries through political and military alliances, policy statements, forward deployment of forces, and defense concepts that linked U.S. conventional forces with tactical, theater, and strategic nuclear forces. The latter was particularly important in Europe, where, in essence, the United States managed the perceived shortfall in NATO conventional capabilities by threatening to escalate to the nuclear level if NATO were unable to stop a Warsaw Pact invasion with conventional means.

The second way that the United States responded to the gap between military requirements and resources was by identifying and focusing investment on priority needs, accepting some additional level of risk in other areas. As we explain in some depth in this monograph, an "additional level of risk" exists when (1) the probability that a threat to national security will manifest itself increases or (2) when a threat

[1] A classic treatment of this topic is Alain C. Enthoven and K. Wayne Smith, *How Much Is Enough? Shaping the Defense Program 1961–1969*, Santa Monica, Calif.: RAND Corporation, CB-403, [1971] 2005.

does manifest itself, it imposes larger negative effects on national security. For example, the pressing force structure, munitions, financial, and manpower demands of the Vietnam War shifted resources away from Europe between 1965 and 1975, increasing the level of risk in that theater and the dependence on the nuclear threat. Once that conflict was over, the U.S. Department of Defense (DoD) wasted no time shedding most of the specialized capabilities for counterinsurgency (COIN) that it had developed. Europe once again became the top priority for investment. Major new conventional (e.g., F-15, F-16, F-14, M-1 Abrams, M-2 Bradley) and nuclear (e.g., Minuteman III, Pershing II, ground-launched cruise missile, air-launched cruise missile, Ohio-class fleet ballistic missile submarines [SSBNs]) weapon systems were developed and deployed in the ensuing years, substantially improving the military balance between NATO and the Warsaw Pact and tightening the links between conventional capabilities and the U.S. strategic nuclear arsenal. These and other investments also improved U.S. capabilities to deter and defeat aggression in the Persian Gulf and Korean Peninsula. To free resources for those needs, investments in capabilities for low-level conflict were minimized throughout most of the Cold War.[2]

[2] It would be incorrect, however, to suggest that the U.S. government ignored low-level conflict during the Cold War. Rather, it managed risk in this area by using a diverse set of relatively inexpensive tools. There was great concern in administrations from Truman's to Reagan's over Soviet and other communist government efforts to create or support insurgencies against nations friendly to the United States. Because communism was understood at the time to be a largely monolithic movement controlled by Moscow, unrest anywhere was seen as part of a global threat to Western interests. As a result, the U.S. government was active in efforts to prop up friendly regimes and undermine those sympathetic to or allied with the Eastern Bloc. With the exception of the Vietnam War, most of the U.S. efforts on this front were dominated by State Department, CIA, and U.S. Agency for International Development activities. Military assistance to friendly nations was also substantial. U.S. Army Special Forces teams conducted a large number of advisory and assistance missions throughout the developing world. For example, between 1962 and 1968, the 8th U.S. Army Special Forces Group conducted over 400 internal security missions in Latin America alone. For a discussion of U.S. Army Special Forces activities in Latin America, see Ian F. W. Beckett, *Insurgencies and Counter-Insurgencies: Guerrillas and Their Opponents Since 1750*, London, UK: Routledge, 2001. A vast literature addresses broader themes of the Cold War. Two recent works of interest are John Lewis Gaddis, *The Cold War: A New History*, New York: Penguin, 2006; and John Prados, *Safe for Democracy: The Secret Wars of the CIA*, Chicago, Ill.: Ivan Dee, 2006.

The Policy Problem

Today, the United States faces another gap between resources and requirements that is forcing DoD to make difficult choices between today's operational demands and investments for the future. Just as it did during the Vietnam War, DoD has shifted funding from future investment programs to cover urgent current war needs, accepting some increase in future risk in order to reduce risk in the near term. The tension between current and future operational priorities is likely to worsen as the cost of ongoing operations in Iraq and Afghanistan, global operations against violent jihadists, and looming recapitalization needs across the armed forces constrain the resources available to meet the challenges posed by nuclear-armed regional adversaries, the emergence of China as a great power, and continued unrest in the Middle East. DoD and the U.S. Air Force (USAF) are being asked to meet these threats in the context of competing homeland security and other needs that are likely to produce flat or falling DoD budgets and in a security environment in which nuclear forces are unlikely to be a credible gap-filler for shortfalls in conventional capabilities. Within such a complicated and stressful environment, managing risk across possible missions and between today and tomorrow is of preeminent importance.

As a global power, the United States does not have the luxury of focusing on a single problem or region to the exclusion of others. To do so would, in most cases, increase both the probability and magnitude of bad outcomes in the ignored areas. Nor should it treat all potential problems as equally immediate or important. Some problems will fall away on their own or can be addressed with limited investments and a watchful waiting approach, while others are urgent and will require immediate attention. Neither can the United States seek to minimize risk in every area. The potential list of threats will always exceed the resources necessary to minimize risk across the board. Rather, the challenge for defense leaders and planners is to manage risk in a way that allocates limited resources to the most salient threats, while accepting some degree of risk in areas deemed less essential. This requires that difficult judgments and choices be made.

DoD planners are faced with two stark alternatives as they grapple with risk in force planning. At one extreme, *risk* is often used in an undefined way to justify resource reallocations, as in "We are cutting this program and will just have to accept more risk in this area." The term *risk* is used so often in this casual manner that it is beginning to lose any meaning. At the other extreme are the highly quantitative methods associated with formal risk assessment and management. The latter are framed to address highly bounded problems (e.g., the threat, vulnerability, and consequences associated with a specific threat to a specific facility). The data required to apply their precise algorithms are simply not available to defense planners working at the strategic and operational levels of warfare. Yet DoD and the services have embraced some methods that would suggest that objective measures of probability and harm exist.

Today, DoD, the services, and combatant commands are involved in a bewildering array of risk-assessment processes, involving thousands of man-hours. Many of these activities may be of great value, but at least some are such black boxes that they obscure rather than illuminate risk and uncertainty for senior decisionmakers. Senior leaders do not need yet another risk-management process. Instead, what they need is a way of structuring their deliberations, connecting them to supporting staff and expert inputs, and communicating them to a broader audience.

Purpose of This Monograph

This monograph seeks to assist the USAF in identifying and managing risks in force planning. It does this by offering a risk-management process that would help senior USAF leaders (1) focus planning on the most salient threats, (2) gain greater clarity on the risks associated with alternative courses of action (COAs) across multiple futures, (3) maintain a sense of the persistent uncertainties associated with any policy choice, and (4) effectively communicate their necessarily subjective judgments about risk to key audiences: USAF personnel, the Office of the Secretary of Defense (OSD), and the Congress.

Organization

Chapter Two presents our analytic framework for understanding risk and introduces a scorecard as a means of structuring leadership deliberations on risk. Chapter Three describes our method for selecting futures for analysis. Chapter Four discusses the selection of policy options. Chapter Five presents the "risk engine" used in our analysis: the method we developed to assess the probability and magnitude of outcomes for various futures. Chapter Six presents our conclusions. Appendix A discusses some relevant concepts from formal risk analysis. Appendix B describes the scorecard. Appendix C compares alternative decision rules for risk analysis. Appendix D describes an example exercise concerning the Taiwan Strait. Appendix E describes an example exercise involving the Solomon Islands. Appendix F provides supporting detail on the threats considered to identify the seven threat types described in Chapter Three.

CHAPTER TWO

An Analytic Framework and Risk Scorecard to Support Strategic Force Planning

Napoleon's *coup d'oeil*—his ability to take in the situation on the battleground before him "at a glance" and quickly intuit the best way to exploit it—is an important and perhaps essential skill for any operational military commander.[1] But strategic force planning potentially gives a senior decisionmaker time to discuss and assess options in some depth. Properly applied, risk-assessment tools can help a decisionmaker move from intuition to a more considered assessment, testing intuition against available evidence and alternative perceptions.

We begin with a simple risk-assessment tool—a tree diagram—to illustrate the nature of the problem that a strategic force planner faces when important uncertainties are present. A decision can have many potential outcomes. Any effort to sort out the probabilities of these outcomes and the magnitudes of gains or losses associated with them is inherently subjective, especially when addressing decisions relevant to a high-level activity, such as strategic force planning.[2]

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[1] Carl von Clausewitz called it a "quick recognition of a truth that the mind would ordinarily miss or would perceive only after long study and reflection" (quoted in William R. Duggan, *Coup D'Oeil: Strategic Intuition in Army Planning*, Carlisle Barracks, Pa.: U.S. Army Strategic Studies Institute, 2005, p. 2).

[2] The fundamentally subjective nature of the judgments relevant to strategic force planning led us to use a "Bayesian" approach to risk assessment. A Bayesian approach uses subjective beliefs about the probabilities of future outcomes and magnitudes of gains and losses. Models based on historical data can help inform these beliefs, but in the end, the beliefs reflect the judgments of military professionals. Appendix A discusses the implications of this approach in greater detail.

This chapter briefly describes the principal formal risk-assessment tool the Air Force currently uses to address such issues. It then explains an eight-step analytic process that decisionmakers and planners could use to improve their understanding of their own subjective beliefs about the future and, once these beliefs are defined, to manipulate summary statements about them with risk-assessment tools to clarify the policy implications of these beliefs. This process is complex but orderly.

A scorecard with four levels of information can help decisionmakers and planners organize and integrate the information they develop as they go through this analytic process. The relationships in the scorecard allow decisionmakers to drill down from any final conclusion to the subjective beliefs underlying that conclusion, helping to make the process they used to generate any decision more transparent. These relationships can also help planners to update subjective beliefs about the future as new information becomes available and to determine when this updating should affect the strategic force plans that decisionmakers have put in place.

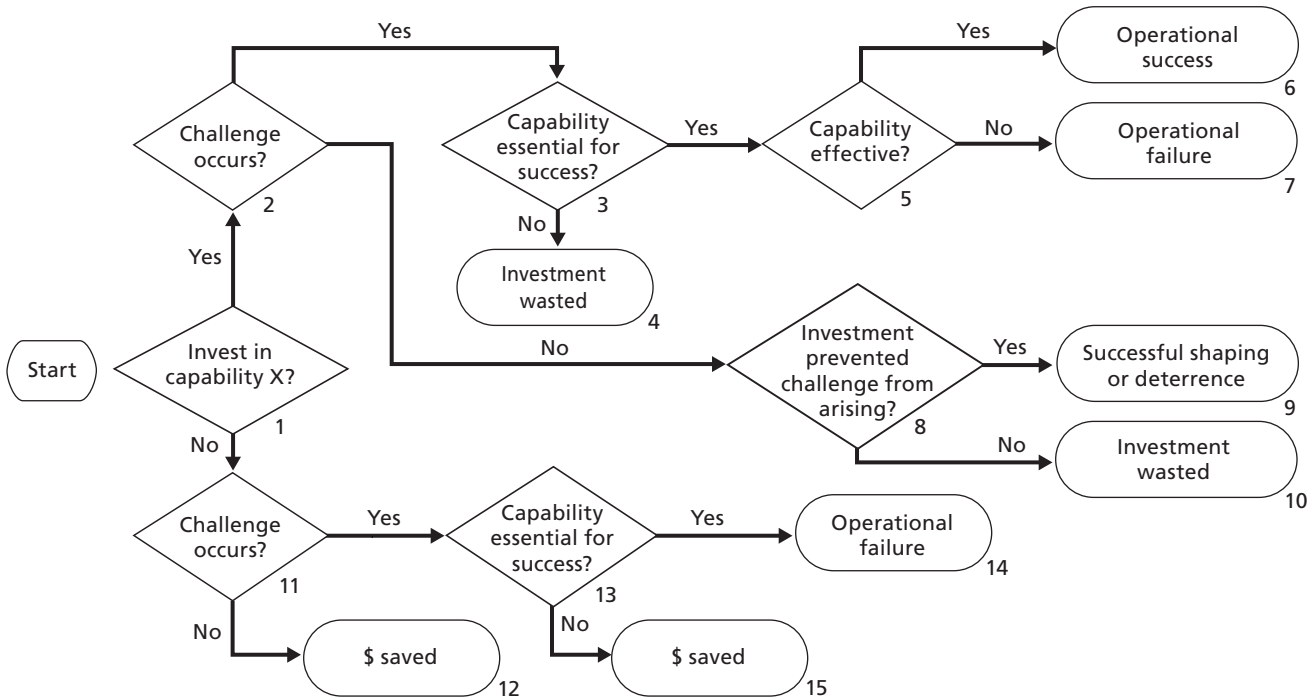
The chapter explains how the Air Force can use a scorecard like that described here to do three things: (1) present and refine the subjective beliefs of the leadership about alternative futures and risks in them, (2) choose among alternative policy packages, and (3) explain the policy package that the leadership chooses to audiences inside and outside the Air Force. It describes an existing planning process similar to the one presented in this document and explains how a scorecard like that described here could enhance the performance of the existing process.

The chapter closes with a brief explanation of how the eight-step process and associated indentured scorecard can help Air Force decisionmakers and planners address the three concerns identified in the introduction.

Insights from a Simple Tree Diagram

Figure 2.1 presents a basic tool of risk assessment—a tree diagram—that we can use to illustrate the basic approach and potential power

Figure 2.1
Tree Diagram to Support a Decision to Invest in a New Capability



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of structured risk assessment. Suppose a senior leader faces a decision about whether to invest in a new capability—for example, to harden forward-deployed air bases against air attack or to introduce new counter–electronic warfare (EW) capabilities in portions of the force (Box 1). Figure 2.1 offers an orderly way to think through the consequences of that decision. It allows us to anticipate alternative ways that things could occur following a decision and ask how these potential futures should inform the leader's decision to invest today.

Suppose the policymaker decides to invest. The tree directs us to Box 2 and asks whether the threat anticipated when the decision occurred in fact becomes active over some planning horizon. For example, are forward-operating bases (FOBs) attacked from the air? If the threat becomes active, does the investment prove to be important to mitigating the effects of the threat that actually becomes active (Box 3)? How much can base hardening improve a base's ability to survive such an attack? If it can have little effect, the investment offers no value and would effectively be wasted (Box 4). If the investment is potentially useful, we can then ask how it actually affects the outcome of the threat that becomes active (Box 5). If it contributes to an operational success (Box 6)—the FOB continues to operate effectively through the attack, allowing forces at the base to stay in the fight—it creates value that can be used to help justify the initial investment. If it does not help prevent an operational failure (Box 7), because the base must shut down for so long that broader operational capability is threatened, no value accrues. In fact, if the Air Force inappropriately relies on this investment for protection, the investment might accrue costs that should be considered in the initial decision.

Now the tree directs us back to the question of whether the threat in question becomes active over the planning period (Box 2). Suppose it does not. Does this occur because the investment prevents the threat from arising (Box 8)? For example, hardening could reduce the value that the enemy expected to achieve by attacking bases enough to induce the enemy to direct its attention elsewhere. If it does, the investment should get credit for having deterred the conflict altogether (Box 9).

Alternatively, the investment may seek not to deter attack but to shape the environment in some other way such that the threat does not

materialize. An example of this would be an investment that greatly expands DoD's capability to train, advise, and assist partner nations in internal defense. In addition to potential contributions on the deterrence dimension (e.g., convincing would-be insurgents that the risks are too great), this investment might also prevent an insurgency by addressing the social pathologies that could precipitate revolt. For example, U.S. training missions might help the military of a partner nation recognize the importance of respectful, lawful, and professional behavior toward its own populace. Reforms that improve military behavior can remove one possible motivation for joining an insurgency. The combination of DoD efforts along these lines with other U.S. agency programs to improve economic opportunities, governance, and treatment of minority populations might prevent an insurgency, not because people are deterred from becoming insurgents but because they no longer have any motivation to take up arms.

Or does the threat fail to become active because the potential adversary has no interest in starting a war or attacking a particular target (Box 10)? In this case, the investment would be wasted.

We have seen many reasons the investment might be a bad idea. The tree returns us to Box 1, where the policymaker has now decided not to invest in the capability in question. FOBs remain vulnerable to air attack. We can now ask again in Box 11, as we did in Box 2, whether the threat that would justify the investment ever becomes active over the planning horizon. If it does not (Box 12), the decision not to invest is justified; a savings occurs. The Air Force can apply the money and effort that it might have applied to harden air bases elsewhere without suffering any harm as a result of this decision. If the threat does become active, we can ask again, as we did in Box 3, whether the investment would have mitigated the effects of the threat that actually became active (Box 13). If it would have, the failure to invest yields an operational failure, a cost that should be reflected in the initial investment decision (Box 14). If an investment would not mitigate the effects, the decision not to invest should get additional support (Box 15). This is another case where the Air Force can apply the money and effort that it might have applied to harden air bases elsewhere without suffering any harm as a result of this decision.

The tree diagram in Figure 2.1 effectively says that decisionmakers should invest if they believe, looking forward, that the investment will generate enough deterrent or shaping effect (Box 9) or, if deterrence or shaping fails, operational success (Boxes 6 and 14) over the planning horizon to justify the investment. Decisionmakers should not invest if, over the planning horizon, they believe that it will not generate enough benefits of either kind (Boxes 4, 10, 12, and 15) or, even worse, that it could generate a false sense of confidence that leads to avoidable failures (Box 7). Table 2.1 summarizes these potential beliefs about the future.

Implicitly or explicitly, an effective decisionmaker weighs the (1) magnitudes of each of these outcomes and (2) the probabilities that they might occur over his or her planning horizon before choosing whether to invest. Thinking about such a decision helps frame the challenge we face in this document:

- The tree diagram in Figure 2.1 is significantly oversimplified. In fact, a much more nuanced range of possibilities is relevant to any major decision.
- That said, even in this simplified form, the contents of the tree diagram are inherently subjective. What values should the Air Force assign to outcomes in Boxes 6, 7, 9, and 14? How likely, over any planning horizon, is a particular threat to become active, to be deterred, or simply not to become active because it never presented a threat? How likely, over any planning horizon, is an

Table 2.1
Outcomes Relevant to the Investment Decision

	Invests	Does Not Invest
Outcomes support investment	Operational success (6) Successful shaping/ deterrence (9)	Operational failure (14)
Outcomes do not support investment	Operational failure (7) Investment wasted (4) Investment wasted (10)	$ saved (12) $ saved (15)

NOTE: Numbers in parentheses refer to boxes in Figure 2.1.

investment to be able to mitigate the effects of any potential threat that becomes active? How much would an investment mitigate these effects if the potential threat actually became active during some planning horizon? It is tempting to say that, for any major decision, decisionmakers and planners can only speculate about the answers to such questions. A more constructive way to express this is to say that decisionmakers and planners can and must construct subjective beliefs about such answers. The subjectivity implicit in the tree diagram is not a weakness of some kind that we can avoid; it is a quality of the future that we must accept and work with as honestly as possible.

- Professional military judgment is relevant to the assessment of the kinds of probabilities and magnitudes implicit in Figure 2.1. One of the most important products of a career of military experience is (presumably latent) knowledge relevant to making just such assessments.
- That said, the classic *coup d'oeil* of the commander in the field will limit his or her ability to parse considerations of the kind shown in Figure 2.1 and develop coherent subjective beliefs about them. The commander's beliefs could easily be subject to the biases and heuristics that cognitive scientists have shown can lead to faulty decisions.[3] Without well-defined and well-articulated subjective beliefs, the commander will have difficulty discussing them with peers and support staff or communicating them to others whom he or she seeks to influence. In the absence of the urgency to act, an opportunity exists to help the commander work through his or her intuitions and sharpen them into more clearly defined subjective beliefs about basic factors relevant to the decisions the

[3] As Paul K. Davis, Jonathan Kulick, and Michael Egner explain in *Implications of Modern Decision Science for Military Decision-Support Systems* (Santa Monica, Calif.: RAND Corporation, MG-360-AF, 2005), a traditional "descriptive" literature emphasizes that decisionmakers typically use heuristics or cognitive shortcuts, which can introduce unintended biases. This literature seeks ways to "debias" the presentation of information. A newer literature on "naturalistic" decisionmaking emphasizes the strengths of intuitive decisionmaking based on heuristics and questions the desirability of debiasing. Davis, Kulick, and Egner contrast these schools of thought and suggest steps toward a synthesis.

commander must make. Below, we offer simple tools, like the tree diagram in Figure 2.1, that seek to do just that.

- No matter how refined the risk analysis offered to a commander or how refined the intuitions of the commander and his or her staff become, large uncertainties will persist. A key goal of any risk analysis will be to explore these uncertainties and help the commander understand their importance to any decision under review.

The Air Force Capability Review and Risk Assessment

The Transformation Flight Plan for 2003 identified a planned transition

> from a platform-based garrison force to a capabilities-based expeditionary force. The Air Force is committed to make effects and the capabilities needed to achieve them the driving force behind its ongoing transformation. To make this essential shift, the Air Force has developed **six new CONOPS[s]** [concepts of operation]**: Global Mobility, Global Response, Global Strike, Homeland Security, Nuclear Response, and Space&C4ISR** [space and command, control, communications, computers, intelligence, surveillance, and reconnaissance]. . . .
>
> In order to precisely assess each CONOPS, the **CRRA** [Capability Review and Risk Assessment] identifies and analyzes current and future capabilities, capabilities' shortfalls, health, risks, and opportunities. The CRRA is a twofold process: each CONOPS executes a CRRA within its effects and capability purview. Then, an Integrated CRRA assesses capabilities and capability shortfalls across all CONOPS[s]. The CONOPS[s] first identify desired warfighting effects and then develop top-level capabilities required to generate those effects. The CRRAs then identify capability gaps, overlaps, and robustness within each top-level capability. Finally, the Integrated CRRA identifies an acceptable level of risk and risk mitigation measures within each capability. This assessment helps the CONOPS Champions articulate any disconnects between required capabilities and programs.

> This provides senior Air Force leadership an operational, risk, and capabilities programmatic-based decision-making focus. Metrics to measure the Air Force's progress towards "transformation" will be derived from this analysis once the CONOPS[s] and CRRAs have been finalized and have determined specific required capabilities.[4] [Bold in original.]

In principle, such an approach might effectively address the challenge of supporting decisions like those in Figure 2.1. For example, a tree diagram could map a CONOPS with a variety of alternative outcomes possible. Air Force investments made in different capabilities in support of individual CONOPSs could change the probabilities and outcomes in the tree. The Air Force could then compare alternative investments by comparing their alternative effects on the CONOPS tree.

As the Air Force implemented the CRRA approach, something like this emerged. Figure 2.2 outlines the basic approach that had developed by October 2005.[5] The CRRA used a strategy-to-tasks approach to translate each CONOPS into a set of effects that the Air Force had to achieve to execute the CONOPS. The Air Force required a set of capabilities to achieve each effect. And a number of programs were required to create each capability. This approach effectively translated a CONOPS-based *strategy* into a set of capability-related *tasks* that had to be resourced.

As the Air Force refined its implementation of this approach, it represented each CONOPS as an end-to-end process with many

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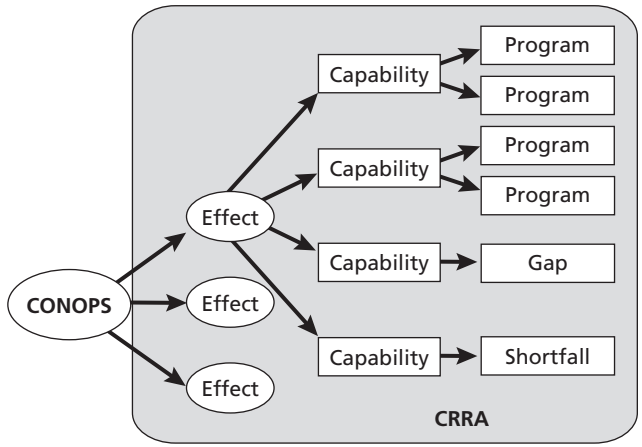
[4] U.S. Air Force, *Transformation Flight Plan*, Deputy Chief of Staff, Plans and Programs, Washington, D.C., November 2003, p. v. See also Duncan J. McNabb (Lt Gen, USAF), "Statement Regarding Air Force Transformation," statement before the Committee on Armed Services Subcommittee on Terrorism, Unconventional Threats and Capabilities, U.S. House of Representatives, Washington, D.C., February 26, 2004.

[5] Karan Fowler, "U.S. Air Force Approach to Effects-Based Capabilities Planning," briefing, WR-ALC/XPXM, Warner Robins Air Logistics Center, Robins AFB, Ga., October 2005, Chart 12. See also (Maj) Rob Renfro and Darrell Newcomb (FTI), "Air Force Capability Review and Risk Assessment (CRRA) Analytic Methodology," AFSAA/SAPT, Air Force Studies and Analysis Agency, Washington, D.C., October 20, 2004.

Figure 2.2
CRRA Implementation of the Strategy-to-Tasks Approach



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subprocesses and nested sub-subprocesses. More refinement yielded ever-increasing detail. The resulting process map in effect defined a critical path along which Air Force activities would have to progress to execute any CONOPS.[6] The probability of successfully executing the whole end-to-end process could be represented as a function of the probabilities of success for each sub-subprocess in the map. That is, if the Air Force could determine the probability of success associated with each critical element of the end-to-end process, it could calculate the probability that it could execute the CONOPS represented by the end-to-end process. A CRRA could then assess any particular program

[6] In particular, the approach was similar to that used to define the critical path that falls out of a stochastic mapping of the Integrated Master Plan (IMP) that acquisition specialists use to manage complex programs. Important differences are that (1) everything in an IMP can be expressed in terms of a common measure—time; (2) information is available from past acquisitions, at least potentially, to inform subjective beliefs about the time associated with generic elements of an IMP; and (3) as complex as it is, acquisition normally occurs in a less uncertain environment than the CONOPSs defined by the Air Force would. For more information on how to reflect uncertainty in program acquisition, see Mark V. Arena, Obaid Younossi, Lionel A. Galway, Bernard Fox, John C. Graser, Jerry M. Sollinger, Felicia Wu, and Carolyn Wong, *Impossible Certainty: Cost Risk Analysis for Air Force Systems*, Santa Monica, Calif.: RAND Corporation, MG-415-AF, 2006.

by asking how it would affect the probabilities in the end-to-end map and, ultimately, how it would affect the probability of successful execution of the CONOPS.

As implementation proceeded, the Air Force mobilized subject-matter experts to address the hundreds of elements in the end-to-end map associated with each CONOPS. The Air Force developed detailed scenarios to describe the environment in which it expected each CONOPS to occur. It then elicited the professional judgment of groups of subject-matter experts on the shapes of the subjective probability distributions associated with each element of each end-to-end map.

Those involved in the process noted several difficulties. It was difficult to ensure that all subject-matter experts used the same understanding of the underlying scenario for each CONOPS. It was difficult to maintain documentation on the basis for their judgments—specifically, it was difficult to explain their judgment on how changes in programs might change individual subjective probability distributions. And in the end, it was difficult for senior leaders not involved in the process to understand the process itself and the products generated by it. In particular, it was difficult for them to determine whether the professional judgments that went into the process were comparable to their own.

The CRRA process continues.[7] To our knowledge, it has had only limited substantial effects on actual strategic force structure or resource decisions in the Air Force. A great deal can be learned from CRRA efforts to date. We built on those efforts and sought an approach that (1) is more attuned to the inherently subjective nature of the judgments the leadership must make in its strategy decisionmaking, (2) involves professional military judgment of the senior leadership more directly in the risk-assessment process, (3) is simple enough to allow transparency of the process used to reach high-level judgments about risk, (4) speaks in a language that is natural for military leaders to use when considering risk, and (5) in particular, addresses uncertainty about the future

[7] Official guidance can be found in U.S. Air Force, *Capabilities-Based Planning and Requirements Development,* Air Force Policy Directive 10-6, Headquarters (HQ) USAF/A5RD, Washington, D.C., May 31, 2006a.

in more direct and visceral ways. The remainder of this chapter outlines the approach we developed to reflect these priorities.

A Basic Framework for Risk Assessment Relevant to Strategic Force Planning

At its heart, strategic force planning involves a process that sets the Air Force on a course into the future while having only a limited understanding of what the future will look like. This section describes a framework that planners and the decisionmakers they support could use to improve their understanding of the outcomes of any planning decision today if alternative versions of the future in fact occurred. The framework brings together the subjective beliefs of decisionmakers and formal risk-assessment tools that can help refine these beliefs in a way that improves decisionmakers' understanding of what the outcomes of the planning decisions that they make today would be in different versions of the future. In places, the framework remains more a conceptual architecture than a blueprint ready for implementation. This section describes the framework in its current status. Future work can refine the framework further, preparing it more completely for implementation.

Ideally, such a framework would yield a scorecard like the matrix in Figure 2.3. Each row represents a plan to apply a different package of policies, resources, and capabilities over the planning horizon. The scorecard shows a baseline, representing the current plan, in the first row and m alternative packages in the remaining rows. Each column represents a different version of the future. The scorecard shows n different versions. Taken together, these futures span a "futures space" containing a range of plausible events typified by an abstracted set of scenarios.[8] R_{ij} represents some measure of the "risk" that

[8] See, for example, Robert J. Lempert, Steven W. Popper, and Steven C. Bankes, *Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis*, Santa Monica, Calif.: RAND Corporation, MR-1626-RPC, 2003; and Paul K. Davis, Steven C. Bankes, and Michael Egner, *Enhancing Strategic Planning with Massive Scenario Generation: Theory and Experiments*, Santa Monica, Calif.: RAND Corporation, TR-392, 2007.

Figure 2.3
General Structure of a Risk-Assessment Scorecard

	Future 1	Future 2	.....	Future n
Baseline policies, resources	R_{01}	R_{02}	.....	R_{0n}
Policy-resource alternative 1	R_{11}	R_{12}	.....	R_{1n}
Policy-resource alternative 2	R_{21}		.....	R_{2n}
	:	:	:	:
Policy-resource alternative m	R_{m1}	R_{m2}	.....	R_{mn}

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decisionmakers associate with the *i*th planning package and the *j*th version of the future.

Risk connotes the potential for some negative outcome in the future that would damage the national interests of the United States. We say more about how to characterize this potential below. For now, it is worth noting that the risks of greatest interest to us here are those that can occur when it turns out in the future that the Air Force policy and resources available for application do not match the planned Air Force mission well. In its mission, the Air Force conducts activities designed to deter specified activities by countries and groups that endanger the national security of the United States and to strengthen countries and groups important to the security of the United States. If deterrence fails, the Air Force must rely on its existing policies and resources to defeat specified types of threats to U.S. national security. If the Air Force has too much of one thing and not enough of another, it may fail to deter enemies that it could have deterred, strengthen friends that it could have strengthened, or defeat enemies when they threaten the United States. Or the Air Force might find that it takes too long or consumes too many resources to do these things. When "risk" exists, dangers are present that the Air Force can potentially mitigate by changing its mix of policy and resource applications.

A scorecard like that in Figure 2.3 should help decisionmakers to choose which plan for the future application of Air Force policies and resources to prefer today. The remainder of this section presents

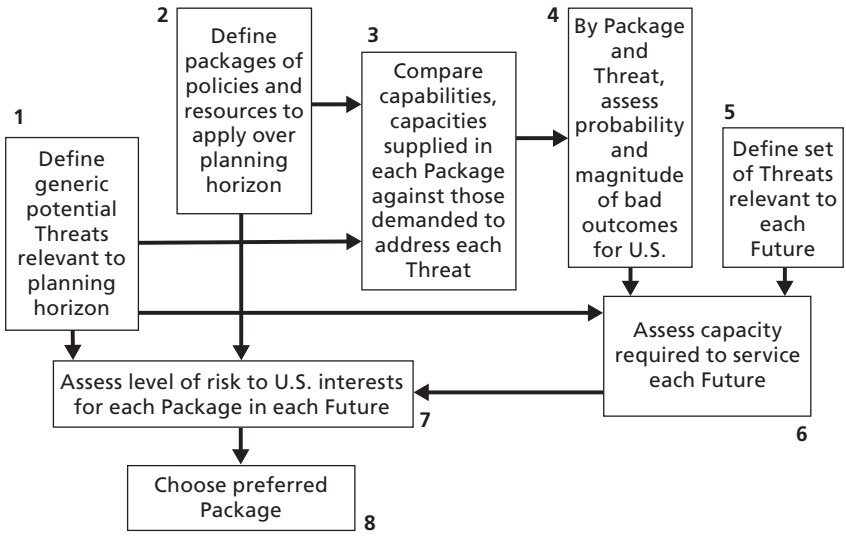
an analytic process, defined as a series of eight steps, that the Air Force could use to build and then apply such a scorecard. Figure 2.4 depicts the process graphically, using numbers next to boxes to enumerate the eight steps of the process.

Step 1: Define Generic Potential Threats Relevant to the Planning Horizon

A "potential threat" is a source of potential danger to U.S. national interests. Chapter Three discusses how to define a practical taxonomy of generic threats. In particular, it explains how the following list can capture the vast majority of the potential threats that the Air Force currently plans against:

- natural disaster
- state failure
- terrorism

Figure 2.4
Framework for Building and Using a Risk Scorecard in Strategic Force Planning



- insurgency
- traditional conventional conflict
- high-technology conventional conflict
- state nuclear threat or use.

Chapter Three defines each of these in detail.

Step 2: Define Packages of Policies, Resources, and Capabilities to Apply over the Planning Horizon

Strategic force planning in DoD is not resource-constrained in the same way that programming is. In fact, within DoD, it might be argued that strategic planning helps an organization define its requirements in a way that indicates how resources beyond the program might best be applied. In the context of risk assessment of the kind we envision here, such an approach to planning would indicate specifically how the danger to U.S. national interests—"risk"—would fall if resources were applied beyond the program. In that spirit, the risk relevant to any strategic force-planning activity is contingent on the policies, resources, and capabilities that planners expect to be applied over the planning horizon. That is, such strategic force planning occurs relative to resource constraints. Specific plans themselves need not be resource-constrained if the Air Force believes that they can be used to justify application of resources beyond the program. But if it is unrealistic to expect resources beyond the program, discussion of risk is meaningful only if any statement about risk is conditioned on a plan to apply policies and resources over a planning horizon.

Decisionmakers can ask for any set of packages that they want to consider in a planning cycle. Our analysis suggests that structured risk assessment will help them most if they ask for a small number of packages, each of which addresses the risks that the Air Force faces in qualitatively different ways. Chapter Four discusses such issues in more detail.

Step 3: Compare Capabilities and Capacities Supplied in Each Package Against Those Demanded to Address Each Threat

For our purposes, *capabilities* are sets of policy; human, physical, and information assets; and fungible resources that allow the Air Force to perform certain high-level tasks relevant to its mission. Examples might be abilities to

- strike targets anywhere in the world with a short lead time
- support sustained combat anywhere in the world with a short lead time
- gather information relevant to the Air Force's mission anywhere in the world with a short lead time.

For our purposes, *capacities* are measures of how much of any capability the Air Force can employ at any time. For example,

- How many targets can the Air Force strike in parallel?
- How large a total force can the Air Force sustain forward at any time?
- How much coverage can the Air Force sustain when collecting information?

The capabilities and capacities relevant to any potential threat depend on the nature of the threat and the options the United States might apply to mitigate risks associated with the threat. For example, if the threat involves high-technology conventional warfare, the United States is likely to seek high-technology instruments of conventional warfare—traditional Air Force warfighting capabilities—to counter the threat. On the other hand, the threat could involve the potential for terrorism, insurrection, or state failure that could hurt U.S. national interests by destabilizing a region where the United States has vital interests. In this case, Air Force capabilities that could help the U.S. government shape the political-military environment in the region would probably be more useful to counter the threat. Chapter Five explains a structured way to evaluate potential threats and illustrates it with examples in which both Air Force warfighting and shaping capabilities are relevant.

Step 4: By Package and Threat, Assess the Probability and Magnitude of Bad Outcomes for U.S. National Interests

To characterize the risk relevant to any package of policies and resources and potential threat, we use a high-level, subjective assessment of the degree to which that threat could damage U.S. national interests when the package of policies and resources in question is applied over the planning horizon. In particular, we characterize the risk relevant to any potential threat in terms of (1) the probability that such a threat will become active enough to be relevant to U.S. national interests over the planning horizon and, if it does, (2) the magnitude of effects on U.S. national interests. The "risk" associated with any potential threat rises if the probability or magnitude relevant to U.S. interests rises.

For example, over a ten-year planning horizon, planners might assess that, in each country facing the potential for insurgencies, the probability that an insurgency will become active enough to concern the United States will be low—for example, 20 percent—and, if this occurs, the magnitude of U.S. concern will be moderate. If this situation exists in ten countries, there is a 14-percent chance that no insurgency will become active enough to draw active U.S. concern within the planning horizon, a 27-percent chance that one insurgency will do so, a 27-percent chance for two, an 18-percent chance for three, a 9-percent chance for four, and a 5-percent chance for more than four.[9]

Risk can be characterized in many ways. A characterization that focuses in this way on a probability and magnitude of effects on U.S. national interests displays three advantages:

- In our discussions with Air Force decisionmakers and planners, we found that they often characterize risk in these terms.

[9] These probabilities are based on assuming that active insurgencies follow a Poisson distribution, with $\lambda = 2$, which is consistent with an expectation of two insurgencies during a 10-year planning horizon—that is, with a probability that an insurgency will become active in any specific situation of 0.2.

- DoD publications on risk assessment encourage an approach that characterizes risk in this way.[10]
- It appears likely that treating risk this way would lead decision-makers to make choices similar to those they would make if they used an approach to risk assessment based on more complete characterization of subjective probability distributions.

Appendix A explains in more detail why these advantages led us to characterize risk in this way. Chapter Five explains how we assess probabilities and magnitudes for potential threats, and Appendixes D and E illustrate the approach with specific examples.

To this point, the analytic process described here, properly applied, could generate a kind of "interim" scorecard like that shown in Figure 2.5. It displays the same rows as those in Figure 2.3. Columns now refer to q potential threats, not n futures. And for policy package i and potential threat j, the framework generates a probability that the threat becomes active enough to hurt U.S. national interests, p_{ij}, and, if so, a magnitude of the damage, M_{ij}. If planners are concerned primarily with assessing the qualitative *capabilities* that the Air Force maintains over the planning horizon, a scorecard of this kind may be all that they need. But it cannot tell them

Figure 2.5
Interim Scorecard Relating Policy Packages and Potential Threats

	Threat 1	Threat 2	.....	Threat q
Baseline policies, resources	p_{01}, M_{01}	p_{02}, M_{02}	.....	p_{0q}, M_{0q}
Policy-resource package #1	p_{11}, M_{11}	p_{12}, M_{12}	.....	p_{1q}, M_{1q}
Policy-resource package #2	p_{21}, M_{21}	p_{22}, M_{22}	.....	p_{2q}, M_{2q}
	:	:	:	:
Policy-resource package #m	p_{m1}, M_{m1}	p_{m2}, M_{m2}	.....	p_{mq}, M_{mq}

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[10] See, for example, Department of the Army, *Risk Management: Multiservice Tactics, Techniques, and Procedures for Risk Management*, Field Manual 3-100.12, Langley AFB, Va.: Air Land Sea Application Center, February 2001.

much about risks associated with the quantitative level of *capacities* that the Air Force needs of each of these capabilities to deal with the many potential threats against which it must plan. To assess risks associated with planned capacities, planners need additional tools.

Step 5: Define Each Future in Terms of the Set of Threats Relevant to the Planning Horizon

In this step, we define a *future* in terms of the set of generic potential threats that exist within the planning horizon. Each distinct future is associated with a different set of such threats.[11]

Chapter Three describes two different ways to think about such futures. The first considers the single threat type that is most important, in terms of its potential effects on national security, over the course of the planning period. Appendix C applies this definition to show how it can be used to characterize the effects of alternative policies in different futures.

A more analytically satisfying—and more demanding—approach defines a *future* as a complete set of threats relevant to the planning period. For example, a future relevant to the next ten years might include the potential for two natural disasters on the scale of Hurricane Katrina and the Indonesia earthquake, failures in four states relevant to U.S. interests, transnational terrorism on a scale comparable to the current threat, ten insurgencies in states relevant to U.S. interests, traditional conventional conflict in which the United States is a direct participant in one location and high-technology conventional conflict in another, and one use of state nuclear capability against U.S. interests.

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[11] Our approach to reflecting uncertainty about the future in a set of alternative futures is similar in many ways to other approaches currently under development at RAND. See, for example, Mayhar A. Amouzegar, Ronald G. McGarvey, Robert S. Tripp, Louis Luangkesorn, Thomas Lang, and Charles Robert Roll, Jr., *Evaluation of Options for Overseas Combat Support Basing*, Santa Monica, Calif.: RAND Corporation, MG-421-AF, 2006; Frank Camm, James T. Bartis, and Charles Bushman, *Federal Financial Incentives to Induce Early Experience Producing Unconventional Liquid Fuels*, Santa Monica, Calif.: RAND Corporation, TR-586-AF/NETL, 2008; Davis, Bankes, and Egner, 2007; Lempert, Popper, and Bankes, 2003; and Don Snyder, Patrick H. Mills, Adam Resnick, and Brent Fulton, *Assessing Capabilities and Risks in Air Force Programming: Framework, Metrics, and Methods*, Santa Monica, Calif.: RAND Corporation, forthcoming.

To aid planners in visualizing such futures, these potential threats can be placed in more specific contexts. But our primary goal here is to develop a view of the future in which Air Force planners prepare to address such threats wherever they might arise. Any effort to target Air Force investments today at potential threats defined in fine detail will surely choose the wrong targets; we seek a view of risks relevant to Air Force capabilities and capacities that encourages flexibility. In this spirit, each future in this approach to risk assessment emphasizes a different mix of generic potential threats.

See Chapter Three for additional detail on how to define futures in terms of threats.

Step 6: Assess the Levels of Capacity Required to Service Each Future

A quantitative assessment of the Air Force's demand for capacity (in addition to a more qualitative assessment of its demand for capability) becomes important when it is possible that more than one potential threat can become active at the same time or close enough in time so that it is impossible to swing available capacity from addressing one active threat to addressing another. Planners can use information from Steps 4 and 5 to assess the potential for such simultaneity. In particular,

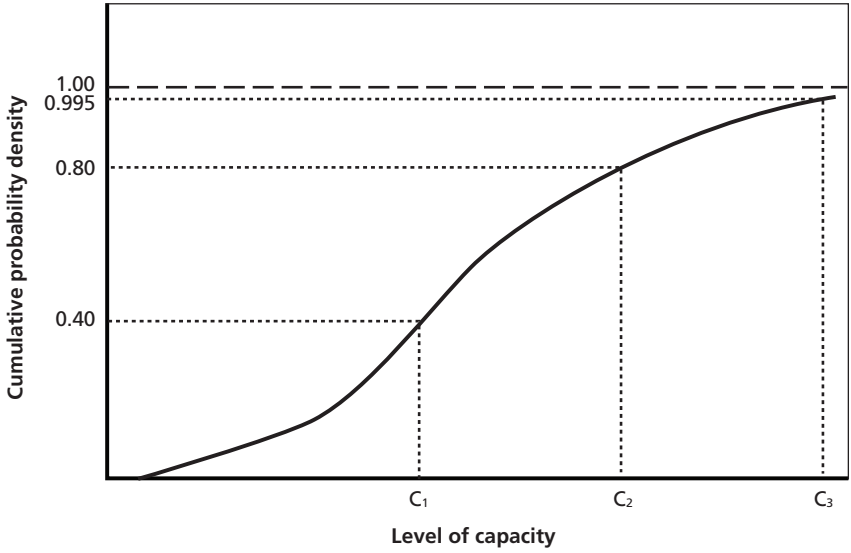
- Step 4 yields the probability that a potential threat becomes active at some point within the planning horizon. As Chapter Five demonstrates, the assessment underlying this probability and the magnitude of loss if a threat becomes active reveals the key capabilities the Air Force needs to address any active threat.
- Step 5 yields information about the number and timing of potential threats.

Planners can use this information, taken together, to generate a joint probability distribution of the demand on any key capability that they want to assess. Such an assessment would indicate the (subjective) probability that, over the planning horizon, the Air Force would need capability associated with a base level of capacity and the (subjective)

probability that the Air Force would need additional increments, probably corresponding to the addition of suitable organizations, of capacity beyond that base level.

This information would constitute a subjective probability distribution of the capacity of any capability that the Air Force would demand over the planning horizon.[12] Figure 2.6 offers an illustrative example of what such a distribution might look like. The horizontal axis displays the level of capacity, which might be measured in terms of equivalent dollar flows, numbers of billets, or some other resource metric. The vertical axis shows cumulative probability density. In this illustration, to achieve any capability in this area, the Air Force

Figure 2.6
Subjective Probability of Demand for Capacity in One Future



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[12] For a basic discussion of what a subjective probability distribution is and how to interpret it in the context of decision support, see Appendix A.

must sustain at least a level of C_1.[13] Beyond this, smaller, equal increments can add more capacity. This distribution reports an assessment, based on subjective beliefs, that something like a 60-percent probability exists that the future in question will induce a demand for more than the base level of capacity shown at C_1. There is about a 20-percent probability that it would induce a demand for more than an additional increment, shown at C_2. And it is close to certain that a second increment, shown at C_3, would cover any demand induced by this future.

Step 7: Assess Level of Risk to U.S. Interests for Each Package in Each Future

The level of risk associated with each package depends directly on whether it includes sufficient capacities of key capabilities to address the potential threats present in a particular future. If it does, the analysis above can support an assessment of this risk. If not, additional work is required. We proceed in two steps.

We first ask how the future demand for any capacity level of a key capability compares with the level provided in the package of policies and resources under review. For example, in the context of Figure 2.6, does the package provide a level of capacity closer to C_1, C_2, or C_3? If it is near or above C_3, Air Force planners can expect to counter all potential threats in the way that they assumed in Steps 3 and 4.[14] They can then use the information on probabilities and magnitudes from Step 4 to assess the number of active threats they expect in each future and

[13] Sixty percent of the area under the probability density function lies to the right of C_1. Ten percent lies to the right of C_2.

[14] The area to the right of C_3 in effect defines the level of risk the Air Force is willing to accept. Army policy on risk assessment emphasizes that any attempt to reduce risk to zero is self-defeating, because doing so tends to paralyze action. Department of the Army (2001) discusses how a commander should address the level of "acceptable risk" in a military setting. Fischhoff et al. provide a much broader discussion, which compares three alternative ways to assess acceptable risk (Baruch Fischhoff, Sarah Lichtenstein, Pail Slovic, Stephen L. Derby, and Ralph L. Keeney, *Acceptable Risk*, Cambridge, UK: Cambridge University Press, 1981).

the total magnitude of damage to national interests that they associate with each future.[15]

If a package provides a level of capacity closer to C_1, the Air Force does not have the capacity required to execute the mitigations assumed in Steps 3 and 4. In the light of this information, planners must return to Steps 3 and 4, constrain the capacities for relevant capabilities where shortages become apparent in Step 7, and develop new assessments of relevant probabilities and magnitudes. Such iteration must continue until the analysis in Step 6, documented in a distribution like that in Figure 2.6, reveals that the Air Force will have enough capacity in all key capabilities to cover the demands implied by the probabilities assessed in Step 4. What level of capacity of C_2 in Figure 2.6 is "enough"? That is a subjective judgment that planners must make in the context of their ongoing planning.

This discussion emphasizes how important it is for force planners to sustain their awareness of relevant resource constraints. If the assessments conducted in Steps 3 and 4 are not compatible with the basic constraints imposed in Step 7, the subjective beliefs developed about probabilities and magnitudes of damage to U.S. national interests are fundamentally flawed.

When the iteration described here is complete, the analysis to this point should provide information that decisionmakers and planners can use to assign subjective valuations of risk to the cells in the scorecard shown in Figure 2.3, which associates a risk value with each future and policy package. That value could be stated as a probability and magnitude, as in Figure 2.5, but it is now associated with a future rather than a threat.

Note that the description of this framework implicitly assumes that the capacity that a package of policies, resources, and capabili-

[15] In the simplest formulation, they could treat all potential threats as independent, stochastic variables that are distributed Poisson with λ equal to p_{ij}, as shown in Figure 2.5. This assessment would yield a distribution of the number of active threats of each type over the planning horizon. The magnitude of loss for any future goes up with the number of active threats and the M_{ij} from Figure 2.5 relevant to each threat type in the future. A more complete analysis would assess dependencies among threats. Appendix A discusses the challenges of eliciting subjective beliefs about such dependencies.

ties makes available to apply to the Air Force as a whole is the suitable object of the analysis in this step. In principle, the Air Force could also apply the framework at the level of major commands (MAJCOMs) or at the level of DoD as a whole. For example, if the Air Force depends on the MAJCOMs to conduct the strategic force planning relevant to their regions and then allocates resources to them based on such planning, analysis of this kind could be useful at the MAJCOM level. That said, over any significant force-planning horizon, the Air Force retains the option to reallocate resources among MAJCOMs. So at some point, this kind of planning should occur for the Air Force as a whole.

Analogously, because the Air Force acts as part of a joint team, and other members of this team have capabilities that operational commanders might choose to substitute for Air Force capabilities, analysis of this kind could be useful for DoD as a whole. Even if the Air Force takes the lead on this kind of planning, it may find a DoD-wide perspective useful when communicating its view of risks to decisionmakers in other parts of DoD.

Whether the Air Force chooses to frame its risk assessment in broader joint terms or not, its analysis of the consequences of its own capabilities and capacities must reflect beliefs about what kind of support it will get from its sister services and agencies and what kind of support they will expect from the Air Force. At the most basic level, for example, the Air Force's share of the national budget will depend on its ability to compete with other DoD and nondefense federal priorities. The planning and execution of each air tasking order will depend on how the Air Force and Navy coordinate their processes. The demand for close air support will depend on the Air Force's ability to substitute its capabilities successfully for Army and Marine Corps indirect fire and airborne strike capabilities. Its own access to the airlift services that it provides for DoD at large will depend on the support CONOPSs in the other services. The documentation of the assumptions that underlie the Air Force's assessments of risks relevant to its own force structure will be more compelling, inside and outside the Air Force, the more clearly it states the beliefs of the senior Air Force leadership about such issues.

However the Air Force frames its risk assessment, this step is demanding. The two example exercises described in Appendixes D and E illustrate the complexity involved. As planners and leaders visualize threats, futures, capabilities, and capacities in terms concrete enough to make informed professional judgments about how they interact to affect levels of risk, they must keep in mind the possibility that specific assumptions—for example, about the timing of specific events or the degree of advanced warning—may inappropriately shape their judgments. As the example exercises demonstrate, risk assessment of the kind described here benefits from a thorough exploration of circumstances to identify sensitivities and account for them in the assessment.

The Air Force can help manage this complexity in three ways. First, it can limit the number of policy packages it chooses to focus on in Step 2. Planners might consider a broader set in less depth, but they should limit the number considered in any cycle so that senior leaders can invest the limited time they have available to participate in this process as effectively as possible. Second, it can limit the number of futures it chooses to focus on in Step 5. It can do this by limiting the number of threats chosen in Step 1 or limiting the number of futures constructed from these threats once they are chosen. Again, planners might consider a broader set of threats or futures in less depth, but in any cycle should focus on futures likely to stress the current baseline policy package enough to demand the extended attention of the senior leadership. Third, the Air Force can embed the process described here in an ongoing planning cycle. This approach allows each cycle to build on information developed in earlier cycles. Step 7 then becomes an incremental enhancement of the risk assessments the Air Force has conducted in earlier cycles. Given that Air Force planning occurs in the context of ongoing Planning, Programming, and Budgeting System (PPBS) and Quadrennial Defense Review (QDR) cycles, it is hard to imagine that the process described here would not be aligned to these cycles.

Step 8: Choose Preferred Package

At the end of the planning cycle, decisionmakers will choose a preferred package. Properly executed, the steps described above should

generate information that shapes the decisions of senior leaders. These steps seek to help these leaders understand their subjective beliefs about uncertainty more clearly; if the steps succeed, this in itself will improve the final decision. In addition, these steps seek to refine the subjective beliefs of senior leaders by applying formal risk-assessment methods. This can help leaders see implications of their beliefs that may not feel intuitive. To the extent that leaders come to accept the value of these counterintuitive implications, the final decision may improve further.

Formal risk assessment can potentially assist decisionmakers in one final way as they choose a preferred package. Methods are available to aggregate the information developed above in a way that can offer decisionmakers a suggested final choice. In all likelihood, wise leaders will not delegate their responsibility to choose to a set of specialists who can apply these tools; by definition, formal methods simplify, abstracting from reality to make any problem tractable. Such simplification can help leaders see through potentially distracting detail not relevant to the key issues at hand. Simplification can also remove issues relevant to the decision, especially when subjective judgments are hard to reflect in risk analysis. So wise leaders will not rely solely on aggregative risk-assessment tools to determine their decisions. But such tools can provide a final set of insights that decisionmakers can use to inform their own decisions.[16]

Summary of the Analytic Framework

Table 2.2 provides a summary of the steps in the framework that we describe here. The first two columns reiterate the steps that the Air Force would use to implement the framework. The last column indicates where to look in this document for additional information on each step. We emphasize that more analysis will be required before the Air Force has a blueprint of this framework that it could implement. This document reports the status of analysis to date, which is considerably more advanced for some steps than for others.

[16] Appendix C discusses four decision rules that policymakers can use to do this.

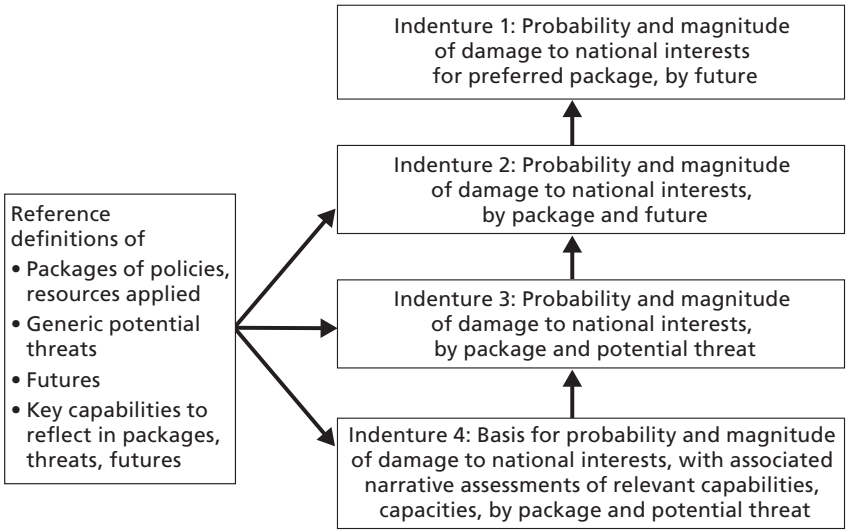
Table 2.2
Where to Look for Additional Information on Steps of the Framework

Step	Action	Additional Discussion in This Document
1	Define generic potential threats relevant to planning horizon	Chapter Three, Appendix F
2	Define packages of policies and resources to apply over planning horizon	Chapter Four
3	Compare capabilities supplied in each package against those demanded to address each threat	Chapter Five
4	By package and threat, assess probability and magnitude of bad outcomes for United States	Chapter Five, Appendix A
5	Define set of threats relevant to each future over planning horizon	Chapter Three
6	Assess capacity required to service each future	Appendix A
7	Assess level of risk to U.S. interests for each package in each future	Appendix A
8	Choose preferred package	Chapter Two (see below), Appendix C

An Indentured Risk Scorecard

The steps in the framework described above provide a set of information that decisionmakers and planners can organize as an indentured scorecard. Figure 2.7 displays the structure of such a scorecard. At the top (Indenture 1) is a summary assessment, for their preferred package of policies and resources to be applied over the planning horizon, of the risk of damage to national interests that planners anticipate in different futures. This is essentially the row in the scorecard in Figure 2.3 corresponding to the preferred policy-resource package, but with risk described in terms of a probability that each future occurs and a magnitude of loss if that future occurs. This assessment serves as a standing reminder to decisionmakers and those with whom they communicate that significant uncertainty persists over any reasonable strategic planning horizon. It also stands as a natural baseline for ongoing planning as

Figure 2.7
Indentured Risk Scorecard to Organize Information from the Framework



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the Air Force considers alternative packages to address changes in the environment and capabilities of the Air Force as they occur.

The second indenture maintains current information about the range of packages that the Air Force might substitute for the current baseline. It includes the full contents of the scorecard shown in Figure 2.3, again, with risk stated in terms of a probability that each future occurs and a magnitude of loss if that future occurs. Sustaining this information over time provides a useful context for assessing the preferred plan as its implementation goes forward. Is it performing as expected relative to alternatives? Have subjective beliefs about the risks associated with alternative packages in various futures changed? Has the nature of relevant futures changed? As subjective beliefs about the performance of packages in various futures and the nature of those futures themselves change, this second indenture provides a natural set of starting points for the next round of planning. As that cycle proceeds, the information in this indenture should change to reflect new information and the new subjective beliefs that accompany this information. If beliefs change enough, it may become appropriate to adjust

the preferred package. This indenture sustains the information that planners and decisionmakers need to decide when that is appropriate.

The third indenture preserves more detailed information about risks associated with the potential generic threats underlying alternative futures. If this information remains stable, the information in the indenture above it could shift to reflect changes in subjective beliefs about which threats planners should emphasize in each future. Analogously, if subjective beliefs about relevant futures remain stable, planners could adjust information in the indenture above if beliefs change here about the risks associated with potential threats.

The fourth indenture preserves more detailed information about the basis for probabilities and magnitudes that planners associate with potential threats under various packages. The "interim" scorecard in Figure 2.5 displays these values. This final indenture also maintains succinct narrative summaries of the capabilities and capacities considered in the planning that yielded the probabilities and magnitudes reported here. If the details considered here change as planning continues, these changes can eventually induce changes in the echelon above, potentially inducing changes all the way to the top of the chain.

A central database, shown at the left in Figure 2.7, preserves definitions of packages of policies and resources to be applied, generic potential threats, futures, and relevant capabilities used in all four echelons of the scorecard.

Taken as a whole, the scorecard provides an internally consistent set of subjective beliefs about risks defined at each level in the scorecard. In effect, the scorecard preserves a transparent set of accounts of what beliefs underlie the current preferred package of policies and resources. When questions arise at higher levels in the scorecard, the scorecard provides a drill-down capability that provides an audit trail to the beliefs underlying the information in the upper echelons. When ongoing planning leads to changes in the definitions of relevant packages, potential threats, futures, or capabilities in the central database or to changes in the details of assessments in the lowest echelon of the scorecard, the scorecard provides a structure that planners can use to work out how such changes should affect beliefs at higher levels in the scorecard.

Viewed in this way, the scorecard shares many features of a "balanced scorecard," a management tool widely applied in large, complex organizations to (1) develop and sustain consensus on an organization's priorities and then (2) use that consensus to drive coordinated changes in the application of policies and resources throughout the organization. For example, at the direction of OSD, the Air Force is currently implementing a series of "cascaded" balanced scorecards throughout its structure. The scorecard described here is not a traditional balanced scorecard. But it is highly likely that Air Force planners could use information in such scorecards, as various parts of the Air Force implement them, and methodological similarities to facilitate the implementation of the scorecard described here. Appendix B provides more information about what a balanced scorecard is and how it relates to the scorecard described here.

Examined from a different perspective, such a scorecard shares many features associated with a war game used to support planning or programming. Such a war game is essentially a detailed set of accounts that documents many interactions and the justifications for the outcomes of these interactions.[17] It is typically the product of many individuals whose inputs accumulate as the game is refined through time. Although the accounts maintained may state beliefs in precise, quantitative terms, the importance of military art to wargaming ultimately ensures that the inputs have heavily subjective components. That is, as planners apply a war game over time, they develop an effective consensus on the subjective judgments relevant to the definition of the game and its outcomes. As planners apply a scorecard of the kind described here, it could yield a similar consensus on subjective beliefs.

[17] For useful discussions of wargaming and the subjective judgments that they house, see Garry D. Brewer and Martin Shubik, *The War Game: A Critique of Military Problem Solving*, Cambridge, Mass.: Harvard University Press, 1979; and James S. Hodges, "Six (or So) Things You Can Do with a Bad Model," *Operations Research*, Vol. 39, No. 3, May–June 1991, pp. 355–365.

Using the Scorecard to Choose a Preferred Package of Policies and Resources

We envision the indentured scorecard described in Figure 2.7 as a tool that senior Air Force leaders and their planning staffs can use to do three things:

- Elicit from senior leaders what their subjective beliefs are about potential alternative futures and the risks associated with them, and then refine these beliefs.
- Given these beliefs, compare alternative policy packages and choose one to promote in the current planning cycle.
- Communicate the justification for the policy package chosen, inside and outside the Air Force, first to promote higher-level support for the package and then to implement the package effectively throughout the Air Force.

Eliciting and Refining Subjective Beliefs

We envision a planning staff using the scorecard to structure an orderly, intense interaction with senior leaders to elicit and refine their subjective beliefs. Experience shows that such interaction will require more than a little commitment, discipline, and patience on the part of both planning staff and leadership.[18] It requires leaders to explore the beliefs implicit in their current views of alternative futures and the risks associated with them and, potentially, adjust them when internal inconsistencies or misunderstandings become apparent. It requires planners to help leaders do this as efficiently as possible, pressing leaders to clarify their statements without provoking them into becoming defensive and walking away or, even worse, indignantly mandating that statements be accepted without explanation. Tested elicitation methods are available to structure such interaction. Appendix A discusses some of these methods.

[18] See, for example, the description later in this chapter, on pp. 40–41, of a recent Pacific Command (PACOM) risk-assessment exercise.

Ideally, much of this elicitation would occur as part of the normal interaction of leaders and planning staff. The staff would create a structure for an intense, high-level discussion among relevant leaders designed to highlight priorities and justifications for priorities. The staff would record this interaction and use statements from it to hypothesize the nature of shared subjective beliefs and areas of disagreement, using the structure of the scorecard to define these beliefs in terms of probabilities and magnitudes of loss in different situations. The staff would process this information to suggest its implications for policy choices and bring these suggestions back to the leadership for a follow-on, intense interaction on the staff's characterization of its beliefs, the implications of this characterization for policy choices, and adjustments required to represent the leadership's views and its justification for these views more clearly and accurately. Delphi methods could be used as part of this process to promote consensus. A small number of iterations of this kind could continue until the leadership was satisfied with the staff's characterization of its beliefs and the implications of those beliefs for policy. Experience suggests that much of the adjustment that the staff would make over the course of these iterations would, in fact, come from the leadership's improving understanding of its own priorities and their policy implications.

Comparing Alternative Policy Packages

An integral part of the process described above is an ability to translate any set of beliefs about the future into preferences among policy packages. Until leaders see the policy implications of their stated beliefs, they will have difficulty understanding whether the statements of their beliefs are accurate.

Available combat models can help translate subjective beliefs about some combat-related threats into implications for the probability and magnitude of losses associated with these threats. New models can be developed to assess the probability and magnitude of loss associated with shaping or deterrent policies. Chapter Five presents an example of such a new approach. And simple decision rules can help leaders and planning staffs see the implications of any set of subjective beliefs about risks in alternative futures for the relative performance of differ-

ent policy packages. Appendix C offers an illustrative example of how four different decision rules rank six different policy packages in the face of futures dominated by each of the seven threat types described in Chapter Three. It shows how senior leaders and planners can use such decision rules to focus their attention and refine policy alternatives that are most consistent with any set of stated subjective beliefs.

At the end of the day, the senior leadership will choose which policy package to pursue. We offer the scorecard described here as a tool that leaders can use to shape the alternative policy packages they consider and better understand the pros and cons of those packages before they make a final choice.

Communicate the Justification for the Policy Package Chosen

Once a package is chosen, the leadership faces the challenge of promoting the package in a joint setting, up through OSD to the White House Office of Management and Budget and to Congress. If the leadership succeeds in these settings, it finally must explain the basis for the package to those who must implement it. This is essential if implementation is going to yield something close to what the leadership intended.

Here is where the scorecard we envision shares the greatest similarity with the "balanced scorecards" under development elsewhere in the Air Force and DoD at large. If the scorecard has helped Air Force leaders speak among themselves, sharing their beliefs in more crisply stated terms and explaining their preferences among policies in terms of their likely effects in different futures, it naturally sets the stage for Air Force leaders to speak beyond themselves.

The scorecard will be most effective if it anticipates this role from the very beginning. That requires addressing threats and futures relevant not just to the Air Force but to the other players that the Air Force must engage to promote a policy package. It requires anticipating that other players may see the future quite differently than the Air Force leadership, clarifying the basis for such differences, and building the case wherever possible for the beliefs that drive the Air Force leadership's decisions. The scorecard will be most useful to the Air Force leadership if it anticipates such differences and builds risk assessments

that address these differences and, ideally, remain robust in the face of them.

Can the Air Force Do This? A Historical Illustration

The full application of the scorecard described here will not occur overnight. It will take time for leaders and staffs to learn to interact as suggested. It will take time to refine the tools used to identify salient threats, to assemble them into potential futures, and to assess probabilities and magnitudes of loss associated with them. This process will morph and evolve as the Air Force gains experience. For example, the Total Army Analysis process, which includes elements of what we have described here, began in the 1970s, has adjusted itself through application in each planning cycle since then, and is still very much a work in progress. The same could be said more broadly of DoD's PPBS process, which has continuously evolved through application since the 1960s.

But can the Air Force even get started on such a process? Does such a process fit the culture of a military organization? We heard descriptions of a similar planning process, which PACOM applied during 2006–2007 to produce its Integrated Priority List (IPL), that suggest that it could work well in a military setting.[19] The PACOM exercise sought to achieve command-wide consensus on a short list of priorities that PACOM could use, not only to produce an input required by the joint IPL process, but also to clarify and promote the pursuit of PACOM's own high-level goals throughout the command.

To do this, PACOM implemented a highly interactive process over the course of a year. Senior leaders from across the functional areas of the command met periodically for short, intense interactions designed to clarify the different priorities that existed across the command and then weigh them against one another until a consensus emerged. In each iteration, staff prepared an agenda, senior leaders met to execute the agenda, and new directives went to the staff to prepare material that would inform the next meeting. In each meeting, one participant told us that senior leaders from across PACOM "sat as a

[19] This description is based on interviews conducted with PACOM senior officers and staff, Camp H. M. Smith, Hawaii, February 27, 2007.

body and wrestled with judgments on probability and consequences of risk." As they did this, they found themselves balancing risk across different time horizons, different parts of PACOM's area of responsibility, different kinds of threats and mitigations, and so on. They found that they had to address shaping, deterrent, and operational considerations in ways that allowed useful comparisons of risks associated with very different types of COAs.

The participants found this process to be personally and professionally challenging. It forced them to confront high-level differences in perspective and resolve them instead of finessing them with consensus talking points that were too broadly stated to guide concrete actions. Most of all, however, they found that this approach allowed the leaders involved to "deliver solutions, not receive them" from their staffs. The persistent and repeated engagement of the most senior leaders in the command ensured that they kept the initiative and drove the ultimate IPL that emerged through their strategic decisions on very specific issues. The result was a very short list of specific priorities that drove decisionmaking within PACOM for the remainder of the commander's tenure.

As described here, this PACOM process is completely compatible with the application of the scorecard that we envision. Application of the scorecard would not change the macro-process at all. It would affect the issues discussed in meetings of senior officials, the analytic activities the staff performed to support these meetings, the specific language that the leaders and their staffs used to communicate with one another, and ultimately the language the leaders used to explain the basis for the priorities they identify at the end of such a process. It would help everyone speak more precisely about their beliefs and the reasoning underlying them. Clearer communication and more focused analysis could allow consensus priorities to be developed more efficiently, help the leaders verify that they had identified the right priorities, and then help them communicate the basis for those priorities in the joint arena and down through PACOM itself.

How This Framework and Scorecard Address Our Core Concerns

As explained in Chapter One, the integration of risk-assessment tools in force planning can potentially help guide senior leaders as they make necessarily subjective judgments about relative probabilities and potential harm associated with alternative policy options across multiple futures. By giving them more-transparent ways to examine and refine their beliefs, it should help them achieve three specific goals.

Give Decisionmakers a More Visceral Sense of the Persistent Presence of Uncertainty and Its Implications for Policy Decisions

The approach described above seeks to provide an enhanced understanding of uncertainty and its implications in two ways. First and most directly, it offers a first-echelon presentation of risk that highlights the range of the risks that remain active after senior leaders have committed themselves to a preferred package of policies and resources to apply over the planning horizon. Many futures can occur over that planning horizon; a final decision on a plan cannot wash away much of the uncertainty that will affect the success of that plan. The presence of this uncertainty invites leaders to watch for indicators of which future they will face and to stand ready to adjust their plans as information accumulates.[20]

Less directly, the approach draws on an active, structured interaction between decisionmakers and their support staffs to elucidate the leaders' subjective beliefs about key uncertainties and express those beliefs in a form that allows a more systematic exploration with risk-assessment tools. The approach recognizes the primacy of the subjective beliefs of Air Force decisionmakers. That said, it gives them a language that should help them express their intuitive beliefs more precisely. And it encourages them, throughout the planning process, to think more clearly about how much they really "know" about the future. It helps

[20] The identification of "signposts" to watch for and adjustment of plans based on these indicators are key elements in assumption-based planning—a powerful tool for planning under uncertainty. See James A. Dewar, *Assumption-Based Planning: A Tool for Reducing Avoidable Surprises*, Cambridge, UK: Cambridge University Press, 2002.

them reflect their doubts in a risk-assessment framework that makes it easier for them to see the value of more flexible, robust plans built to address their uncertainties about the future.

Filter and Aggregate the "Parade of Terribles" So That Decisionmakers Can Focus on Planning on the Most Salient Threats

The approach described above uses the concept of a "generic potential threat" as a core concept. Doing so reflects two insights. First, as the next chapter explains in detail, a short list of such threats can capture the most important features of a long list of potentially "terrible" threats that Air Force planners have addressed in recent years. As a result, planning against a few generic threats can potentially prepare the Air Force for dealing successfully with most of the "terribles" it might face.

Second, the fact is that, over any significant planning horizon, the Air Force simply cannot know which of these specific "terribles" will occur. It is far more likely that the Air Force can make useful predictions about what types of threats and how many of them might become active over a planning horizon than that it can predict which specific threats of any type will become active. Even though insurance companies and inventory managers cannot predict very well who will make claims or orders in any period in the future, they can predict with confidence how many total claims or orders they will face over the same period. And so it is with Air Force planners: To the extent that planners can associate a wide variety of "terribles" with a short list of potential threats, they can more effectively plan against the right numbers, even if they cannot predict which specific ones will occur.

This second insight is useful only to the extent that the Air Force builds enough flexibility into its ability to respond to threats as they become active to address them effectively, even if it cannot predict which specific threats it will have to address. Decisionmakers and planners cannot really make effective use of categories of generic potential threats unless the factors that define these categories give them a way to plan against whichever members of each category in fact become dangerous. Encouraging decisionmakers and planners to think more in terms of such generic threats can be seen as one way to encourage

them to think more about the flexible force planning that makes such categories useful. The more decisionmakers understand the usefulness of planning against generic threats, the more successful we are likely to be in giving these same decisionmakers a more visceral sense of the persistence of uncertainty.

Help Decisionmakers Better Understand and Communicate the Policy-Relevant Consequences of "Taking Risk" When Resource Shortages Occur

The approach described above highlights the close link between risk and resource constraints; decisionmakers and planners cannot make meaningful statements about risk—the potential for damage to our national interests—without placing their planning activities in a resource-constrained environment. That said, the approach seeks ways to induce decisionmakers and planners to focus more on the risk side of this relationship than on the resource side. It does this on two levels.

On the first, it asks decisionmakers to assess their beliefs about the probability and magnitude of damage to national interests that they associate with various threat types when they have specified packages of policies and resources available to address these threat types. In all likelihood, decisionmakers will need to learn how to do this by addressing this question repeatedly in different settings and clarifying their beliefs about the relative levels of probabilities and magnitudes in different situations. That is exactly how company-grade Army officers learn to assess the probabilities and magnitudes of loss they associate with alternative tactical COAs as part of their standard leadership training.[21] The approach offered here provides a construct within which more senior decisionmakers and planners can do the same thing to inform strategic force planning.

On the second, it asks planners to think about how the various threats that might become active during a planning period compete for the capacities of key capabilities present in the Air Force. When resource shortages exist in this setting, operational commanders must

[21] Appendix A provides more information on the risk-assessment framework used to do this.

trade off one source of damage to the national interest for damage from another source. Effective assessment of risk on the first level above must reflect "taking risk" by allocating available capacity from one threat to another, in the way that operational commanders are likely to do this. Seeing risks in this light should support the training described in the previous paragraph by helping decisionmakers see how risks associated with one threat relate to risks associated with another whenever a resource shortage exists. Decisionmakers will better appreciate the kinds of choices commanders will have to make when resources are short, as well as the implications of these shortages for damage to national interests.

As noted above, the approach focuses on giving decisionmakers and planners a more precise language to talk about their subjective beliefs about uncertainty. As they learn how to use this language, they should also be able to use it to communicate more effectively—decisionmaker to staff, operator to planner, peer to peer, and Air Force advocate to any stakeholder outside the Air Force.

CHAPTER THREE

Defining Alternative Futures

Today's defense planners must grapple with a wide range of potential challenges and threats. Al Qaeda could conduct a terror campaign on U.S. soil, targeting symbols of national power and key economic arteries. Iran could embark on a campaign to disrupt shipping in the Persian Gulf. A powerful hurricane could strike a densely populated area on the East Coast. Faced with what may seem like an endless "parade of terribles," force planners must focus their efforts on a select set of key challenges or risk becoming overwhelmed. How can force planners winnow the "parade of terribles" to a manageable set while covering as much of the waterfront as possible? How can force planners use the select set of challenges to construct a set of alternative futures against which to evaluate different policy options?

This chapter presents an approach to dealing with these two questions. The first section describes an approach that filters the "parade of terribles" so that only the most salient scenarios are carried forward in the force-planning process. The second section describes how to construct alternative futures from the salient scenarios.[1]

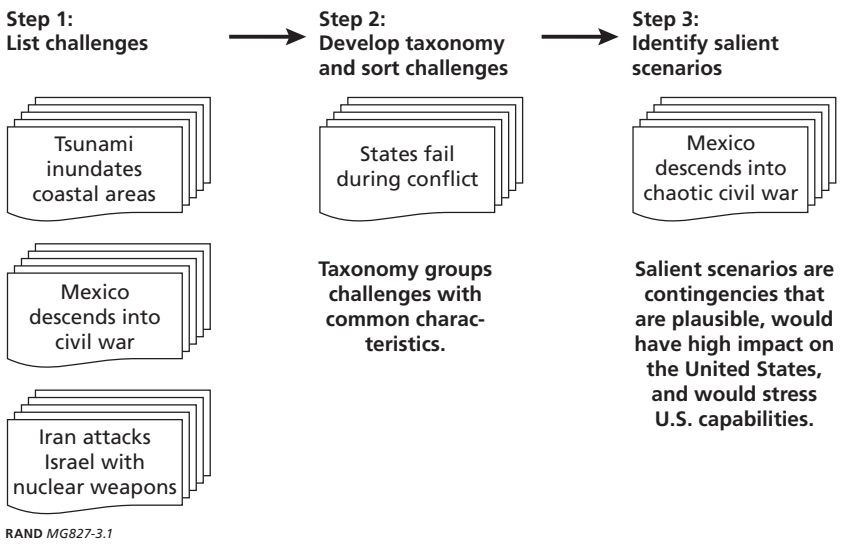
[1] There are, of course, other approaches for defining alternative futures. See, for example, Lempert, Popper, and Bankes, 2003; and Brian Nichiporuk, *Alternative Futures and Army Force Planning: Implications for the Future Force Era*, Santa Monica, Calif.: RAND Corporation, MG-219-A, 2005.

Defining Threat Types and Identifying Salient Scenarios

Our approach to defining policy-relevant threat types and identifying scenarios that are salient for force planning involves a three-step process (see Figure 3.1). It begins with compiling an extensive list of potential challenges and threats—a "parade of terribles." While this may appear to be a trivial exercise, it is a key step in the process. Neglecting important challenges at this stage could lead to blind spots in planning. Accordingly, planners should cast a wide net in their search for candidate challenges.

Once planners are satisfied with the list of challenges, the next step involves discerning common characteristics among the various challenges, developing a taxonomy of threat types based on those common characteristics, and sorting the challenges from the list into the appropriate "bins." Several iterations of this process may be required before a satisfactory taxonomy can be devised. This taxonomy defines the set

Figure 3.1
Approach for Defining Threat Types and Identifying Salient Scenarios



of generic threat types that serve as building blocks in defining alternative futures.

In the final step, planners identify the most salient scenarios for force planning through the application of a simple set of criteria to each of the challenges within each "bin." The "salient scenarios" are contingencies that are plausible, would endanger vital U.S. interests, and would prove stressing for U.S. military forces.

The first two of the three following sections describe the process the study team employed to construct its own "parade of terribles" and develop a taxonomy of threat types. The third provides a more detailed discussion of an approach for identifying salient scenarios.

The Parade of Terribles

To compile our list of challenges and threats, we surveyed several high-level strategy and planning documents and other authoritative reports from DoD, Congress, RAND, and other academic and research institutions. We included every challenge and threat we could find. For the purposes of this study, we limited ourselves to unclassified sources. Should planners in the Air Force or elsewhere within DoD employ this approach, we would expect them to survey classified sources as well. The vast majority of potential challenges and threats on our list were drawn from the following sources:

- *The 2004 National Military Strategy*.[2] In support of the goals and objectives of the National Security Strategy and the National Defense Strategy, the National Military Strategy outlines the plan of the U.S. armed forces for achieving military objectives in the near term and a vision for transforming U.S. forces to meet future challenges. It provides a broad but useful discussion of current and emerging challenges and threats arising from the security environment.

[2] Office of the Chairman of the Joint Chiefs of Staff, *The National Military Strategy of the United States of America: A Strategy for Today, A Vision for Tomorrow*, Washington, D.C., 2004.

- *The 2006 Quadrennial Defense Review Report*.[3] The latest in a series of comprehensive reviews of defense strategy, force structure, modernization plans, infrastructure, budgets, and other elements of the defense program, the QDR describes DoD's blueprint for providing the capabilities required to meet current and future challenges over the next 20 years. Although the report focuses on identifying needed capabilities and how to reorient the defense program to provide them, it also describes a broad array of current and potential threats and challenges that DoD may confront over that time horizon.
- *The Committee Defense Review (CDR) report*.[4] Intended to serve as a "threat-based" complement to DoD's QDR, the House Armed Services Committee's CDR report provides a particularly rich source of potential challenges and threats.
- *Strategic Survey 2006*.[5] Published by the International Institute for Strategic Studies, this annual review of world affairs provides a useful appraisal of major events and trends in key regions and countries around the world.

To test the comprehensiveness of the list, we also conducted a brainstorming session to see whether we could conceive of potential threats and challenges that were not already included. This effort benefited from both the expertise resident within the team and insights gained from scenario development and gaming conducted at RAND. The few that were qualitatively different were added to our list.

Here is a sample of threats from the "parade of terribles":

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[3] DoD, *Quadrennial Defense Review Report*, Washington, D.C., February 6, 2006a.

[4] U.S. House of Representatives, House Armed Services Committee, *Committee Defense Review Report*, Washington, D.C., December 2006. Also known as the Defense Review of the House Armed Services Committee, the CDR was initiated out of concern that DoD's QDR would be a "resource-constrained" exercise that would inform decisionmakers about what could be afforded instead of what might be required to deal with current and potential threats.

[5] International Institute for Strategic Studies, *Strategic Survey*, Vol. 106, No. 1, January 2006.

- Transnational terrorist networks attack the United States and its allies.
- Drug cartels subvert Colombia.
- Political violence erupts in Haiti.
- Venezuela threatens Colombia.
- Democracy erodes in Russia.
- North Korea exports nuclear technology to Iran.
- Failure of the Iraqi state leads to civil war.
- Turkish and Iranian forces enter Kurdistan to suppress the Kurdish independence movement.
- The Taliban and drug lords threaten Afghanistan's future.
- Al Qaeda attacks the United States or its allies with a nuclear weapon.
- Al Qaeda attacks the United States or its allies with a biological weapon.
- North Korea attacks Japan with a nuclear weapon, causing an electromagnetic pulse (EMP).
- China blockades or invades Taiwan.
- Islamic rebels seize nuclear weapons in Pakistan.
- Iran sponsors terrorist attacks in the Middle East and attacks U.S. forces with a nuclear weapon, causing EMP.

We provide the full "parade of terribles" in Appendix F, but the sample list above should confirm that we captured a broad range of challenges that today's force planners face. There are threats involving transnational terrorism, interstate conflict, state failure, and more. Some involve threats that are more familiar, such as a potential civil war in Iraq. Other challenges are less familiar, such as those posed by a nuclear-armed North Korea or Iran.

A Taxonomy of Threats

The process of defining a taxonomy of threat types involved a great deal of iteration. We began by taking the "parade of terribles" and forming loose clusters of similar-sounding challenges and threats, combining some along the way to eliminate duplication. We examined the challenges and threats in the clusters for common character-

istics and developed alternative taxonomies based on various combinations of those characteristics. We tested a candidate taxonomy by sorting each challenge and threat from the list into the appropriate "bin." If the sorting process resulted in too many odd or incoherent groupings, we discarded the taxonomy and tried another. If the sorting process yielded relatively coherent groupings, we continued to refine it.

Complicating matters further was the need to limit the number of threat categories without committing the sin of overaggregation. A fine-grained taxonomy with numerous threat types would yield unwieldy scorecards for decisionmakers. A coarse-grained taxonomy with a limited number of overaggregated threat types would obscure important differences among threats.

After several iterations, we devised a taxonomy that grouped the challenges and threats from our "parade of terribles" into the following seven categories:

- Natural disasters cause humanitarian emergencies.
- States fail during internal conflict.
- Terrorists attack U.S. or allied interests.
- Insurgencies threaten friendly governments.
- States wage traditional conventional conflict.
- States wage high-technology conventional conflict.
- States brandish or use nuclear weapons.

These seven threat types serve as building blocks for the development of alternative futures, as discussed later in this chapter. The challenges and threats in each category share roughly similar causes and effects and exhibit similar dynamics over time (see Appendix F for a list of threats sorted by category). Table 3.1 summarizes the shared characteristics of the threats within each category. All the rows except those dealing with terrorism and insurgency are separated with a thin line, to highlight the close relationship between these two threat types.

Natural Disasters Cause Humanitarian Emergencies. This category of threats is unique within the taxonomy in that there are no human adversaries to dissuade, deter, or defeat. The proximate causes of these events are, of course, natural. They can result in widespread

Table 3.1
Shared Characteristics by Threat Type

Threat Type	Cause	Effect	Dynamics
Natural disaster	Natural	Widespread destruction, suffering, displacement	Political and moral responsibility to respond
State failure	Deep political, societal, and cultural roots	Ungoverned space exploitable by extremists	Mêlée of autonomous armed groups; loose-nukes problem
Terrorism	Intense political and religious motivation	Intimidation of populace and leaders	Highly destructive, spectacular actions
Insurgency	Disaffection with the current government	Subversion, terrorism, guerrilla warfare	Violent competition for allegiance of the people
Traditional conventional conflict	Aggression, mutual escalation, punitive actions	Large-scale organized hostilities by regular forces	Military operations to defeat enemy forces
High-tech conventional conflict	Aggression, mutual escalation, punitive actions	Large-scale organized hostilities by regular forces	Military operations to defeat or deny access to enemy forces
State nuclear threat or use	Deliberate[a] or despairing act of state	Potential for apocalyptic outcomes	Escalatory sequence threatens

[a] In this context, a deliberate act is one that comes as a result of a structured planning process.

destruction, large-scale suffering, and large displaced populations. Government responses are driven by a political and moral responsibility to relieve suffering when calamities strike. Examples of threats within this category include a hurricane striking a densely populated area on the East Coast or a global pandemic that causes a staggering death toll.

Although U.S. military forces have often been called on to conduct humanitarian assistance and disaster-relief operations in the past, planners have not traditionally sized forces to perform these missions. They are generally considered collateral missions for military forces.[6]

[6] This view may be changing. A recent study released by a blue-ribbon panel of 11 retired admirals and generals from the Army, Navy, Air Force, and Marines recommended that

States Fail During Internal Conflict. The causes of state failure often have deep political, societal, and cultural roots. The collapse of state authority creates ungoverned spaces exploitable by extremists. A melee of autonomous armed groups often ensues. If the failed state's arsenal included nuclear weapons, there could also be a "loose nukes" problem.[7] The failure of the Iraqi state leading to civil war or a collapse of the North Korean regime would be examples of challenges in this category.

In the event that U.S. forces are called on to create and sustain an effective government in response to one of these contingencies, trainers, advisors, support forces, and peacekeepers would likely be in high demand. Should the mission call for securing loose nukes, special operations forces along with air and naval forces may be required.

Terrorists Attack U.S. or Allied Interests. The threats in this category generally have their roots in intense political and religions motivations. Successful terrorist attacks—particularly highly destructive, spectacular actions—can intimidate the general populace and the leadership of a targeted country. This category includes a range of potential threats from attacks against oil targets in such countries as Saudi Arabia, Mexico, and Venezuela to an al Qaeda attack on the United States with a nuclear weapon.

Direct action against terrorists could involve both U.S. special operations forces and general-purpose forces. Supporting and assisting partner-nation governments in their own counterterrorism efforts would tend to increase demand for trainers, advisors, and special oper-

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the next QDR assess the capabilities of the U.S. military to respond to the consequences of climate change, especially preparedness for natural disasters from extreme weather events, pandemics, and other missions that U.S. forces may be asked to support at home and abroad. It also recommended an assessment of the capacity of the U.S. military and other institutions to respond to the consequences of climate change. See CNA Corporation, *National Security and the Threat of Climate Change*, Alexandria, Va., 2007, p. 46.

[7] Since the proximate causes of state failures are the same regardless of whether it is a nuclear or a non-nuclear state, we decided to keep them in the same category in the interest of minimizing the total number of categories.

ations forces.[8] Specialized consequence-management capabilities could also be required to deal with the aftermath of a terrorist attack involving nuclear, biological, or chemical weapons.

Insurgencies Threaten Friendly Governments. The threats in this category are typically borne out of disaffection with the current government. Once these threats become active, a violent competition for the allegiance of the people ensues. As the weaker party in this competition (at least initially), the insurgent groups often engage in subversion, terrorism, and guerrilla warfare. The continuing insurgencies in Iraq and Afghanistan are examples of threats in this category.

U.S. responses to such contingencies could follow two general approaches. A more direct approach focusing on the use of U.S. forces in COIN operations could involve large numbers of ground troops and other general-purpose forces. A more indirect approach that focused on supporting or assisting host-nation security forces would place greater emphasis on the use of trainers, advisors, and special operations forces.[9]

States Wage Traditional Conventional Conflict. These contingencies may occur for many reasons, including aggression, mutual escalation, and punitive actions. In general, once these threats become active, military operations to defeat enemy forces (or achieve some other, more limited objective) will commence, resulting in large-scale organized hostilities by regular forces. The canonical invasion of South Korea by a non-nuclear North Korea that was a focus for planners throughout the 1990s exemplifies the types of threats in this category.

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[8] For a concise discussion of military capabilities useful for counterterrorism operations, see David A. Ochmanek, *Military Operations Against Terrorist Groups Abroad: Implications for the United States Air Force*, Santa Monica, Calif.: RAND Corporation, MR-1738-AF, 2003.

[9] For additional discussion of the indirect approach and its implications for force planning, see Alan J. Vick, Adam Grissom, William Rosenau, Beth Grill, and Karl P. Mueller, *Air Power in the New Counterinsurgency Era: The Strategic Importance of USAF Advisory and Assistance Missions*, Santa Monica, Calif.: RAND Corporation, MG-509-AF, 2006; and Adam Grissom and David Ochmanek, *Train, Equip, Advise, Assist: The USAF and the Indirect Approach to Countering Terrorist Groups Abroad*, Santa Monica, Calif.: RAND Corporation, 2008, not releasable to the general public.

In general, U.S. responses to these contingencies would seek to defeat opposing forces and impose peace. General-purpose forces would play a primary role, with support from special operations forces.

States Wage High-Technology Conventional Conflict. These contingencies tend to have causes and effects similar to those of the contingencies in the previous category. The primary difference is that the potential adversaries in these scenarios possess substantially more-advanced capabilities. Equipped with "high-tech" conventional weapon systems, such as accurate ballistic and cruise missiles, advanced integrated air defenses, and fourth-generation fighters, these adversaries wield substantial anti-access and area-denial capabilities.[10] These contingencies would likely exhibit dynamics that are significantly different from the dynamics of contingencies in the traditional conventional conflict category. A prime example of this type of contingency would be a cross-strait invasion of Taiwan (discussed in Appendix D).

In general, a U.S. response would seek to defeat enemy forces and deny adversary objectives. Moreover, if the adversary possessed nuclear weapons, U.S. offensive operations may be constrained to minimize the potential for escalation. General-purpose forces would likely play a primary role, with support from special operations and missile-defense forces. Nuclear forces may also play a role in contributing to deterrence.

States Brandish or Use Nuclear Weapons. The threats in this category could arise as a result of deliberate (i.e., the result of a structured planning process) or despairing acts of state. Once these threats become active, escalatory sequences could lead to catastrophic—possibly even apocalyptic—outcomes. Examples include a large nuclear assault on U.S. cities by a major power or a North Korean nuclear attack on Japan.[11]

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[10] See Roger Cliff, Mark Burles, Michael S. Chase, Derek Eaton, and Kevin L. Pollpeter, *Entering the Dragon's Lair: Chinese Antiaccess Strategies and Their Implications for the United States*, Santa Monica, Calif.: RAND Corporation, MG-524-AF, 2007.

[11] For a discussion of the problems posed by nuclear-armed regional adversaries, see David Ochmanek and Lowell H. Schwartz, *The Challenge of Nuclear-Armed Regional Adversaries*, Santa Monica, Calif.: RAND Corporation, MG-671-AF, 2008.

In these contingencies, the United States could attempt to deter and defeat attacks or perhaps to limit damage. Air, missile defense, and nuclear forces may play primary roles in these contingencies.

Identifying the Salient Scenarios

The final step of our approach to filtering the "parade of terribles" involves identifying the most salient scenarios for use in detailed planning tasks. This may be accomplished by applying a simple set of criteria to assess the salience of each scenario within a specific threat type. Planners could then select the most salient scenario (or scenarios) that would be representative of that threat type. Repeating the process for each threat type would yield a set of the most salient scenarios.

Until we identify the most salient scenarios described here, we cannot perform any assessment of the probability and magnitude of harm to national security associated with any threat type. But we face a kind of chicken-and-egg dilemma in selecting the "salient threats" most deserving of the kind of detailed risk assessment to be described in Chapter Five. In principle, we could apply the methods described in Chapter Five to filter the threats clustered in each threat type to find the "most salient." As a practical matter, we need a simple way to do such filtering so that we can focus the resources required to perform the in-depth risk assessments described in Chapter Five where they can add the most value to Air Force strategic force planning. The approach described here seeks to cover much of the ground discussed in Chapter Five at a much lower level of resolution.[12]

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[12] One way to understand the difference between the approach described here and that described in Chapter Five is to think about the concept development and full system development phases in a weapon system acquisition. Both seek to identify the best way to achieve the goals that the Air Force emphasizes in the creation of a new weapon. Concept development does that by reviewing many options at a high level to determine where it is worthwhile to invest the substantial time and resources required to learn more. Even though this high-level activity consumes significantly fewer resources and much less time than full system development, it yields strategic decisions that tightly constrain the decision space relevant to the far more resource-intense development activity that follows. Each phase asks questions about similar issues, but concept development uses a much broader, shallower focus than full system development. The same is true of the approach we propose here: first to identify

For our purposes, we define the salience of a scenario to be a function of three factors:

- the likelihood that the scenario will occur during the relevant planning horizon
- the degree of U.S. interests at stake
- the stress on U.S. forces if the United States were to respond.

An exemplar salient scenario would be a contingency that was likely to occur, would threaten important U.S. national interests, and would prove very stressing for U.S. forces. However, it is possible that the most salient scenario arising from a given category of threats may fall short of this standard with respect to one (or more) of the three factors.[13]

Scorecards provide a useful means for implementing the salience assessment. A scorecard approach would ensure that the criteria are applied uniformly across all the scenarios within a given threat type. It would also force participants to make the rationales for their judgments explicit.

An illustrative scorecard for assessing the salience of threats from the "states brandish or use nuclear weapons" category is shown in Figure 3.2. There are three major factors—likelihood, U.S. interests at stake, and stress on U.S. forces—that are functions of other lower-tier factors.

Likelihood. This is an assessment of the likelihood that the scenario will occur during the relevant planning period. It depends on

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the "most salient scenarios" and then to focus in-depth risk-assessment efforts on these most salient scenarios. The goals are the same in both phases; the methods are different.

[13] It is possible that a scenario may arise that does not seem relevant for the USAF at first glance. If a more detailed assessment or concept-development effort comes to the same conclusion, the scenario should be discounted and perhaps raised to the OSD level for consideration. For more information on conducting concept-development efforts, see John Birkler, C. Richard Neu, and Glenn Kent, *Gaining New Military Capability: An Experiment in Concept Development*, Santa Monica, Calif.: RAND Corporation, MR-912-OSD, 1998.

Figure 3.2
Notional Scorecard for Assessing Salience of Scenarios

Threat	Likelihood			U.S. Interests at Stake			Stress on U.S. Forces			Net
	Importance of Goals	Adversary Ability	Estimate of External Response	Security	Political	Economic	Shortfalls	Gaps	Potential for Bad Surprises	
North Korea threatens nuclear use against Tokyo										
North Korea attacks U.S. air base at Misawa with nuclear weapon										
Iran detonates nuclear weapon at high altitude over U.S. CSG to create EMP effects										
Near-peer conducts large-scale nuclear attack on United States										

NOTE: CSG = Carrier Strike Group.

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three lower-tier factors that should be assessed from the potential adversary's perspective:[14]

- *Importance of Goals.* This captures the level of importance the adversary would place on achieving its goals in the scenario. All else equal, the greater the importance of the goals to the adversary, the greater the likelihood that the scenario will occur.
- *Adversary Ability.* This represents the adversary's assessment of its own ability to achieve its goals if external actors do not respond. All else equal, the greater the adversary's assessment of its abilities, the greater the likelihood that the scenario will occur.
- *Estimate of External Response.* This represents the adversary's assessment that external actors will respond in a way that can thwart its efforts. All else equal, the lower the expected effectiveness of an external response, the greater the likelihood that the scenario will occur.

U.S. Interests at Stake. This is an assessment of the potential degree of harm that U.S. national interests could suffer if the scenario occurs. In this construct, there are three different types of interests that could be harmed:

- *Security.* This represents the degree of harm that U.S. security interests could suffer if the scenario occurs. All else equal, the greater the potential harm to U.S. security interests, the greater the U.S. interests at stake.

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[14] In the interests of simplicity, the definition for *likelihood* presented here is intended to be broadly applicable across as wide a range of threat types as possible. While it may be applied to many types of threats and challenges, there will undoubtedly be exceptions. Natural disasters, for instance, are a clear exception. Quantitative tools could be brought to bear to estimate likelihoods (and magnitudes of effects) for these types of threats. Planners should feel free to use preferred approaches for assessing likelihood, as long as the approach is applied uniformly to each scenario within a threat type. To assess the likelihood of scenarios involving terrorism, for example, planners could base their judgments on such factors as the intent and capability of the terrorist group and the vulnerability of the defender. See Michael D. Greenberg, Peter Chalk, Henry H. Willis, Ivan Khilko, and David S. Ortiz, *Maritime Terrorism: Risk and Liability*, Santa Monica, Calif.: RAND Corporation, MG-520-CTRMP, 2006.

- *Political.* This represents the degree of harm that U.S. political or diplomatic interests could suffer if the scenario occurs. All else equal, the greater the potential harm to U.S. political or diplomatic interests, the greater the U.S. interests at stake.
- *Economic.* This represents the degree of harm that U.S. economic interests could suffer if the scenario occurs. All else equal, the greater the potential harm to U.S. economic interests, the greater the U.S. interests at stake.

Stress on U.S. Forces. This is an assessment of how stressing the scenario would be on U.S. forces—specifically, the force we expect to have during the relevant planning time frame—if the United States were to respond to prevent the adversary from achieving its goals. In this construct, there are three factors to consider:

- *Shortfalls.* This is an assessment of shortfalls in capacity that may arise if the scenario occurs. It is based on our best estimate of the adversary's capabilities and most likely course of action. A shortfall in capacity occurs when we have units of sufficient quality but lack sufficient quantities. All else equal, the larger the shortfall, the greater the stress on U.S. forces.
- *Gaps.* This is an assessment of gaps in capability that may arise if the scenario occurs. It is based on our best estimate of the adversary's capabilities and most likely course of action. A gap in capability occurs when U.S. forces lack the ability to accomplish important operational tasks. All else equal, the larger the gap, the greater the stress on U.S. forces.
- *Potential for Bad Surprises.* This is an assessment of the possibility that the adversary in question could surprise us with an unforeseen operational capability that could have a significant impact on the outcome of the scenario. It acknowledges the fact that we may have a better understanding of some adversaries' capabilities than others. All else equal, the larger the potential for bad surprises, the greater the (potential) stress on U.S. forces.

Net. This is the overall net assessment of the salience of the particular scenario.

Combining Threats into Futures

For the past 15 years, the Air Force was involved in operations that responded to a variety of threats and challenges. Between 1992 and 2008, the USAF

- conducted a 12-year "air occupation" of Iraq that was part of the aftermath of *Operations Desert Shield/Storm* (1990–1991)—a traditional conventional war with Iraq.
- participated in multilateral peace-enforcement operations in the Balkans, including *Operation Deliberate Force* (mid-1990s)—a response to a complex conflict following the demise of Yugoslavia. (We categorize the threat here as state failure.)
- participated in a coercive air campaign against Serbia in *Operation Allied Force* (1999). (We categorize the threat here as state failure.)
- provided humanitarian assistance and disaster relief in two major natural disasters (the Indonesian earthquake and tsunami of 2004 and Hurricane Katrina in 2005) and multiple smaller but serious natural disasters.
- responded to the September 11, 2001, terrorist attacks with both homeland defense operations and *Operation Enduring Freedom*.
- participated in regime takedowns in Afghanistan (2001) and Iraq (2003) and the COIN operations that followed. (The first of these clearly falls into the terrorism category; the latter is harder to categorize. According to U.S. leaders at the time, the operation sought to head off future conventional and nuclear threats to the region as well as possible terrorist attacks armed with weapons of mass destruction [WMD].)

In this period, the USAF did not experience any high-technology conventional wars or open threats of state use of nuclear weapons against

the United States, its allies, or their armed forces. That is, we can think of the past 15 years in terms of a set of threats of the kind described above. In 2023, looking back over the previous 15 years, a future observer could create a similar summary list. It would describe a single future—the one that actually unfolded beginning in 2008—as a set of threats. The next 15 years might unfold in many ways; no matter what occurs, observers will be able to describe it after the fact in terms of a set of threats. In our analysis, we define alternative futures—alternative pictures of the period relevant to force planning—in terms of the threats that compose them. We thought about the threats relevant to alternative futures in two different ways.

In the first, illustrated in Appendix C, we considered a set of futures that were each dominated by one type of threat. Defining a set of alternative futures in this manner serves to emphasize differences in capabilities as alternative packages of policy options are assessed against each future.

A more analytically satisfying, but much more demanding, approach would identify the relative importance of all threat types in each future. For example, Future 1 might include two natural disasters of the scope of Hurricane Katrina; one failure of a state of great importance to the United States, such as Pakistan; three terrorist events on the scale of 9/11; five insurgencies similar in scale to that in Mindanao in the Philippines; and one state use of nuclear weapons against deployed U.S. force. Future 2 might have one major natural disaster; no state failures, conventional wars, or nuclear attacks; but pervasive insurgencies and major terrorist events. And so on. Further, each of these futures should include information on the timing of these threats—particularly how many become active at the same time.[15]

The first approach, which highlights one dominant threat type in each future, offers a way to think broadly about how the weight of capabilities within the Air Force should shift over the planning period. The second, more detailed approach makes it possible to think not only about capabilities, but also about the quantitative capacities of each

[15] In this context, the timing of threats refers to the degree or level of simultaneity—i.e., how many conflicts occur concurrently or have overlapping time frames?

that the Air Force would require to deal with multiple active threats in proximity in time. Either way, planners should construct each future explicitly to stress the Air Force in some way that would require a change in the policies and resource application planned over the future period to be examined.

A 2006 RAND report by Amouzegar et al.[16] demonstrates a simple application of the second approach. It seeks to identify where to locate combat support bases to ensure that the Air Force can support combatant commands in any future worth planning against.[17] To do this, Amouzegar et al. define what we call threats in terms of conflicts that involve (1) different numbers of forward operating locations in (2) different regions of the world. For example, one threat might be a conflict in Central Asia that would require three Air Force forward operating locations. Numbers of forward operating locations in conflicts considered are usually around one to four, but range as high as 14. The authors then combine different mixes of these to construct five "timelines" or "streams of reality" (what we would call futures):

> Each timeline was designed to include two major conflicts in order to sufficiently size the facilities to support regional conflicts specified in the planning guidance. However . . . since the operational cost for wartime execution is not included in the POM [program objectives memorandum], it can be assumed that these conflicts occur at the end of the six-year Future Years Defense Program (FYDP). The baseline scenario represents the most likely timeline and is used as the starting point for analysis. Each subsequent stream widens the geographical net and adds more stress to the combat support system.[18]

The five streams of reality include from 12 to 16 conflicts, other than major conflicts, over the course of a six-year POM period. Each emphasizes different degrees of simultaneity and different regions.

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[16] Amouzegar et al., 2006.

[17] Amouzegar et al., 2006, pp. 23–32.

[18] Amouzegar et al., 2006, p. 31.

Because the goals of the strategic force planning we examine here differ from those of the Air Force combat service support system, the sets of futures likely to stress the programmed force of interest will probably be different in each case. So we do not advocate that strategic force planners use the set of futures described in the 2006 Amouzegar et al. report. Their approach, however, does have promise to build composite futures from threat-type building blocks. This, in turn, would help strategic planners assess the robustness of alternative policy options across multiple futures. In the next chapter, we describe a process through which USAF planners and decisionmakers can identify these policy options.

CHAPTER FOUR

Defining Packages of Policy Options for Risk Analysis

As discussed in Chapter Two, the risk-management process has three components: (1) Define packages of policy options, (2) Define generic potential threats, and (3) Assess the probability and magnitude of bad outcomes. This chapter provides additional detail on the process by which packages of policy options are defined.

Planners and decisionmakers have two major challenges in defining policy packages. The first is to determine what level of option is appropriate for risk analysis. The second is to select a manageable number of options for comparison. Neither can be done in isolation, since the level of option is very much interwoven with the number of options.

Risk Management at Three Levels

Within DoD, risk analysis takes place at multiple levels, from the program element to the grand strategic. In this chapter, we consider the relative merits of using policy options at three levels for risk analysis: grand strategy, operational level of warfare, and program element.

Grand Strategy

Defense planning typically starts with high-level objectives and considers options commensurate with these objectives. For example, in its fourth section, the 1997 QDR report considered three "alternative paths" to achieve the objectives identified in its Defense Strategy section. The path options were (1) "Focus on Near-Term Demands,"

(2) "Preparing for a More Distant Threat," and (3) "Balance Current Demands and an Uncertain Future."[1] These options are at the level of grand strategy or perhaps might be viewed as alternative strategic directions. More concretely, OSD planners might choose to focus strategy on one particular region over others or on a particular problem. For example, during the Cold War, defense strategy emphasized the defense of Western Europe over competing priorities. Similarly, the 2006 QDR made clear that defeating global terrorism was DoD's current priority.[2] In practice, decisionmakers and planners are loath to embrace stark choices and will always seek a mixed strategy. Thus, in 1997, Secretary of Defense Cohen chose option 3, "Balance Current Demands and an Uncertain Future," and the 2006 QDR presented a strategic vision to address a broad range of security challenges beyond the priority mission of countering terrorism. In the same spirit, the *USAF Strategic Plan: 2006–2008* listed three priorities, including "Winning the war on terror . . . while preparing for the next war."[3]

Yet there is the rub. Leaders want to both establish priorities and hedge against uncertainties. They also have to placate important constituencies at home and abroad who will oppose shifts of emphasis and resources away from their interests, programs, regions, or countries. For that reason, one rarely hears a senior government official suggest that a country or region is of lower priority to the United States or that resources could be shifted from this area to a higher-priority one.[4] Yet,

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[1] William S. Cohen, Secretary of Defense, *Report of the Quadrennial Defense Review*, Washington, D.C.: Department of Defense, May 1997, pp. 21–22.

[2] DoD, 2006a.

[3] U.S. Air Force, *USAF Strategic Plan: 2006–2008*, Washington, D.C., 2006b, p. 5.

[4] Such a statement might also undermine deterrence or otherwise increase instability in an area if the United States were viewed as an important guarantor of security. A widely cited example of this is the January 12, 1950, speech by Secretary of State Dean Acheson before the National Press Club in Washington, D.C. In that speech, he implied that Korea lay outside the U.S. defensive perimeter and that the United States would not fight to defend it. Acheson said

> The defensive perimeter runs along the Aleutians to Japan and then goes to the Ryukyus . . . the defensive perimeter runs from the Ryukyus to the Philippine Islands . . . So far as the military security of other areas in the Pacific is concerned, it must be clear

while diplomatic sensitivities, domestic political pressures, and a desire to hedge against uncertainties all may push toward strategies that are all things to all people, resource constraints do in fact force choices.[5] As the defense community is beginning to appreciate, the ongoing conflicts in Iraq and Afghanistan are so costly that investments necessary to "prepare for the next war" are in fact being deferred. This reflects a decision to accept more risk in the future in order to reduce near-term risks in these conflicts. Clearly, priorities set at the level of grand strategy can guide resource allocations and be quite real in their impacts, but this level has limited direct value for force planners seeking to identify policy options for risk analysis. *Guidance at this level may be most helpful in selecting which future or scenario to emphasize in planning rather than in structuring or selecting policy options.*

Operational Level of Warfare

The operational level of warfare offers more concrete problems and policy choices for risk analysis. Capabilities-based planning, mission-system analysis, and strategy-to-tasks analysis address military challenges at this level.[6] These approaches are all helpful in identifying

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> that no person can guarantee these areas against military attack. But it must also be clear that such a guarantee is hardly sensible or necessary within the realm of practical relationship. Should such an attack occur—one hesitates to say where such an armed attack could come from—the initial reliance must be on the people attacked to resist it and then upon the commitments of the entire civilized world under the Charter of the United Nations.

Following the withdrawal of the last U.S. combat forces from Korea, this speech did appear to convince Kim Il Sun, Jospeh Stalin, and Mao Zedong that the United States would not intervene if the North Koreans acted to unify the nation. Their invasion followed six months later in June.

[5] We are not advocating against strategies that seek to be "all things to all people," but instead are simply recognizing pressures that constrain what leaders say publicly or what strategies or policies are contained in public documents. Internal analysis and considerations of policy options should be as unhindered by such concerns as humanly possible.

[6] For a description of capabilities-based planning and mission-system analysis, see Paul K. Davis, *Analytic Architecture for Capabilities-Based Planning: Mission-System Analysis and Transformation*, Santa Monica, Calif.: RAND Corporation, MR-1513-OSD, 2002. The strategy-to-tasks methodology is a framework for defense planning developed at RAND

policy options for risk analysis. Capabilities-based planning[7] has several steps:

1. Appreciate the range of possibilities.
2. Select illustrative scenarios.
3. Identify the generic capabilities that might be needed to accomplish U.S. objectives in these scenarios.
4. Develop alternative CONOPSs and identify forces and programs necessary to enable them.[8]
5. Conduct mission-system analysis to assess the value of various CONOPSs across scenarios.

Chapter Three described the method we propose to capture and bound future possibilities and select illustrative scenarios. Having done that, how would we identify the generic capabilities necessary to accomplish U.S. objectives? The strategy-to-tasks method illustrated in Figure 4.1 offers a disciplined way of stepping down through a hierarchy of objectives to identify operational objectives and tasks.

Beginning with the highest-level national goals (e.g., provide for the common defense), the hierarchy then identifies five subordinate levels of activities necessary to achieve them. Each of these subordinate levels captures tasks necessary to accomplish the objective above it and presents objectives for the next-lower activity to accomplish. Thus, national security objectives (e.g., deter/defeat aggression against partner nations) guide national military objectives (e.g., deter/defeat a North Korean invasion of South Korea). National military

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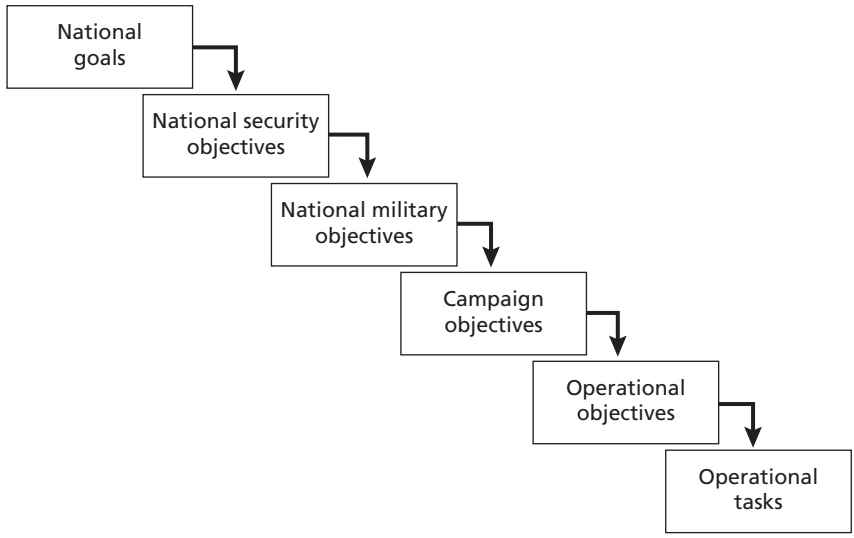
in the early 1980s by Glenn A. Kent. Since that time, the approach has evolved and been applied to a wide variety of planning challenges. For an overview, see David Thaler, *Strategies to Tasks: A Framework for Linking Means and Ends*, Santa Monica, Calif.: RAND Corporation, MR-300-AF, 1993; and Glenn A. Kent and David E. Thaler, *A New Concept for Streamlining Up-Front Planning*, Santa Monica, Calif.: RAND Corporation, MR-271-AF, 1993.

[7] This short, simplified description is drawn from Davis's much more sophisticated and detailed presentation of these ideas. See Davis, 2002.

[8] For detailed recommendations on how to systematically develop new CONOPSs or employment, see Glenn A. Kent and David A. Ochmanek, *A Framework for Modernization Within the United States Air Force*, Santa Monica, Calif.: RAND Corporation, MR-1706-AF, 2003; and Birkler, Neu, and Kent, 1998.

Figure 4.1
Hierarchy of Objectives Links National Goals to Operational Tasks



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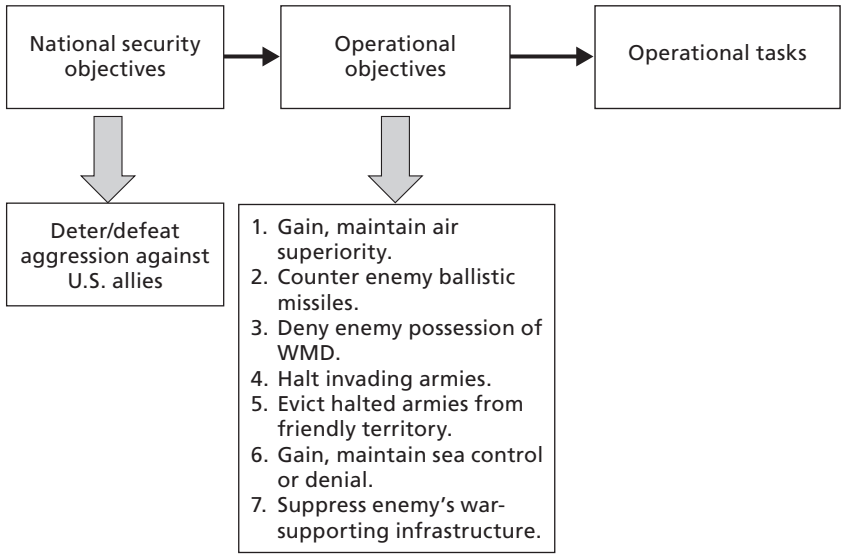
objectives guide campaign objectives (e.g., rapidly shift to offensive operations) and so on through operational objectives (e.g., halt invading army) and operational tasks (e.g., detect armored columns).

Figure 4.2 simplifies this hierarchy to focus on national security objectives, operational objectives, and operational tasks. The list of operational objectives is illustrative of those the United States would seek to achieve in the defense of South Korea from a North Korean invasion.

Figure 4.3 lists operational tasks associated with one operational objective, that of halting an invading army. The level of detail necessarily varies with the planning activity and could ultimately be taken down to a nearly endless listing of tasks at the tactical level (e.g., "infantryman loads rifle"). For strategic force planning, operational objectives are typically the most interesting level for new concept development.[9]

[9] In the latest iteration of the strategy-to-tasks methodology, Kent and Ochmanek (2003, p. 8) offer a slight modification of terminology, with "concepts of employment" designed to

Figure 4.2
Operational Objectives from Simplified Hierarchy



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Using the strategy-to-tasks approach for representative scenarios for each of the seven futures discussed in Chapter Three yields a list of operational objectives, some unique (e.g., deny enemy ability to use nuclear weapons), some common to many (e.g., gain and maintain air superiority), and some common to all (e.g., move U.S. forces at global distances). Current or programmed forces will be able to achieve many, but not all, of these objectives. The objectives for which the United States has insufficient capability can then be used as a priority demand function for modernization.[10]

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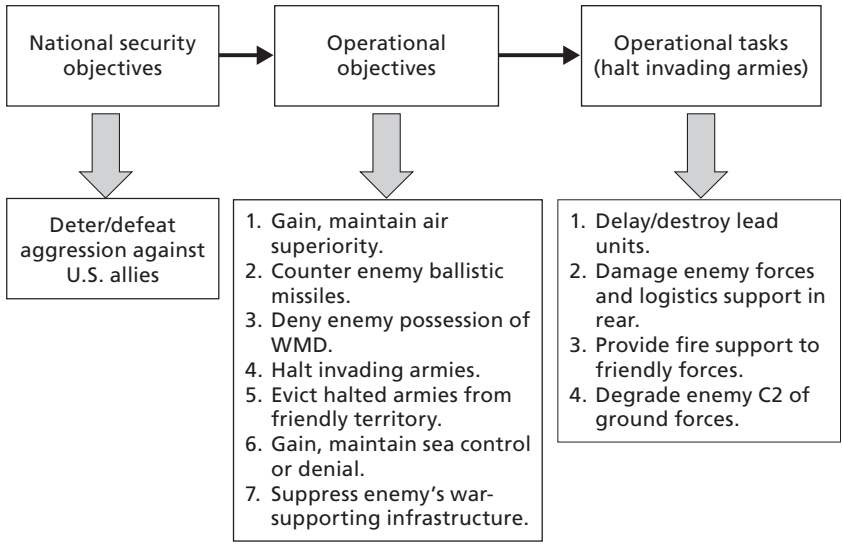
accomplish operational objectives and "concepts of execution" designed to achieve tactical tasks below them.

[10] Davis uses a similar approach in his analysis of challenges for projection forces. He provides a table of "Priority Operational Challenges for Projection Forces," a compilation of operational objectives that current forces cannot accomplish. See Davis, 2002, Table 3.2, p. 20.

Figure 4.3
Operational Tasks from Simplified Hierarchy



NOTE: C2 = command and control.

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Program Element

Finally, planners and decisionmakers may at times be forced to compare policy options at the program element (PE) level. Although the force-planning process should be independent of near-term programming decisions, there is overlap, and, ultimately, choices made by force planners must be translated into programs and dollars. Thus, at times, the discussion may be forced down to the PE level.

The programming and budgeting process requires that resource-allocation decisions be made PE by PE; that is, that process addresses each PE in turn and makes decisions relevant to each PE, one at a time. Although the most compelling arguments for major systems are based on their contribution as part of a joint team, the competition for scarce dollars often pits program against program, encouraging unreasonable claims that a single system by itself is a war winner. It is reasonable to compare a new fighter aircraft against older systems or alternative new aircraft. Risk analysis at the level of force planning, however, is con-

cerned with higher-level comparisons—not the relative merits of similar systems. In our test runs of the risk scorecard, we found little variation in outcomes when we compared dissimilar options at the program level. That is because few systems operate autonomously. For example, virtually all strike aircraft are dependent on national, joint, and USAF intelligence, surveillance, and reconnaissance (ISR) assets to find targets, tankers for deployment and strike operations, and mobility forces to move support functions, munitions, and fuel.

How Many Policy Options Are Appropriate for Risk Analysis?

As argued above, a strategy-to-tasks approach can be used to identify the five or so key operational objectives associated with each scenario. When combined across futures, this list might contain 15 or 20 unique objectives—too many for high-level deliberations.[11] A process such as the one we propose in Chapter Three can be used to identify the five or so most salient scenarios. For this shorter list of scenarios, operational objectives are identified, and only those that significantly stress the current or programmed force are retained. Promising CONOPSs are then identified to achieve these objectives. The risk scorecard can then be constructed using these CONOPSs as options.[12] Each CONOPS is then evaluated based on its potential to reduce the probability or magnitude of bad outcomes for each future.

Below are five illustrative CONOPSs[13] (which can be also viewed as capability packages) that have the potential to achieve operational objectives that stress the current force:

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[11] A risk scorecard that contained ten options for seven futures would require corporate leaders to make judgments for 70 cells, well beyond what is reasonable for deliberations at that level. To be practical, the options and futures need to be collapsed to something on the order of a five-by-five matrix.

[12] See Appendix C for an example of a complete scorecard with these policy options.

[13] CONOPSs are not new to the USAF. Lt Gen Glenn Kent (USAF, retired) developed the strategy-to-tasks/CONOPS development method in the 1980s at RAND and has introduced multiple generations of USAF officers to this approach. During the fall 1999 CORONA

- **Capability to operate from FOBs in the face of severe anti-access threats.** Such capability is primarily defensive and includes such measures as ballistic missile defense, base hardening, and quick repair and reconstitution capability following any attack.
- **Capability to conduct large-scale COIN operations using U.S. forces.** The exemplar here is an addition of capability that is roughly comparable to current U.S. capacity to conduct operations like those ongoing in Iraq.
- **Capability to build partner capacity for irregular warfare in many nations simultaneously.** This involves low-cost military-to-military contact in the form of training and coordination, as well as limited investment in local tactical capabilities, in many different locations.
- **Capability to conduct offensive air operations exclusively from long range.** In principle, this would ultimately eliminate the need for FOBs and concentrate Air Force–deployed attack and intelligence capabilities in a small number of bases located so that they could quickly and reliably service any global requirements that arise.
- **Capability to operate from FOBs under nuclear attack from a regional power.** This policy package focuses defensive base preparation on defeating ballistic/cruise missile and air attacks, hardening structures against blast effects, hardening information systems against EMP and other effects, and other measures to mitigate the effects of any nuclear attack on U.S. bases.

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meeting of USAF leaders, they recognized "that they had to give greater attention to assessing the interconnectedness of programs and systems from the standpoint of the capabilities that they sought to maintain or obtain" (Michael Barzelay and Colin Campbell, *Preparing for the Future: Strategic Planning in the U.S. Air Force*, Washington, D.C.: Brookings Institution Press, 2003, p. 147). It was at this meeting that General John Jumper, then Commander, U.S. Air Forces in Europe, pushed for CONOPSs as a way to flesh out planning based on what the USAF then called "core competencies." When Jumper became Chief of Staff in 2001, he implemented a system that integrated key USAF capabilities under six CONOPSs. (We should note that current USAF CONOPSs are broad capability clusters, such as "Global Strike" and "Homeland Security." They are not identical to the focused set of ideas and systems used in the strategy-to-tasks approach to accomplish specific operational goals.) See Barzelay and Campbell, 2003.

Packages based on other CONOPSs might be chosen. For example, a CONOPS to defend the United States from attack by nuclear-armed ballistic missiles might belong on a USAF list. A U.S. Navy list along these lines might have an option to project power exclusively from the sea. A U.S. Army list might contain a CONOPS to conduct peace operations or COIN without putting large numbers of U.S. personnel at risk. An Army or Marine Corps list might contain a CONOPS to take down an enemy WMD facility and hold it for the days it could take to search for and secure WMD. The key point is that the most stressing security challenges that DoD faces can be addressed with a small number of CONOPSs and that they typically require the integration of capabilities across services.

Each of these options would require multiple supporting programs and systems, often from multiple services. For example, the CONOPS to operate aircraft despite anti-access threats[14] would likely involve a host of offensive and defensive operations and active and passive measures. These include attacks on enemy air bases, the ability to detect and kill mobile ballistic and cruise missile launchers, layered sea- and land-based ballistic and cruise missile defenses, air defenses, sheltering and/or dispersal of aircraft, proliferation of landing surfaces, burying of fuel systems, hardening of critical support facilities, and so on. It most likely would also involve increased antisubmarine warfare (ASW), air defense, anti-mining, and convoy protection operations by the Navy to protect ships carrying fuel to the FOB or keep enemy submarines from threatening Aegis ships acting as part of the layered missile defenses for the FOB. In turn, the FOB would likely be flying ISR (e.g., Airborne Warning and Control System [AWACS]), ASW (e.g., P-3), and air defense (e.g., F-22) sorties to protect the Aegis ships protecting the base. As this short discussion should make clear, defeating advanced anti-access threats is a huge undertaking of staggering complexity. No single system or even single service can by itself overcome threats of this depth and breadth.

These CONOPSs represent capability packages that, in most cases, would run into tens if not hundreds of billions of dollars. They

[14] See Cliff et al., 2007.

offer the potential to solve vexing and vital operational challenges. The failure to solve these operational challenges would, in many cases, result in strategic failures for the United States. They represent *real, fundamental* choices. In most cases, to choose one is to exclude the others. A risk scorecard with five or so compelling scenarios on one axis and CONOPSs along these lines on the other axis would present the corporate leadership with a tool to guide their deliberations and record their thought processes and decisions on the most compelling and vital challenges faced by the nation and the USAF.

Having worked through a process to identify futures in Chapter Three and policy options in this chapter, we now turn to Chapter Five, which addresses the crux of the risk scorecard—the process by which judgments are made about probabilities and magnitudes of outcomes.

CHAPTER FIVE

Assessing Strategic Risk

Introduction

We turn now to the challenge of assessing the probability and magnitude of harm to national security in various futures when current decisionmakers choose any particular policy package. The risk assessment associated with force planning is, in many ways, more difficult than other forms of risk analysis. In engineering, finance, and other fields in which many similar events occur over time, historical data can be collected and future probabilities and magnitudes can be calculated with relatively high degrees of accuracy. In the geopolitical world, however, all events of consequence are highly complex, and no two are truly alike. This almost infinite number of variables and potential outcomes renders a statistical model impossible. Consequently, analysts are forced to consider subjective probability distributions and decisionmaking tools designed to elicit the judgment of experts in efforts to characterize these variables in context and estimate what the future might hold.

In addition, several peculiarities of strategic risk assessment may make it difficult to determine which policy package is best. For instance, one cannot assess the quality of investments in terms of warfighting capability alone. Investing in warfighting capabilities against all potential threats in multiple futures would be inefficient and unaffordable. Moreover, investing in certain capabilities might prompt other actors to invest or behave in ways ultimately contrary to one's interests. Alternatively, investing in warfighting capabilities that are never used in warfare is not necessarily money wasted (as certain forms of risk analy-

sis might suggest). Possessing those weapons might deter potential adversaries from attacking, thereby staving off the costs of war—costs that are often severe, even in victory. In sum, strategic risk assessment entails a careful, balanced analysis of policies and investment options for shaping, deterrence, and warfighting. The best solution will be a coherent strategy calling for a robust but affordable portfolio of capabilities that shapes the strategic environment in ways most favorable to the nation's long-term interests, yet provides sufficient warfighting capability to hedge against deterrence failures and, if necessary, secure the nation's interests by force.

This chapter presents a framework to systematically and transparently evaluate strategy options that guide investments to mitigate risk. It begins with an examination of the fundamental logic of strategic risk assessment. Using a strategy-to-tasks approach, it explains how, in any given scenario, a strategic risk assessment must begin with a careful examination of each actor's relevant interests in geopolitical context to understand the source and motivation of potential threats. The assessment logic then calls for planners to work through the strategy options available in the given scenario to identify an investment portfolio that reduces the probability and magnitude of harm to an acceptable level. The chapter explains how to apply this logic in a systematic manner using a decision flow chart we call the *risk engine* to structure and guide the analysis. By applying such a methodology, planners can harness expert judgment in the analysis of specified scenarios to examine (1) how alternative strategies and investments can affect the probability of harm to the United States and (2) how shaping strategies and investments in warfighting capability affect the potential magnitude of that harm, should war occur.

The Logic of Strategic Risk Assessment

Risk assessment is an important component of defense planning. As such, it is done most effectively when approached systematically, using a logical framework designed to ensure that all investment decisions link to goals and objectives according to a coherent strategy. RAND's

strategy-to-tasks methodology is often used to provide this coherence in defense planning, and it can benefit strategic risk assessment as well. However, to apply it in the context of strategic risk, one must begin at a higher level than is normally done in the standard strategy-to-tasks approach. As risk assessment deals with hazards, defense planners must first understand threats emanating from the geopolitical environment and weigh those threats against U.S. interests before they can consider strategies leading to force-allocation changes, new technologies and capabilities, or resource-allocation decisions. Consequently, the logic of risk calls for analysts to begin with an examination of the interests of relevant actors in geopolitical context to appreciate not only the nature of the threats these actors might present, but the strength of commitment behind them as well.[1] From there, the logic of strategic risk assessment examines what tools are available in the "Blue strategy space"—that is, what means the United States possesses to shape the geopolitical environment in ways most favorable to its interests and what capabilities are needed to protect those interests should shaping and deterrence fail. Finally, the logic of risk assessment considers how to develop robust investment strategies to reduce the overall probability and magnitude of harm from threats, while managing risks of negative impacts of those investments on U.S. relations with other regional and global actors.

Figure 5.1 illustrates the logic of strategic risk assessment. Subsequent sections explain that logic from the top down.

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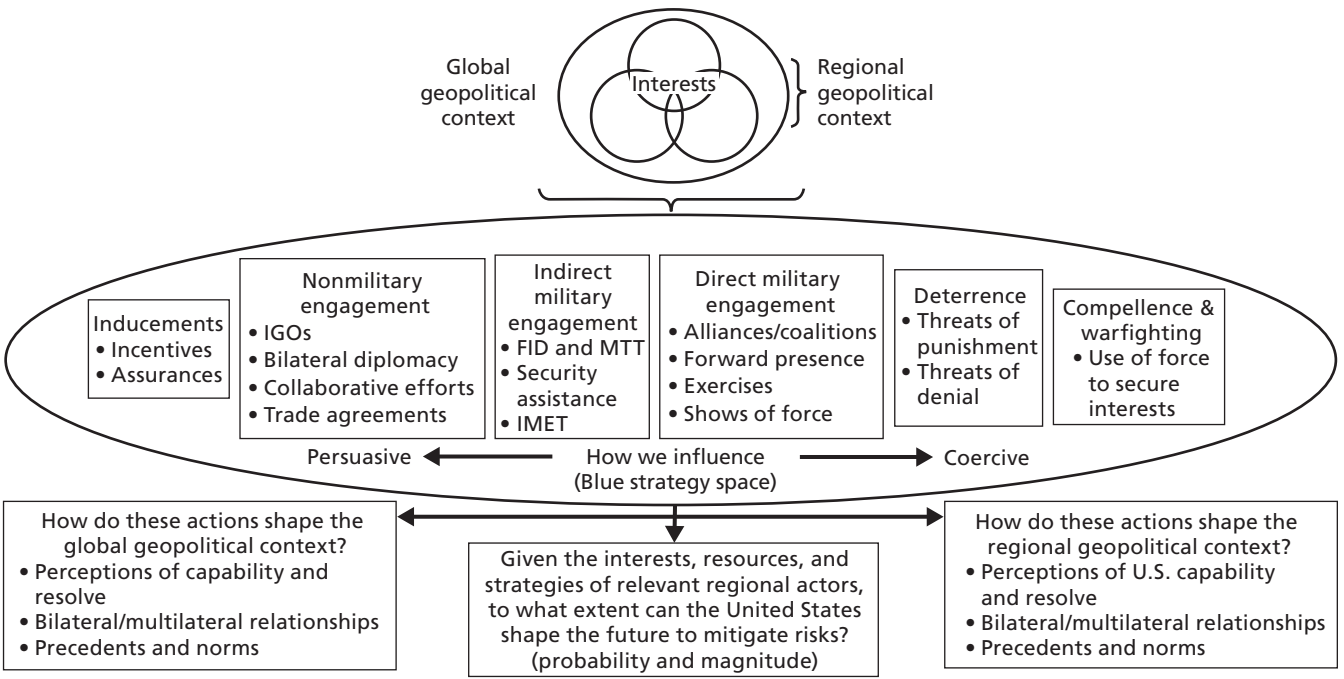
[1] The logic of strategic risk assessment also differs from the strategy-to-tasks methodology in another way. Strategy-to-tasks approaches typically begin with an assessment of the National Security Strategy (NSS) of the United States, then trace mission requirements down through the National Military Strategy (NMS) and any relevant operational plans to determine appropriate task requirements. Strategic risk assessment does not directly address those sources for two reasons: (1) the NSS and NMS are too broad and vague to provide strategic guidance of the kind needed for effective risk assessment, and (2) while operational plans provide insights on combatant commanders' requirements, they are developed with current threats and existing resources in mind. Consequently, they tend to focus too narrowly on contemporary warfighting solutions and rarely provide sufficient insights on future requirements to support effective risk analysis. Despite these differences, the strategy-to-tasks approach's top-down philosophy informs our methodology for strategic risk assessment.

Figure 5.1
Graphic Depiction of the Logic of Strategic Risk Assessment



NOTE: IGO = intergovernmental organization; FID = foreign internal defense; IMET = international military education and training; MTT = military training team.

Interests and Context

To begin any assessment of strategic risk in the context of a particular scenario, one must first examine the interests of all relevant actors and consider how these factors might interact in future regional and global geopolitics. Defense planners rarely begin their work without a sound appreciation of U.S. interests and objectives. However, as the topmost ellipse in Figure 5.1 illustrates, U.S. interests do not exist in a vacuum. Only by understanding the full context of all relevant actors can risk assessors estimate the source, nature, and gravity of potential threats. This is no easy task. Every region has many actors, local and global, and each has multiple interests and complex relationships with other actors. Pairs or groups of actors may have mutual interests in some issues and opposing interests in others. Regional actors that are friends or allies of the United States may have mutual interests with other actors that directly oppose key U.S. interests. All of these drivers and constraints operate in a complex tableau of treaties and alliances, organizational memberships, historical animosities, ethnic ties, debts, grudges, and economic interdependencies. Only through a careful analysis of these complex relationships can planners anticipate how threats might manifest themselves and the range of options the United States might have for dealing with them.

Blue Strategy Space

Thorough geopolitical analyses do more than just help defense planners anticipate how threats might manifest in a given scenario; they also provide insights into what tools the United States can bring to bear to mitigate risks from those threats most effectively. We call this array of tools the *Blue strategy space*. As the large ellipse in the center of Figure 5.1 illustrates, that space encompasses a spectrum of options for engaging regional actors in efforts to shape their behavior in ways favorable to U.S. interests, as well as capabilities to deter aggression and, ultimately, secure U.S. interests by force, should it become necessary to do so.

The concept of shaping was first introduced in the U.S. defense planning community in 1989 when Paul Davis and Paul Bracken proposed that the United States should act in ways that mold the future

to its advantage, versus passively waiting for events to unfold and then reacting to them. Davis and Bracken advocated putting more effort into developing shared interests with regional actors, giving them more reason to cooperate than to fight, and presenting the United States as a force for good that would positively engage allies and friends while still maintaining a "hard power" advantage.[2] In the years since, defense planners in three presidential administrations have embraced shaping. National strategy documents since 1993 have addressed it specifically, as has every QDR from 1997 to the present.[3] Over the years, however, the concept of shaping has broadened from the emphasis on persuasive approaches that Davis and Bracken envisioned to one more explicitly including coercive aspects of defense policy and strategy, such as force posturing and deterrence. Similarly, risk assessment acknowledges that coercive threats play an important role in shaping the strategic environment, but, for analytical purposes, we place tools that are more explicitly coercive, such as deterrence and compellence, in separate categories in the Blue strategy space.[4] For this study, shaping encompasses such activities as offering incentives and assurances and wielding other levers of diplomatic and economic influence. It also includes various forms of indirect military engagement, such as providing security assistance and IMET, and engaging in direct military activities, such as positioning forces in theater and conducting military exercises.

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[2] These concepts can be found in a paper Paul Davis authored for the "Conventional Forces and Arms Control: Technology and Strategy in a Changing World" conference organized by the Center for National Security Studies at the Los Alamos National Laboratory and held September 25–26, 1989 (Paul K. Davis, *National Security Planning in an Era of Uncertainty*, Santa Monica, Calif.: RAND Corporation, P-7605, 1989). Paul Bracken is not listed as a coauthor, but Davis acknowledges that he helped develop some of the principal ideas.

[3] See, for instance, Secretary of Defense Dick Cheney, *Defense Strategy for the 1990s: The Regional Defense Strategy*, Washington, D.C.: U.S. Department of Defense, January 1993, p. 7.

[4] It is important to note that, while we sort tools in the Blue strategy space into discrete boxes, in actual practice, those activities overlap in function along a graduated continuum. For instance, activities we categorize as direct military engagement, while not explicitly coercive, are often undertaken for their deterrent effect. Similarly, while we classify explicit threats of retribution as deterrence, they also shape the strategic environment.

As Figure 5.1 indicates, shaping tools range from the most persuasive, such as offering regional actors political or economic inducements to change their behavior, to those that include elements of deterrence, such as direct military engagement. While a complete list of shaping options would be too lengthy to put in any box in Figure 5.1, such tools all possess several common elements. First, when properly fashioned, they alter the cost-benefit calculations of key regional actors in ways that encourage them to support (or, at least, not threaten or impede) U.S. interests. Ideal shaping strategies provide those actors options consistent with their own interests, creating "win-win" solutions for all involved. Second, effective shaping strategies strengthen the security of U.S. friends and allies—and therefore serve U.S. interests—at the expense of those actors who might oppose them. Finally, well-constructed shaping strategies find avenues for U.S. engagement that are not so intrusive that they undermine the legitimacy of regional friends and allies.

Deterrence is another important tool in the Blue strategy space. As mentioned above, no state can afford to defend against every conceivable threat. Nor are effective defenses available against every possible form of attack. Therefore, defense planners need to determine which threats merit investing the nation's limited resources to defeat them and which can be deterred by threats of retribution, focused investment in defenses, or both.[5] In simple terms, deterrence entails discouraging potential adversaries from attacking by threatening to make the costs of their attacks exceed any benefits they might gain from them.[6] Deterrent threats may be explicit, such as openly declaring one's intention to take retribution, or they may be implicit, such as posturing forces to suggest that one can adequately defend against an attack or that one will use those forces to punish the attacker. Deterrence strate-

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[5] As deterrence was the central focus of U.S. strategy during the Cold War, literally hundreds of books and journal articles were written on the concept during that era. Just a few of the most prominent and influential monographs include Bernard Brodie, *Strategy in the Missile Age*, Santa Monica, Calif.: RAND Corporation, CB-137-1, [1959] 2007; Thomas C. Schelling, *Arms and Influence*, New Haven, Conn.: Yale University Press, 1966; and Alexander L. George and Richard Smoke, *Deterrence in American Foreign Policy: Theory and Practice*, New York: Columbia University Press, 1974.

[6] George and Smoke, 1974, p. 11.

gies that threaten retribution are called *punishment strategies*. They seek to manipulate the cost side of the adversary's decision calculus, raising the expected costs until they outweigh any expected benefits of the attack. Conversely, deterrence strategies designed to cause a potential attacker to doubt whether an attack will succeed are called *denial strategies*. They focus on the other side of the adversary's decision calculus by threatening to deny the attacker sufficient benefit to make the attack worth the expected cost of aggression.[7]

Strategies to deter nuclear attacks rely almost exclusively on threats of punishment, as current defenses and counteroffenses are not yet effective enough to credibly deny a state adversary success in a nuclear missile attack. Strategies designed to deter conventional war, on the other hand, rest more heavily on defensive capabilities, as threats of retribution with conventional weapons are not as potent as nuclear threats. Historically, determined attackers have been willing to bear the costs of conventional punishment when they believed that their attacks would ultimately succeed.[8]

Whether considering deterrence strategies that focus on punishment, denial, or some combination of both, one must always remember that deterrence relies on manipulating an adversary's perceptions and calculations; therefore, several issues are crucially important. First, the viability of deterrence rests largely on the *credibility* of threats.[9] If a would-be attacker suspects that the target of its intended aggression lacks either the capability to defend itself or the resolve to carry out a threat of retribution, deterrence may fail. Second, the nature of threats and their supporting capabilities can either enhance or under-

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[7] Glen Snyder was first to make this distinction in his book, *Deterrence by Denial and Punishment*, Princeton, N.J.: Center of International Studies, 1958. Thomas Schelling is probably the best known of the many theorists who focused on deterrence via threats of punishment. John Mearsheimer did the seminal work on the importance of denial in conventional deterrence. See Schelling, 1966; and John J. Mearsheimer, *Conventional Deterrence*, Ithaca, N.Y.: Cornell University Press, 1983.

[8] Mearsheimer, 1983, pp. 23–24, 28–30. Also see Karen Ruth Adams, "Attack and Conquer? International Anarchy and the Offense-Defense-Deterrence Balance," *International Security*, Vol. 28, No. 3, Winter 2003–2004, pp. 45–83.

[9] Schelling, 1966, pp. 36–43.

mine *crisis stability*, the degree to which mutual deterrence can hold in a confrontation.[10] Pure punishment strategies, those that rely exclusively on threats of retribution and lack capabilities for preemption or defense, are widely held to enhance crisis stability with most rational adversaries, provided that those capabilities themselves are not vulnerable to preemption. However, a force structure built around punishment capabilities alone leaves its owner undefended should deterrence fail. Alternatively, denial strategies based on strong defensive capabilities provide a hedge against deterrence failures. But if capabilities enabling such strategies appear overly threatening, the adversary may conclude that they are really intended for attack and decide that preemption is the least costly course of action.[11]

Lastly, as deterrence outcomes ultimately depend on what the adversary decides to do, they can fail no matter how sound the strategies developed are or what capabilities are fielded. Effective deterrence depends on rational decisionmaking. While few world leaders are ever pathologically irrational, neither does any individual or organization ever enjoy perfect rationality. Gaps in information, errors in judgment, political maneuvering, and bureaucratic rigidities characterize governmental decisionmaking in the best of times; in the heightened stress of a crisis, tendencies for such defects may be magnified, with potentially catastrophic results.[12] Moreover, some adversaries, even rational ones making sound decisions, cannot be deterred. It is extremely difficult to

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[10] Charles L. Glaser describes crisis stability as "a measure of the countries' incentives not to preempt in a crisis, that is, not to attack first in order to beat the attack of the enemy" (*Analyzing Strategic Nuclear Policy*, Princeton, N.J.: Princeton University Press, 1990, p. 45).

[11] Defensive strategies that incorporate strong offensive components obviously fall into this category. But even powerful capabilities that are purely defensive can unnerve opponents and destabilize deterrence, as adversaries may conclude that a defensive shield would free its owner to attack with other capabilities without fear of retribution. This concern was one of the objections to President Ronald Reagan's Strategic Defense Initiative, the plan to develop a national missile defense.

[12] A great deal of research has been done on the peculiarities of organizational decisionmaking. For the seminal work on how bureaucratic and political processes can bias strategic behavior, see Graham T. Allison, *Essence of Decision: Explaining the Cuban Missile Crisis*, New York: Harper Collins Publishers, 1971. For a succinct summary of these dynamics, see George and Smoke, 1974, pp. 72–76. For a thorough Cold War–era analysis of these concerns and

fashion credible threats against terrorists and other nonstate actors who have no infrastructure to protect and do not believe that they can be found. It may also be difficult to fashion deterrent threats sufficiently potent to deter attacks from some states, when leaders of those regimes believe that their current lot is so bad that even a slim chance of victory is worth tremendous risks, and deterrence is impossible if they conclude that the probable consequences of even an unsuccessful war are preferable to the status quo. Similarly, when states are threatened with regime change, threats meant to deter them from preemptive attack or the use of prohibited weapons lose coercive leverage, as leaders of those regimes are likely to conclude that they have little to lose in using every stratagem and capability at their disposal.[13]

Therefore, capabilities for compellence and warfighting are also important tools in the risk analyst's Blue strategy space, not only because deterrence failures can occur, but because U.S. policymakers and military leaders must also have means available to impose the nation's will on other world actors when U.S. interests dictate that they do so. Simply stated, compellence entails using threats of force to persuade adversaries to do things they would not otherwise choose to do, or to stop or reverse actions they have already begun. Like deterrence, compellence involves influencing an opponent's behavior by manipulating its calculation of expected costs and benefits.[14] Compellence campaigns sometimes involve employing force in a measured way to inflict pain

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others regarding the rational-actor model, see Robert Jervis, *The Illogic of American Nuclear Strategy*, Ithaca, N.Y.: Cornell University Press, 1984.

[13] For a closer examination of the difficulties of deterring nonstate actors and desperate state leaders, see Forrest E. Morgan, Karl P. Mueller, Evan S. Medeiros, Kevin L. Pollpeter, and Roger Cliff, *Dangerous Thresholds: Managing Escalation in the 21st Century*, Santa Monica, Calif.: RAND Corporation, MG-614-AF, 2008.

[14] Theoretically, compellence resembles deterrence more than it does war. As Thomas Schelling maintains, deterrence and compellence are both forms of coercion, with deterrence the passive form designed to enforce a status quo and compellence the active form, with a coercer seizing the initiative and attempting to force an opponent to change behavior (Schelling, 1966, pp. 69–72). But in strategic risk assessment, it is more appropriate to group compellence with warfighting. Compellence campaigns and wars more often resemble discrete events, whereas deterrence is an ongoing peacetime activity. Capabilities needed for compellence campaigns are, essentially, subsets of those needed to fight wars.

on an adversary and demonstrate that more punishment will follow if compliance is not forthcoming.[15] Other approaches entail denying an enemy the benefits of battlefield success as a means of compelling that enemy to accept one's demands.[16] Either way, as such efforts escalate, they become indistinguishable from war. Therefore, in many respects, capabilities for deterrence, compellence, and war overlap. The ability to punish can support both deterrent threats of retribution and compellent demands for changes in behavior. Investments in assets to support denial-based deterrence strategies also provide some of the capabilities needed for compellence campaigns and making war.

But compellence and warfighting differ from deterrence in distinctive ways, and those peculiarities drive different investment decisions. As deterrence is about discouraging an adversary from attacking, the ideal denial-based deterrence strategy is one that presents a visible, effective defense that is not so threatening that the opponent decides to preempt, having concluded that one's forces are postured to support an imminent attack. Such strategies tend to eschew offensive capabilities for seizing the initiative or taking the battle deep into the opponent's territory. But compellence campaigns, even those based on denying the enemy battlefield success, require capabilities for offensive operations, and war is about using force to impose one's will on the enemy.[17] Most forms of compellence and warfare demand seizing the initiative and taking the battle deep. War almost always involves taking enemy territory, and compellence frequently does as well. Moreover, preparing for war requires investments in capabilities that one would not want to make visible to potential enemies, both to preserve the element of sur-

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[15] Schelling, 1966, pp. 170–176.

[16] Although he preferred to call it *coercion*, Robert Pape did the seminal work on what we would describe as denial-based compellence. See Robert A. Pape, Jr., *Bombing to Win: Air Power and Coercion in War*, Ithaca, N.Y.: Cornell University Press, 1996.

[17] Indeed, Prussian military theorist Carl von Clausewitz anticipated the nearly synonymous relationship that would emerge between compellence and war when he defined war as "*an act of force to compel the enemy to do our will*" (*On War*, ed. and trans. by Michael Howard and Peter Paret, Princeton, N.J.: Princeton University Press, [1832] 1976, p. 75; italics in original).

prise and to deny them incentives and opportunities to develop counters to those systems.

In sum, working through the Blue strategy space in terms of shaping and deterrence alone would lead to insufficient investment in essential capabilities to impose the nation's will on other actors when necessary to safeguard U.S. interests. The United States will always need the ability to compel or defeat its enemies. But resources are scarce, and overinvestment in some capabilities may leave other requirements unfulfilled or even undermine the benefits of other important investments. Strategic risk assessment provides a logical framework for evaluating each threat scenario and balancing investments across the Blue strategy space in ways that mitigate risk most effectively.

Evaluating Strategic Risk in Alternative Investment Strategies

Having considered each relevant actor's interests in a given scenario and having surveyed the full range of policy tools the United States has available, planners can begin weighing investment options, assigning risk scores, and assembling candidate investment strategies for comparison. Investment options are alternative ways of providing the capabilities needed to employ the policy tools identified as useful. Each one must be carefully assessed and assigned a first-order utility rating based on the strengths, limitations, and dangers that its availability would bring to the scenario at hand. As the lowermost box in Figure 5.1 indicates, these ratings guide planners as they select options for candidate investment strategies, which they then assess in terms of the likelihood that a potential adversary will use military force in a way that damages U.S. interests (probability of harm) and, if so, how much damage that action might cause (magnitude of harm). In any given scenario, a robust strategy will entail selective investment in a range of policy tools providing the appropriate balance of capabilities for shaping, deterrence, and warfighting to mitigate risk from whatever threats are anticipated.

However, the assessment is not yet complete. Changes in U.S. policy and capability do not only affect the nation's standing vis-à-vis potential adversaries, they may also impact U.S. relations with other actors in the regional and global geopolitical environment. Consequently, as

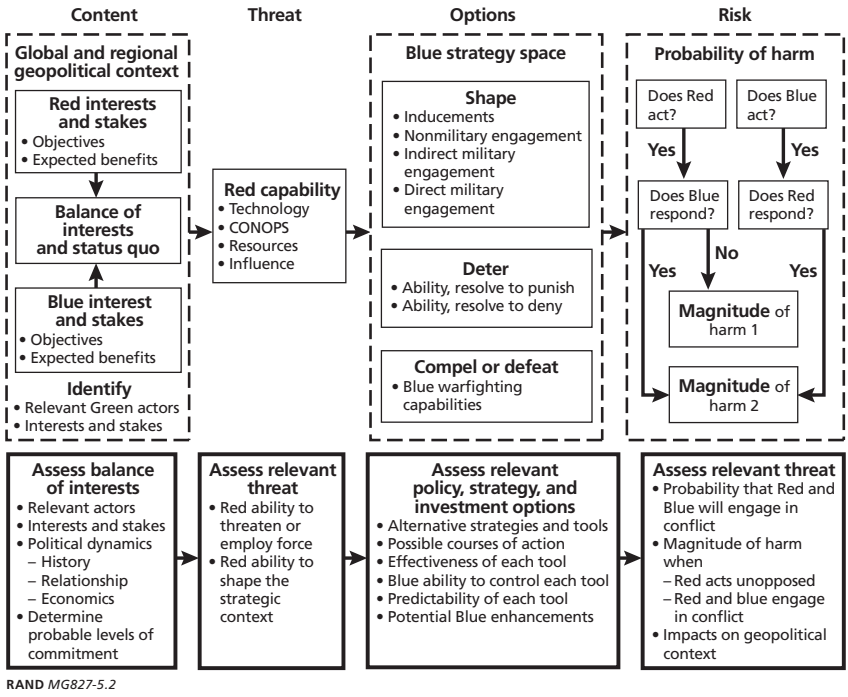
the two side boxes at the bottom of Figure 5.1 indicate, all significant changes in policy or force structure need to be weighed in terms of how they might affect the nation's bilateral and multilateral relationships with regional and global partners and, more broadly, how they might affect international perceptions of U.S. capability and resolve. Finally, planners should also consider whether proposed changes in policy or force structure set precedents that risk creating norms in international behavior that ultimately work against U.S. interests.

The strategic risk-assessment framework can help planners do several things. Its primary use is to identify those investment options that offer the greatest promise for reducing the probability and magnitude of harm in any given scenario. However, the method can also be used to assign component or overall risk scores to existing force structures or any proposed alternative in the context of a specified scenario. Finally, the risk-assessment methodology can be used to evaluate the severity and saliency of regional threats. In working through the framework to evaluate policy and investment options, planners determine a first-order assessment of the extent to which the United States can shape the strategic environment in ways favorable to interests, deter aggression, compel potential adversaries to change threatening policies, and, if necessary, impose its will on other actors. In some regional scenarios, a risk assessment will indicate that the United States does indeed have multiple, potent options for protecting its interests. In other scenarios, the assessment may reveal how weak U.S. leverage really is against certain kinds of threat. As disconcerting as that may be, such revelations are essential inputs for sound defense planning.

The Risk Engine

Understanding the logic that underpins strategic risk analysis is important, but in itself is not enough. Planners need a mechanism with which they can apply that logic in a systematic manner. Figure 5.2 provides such a mechanism. It illustrates the *risk engine*—a conceptual algorithm that defense planners can use to work through specified scenarios and estimate probabilities and magnitudes of possible outcomes. *This*

Figure 5.2
The "Risk Engine"



RAND *MG827-5.2*

algorithm is based on expert-level subjective inputs to risk variables that are systematically ordered and derived from the underpinning logic of shaping, deterrence, and warfighting; the engine then accumulates these variables into scores that guide risk judgments. In this section, we show how this device can be used to assess alternative strategies and tailor policy and investment options to mitigate risk most effectively *by allowing strategic planners to make a first-cut assessment of risk that is both transparent and verifiable*. Though the algorithm does not generate quantitative scores, it does provide an analytical framework for harnessing the judgment of subject-matter experts to develop subjective assessments that are meaningful.[18] Senior leaders can then evaluate these assessments on policy

[18] With our risk engine, we do not explicitly intend to structure an elicitation technique to address the risk of a specific scenario and capabilities portfolio. Rather, we set out with

scorecards as they weigh options for shaping the strategic environment, deterring aggression, and employing force to protect U.S. interests as required.

Step 1: Assessing Context and the Balance of Interests

As Figure 5.2 indicates, the first step in assessing risk in any specific scenario is to ascertain each actor's interests in the issues at hand in their geopolitical context. Planners need to identify all relevant actors and examine the historical and contemporary relationships between them.[19] Treaties and alliances, organizational memberships, economic interdependencies, ethnic ties, debts, and grudges must all be taken into account to estimate the potential trajectories of future conflict in the region. This assessment is vitally important to understanding where and how threats might arise and what stakes each actor might have in changing or preserving the status quo. Policy analysts need to make a frank assessment of each actor's interests and determine where those interests might conflict with those of the United States, its allies, and its friends. Most importantly, analysts must evaluate the balance of interests between relevant actors to anticipate how committed they will be to defending their interests and appreciate how difficult it might be to influence those actors in ways favorable to the United States.

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the mindset of a modeler: We want to prototype a strategic risk calculator that uses various inputs to compute a score. That said, expert elicitation tools are not completely absent from this computation. In the case of strategic risk, many of the variables we identify can be neither adequately nor objectively quantified due to the nature and complexity of the type of risk, and therefore subjective input is needed, which is where expert elicitation comes into play. While it is true that the successful implementation of the risk engine depends on being able to effectively input subjective scores based on subjective judgments, the engine as a risk algorithm provides a certain level of guidance to ensure that the scores are reproducible and transparent, so that appropriate reasoning lies behind each evaluation. While there exists a certain flavor of expert elicitation, the risk engine cannot be fully characterized as an elicitation tool.

[19] As we describe the risk engine and how to employ it, we occasionally refer to functional specialists, such as strategic planners, policy analysts, risk analysts, operational military analysts, political-military specialists, and political advisors. However, we recognize that, depending on the size of the planning staff and the resources available to it, these functions may be performed by a large team of specialists or some smaller group of planners, each wearing multiple hats.

Risk analysts should score this assessment in terms of whether the United States' interest in any contested issue is *greater than*, *equal to*, or *less than* that of potential adversaries. Analysts must, in particular, be prepared to recognize situations in which a potential *adversary's interest in redressing the status quo is so great that it may be impossible to deter that actor from employing force to impose change*. Such situations must be scored accordingly and brought to the attention of senior leaders.

Step 2: Assessing Relevant Threats

Next, planners need to determine to what degree potential adversaries can threaten U.S. interests. As the "Threat" column in Figure 5.2 indicates, this largely comes down to assessing adversaries' military capabilities in terms of what forces they have at their disposal, the resources and technologies available to those forces, and whether they have acquired a sufficient mastery of the operational concepts needed to employ their forces in ways that threaten those of the United States and its allies. But this assessment cannot be made in isolation from the context analysis done in Step 1; rather, it must focus on what capabilities potential adversaries have to execute specific COAs to obtain military objectives that flow from the most likely operational concepts they might employ to secure the interests identified in the context analysis as potential sources of conflict. All of this requires considerable intelligence collection and military operational analysis that includes, but is not limited to, wargaming.

Planners also need to consider what other capabilities potential adversaries might have for shaping the geopolitical environment in ways that damage U.S. interests. Once again, such an analysis cannot be done without a deep understanding of the complex sociocultural, economic, and political relationships present in every region. So, like the military capabilities analysis, this portion of the assessment must go hand-in-hand with the contextual analysis done in Step 1.

To score this phase of the analysis, military and political subject-matter experts must identify which operational concepts are most plausible for potential adversaries to employ in pursuit of their interests, then break each one down into its critical COAs—those actions required to obtain the military objectives on which success of the enemy strategy

would depend. The experts must then provide a subjective assessment as to whether each potential adversary clearly *has capability*, *has some capability*, or *lacks capability* to execute each of those COAs.

Step 3: Assessing Relevant Policy, Strategy, and Investment Options

Armed with a firm understanding of relevant threats in their geopolitical context, planners are ready to survey what tools the United States currently has at its disposal (including new capabilities already programmed for delivery within the planning horizon) to counter those threats and what policy, strategy, and investment options might be available to improve U.S. capabilities and mitigate risk more effectively. As the "Options" column of Figure 5.2 indicates, this array of tools, whether existing or notional, makes up the Blue strategy space.

This phase of the analysis calls for planners to assess the utility of existing and programmed capabilities in terms of how well they counter the potential threats identified in Step 2. In doing so, planners need to consider not only each tool's effectiveness individually, but how well it can be orchestrated with others in the COAs that U.S. and allied leaders are most likely to employ against the threat envisioned. Tools available for protecting U.S. interests go beyond those within the military domain and even include some provided by friends and allies of the United States. However, planners need to consider the limits of the influence the United States might have over tools controlled by such third parties and assess how predictable the outcomes of any approaches considered, including tools wielded in the diplomatic and economic arenas, are. Once planners reach a firm understanding of existing capabilities and limitations, they may then apply the same reasoning to assess what new policies, strategies, and investments might improve U.S. capabilities to shape the geopolitical environment, deter threats, and, in the event that force is needed to secure U.S. interests, defeat those threats.

Shaping Tools. As the logic of risk assessment indicates, tools available for shaping the environment lie mostly at the persuasive end of the Blue strategy space. If the United States can adequately protect its interests against certain threats mainly by relying on such tools, it may be preferable to do so. Shaping options are usually less costly than

capabilities needed for more coercive approaches, and engagement often pays political dividends that go beyond those associated with countering immediate threats. Moreover, even if the longer-term benefits of persuasion are doubtful, opting for that route may save the political costs so often associated with coercive threats and uses of force. In fact, political and military shaping tools may be the most effective means for dealing with some threats, such as terrorism, insurgency, and state and regional instability writ more broadly.

Well-crafted shaping strategies orchestrate a carefully chosen array of policies—no one shaping tool can work in isolation. Nevertheless, before alternative strategies for shaping can be assembled and evaluated, planners need a first-order assessment of what utility each individual shaping tool might bring to the effort. Therefore, policy analysts and regional specialists should list all tools that might play a role in shaping the regional geopolitical environment in ways favorable to U.S. interests, then identify possible COAs associated with each tool. Once a list of all plausible shaping tools and associated COAs is compiled, experts must provide a frank assessment of the strengths, limitations, and dangers that each COA might bring to the scenario, then subjectively assess each COA's utility in terms of whether it would likely provide a *strong positive influence* on U.S. interests; provide *some positive influence* on U.S. interests, though it may be unreliable; or provide *no positive influence,* or risk *negative influence*, on U.S. interests.

This first-order assessment of the utility of individual shaping tools should be posted directly on the scorecards presented to senior leaders, informing their efforts to fashion the most coherent and effective shaping strategy possible. However, even when shaping is done with greatest possible effect, it cannot protect U.S. interests against every threat. Some potential adversaries have such heavy stakes in interests that conflict with those of the United States that no amount of shaping alone will provide adequate security for the United States or its friends and allies. Therefore, we must turn to more coercive tools in the Blue strategy space.

Deterrence Tools. As explained in previous pages, deterrence involves discouraging potential adversaries from attacking by threatening to make the expected costs of their attacks outweigh any benefits

they might expect to gain from them. To apply this logic using the risk engine algorithm, planners must examine the critical COAs that make up each potential adversary's probable strategy (as identified in Step 2 of the risk engine analysis) and determine whether capabilities exist or can be acquired to fashion a deterrent threat with sufficient force and credibility to discourage such an attack.

Threats of punishment are those most often associated with deterrence, and, indeed, punishment strategies are often necessary and appropriate for deterring potential state adversaries from employing COAs that include attacking U.S. territories or military forces with nuclear, chemical, or biological weapons. However, because threats of punishment suffer in credibility when issued to deter conventional attacks, risk analysts must consider whether existing defenses (or potential enhancements to them) against prospective enemy COAs are potent enough to raise sufficient doubt in the minds of would-be attackers to discourage them from attempting any strategy whose overall success might depend on carrying out those COAs.

When evaluating such denial-based deterrence strategies, planners will often find that the credibility of deterrent threats lies largely in the capability to carry them out, as the resolve to defend U.S. forces and U.S. allies from conventional attack is rarely in question. However, U.S. resolve to pursue a given COA cannot be taken for granted. In many conventional warfare scenarios, U.S. military forces will be constrained from striking targets if doing so risks escalating the conflict or incurring unacceptable political costs. If defending against certain kinds of attack requires counteroffensive strikes against such targets, threats to do so may lack the credibility needed for effective deterrence by denial. Therefore, evaluating baseline deterrence capabilities and potential enhancements requires planners to assess not only the capability to punish or deny the success of each individual enemy COA, but the resolve to do so as well. Risk assessors need to weigh the strengths, limitations, and dangers associated with every option considered. The assessment should reflect the subjective beliefs of military experts about whether, say, a high, medium or low capability exists (or can be acquired) to punish adversaries or deny the success of their potential COAs. At the same time, political-military experts must assess whether,

in the context of the scenario being considered, U.S. leaders will likely have, say, a high, medium, or low resolve to carry out actions required to punish adversaries or deny them success in their attacks.

When planners and political-military experts have assessed the degree of U.S. capability and resolve associated with countering all probable enemy COAs, planners must then make a subjective assessment of the likely overall deterrence outcome in terms of whether deterrence has a *high*, *medium*, or *low* probability of failure in the scenario for the suite of policy, strategy, and investment options being evaluated. This assessment should consider not only Blue capabilities and resolve to carry out deterrent threats, but enemy stakes in the issue as well. Therefore, planners must always bear in mind the balance-of-interest assessment made in Step 1 of the analysis and factor that into their assessment of the viability of deterrence.

Warfighting and Compellence Tools. Because even the best shaping and deterrence strategies are not infallible, the United States must always maintain capabilities to defend against deterrence failures, compel other actors to change their behavior, and, if required, forcibly impose its will on those actors to secure U.S. interests. Therefore, risk assessors must evaluate U.S. warfighting capabilities against specific threats and inform planners and senior decisionmakers in their efforts to reduce magnitudes of harm to the United States and its military forces in the event of war.

Methods for assessing current and prospective warfighting capabilities are nearly identical to those used to score denial-based deterrence, as the latter entails persuading a prospective adversary that one's defenses are sufficiently capable to put the success of an enemy attack in doubt. Therefore, analysts should begin, once again, by identifying critical COAs supporting the most likely operational concepts that potential adversaries might attempt in specified scenarios, then score U.S. capabilities and resolve to defeat those COAs.

However, while the analysis methodology is similar, the results may differ for several reasons. First, because objectives in war go beyond simply putting the success of a potential enemy attack in doubt, risk analysts need to consider whether U.S. capabilities are sufficiently robust to soundly defeat prospective attacks and achieve posi-

tive, offensive objectives. Second, analysts need to consider prospects of escalation; if escalation occurs, it may loosen the political constraints that undermine the credibility of deterrence threats, and it may also require capabilities to fight at longer ranges and at higher levels of violence than those deemed acceptable for deterrence. Most importantly, since victory in war requires actions that go well beyond simply defeating enemy attacks, planners and risk analysts must examine all relevant joint operational plans, anticipate likely Blue COAs that might emerge in the crisis-action planning process, and critically assess U.S. capabilities and resolve to carry out those COAs.

As in the deterrence analysis, risk assessors should consider the potential enemy's stakes in the issue to anticipate its level of resolve, then score the "defeat" factors in terms of whether the force structure being evaluated (current or proposed) has *strong*, *some*, or *little or no* capability and resolve to execute the critical actions needed to fight and win a war in the specified scenario.

Step 4: Assessing Probabilities and Magnitudes of Harm

The ultimate product of a strategic risk analysis is an overall assessment of the probabilities and magnitudes of harm associated with whatever bad outcomes are deemed possible in any specified scenario. To accomplish this stage of the analysis, planners must consolidate the assessments of utility, capability, and resolve determined in the shaping, deterrence, and warfighting analyses and make a subjective evaluation of the overall risk associated with the force structure and policies under examination. Moreover, they must organize and present this information in a way that senior decisionmakers can readily understand and act on.

As the "Risk" column in Figure 5.2 illustrates, the first step in this stage of the analysis is to assess the *probability of harm* associated with a given threat—that is, the probability that the United States and some adversary will engage in conflict in the scenario being examined. Risk analysts arrive at this probability by posting all shaping COAs with positive utility scores—those estimated to have at least *some positive influence* on U.S. interests—along with the overall deterrence score, on a composite scorecard. Then, subject-matter experts consider this

information holistically and subjectively assess whether there exists a *low*, *moderate*, or *high* probability that conflict will occur, given the force structure and strategy being evaluated in the specified scenario. When doing this assessment, analysts must bear in mind that conflict can result not only from attacks against the United States or its allies, but also from actions directed by U.S. leaders if they deem it necessary to threaten or employ force proactively in support of U.S. interests.

Evaluating the magnitude of harm that might result in these situations requires risk analysts to consider whether an adversary or the United States might be the first to employ force and, in either case, whether the other actor will resist. If the United States elects to intervene in some crisis and no potential adversary opposes that action, some harm to U.S. interests may eventually result, but because that harm is outside the scope of current military planning, we do not address it in this analysis. Alternatively, if a potential adversary acts in a way that damages U.S. interests and the United States fails to respond, then the magnitude of harm consists of the direct impact on U.S. interests caused by that adversary's actions. As that impact will likely affect the security of the United States and its friends and allies, we address it, labeling this outcome *magnitude of harm 1*. To score this impact, political-military experts should refer back to Steps 1 and 2 of the risk engine analysis (context and threat assessments) and estimate whether a U.S. failure to respond to the prospective aggression would result in a *high*, *medium*, or *low* magnitude of harm. If either the United States or a potential adversary acts and the other responds with military force, then conflict occurs resulting in *magnitude of harm 2*. Risk analysts subjectively score this impact as *high*, *medium*, or *low* based on their assessments of the potential benefits of shaping and the levels of capability and resolve associated with the warfighting tools examined in Step 3 (options assessment) of the risk analysis.

To make this somewhat abstract discussion more concrete, we include example exercises that apply the method to real-world problems. Appendix D illustrates the application of this method to the defense of Taiwan, a case where warfighting and compellence tools dominate. Appendix E applies this approach to the problem of insurgency in the Solomon Islands, a case where other shaping tools are more salient.

Using the Risk Engine in Force Planning

Risk analysis is an important component of force planning, but to employ it effectively, planners need a logical framework that enables them to identify, gather, organize, examine, and weigh a host of qualitative factors in a systematic fashion. The risk engine algorithm offers such a framework; it provides a mechanism that force planners can use to harness the judgment of subject-matter experts and present their assessments to senior leaders in a format that is comprehensive, balanced, and concise.

The risk engine can be used to support a wide range of force-planning tasks. Political advisors can use it to assess dangers in the current security environment, identifying conflicts of interest in each region and highlighting those situations in which current U.S. policies have negative impacts or little positive influence. Military analysts can use the risk engine to identify existing and projected military threats, weigh alternative strategies to confront those threats, and assess gaps in capabilities needed to better safeguard U.S. interests. But the most promising application for the risk engine is in comparative analysis of alternative investments in force structure. Indeed, that is where the mechanism is most powerful. Using the risk engine, planners can, for any specified scenario, compare the probabilities and magnitudes of harm associated with any number of alternative force structures, existing or notional. They can then provide their assessments and recommendations to senior leaders, supported by detailed analyses showing how specific enhancements might affect U.S. capabilities and resolve to carry out critical COAs.

The most important strength of the risk engine, however, may lie in what it is not and what it does not do. The risk engine is not a black box that responds to formulaic inputs with canned, mechanical solutions that are irrelevant to any particular geostrategic context and therefore dangerous to apply. Rather, the risk engine is a flexible tool that is responsive to global and regional geopolitical conditions and sensitive to the realities of military and political decisionmaking. The risk engine does not provide answers. It does not make decisions. Instead, it guides analyses and provides a structured framework within

which to present the results of those analyses to the people who do make important decisions: senior military and political leaders.

CHAPTER SIX

Conclusion

In the course of the analysis underlying this monograph, we came to appreciate a few key aspects of dealing with uncertainty about the future in the context of force planning. We identified two important ways to address such uncertainty in this context. We additionally identified four elements of a more formal approach to risk assessment that force planners in the Air Force can use to help manage uncertainty about the future more effectively. This closing chapter summarizes our analytic findings on these points.

The Challenge of Managing Uncertainty About the Future

Uncertainty inherent in the future can encourage senior leaders to speak imprecisely about the future and to assert their professional military expertise when challenged on this imprecision. Although they are right to assert the value of professional military judgment, they can sharpen any judgment by applying it more precisely. To do this, it may be helpful for senior leaders to more closely examine three aspects of this uncertainty when they must make decisions today.

Risk Is About the Consequences of Policy and Resource Decisions

Many leaders and their staffs speak of "taking risk" and "accepting resource shortage" as being synonymous. Although it may be true in some instances that a high-level decision to remove resources from an Air Force activity increases risk to the Air Force and nation, this is

not necessarily the case. It also could be that little or no increased risk is associated with the resource decision. Even if risk is increased, the decision may be necessary to free resources to address other priorities within the USAF or elsewhere in DoD. The broader issue is "What is the net effect on risk to the nation?" It is not helpful—that is, it is not informative in the public policy debate—simply to speak of "risk" when Air Force resources fall. Risk of what? What are the policy consequences when such resources fall? Is national security damaged or compromised when this occurs? In what way? Under what circumstances? How likely is the damage to occur if the resource reallocation persists? If the damage in fact occurs, how severe will it be? And compared with what?

In the context of Air Force force planning, *risk* increases when damage to U.S. national security interests becomes more likely or, given that damage occurs, the magnitude of damage rises. Such effects may accompany changes in the allocation of resources within the Air Force or between the Air Force and other parts of DoD or the economy. But speaking only about such resource shifts without talking about their policy consequences does not provide useful information to the decisionmakers with the authority to affect such resource changes. Risk assessment will influence the public policy debate to the extent that it characterizes the policy consequences of resource decisions.

Note how closely we have tied changes in available resources, risk, and policy consequences. Observers often distinguish planning from programming by saying that planning is not resource-constrained in the same way that programming is. We argue here that, to take advantage of formal risk-assessment tools, planning must be fully aware of the resource constraints that will apply over any planning horizon. We cannot address the policy consequences of any plan without knowing the nature of the threats that such a plan will address in alternative futures and the resources that will be available to address these threats. Even though we wish to distinguish "taking risk" from "accepting resource shortages" here, we also emphasize that no planner can speak precisely about taking risk without a very clear set of beliefs about what resources will be available.

The Future Is Inherently, Persistently Uncertain and Full of Risks

Future policy consequences of resource decisions made today are inherently uncertain. Why? Simply because what will happen in the future is uncertain, and increasingly uncertain as we consider decisions today that have effects further in the future. The future is uncertain even if the Air Force makes no changes in its policies or how it applies available resources. The effects of changes in policy and the application of resources are themselves uncertain. No objective methods are available to remove such uncertainty; we must live with it.

But simple methods are available to deal with unavoidable uncertainty. One is to adopt policy and resource applications that are likely to pay off no matter what happens in the future. For example, consider two options for designing a reconnaissance platform. One option is customized to provide real-time, high-precision imagery from a far enough distance to avoid enemy air defenses. The other is a rugged, adaptable frame that can accept a wide variety of sensors on short notice. And some of these sensors can be customized to specific, local uses fairly quickly. One option or the other may be preferred in certain futures but, as uncertainty about the future increases, the second becomes increasingly attractive relative to the first because of its flexibility. Similar choices might address whether to invest in materiel inventory (option 1) or maintenance capability to refurbish any asset as the need arises (option 2); or whether to invest in highly specialized training (option 1) or training that allows personnel to be more adaptive in any situation (option 2). In each case, some mix is appropriate, but the mix shifts toward the second option as uncertainty about the future increases.

Another way to address uncertainty is to characterize future threats in ways that complement the flexible strategies described above. The approach here is analogous to that above. The first option is to identify very precise threats with high risks and plan against them. Alternatively, one can identify classes of similar threats and plan against classes; the Air Force can then address whatever threat arises in a class, even if it cannot address the one that arises as well as it could have if it had planned against that one particular threat.

The first approach produces a "parade of terribles." The second approach produces an approach like that described in Chapter Three—a short list of threat types with similar causes and outcomes so that the Air Force can use similar methods to address most of the threats in each class. The first approach seeks to know when and where each threat will occur; the second seeks to predict how many threats of a general type will occur and then seeks mitigations that the Air Force can apply no matter where that threat arises. Such an approach works only if the Air Force accompanies it with policies that sustain enough flexibility in force capabilities to allow effective mitigation wherever a threat arises.

Professional Military Judgment Provides Subjective Beliefs to Manage Uncertainty

Even when significant uncertainty about the future persists and objective means do not exist to reduce it, we are not wholly ignorant of what might occur in the future. We have subjective beliefs that we can use to make coherent decisions. For example, we cannot know with certainty where or when the next insurgency or failed state will rise to a level requiring U.S. attention, but history and social science can help us make predictions that can support planning. We cannot know whether the United States will ever face another traditional conventional war, but we can predict with confidence the military requirements associated with the combat phases of such a war.

Ultimately, given that it is easier to speak convincingly of military art than of military science, professional military judgment comprises precisely this kind of knowledge about the future—a set of subjective beliefs about how the world works that senior leaders spend their careers accumulating and refining. In fact, they presumably are senior leaders today precisely because they sustain subjective beliefs that have proven their usefulness over their careers. But different leaders have different degrees of such knowledge, and no set of knowledge is perfect. Given uncertainties about the future, most leaders surely have subjective beliefs that are more likely to be useful in preparing for some futures than for others. When the Air Force calls on its leadership to develop a consensus view of the future and the risks associated with

it, it is not adequate for each leader to assert "professional military judgment" as a basis for promoting his or her subjective beliefs. Such an approach becomes less satisfactory as our beliefs about the future become more diffuse and less certain.

Because the future is inherently and irreducibly uncertain, and because the subjective beliefs of military professionals have repeatedly proven to be useful in the face of such uncertainty, the challenge before us here is to explore how we might refine the beliefs of senior leadership about the future in ways that are likely to improve the decisions they must make today as a team.

Goals for the Use of Risk-Assessment Tools in Planning

Formal risk assessment can potentially help senior leaders and planners sharpen their professional military judgments about the future and the risks associated with it. Where it can do this, it can also help them communicate their judgments to each other and to important external audiences.

Sharpen Subjective Military Judgment About the Future

In discussions with senior leaders and planners, we heard them refer repeatedly to the probabilities of various things happening in particular future periods and the consequences for U.S. security if they occurred. So these basic elements of formal risk assessment appear to be intuitively appealing in current military planning. These risk-assessment methods and tools can help leaders and planners place these intuitive concepts in a better-defined setting. Doing so can help leaders and planners use the terms more precisely and test the validity of their beliefs about the future for internal consistency.

For example, if we compare the policies that a leader supports and the leader's stated beliefs about the probabilities and magnitudes of damage associated with these policies, are the policies the leader supports compatible with his or her stated beliefs? Unless a leader has systematically explored his or her beliefs and used them to assess alternative policies, inconsistencies typically become quickly apparent,

because the leader can implicitly hold beliefs about probabilities and magnitudes of harm that differ from those he or she states. Adjustments can help leaders assess alternative policies in a more consistent fashion. Similarly, if we examine stated beliefs about the relative likelihood of alternative futures, two at a time, are all such pairwise comparisons internally consistent? Are stated beliefs about relative magnitudes of damage in different futures, considered two at a time, consistent across many pairwise comparisons? Repeated comparisons of this kind typically help respondents move their stated beliefs toward internal consistency. Internal consistency should help them assess alternative policies more consistently.

It is tempting, in the pursuit of precision, to conclude that adding detail improves precision. In fact, we seek to capture a sharper image of leaders' subjective beliefs about the future and risks associated with it. There is clearly room to benefit by pursuing greater detail about these beliefs than we have today. But as models designed to track and record beliefs become more and more detailed, they potentially become impenetrable, even by the specialists who create and sustain the models. These detailed models track so many assumptions that it becomes impossible to audit the sources of the assumptions or to update the models effectively as circumstances change or information improves. They become so complex that it becomes impossible to unravel why they predict certain outcomes. When detail and complexity make it impossible to understand precisely what is happening in a model, the model cannot provide the transparency we seek in order to document the subjective basis for leadership decisions. Risk-assessment tools can meaningfully sharpen profession military judgment only as long as they sustain transparency about the beliefs embodied in this judgment.

Improve Communication of Subjective Military Judgment

Senior leaders and planners rarely develop beliefs about the future and the risks associated with it in isolation. Subjective beliefs arise through interaction between leaders and their staffs, as well as through discussions among peers. These beliefs, moreover, are updated over a career in contact with superiors, peers, and staffs, as shared sets of beliefs are repeatedly tested against operational experience. Even if each leader

and staff member holds specific subjective beliefs of his or her own, the planning process must ultimately yield a plan for dealing with the future that, implicitly or explicitly, embodies a set of shared beliefs about the future and risks associated with it. Such a plan is more likely to be coherent (that is, to embody internally consistent beliefs) and effective (to make the best use possible of the beliefs it embodies) if it properly reflects the subjective beliefs of the leaders and staff who together crafted the plan. That should become more likely as leaders and staffs learn how to test their own beliefs about the future for internal consistency so that they can state and defend them more clearly. That is, the very methods that help leaders and planners sharpen their professional military judgments about the future should give them tools to communicate those judgments more precisely during the planning process.

What works within the planning process should set the stage for effective communication outside the process, particularly if the planning process anticipates the need for external communication when a plan is finalized. For example, rather than telling Congress that the Air Force will have to "accept risk" if resources are transferred from acquisition of Air Force weapons to support for currently deployed Army troops, it can state more clearly that such a transfer will affect the Air Force's ability to shape the behavior of emerging potential opponents with high-technology capabilities or affect the capabilities of allies to manage irregular warfare without U.S. participation; that this change will affect the likelihood that specific futures injurious to U.S. security will occur; and that, if such futures occur, the resource transfer will change the damage to U.S. interests that occurs by limiting the Air Force's ability to respond. All of these statements are inherently subjective—that is the nature of the future—but they are more meaningful to external audiences than amorphous statements about the Air Force "taking risk" when it loses resources.

Similarly, when the leadership receives approval for a plan, it can use these same explanations to focus the implementation of the plan on the real goals. A plan is not just designed as a "cut drill" in one part of the Air Force to free resources for application elsewhere, although that is often all the leadership can say today about its goals when it moves

resources. Rather, it is the product of a difficult but necessary effort to weigh subjective beliefs about the consequences for different parts of the Air Force of moving resources. Stating these beliefs clearly creates a baseline that planners and programmers can potentially use to test the accuracy of the beliefs and update their beliefs about the future as experience accumulates.

Balanced scorecards being applied throughout the Air Force are explicitly designed to build such baselines to support implementation. The subjective beliefs that leaders and planners express in the scorecard described here can potentially complement these broad balanced scorecards, drawing data from them and providing inputs on beliefs about the future to them.

Key Elements of Risk Assessment in Force Planning

In many ways, structured risk assessment simply provides a set of accounts for keeping track of the application of common sense. The challenge lies in identifying common sense in the context of great uncertainty and high national stakes. The analysis in this document promotes an approach that highlights the usefulness of four elements of formal risk assessment that can help senior leaders and planners refine and share their professional military judgments about the future and the risks in it, and then communicate these judgments effectively to external audiences.

Apply a Simple Framework Based on Formal Risk Assessment

We offer a framework that focuses on identifying bad things that can happen in the future and on supporting decisions today that can effectively mitigate these bad outcomes. Such a framework is most helpful to decisionmakers who give greater emphasis to avoiding downside risks than to seeking uncertain, but high-payoff, opportunities. Although such an approach might not always be appropriate in specific tactical situations, it embodies a conservative perspective that is appropriate in the context of high-level force planning. As a result, it allows us to build on strong intuitions among senior leaders and planners about the

probabilities and magnitudes of damage to U.S. national security interests in various circumstances and to place these intuitions in a more structured framework, where they can be sharpened.

The framework explained in Chapter Two uses a disciplined series of steps to build and test the subjective beliefs of senior leaders about potential futures, threats in those futures, consequences of those threats in the presence of alternative Air Force policy packages, and high-level preferences among these packages that planners can use to refine the packages through the course of a planning cycle.

Air Force implementation of such a framework would be challenging. It would require leaders and planners to interact in new ways; planners would have to build and maintain new forms of information about the future, risks associated with it, and the effects of current decisions on those future risks. Chapters Three, Four, and Five provide insight into the kinds of risk-assessment methods planners would have to master to choose futures relevant to current planning decisions, design policy packages that effectively span the policy space identified by the futures, and assess the probabilities and magnitudes of damage to U.S. national security interests associated with any combination of policy package and future.

We envision placing the framework in the context of a standard planning cycle that could build the information required to implement the approach through a series of planning cycles. Each cycle would build on risk assessments completed in earlier cycles and create a baseline for similar risk assessments in future cycles.

Use a Scorecard to Capture Key Findings

Air Force planners can use a simple scorecard to capture and sustain information developed by applying the framework above during a planning cycle. The scorecard would sustain information about the probability and magnitude of damage to U.S. national security interests in alternative futures if a baseline policy package, defined by the current programmed force and a reasonable extension of it, remained in place through the planning period. It would sustain information about analogous probabilities and magnitudes for alternative policy packages that might serve as starting points for alternative programmed forces

in future planning cycles. It would allow transparent drill-down from each pair of probability and magnitude, by future and policy package, to (1) an executive narrative of the basis for the probability and magnitude displayed and (2) additional supporting detail, including any analyses or models applied to assess the probability and magnitude. It would allow analogous drill-down to information supporting the choice and definition of alternative futures, of the threats present in alternative futures, and of alternative policy packages.

Such an indentured scorecard is different from, but fully analogous to and compatible with, the balanced scorecards being developed elsewhere in the Air Force and DoD. Most large, complex, global organizations now use some form of these balanced scorecards. In these organizations, such scorecards allow leaders to clarify their subjective beliefs about how an organization works; develop a consensus, high-level view of the priorities of the organization; communicate that consensus to key stakeholders inside and outside the organization; and ultimately translate the consensus priorities into concrete actions to implement specific changes inside the organization that support the priorities.

The scorecard we propose shares the characteristics of these balanced scorecards that allow organizations to do these things. As a result, we believe that a scorecard like that proposed here could help senior Air Force leaders and planners do comparable things. In particular, it could help them refine a consensus view of the future and the risks in it, develop a consensus plan that balances those risks, and effectively communicate the resulting consensus to other audiences inside and outside the Air Force.

Preserve Leaders' Awareness of Persistent Uncertainty

Senior leaders train throughout their careers to be decisive and to use clearly drawn decisions to coordinate the actions of others in complex, challenging circumstances. They can be uncomfortable with the concept of uncertainty. They know combat is chaotic and have learned to adapt quickly as inevitable surprises disrupt even the most carefully crafted plans. Knowing that unpredictable events will disrupt plans, they learn to be a bit suspicious of plans and to accord greater respect

to their ability to act decisively when surprises occur. But in the context of long-term planning, acknowledging the presence of persistent, irreducible uncertainty can give others opportunities to question the one path that a leader advocates and can complicate the leader's effective advocacy and implementation of that path. That is, in this setting, acknowledging significant uncertainty can threaten a leader's authority to lead.

Persistent uncertainty is inescapable. Without a dominant national security paradigm like that which guided U.S. policy for half a century through the Cold War, high-level uncertainty is now an integral, unavoidable, and perhaps even existential element in planning. The approach proposed here seeks to counter senior leaders' natural aversion to acknowledging uncertainty in two ways.

First, it highlights the continuing relevance of multiple potential futures to the performance of any plan designed today. It seeks to direct leaders and planners to make explicit their beliefs about how any plan would perform in different futures. It also preserves planning information about alternatives to the currently preferred policy package to facilitate changes as additional information about the future accumulates.

Second, it challenges senior leaders and their staffs to explore their beliefs about probabilities and magnitudes of damage to U.S. interests in different circumstances. We expect that, if senior leaders consent to participate in such exploration, they will learn that they know less about what might happen in the future than they initially thought. Our framework gives us a way to register that uncertainty in a nonthreatening way. For example, if a leader *must* allocate 100 percent of probability across an exhaustive set of mutually exclusive futures, the leader can record concrete numbers, but must immediately appreciate that these numbers constitute bets. Only one future will occur. But we have to do the best we can to set odds on alternative futures.

Highlighting the primacy of long-term uncertainty in this way represents a basic cultural change that will not come easily. Implementation of the approach we propose will require quiet persistence to help the most powerful people in the Air Force think in new ways about the information relevant to their most basic authority.

Support Continuing, Effective Interaction Between Leaders and Planners

The scorecard described here cannot exist without effective interaction between senior leaders and the planners supporting them. The scorecard reports the consensus subjective beliefs of the leadership. But the methods required to derive and validate these beliefs require a great deal of technical work that only planning staffs with requisite specialized skills and resources can execute. The contents of the scorecard will be meaningful only if planners can test the reported beliefs of leaders and help the leaders adjust them until the beliefs become consistent both internally and with the policy packages that the leaders support.

The contents of the scorecard cannot help develop meaningful consensus or communication of a consensus once it is formed if leaders simply direct planners to report what the leaders demand and the planners cannot question guidance that may be imprecise, inconsistent, or unsubstantiated. The scorecard seeks to report an internally consistent set of subjective beliefs about the future and risks in it; leaders will need to engage in a series of constructive interactions with skilled planners to achieve this.

In PACOM, we have seen the kind of interaction between leaders and planners required to achieve such clearly defined consensus work. The participants report that the process was challenging but rewarding. Why? Because it allowed the leaders to "deliver solutions rather than receive them." Engaging the leadership repeatedly throughout the PACOM planning process made the leaders wrestle, personally and face to face, with challenging decisions that forced them to clarify their beliefs to themselves and their counterparts. The planning staff actively supported this effort throughout, allowing leaders to stay focused on the hard work that only they could do if they wanted to shape the final outcome. We believe that effective interaction of this kind, between leaders and staff, can occur in the right environment. Without it, no planning process can implement the framework and scorecard described above.

Final Thoughts

The USAF is not an autonomous institution that can balance risks in a closed system. DoD, the Congress, and the President will make judgments about risks and resource allocations that, at times, will override the risk-management preferences of the USAF. Even the most elegant and transparent USAF risk-management process will not guarantee that these key decisionmakers reach similar conclusions. A force-planning process that embodies the key elements presented in this monograph would, however, help USAF leaders both make more grounded risk-management choices and communicate those choices and underlying judgments in a more convincing way to diverse audiences. In an imperfect, resource-constrained world, the USAF will always have fewer resources than it would like, but enhanced risk assessment and communication would increase the prospect that the United States has the air and space capabilities most essential to protecting national interests.

APPENDIX A

Some Relevant Concepts from Formal Risk Analysis and Assessment

Formal risk analysis seeks to characterize uncertainty about the future in simple ways that allow analysts to support decisionmakers effectively.[1] This appendix reviews some basic concepts in Bayesian risk analysis designed to support practical decisionmaking.[2] It then illustrates how to use these concepts to think about some basic trade-offs in planning when the Air Force examines multiple sources of risk in its future operating environment. Finally, it discusses the challenge of refining the simple concepts on which we focus and eliciting useful beliefs about them from the decisionmakers we ultimately want the analysis to support.

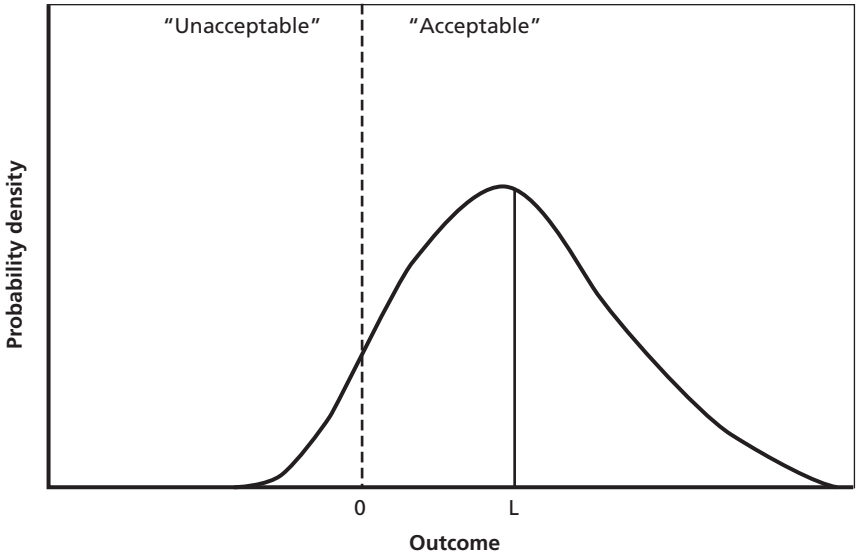
[1] For a useful discussion of the decisionmaking context in which risk assessment might be applied, see James G. March, *Primer on Decision Making: How Decisions Happen*, New York: New Press, 1994. For an excellent discussion of how to balance and integrate formal risk assessment with other decisionmaking approaches, see Baruch Fischhoff et al., 1981 (we thank Henry Willis for bringing this to our attention and helping us appreciate its importance). For useful insights relevant to a defense setting, see Paul K. Davis and James P. Kahan, *Theory and Methods for Supporting High Level Military Decisionmaking*, Santa Monica, Calif.: RAND Corporation, TR-422-AF, 2007.

[2] The fundamentally subjective nature of the judgments relevant to strategic force planning led us to use a "Bayesian" approach to risk assessment. A Bayesian approach uses subjective beliefs about the probabilities of future outcomes and magnitudes of gains and losses. Models based on historical data can help inform these beliefs, but in the end, the beliefs reflect primarily the judgments of military professionals.

Key Concepts

At the heart of Bayesian risk analysis is a "subjective probability distribution," which attempts to summarize a decisionmaker's perception of what might happen in the future in simple statistical terms.[3] Figure A.1 shows an example of such a distribution, represented as a distribution of probability density. The level of some measure of outcome lies on the horizontal axis; the probability of any particular level of outcome lies on the vertical axis. An *outcome* is some ultimate result of a decision about which decisionmakers really care—for example, some summary judgment on the progress of a military campaign. The total area under the probability density function equals the sum of probabilities of all potential levels of outcome—that is,

Figure A.1
Illustrative Subjective Probability Distribution for an Outcome



RAND *MG827-A.1*

[3] The classic reference is Howard Raiffa, *Decision Analysis: Introductory Lectures on Choices Under Uncertainty*, Reading, Mass.: Addison-Wesley, 1970. See also Derek W. Bunn, *Applied Decision Analysis*, New York: McGraw-Hill, 1984; and Robert T. Clemen and Terrence Reilly, *Making Hard Decisions with Decision Tools*, Pacific Grove, Calif.: Duxbury, 2001.

unity. Outcomes to the right of the dashed vertical line are *good*—positive outcomes; those to the left are *bad*—negative outcomes. For our purposes, bad outcomes present unacceptable levels of risks—risks that decisionmakers seek to mitigate. In this particular case, positive outcomes dominate and concentrate around a single most likely or "modal" level of outcome, *L*. Probability falls off from *L* in both directions in something similar to a familiar bell curve shape.

Bayesian risk assessment can characterize uncertainty about not only outcomes, but also *inputs* (things that shape the results of a decision, such as the number of aircraft available) and *outputs* (the immediate results of a decision, such as the effects of a specific aerial attack). Bayesian risk assessment can think about each of these in more than one dimension (for example, aircraft for defensive and offensive missions, effects on military targets *and* unintended collateral damage, and implications in a campaign for military progress *and* geopolitical progress).

It is natural to think about a distribution like that in Figure A.1 as being defined by empirical measurements of historical data—for example, the distribution of percentages of weapons that strike within 10 meters of a target during a series of sorties—or by probability theory—for example, the distribution of the sum of two dice thrown at once. Wherever possible, it is desirable to find such objective bases for the distributions used to represent uncertainties about the future. But decisionmakers rarely have access to such objective bases for the distributions of variables about which they care most; they must rely primarily on subjective probability distributions instead.

Practical risk assessment emphasizes subjective, rather than objective, probability distributions, for two reasons. First, risk assessment is always forward-looking. It focuses on uncertainties about what the future will look like. In the absence of models that can use historical data to reliably predict aspects of the future, beliefs about future states relevant to decisionmakers are inherently subjective. No such models exist in the domain of strategic force planning. Second, even if we examined an immediate decision, beliefs about many of these variables are inherently subjective. It is fairly easy for a decisionmaker to determine the number of aircraft currently available; it is harder for the

decisionmaker to know what a sortie employing these aircraft might accomplish if it occurred right now. Planning factors allow good estimates, but a commander has only so much control over the circumstances in which he or she makes a decision. It is harder still to look beyond the effects of an immediate sortie to predict their implications for broader military and political outcomes.

The challenge of practical risk assessment is finding a way to organize what is currently known about the future for decisionmakers in a way that is likely to improve outcomes in the future. Such assessment needs to be complete enough to capture the implications of key variables, but not so complex that the intricacies of the model introduce more subjective uncertainty than they remove. Practical risk assessment is always a balancing act that seeks the level of complexity that is most likely to improve future outcomes. Typically, this requires an effort to abstract from reality in ways that focus on a few key factors critical to outcomes. Choosing which factors to favor in this setting is typically, in itself, a subjective activity that benefits from past experience with circumstances that can be brought to bear on a decisionmaker's current concerns. The experience of both the decisionmaker and the decisionmaker's support staff is important.

Two broad and related simplifications have proven to be especially useful in practical risk assessment. The first is to *assert* that, given any set of resources and policies today, a decisionmaker seeks to "maximize the utility" associated with the future outcomes resulting from choices he or she makes today. *Utility*, by definition, translates measures of any set of outcomes into a single measure of what the decisionmaker cares about. In our setting, *utility* might signify something as broad and abstract as "national security." In a more local setting, it might signify the degree to which a decisionmaker's actions lead to a successful completion of a campaign, however that decisionmaker conceives success.

Trading measures of outcomes for a measure of utility does two things. First, it effectively reduces judgments about many outcomes to a simple judgment about what level of utility they generate together. In effect, combining judgments about many outcomes forces decisionmakers to reveal how much they value each outcome relative to the others in terms of their relevance to a final decision.

Second, even if only one outcome interests a decisionmaker, talking about it in terms of utility reveals how risk-averse the decisionmaker is. A decisionmaker is defined to be *risk-averse* if an improvement in outcomes adds less value in his or her considerations than an equivalent degradation in outcomes would remove.[4] In terms of the distribution of outcomes in Figure A.1, a risk-averse decisionmaker believes that the negative outcomes have larger negative effects than suggested by the distribution; positive outcomes have smaller positive effects. In effect, a risk-averse decisionmaker would view the outcomes in Figure A.1 in terms of the utilities shown in Figure A.2. The broken-line distribution is the distribution of outcomes shown in Figure A.1. The solid-line distribution reduces the absolute size of each positive *outcome*, yielding a distribution of *utility* to the left of the corresponding distribution of outcomes. The solid-line distribution increases the absolute size of each negative *outcome*, yielding a distribution of *utility* to the left of the corresponding distribution of outcomes. In effect, risk aversion increases the relative importance of bad outcomes in any decisionmaker's view of the future. The decisions of real-world decisionmakers responsible for significant decisions repeatedly reveal that this is how they think about potential bad outcomes in the future. A risk-averse decisionmaker maximizes utility by focusing disproportionately on bad potential outcomes.

The second simplification often applied in practical risk assessment tries to capture the information in a subjective distribution of utility like that in Figure A.2, with a small number of parameters.[5]

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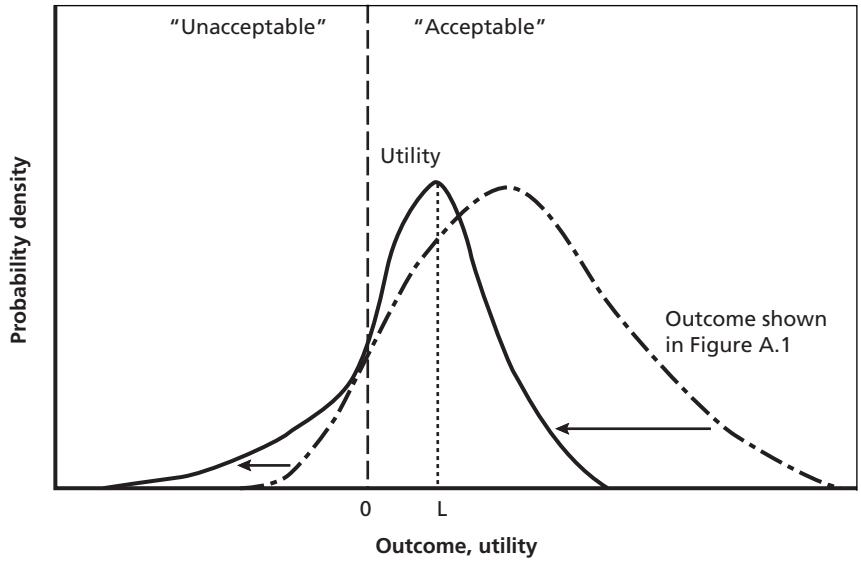
[4] More formally, a decisionmaker is defined to be risk-averse if the marginal utility the decisionmaker associates with any level of outcome—the additional utility the decisionmaker gets from one more unit of outcome—falls as the level of outcome increases. A decisionmaker is "risk-neutral" if this marginal utility is the same at all levels of outcome. If a risk-neutral decisionmaker cares about only one outcome, then the concept of utility is not helpful to him or her, because the decisionmaker can address his or her beliefs about the future entirely in terms of his or her beliefs about potential future levels of this outcome.

[5] Elicitation of expert knowledge is often framed as a matter of using a small set of parameters to summarize a subjective probability distribution that effectively reflects the expert's beliefs about something. Our discussion here addresses a different issue—how best to capture a decisionmaker's intuition about future uncertainty. We will turn to elicitation issues relevant to this challenge later in the appendix.

Figure A.2
Illustrative Subjective Probability Distribution for Utility



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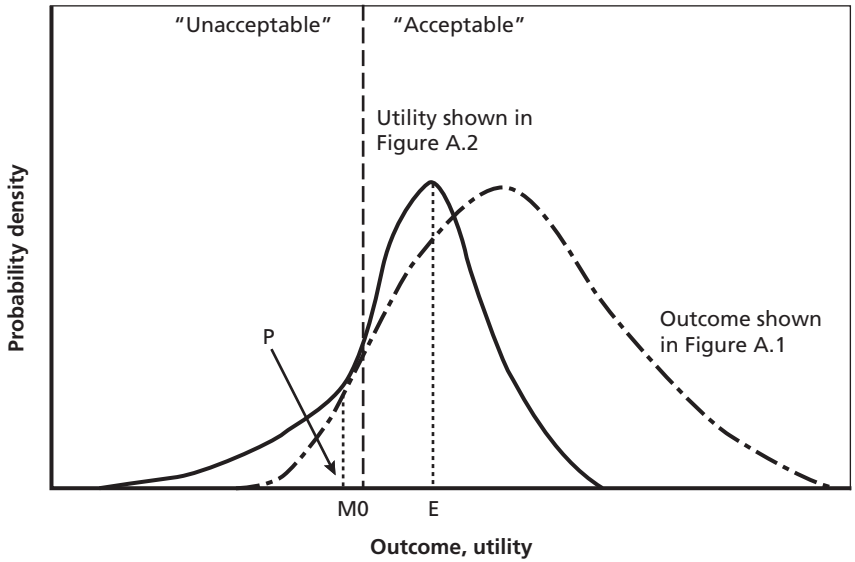
The simplest version focuses on the mean of the utility distribution in Figures A.2 and A.3—literally, the expected value of utility, *E*. An alternative approach focuses on the probability of a negative outcome, *p*, and, given a negative outcome, the magnitude of the outcome, *M*. In the context of Figure A.3, this alternative approach could use the area under the broken-line curve and to the left of 0 as a measure of *p* and the expected value of outcomes in this range as a measure of *M*.

Focusing on expected utility, *E*, places a risk assessment closer to the basic methodological assertion that decisionmakers in fact act as though they are maximizing utility. It also allows an emphasis on a single measure to support decisionmaking. Focusing on the probability and magnitude of bad outcomes carries risk assessment away from its central organizing principle, but in doing so, it also moves away from a concept—utility—that a decisionmaker can find to be too elusive or unfamiliar to be useful. Probabilities and magnitudes of bad things happening are often easier for decisionmakers to wrestle with and form

Figure A.3
Summary Measures of a Subjective Probability Distribution



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subjective beliefs about.[6] If more than one outcome is important, the decisionmaker must wrestle with more than one set of probabilities and magnitudes, further increasing the number the variables in play. But again, if the decisionmaker can work more effectively in terms of multiple outcomes, or even outputs that he or she understands intuitively, than with one or two measures that are so abstract that they offer little practical intuition, moving away from the ideal of utility maximization can

[6] As explained in the text, we see effective risk communication as an essential element of strategic planning. Decisionmakers should be better able to communicate among themselves, with their support staffs, and with external parties that affect Air Force plans if they use language that has a strong intuitive basis for them and those with whom they talk. Such language can help them to be "approximately right"; using a more formally correct framework could easily lead them to be exactly wrong. For more information on effective risk communication, see M. Granger Morgan, Baruch Fischhoff, Ann Bostrom, and Cynthia J. Atman, *Risk Communication: A Mental Models Approach*, Cambridge, UK: Cambridge University Press, 2002; and National Research Council, *Improving Risk Communications*, Washington, D.C.: National Academy Press, 1989.

improve the future outcomes of decisions today by giving the decisionmaker more meaningful—and hence useful—decision support.[7]

As a kind of compromise, formal risk assessment often highlights three factors for examination: threat, vulnerability, and consequence.[8] In effect,

- The level of "threat" or "hazard" defines the probability that some specific bad thing will happen. For example, it could measure the probability that an enemy air defense system successfully engages a friendly attack aircraft during a sortie.
- The level of "vulnerability" defines the probability that, if a threat manifests itself, it will in fact cause harm. In this example, it could measure the probability that, once an enemy air defense system engages a friendly aircraft, it successfully shoots down the aircraft.
- The level of "consequence" defines the magnitude of harm that occurs when harm in fact occurs. In this example, it could measure the harm that occurs from injury or capture of the aircraft crew, permanent loss of the aircraft, or failure of the aircraft's mission.

In this "TVC" view of risk assessment, risk (R) is a product of threat (T), vulnerability (V), and consequence (C). Some risk analysts go even further and invoke a version of expected utility to argue that, literally,

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[7] Focusing on probabilities and magnitudes can implement utility maximization exactly if the decisionmaker is risk-averse in a very special way. Whenever an outcome is positive, increasing the magnitude of outcome yields no additional utility; whenever an outcome is negative, increasing the absolute magnitude of outcome has the same effect on utility at every level of outcome. Viewed in this basic way, such a version of risk aversion sounds improbable.

[8] Ongoing risk analysis on terrorism, for example, tends to favor this approach. See, for example, Henry H. Willis, Andrew R. Morral, Terrence K. Kelly, and Jamison Jo Medby, *Estimating Terrorism Risk*, Santa Monica, Calif.: RAND Corporation, MG-388-RC, 2005; and Yacov Y. Haines, *Risk Modeling, Assessment, and Management*, Hoboken, N.J.: Wiley-Interscience, 2004.

$$R = T \times V \times C, \tag{A.1}$$

where $T \times V$ in effect measures the probability that harm occurs, and C measures the disutility that occurs when harm occurs. Equation A.1 can be interpreted as a literal expression of expected utility if (1) only disutility matters to a decisionmaker and (2) disutility equals zero as long as harm does not occur.[9]

Listening carefully to Air Force and combatant command planners and decisionmakers working in a variety of settings, we heard many variations on this TVC view, even though no one ever suggested that they were applying this approach. For example, an officer might say, "We expect more risk over our planning horizon than we have in the past, because country Xonasia now appears more likely to acquire a capability that can effectively counter U.S. capability. If that occurs, we will lose the ability to" pursue some important national security goal. Another might say, "It would be desirable if we could reduce the probability of a homegrown insurgency in Burfistan or improve the current government's ability to put it down quickly, by itself, if it occurs." One officer even showed us a graphical display that identified 15 to 20 specific planning concerns in each of various countries in a region as points in a space in which (1) the probability that a concern would become relevant to that combatant command over some planning horizon appeared on the horizontal axis and (2) the magnitude of the concern, if it became relevant, on the vertical axis.

We have no evidence that these officers would share the same beliefs about what appropriate planning values are for probabilities or magnitudes of loss in any specific situation or even what "probability" and "magnitude" mean to each of them in any well-defined terms. It is not likely, for example, that such probabilities and magnitudes mean to them exactly what the corresponding variables in Figure A.3 mean relative to a subjective probability distribution. But listening to them talk about their own planning and decisionmaking convinced us that

[9] As noted in a previous footnote, this version of risk aversion sounds implausible. The TVC approach is useful because it supports subjective assessment of risk more effectively in real-world situations than a more formal approach.

(1) the probability of a bad thing happening and (2) the magnitude of loss if it occurred have a strong intuitive appeal to Air Force planners and decisionmakers trying to characterize future uncertainties.

DoD publications on risk assessment take a similar approach. For example, the Army field manual on risk management speaks of a hazard or threat as "a condition or activity with potential to cause damage, loss, or mission degradation and any actual of potential condition that can cause injury, illness, or death of personnel; damage to or loss of equipment and property; or mission degradation." Risk is the "probability and severity of loss linked to hazards."[10] It uses a risk-assessment matrix to translate probability and severity of risk into an overall assessment of risk (see Table A.1). Overall risk rises with probability or severity but is not defined by an explicit algebraic statement like that in Equation A.1.

Similarly, the DoD guide to risk management in acquisition speaks of a future root cause as "the reason, if eliminated or corrected, that would prevent a potential consequence from occurring. It is the most basic reason for the presence of risk."[11] Risk is a "measure of future

Table A.1
Army Risk-Assessment Matrix from Army Field Manual 3-100.12, 2001

	Probability				
Severity	**Frequent**	**Likely**	**Occasional**	**Seldom**	**Unlikely**
Catastrophic	Extremely high risk	Extremely high risk	High risk	High risk	Moderate risk
Critical	Extremely high risk	High risk	High risk	Moderate risk	Low risk
Marginal	High risk	Moderate risk	Moderate risk	Low risk	Low risk
Negligible	Moderate risk	Low risk	Low risk	Low risk	Low risk

SOURCE: Department of the Army, 2001, p. A-D-1.

[10] Department of the Army, 2001, Glossary.

[11] DoD, *Risk Management Guide for DoD Acquisition*, 6th ed., version 1.0, Washington, D.C., 2006b, p. 33.

uncertainties in achieving program goals within cost and schedule constraints. It has three components: a future root cause, a likelihood assessed at the present time of that future root cause occurring, and the consequence of that future occurrence."[12] Consequence is the "outcome of a future occurrence expressed qualitatively or quantitatively, being a loss, injury, disadvantage, or gain."[13] This guide uses a risk-reporting matrix to transform judgments about likelihood (not likely [~10 percent], low likelihood [~30 percent], likely [~50 percent], highly likely [~70 percent], near certainty [~90 percent]) and consequence (minimal or no consequence, minor reduction that can be tolerated, moderate reduction with limited effects on program success, significant degradation that may jeopardize program success, severe degradation that will jeopardize program success) into a qualitative assessment of risk (high, moderate, low).[14]

The planners and decisionmakers with whom we spoke were rarely aware of these methods and had generally not been trained to implement them. But the methods appear designed to take advantage of the same intuitions in military personnel that we want to reflect in our analysis.

As a result, in our analysis, we characterize risk as a product of (1) the probability that a threat manifests itself and (2) the magnitude of loss we expect that threat to generate if it manifests itself. Risk is not necessarily a literal mathematical product of these two values. Rather, an increase in either increases the level of risk relevant to a decisionmaker. In effect, we define (1) probability of loss as being analogous to the threat (*T*) in the TVC framework and (2) magnitude of loss as being analogous to a combination of vulnerability and consequence (*V* and *C*) in the TVC framework. Other formulations are clearly feasible; we choose this one because it appears to capture most directly the intuitions that Air Force planners and decisionmakers have about risk.

In particular, Chapter Five offers a method that planners can use to develop and sustain subjective judgments about the probability and

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[12] DoD, 2006b, p. 33.

[13] DoD, 2006b, p. 33.

[14] DoD, 2006b, pp. 11–14.

magnitude of loss associated with any particular type of threat. Given these judgments, they can then assign a value of risk to each threat. That value of risk provides a basis for assessing the risks associated with different futures, which, in our analysis, comprise different mixes of various kinds of threats that might manifest themselves over the horizon relevant to force planning.

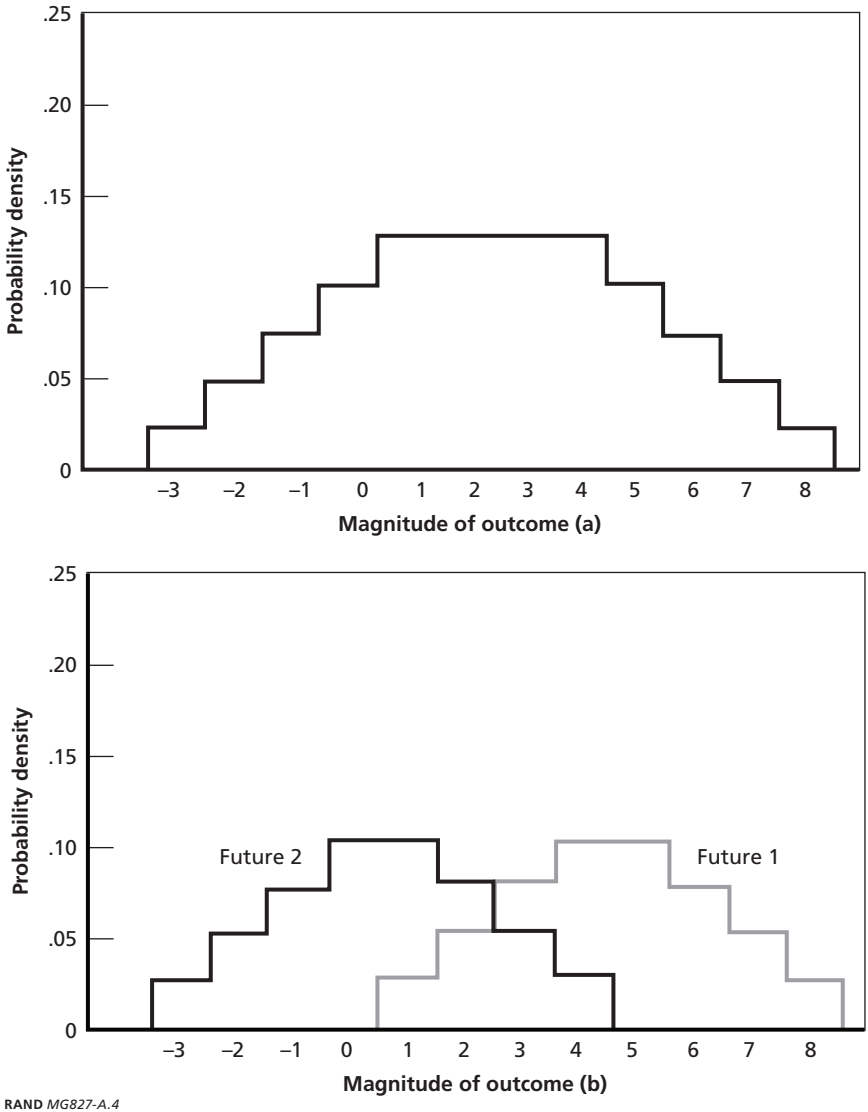
Applying Key Concepts to a Trade-Off

Force planners seek to understand how the composition and size of the force should change to reflect expected changes in external threats, new technologies and opportunities, availability of resources, and so on. They implicitly ask how much of one capability they should be prepared to give up to get more of another. The concepts described above will be helpful to force planners only if they can help these planners reflect their beliefs about future uncertainties better as the planners address such trade-offs.

Consider a situation in which a decisionmaker maintains a subjective probability distribution about the future that looks like that in Figure A.4(a). For the most part, outcomes are positive, but the decisionmaker believes that a 15-percent chance exists that something bad could happen—that is, that there will be an "unacceptable" outcome. A risk-averse decisionmaker would give disproportionate attention to these negative outcomes. How could such a decisionmaker change the force or policies associated with it to improve the pattern of outcomes he or she expects in the future?

As the decisionmaker thinks about these bad outcomes, suppose she concludes that she expects them to occur only if certain futures manifest themselves. In particular, she concludes that two qualitatively different futures might occur with equal probability. For simplicity, let us assume initially that the decisionmaker believes that he or she cannot control the relative likelihood of these two futures. One future is positive—it has all positive outcomes of various magnitudes—perhaps because this is the future against which decisionmakers have planned in the past. The second future presents the possibility of bad outcomes,

Figure A.4
Subjective Probability Distributions for Two Potential Futures



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perhaps because it presents new types of risks that decisionmakers did not plan for in the past. For example, Future 1 might involve mainly large conventional conflicts that current Air Force capabilities can dispose of quickly with few negative effects. Future 2, on the other hand, might be dominated by irregular threats from insurgency and terrorism that are hard to dispose of and can fester for years despite significant applications of the best force capabilities and shaping strategies that the Air Force has available. Figure A.4(b) shows an example of the subjective probability distributions the decisionmaker might attach to these two futures. Taken together, they make up the full range of outcomes reflected in Figure A.4(a). *If* Future 2 occurs, the probability of a bad, "unacceptable" outcome is now 30 percent.

Figure A.5 shows how changes in the current force and policies associated with it might mitigate the worst outcomes and improve expected outcomes enough so that potential negative outcomes no longer occur. As a result, the expected outcome in this future rises. Panel (a) shows how such changes might affect a decisionmaker's subjective probability distribution about outcomes in this future.

With fixed resources, this change in distribution will be possible only if the Air Force gives something up. It must look to Future 1 for capabilities it is willing to lose. For example, it might be willing to take longer to execute a conventional campaign or to swing from a campaign in one theater to one in another. It might be willing to accept more collateral damage to unintended targets. As long as these losses did not threaten the Air Force's ability to successfully complete a campaign in a way that shaped the post-conflict environment in an appropriate way, the Air Force might be willing to accept higher costs of doing this in Future 1 to avoid higher-priority costs associated with Future 2. Panel (b) of Figure A.5 shows how a decisionmaker might expect such a change to shift the subjective probability distribution for Future 2 systematically to the left without allowing any negative outcomes to occur. As this occurs, the expected outcome in this future falls.

Taken together, the incremental reallocation of priority from Future 1 to Future 2 has the total effects shown in Figure A.6. The decisionmaker expects the changes to remove the worst outcomes

Figure A.5
Mitigating Risks Present in One Future by Deemphasizing the Other

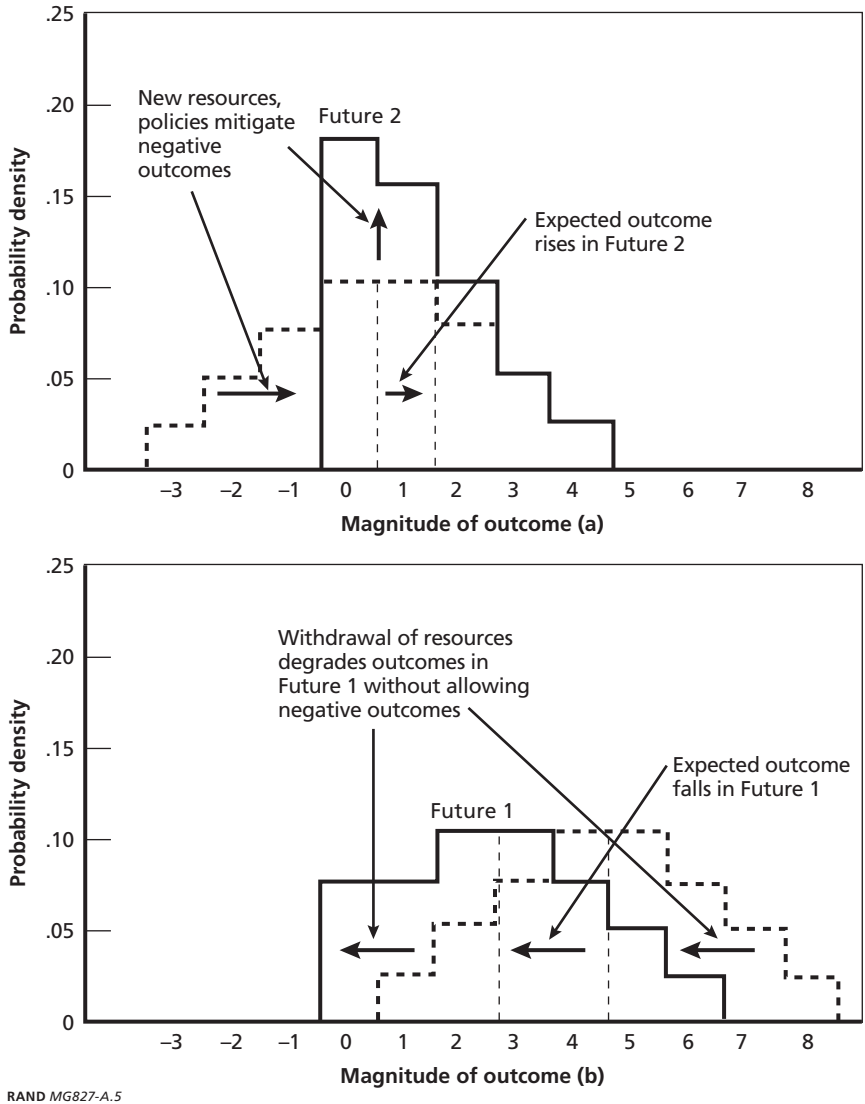

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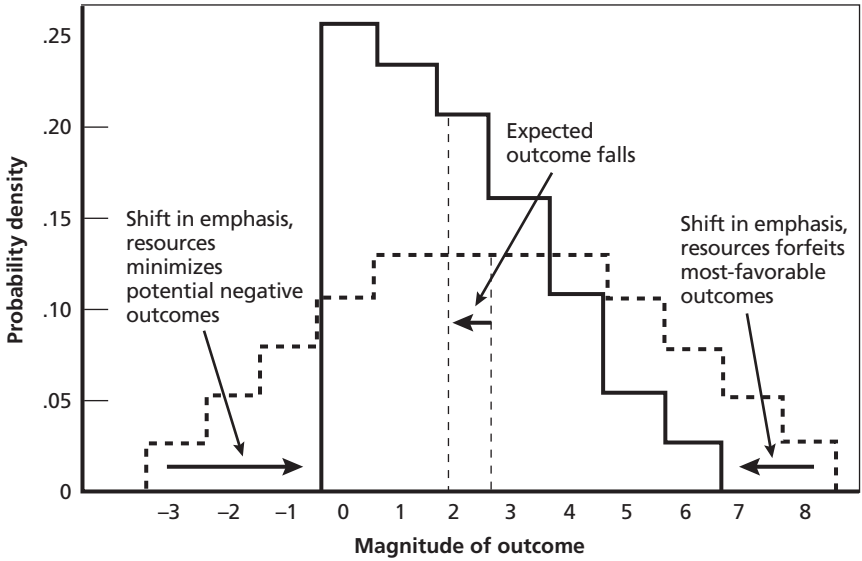
Figure A.6
Effect of Risk Mitigation on Total Subjective Probability Distribution



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feared. It does this at the expense of the best outcomes, effectively reducing the range of outcomes expected. The shift in priorities shown here effectively reduces the expected value of the outcome that the decisionmaker anticipates in the future. Should the decisionmaker plan to implement this shift in priorities?

A risk-averse decisionmaker, focused on removing the worst outcomes, would accept some reduction in overall expected outcome because he or she values the reduction in bad outcomes more than the loss of good outcomes. As noted above, when decisionmakers address choices that have potentially large consequences in the future, they tend to make decisions that err on the side of caution to avoid the worst outcomes.

It would be reasonable to expect senior leaders in the Air Force and their planners to "err" in the same way. That should not be interpreted to say that they will accept any loss in expected out-

come to remove the worst outcomes. But they will give bad outcomes more emphasis in their planning than good outcomes.

In the approach we describe in the main text, we avoid reference to subjective probability distributions like those described here. Our approach in the text deliberately focuses on the worst outcomes. It would approach the situation just described here by noting that, at the beginning of the planning exercise, the decisionmaker expects a 50-percent probability that Future 2 will occur and, if it occurs, that the potential of a bad, "unacceptable" outcome is probably in the range of –2. If Future 1 occurs, there is no serious potential for a bad outcome. Given this expectation, the decisionmaker would focus immediately on seeking (1) to reduce the probability that Future 2 might occur and, if it does occur, (2) to reduce the magnitude of bad outcomes. The decisionmaker would seek resources to address the bad outcomes in Future 2 in a place where they are not needed to avoid bad outcomes—Future 1. The decisionmaker would use these resources to seek to reduce the probability of Future 2 and the potential losses associated with it. The decisionmaker would continue to draw resources away from Future 1 to achieve these ends as long as doing this did not induce potential negative, unacceptable effects in Future 1. In sum, the approach suggested in the text helps the decisionmaker pursue trade-offs in a way that is compatible with an approach based on fully subjective probability distributions without asking the decisionmaker to give too much attention to understanding the full shape of his or her subjective probability distribution relevant to the future or to alternative versions of it. The decisionmaker need focus only on his or her beliefs about the bottom end of this distribution.

As a practical matter, if a decisionmaker thinks appropriately about the future, he or she will appreciate that large uncertainties inhere in it and in any alternative future he or she might imagine. Thinking about many alternative futures, the decisionmaker will appreciate that it will be very difficult to eliminate the possibility of any negative outcomes in most of them. Every significant future will present some potential for negative outcomes. When this occurs, a decisionmaker pursuing the approach outlined in the text will find that trade-offs inevitably trade some increase in the potential for a bad outcome in one future for

a reduction in that potential elsewhere. The decisionmaker's attention will rest squarely on the bottom end of his or her subjective probability distributions for each of these futures, repeatedly asking which trades are most likely to reduce risk given the broad priorities of the Air Force and the U.S. government.

How does that view compare with the broader view of subjective probability distributions described in this appendix? An approach based on fully subjective probability distributions would seek to limit the bad outcomes in each future to the point that any further efforts imposed too large a cost on expected outcomes to justify the gains achieved at the bottom end. This approach would similarly attempt to reduce the probability of the futures with the worst outcomes to the point that any further effects imposed too large a cost on expected outcomes. In this situation, effective decisionmakers would reach a stage at which the opportunities for low-cost reductions on negative outcomes had been exhausted. A sense of balance or tension would prevail, in which a bad outcome in one future could not be further relieved without increasing a bad outcome in another future.

Part of the reason for this situation is that priorities other than national security compete for federal resources. As long as national security outcomes are "good enough," the country will commit its resources elsewhere. The world is a dangerous place and always has been, but resources continue to flow to other priorities despite this danger, and DoD's share of these resources has trended steadily down over time in the face of rising competition from other priorities. Given this general competition for public resources, changes relevant to Air Force force planning are most likely to involve shifts in emphasis within a limited budget, and these shifts are most likely to reflect efforts to balance the dangers in the world that the Air Force is charged to mitigate as those dangers shift. That is, shifts over time in the probability and magnitude of bad outcomes are likely to be the changes that would drive any planning process focused on a broad view of subjective probabilities of positive and negative outcomes. Focusing immediately on shifts in bad outcomes is likely to lead decisionmakers to focus on what matters most to improving their decisions, even if they wish to maintain a broader perspective on potential good and bad outcomes.

Elicitation of Subjective Beliefs

"Elicitation" is a process that can help subject-matter experts formulate their knowledge in a way that reflects the disciplined way in which formal risk assessment addresses uncertainty.[15] Elicitation seeks to formulate knowledge in ways that are most likely to capture an expert's true understanding of it. Understanding of complex topics is often latent and socially situated; it comes to light only when experts interact in the setting of a real problem and reveal their true beliefs as they make decisions to address these problems. For example, as wargamers work through a scenario, their latent beliefs about factors underlying the progress of the scenario come to light only as they determine, together and for themselves, what outcomes appear to be most reasonable. When such considerations are important, elicitation may be most successful if conducted in the context of such an activity.

Elicitation also recognizes that many predictable biases find their way into such an understanding. One danger of choosing an approach to describing future uncertainty that appeals intuitively to Air Force decisionmakers and planners is that such biases can easily be part of their intuition, potentially buried in subtle ways, deep out of sight. We present here a very brief overview of biases that planning staffs should watch for as they elicit judgments from the decisionmakers they support. For more information on how to do this, we direct readers to the detailed guides to elicitation listed in the bibliography.

An extensive empirical literature, based on a wide variety of psychology experiments with individuals, has identified a number of

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[15] Many useful references exist on the theory and practice of elicitation. This discussion draws most heavily on a particularly well-written and succinct summary in Paul H. Garthwaite, Joseph B. Kadane, and Anthony O'Hagan, *Elicitation*, Pittsburgh, Pa.: Carnegie Mellon University Department of Statistics, Technical Report 808, 2004. See also Lionel A. Galway, *Subjective Probability Distribution Elicitation in Cost Risk Analysis: A Review*, Santa Monica, Calif.: RAND Corporation, TR-410, 2007; Mary A. Meyer and Jane M. Booker, *Eliciting and Analyzing Expert Judgment: A Practical Guide*, Philadelphia, Pa.: Society for Industrial and Applied Mathematics and Alexandria, Va.: American Statistical Association, 2001; and Anthony O'Hagan et al., *Uncertain Judgements: Eliciting Experts' Probabilities*, Chichester, UK: John Wiley and Sons, 2006. We thank Lionel Galway for helping guide us through this literature. For a useful discussion in a defense setting, see Arena et al., 2006.

problems to watch for. Those highlighted by Garthwaite, Kadane, and O'Hagan are representative:[16]

- *Judgment by representativeness*. Subjects use the wrong model to apply past knowledge to a new judgment. For example, asked how likely an emitter on the battlefield with specific technical characteristics is to belong to a particular class, an intelligence analyst focuses only on links between these characteristics and the class rather than the number of members of this class expected on the battlefield. Such likelihood is probably low for an emitter in a small class, even if the characteristics appear to link a specific emitter strongly to the class.
- *Judgment by availability*. Subjects draw too heavily on a recent event or easily accessible information to make a judgment. For example, a recent attack by al Qaeda tends to increase the likelihood that intelligence analysts will link additional attacks to al Qaeda.
- *Judgment by anchoring and adjusting*. During an elicitation assessing likelihoods of different situations, subjects tend to "anchor" on the circumstances of the first situations considered and not adjust enough when the circumstances differ in other situations. For example, a review of circumstances in very different countries in a region can easily be colored by which country the review considers first.
- *Law of small numbers*. After receiving a review of a situation based on a quick review of initial indicators, subjects assume that further review will simply yield more of the same and give as much credence to judgments based on such a limited review as they would to judgments based on a more extensive review. For example, analysts might give as much credence to the results of the first few bomb-damage assessments received in a campaign as they would to a complete sample.
- *Hindsight bias*. After an event occurs, subjects have a tendency to revise their beliefs about what they expected before the event

[16] Garthwaite, Kadane, and O'Hagan, 2004.

to bring their prior beliefs more into line with the realized event. For example, asked how much risk has risen over a period of time during which turbulence has increased, analysts may tend to overstate their prior expectations of trouble and so underestimate the degree of change in perceived risk.
- *General confidence*. Subjects tend to underestimate the range of outcomes likely to occur in the future. Experts have a special tendency to do this when they allow their expertise to play down the degree of persistent uncertainty about the future in many settings; they know less about what factors shape the future than they would like to think they do.

A broad empirical literature also informs what kinds of variables subjects are best able to characterize during elicitations. Most of this work focuses on descriptive statistics for individual numbers, so we must be cautious in extending these findings to capabilities relevant to the more subjective factors we emphasize here. But it is informative to appreciate the range of ease that individuals display in framing different kinds of measures, even when the information in question can be stated in terms of exact, well-defined individual numbers. Garthwaite, Kadane, and O'Hagan highlight the following:[17]

- Individuals characterize information about proportions, modes, and medians of samples more successfully than information about means, especially means with skewed distributions.
- Individuals typically have great difficulty characterizing information about variances. They are typically much more successful characterizing the distances between specific percentiles or assigning probability to specifically stated intervals. Even here, though, the tendency to be too confident often yields perceived distances between percentiles spanning the center of a distribution that are too small.
- Assessing the extreme tails of distributions is very hard for most individuals.

[17] Garthwaite, Kadane, and O'Hagan, 2004.

- Assessing relative magnitudes or odds is often more successful than assessing absolute values of magnitudes or probabilities. With care, useful assessments about absolute values can be built up from a series of judgments about relative values.
- Eliciting statements about joint distributions or dependency between variables is far more challenging than eliciting statements about one variable at a time. It is typically easier to obtain useful information about joint distributions if an analyst can frame them in a way that makes each variable in the distribution independent of the others. When this occurs, only marginal distributions for each variable separately need be elicited to characterize jointness successfully.
- Eliciting statements about complex situations tends to be more successful when the elicitation process breaks these situations down, elicits information about individual parts and how they relate to one another, and constructs judgments about the situations as a whole from judgments about their constituent parts.
- Visual aids help in most of these tasks.
- Training and feedback can improve success in many of the characterizations above, but improvement with regard to extreme tails of distributions is hard to achieve.

This very brief overview of the challenges of eliciting information from experts suggests a number of insights relevant to the task at hand. Any attempt to implement the approach described in the text would benefit from giving a great deal more attention to the practical issues associated with elicitation. In the meantime, these broader points are worth noting:

1. Characterizing beliefs about future uncertainty is complex, even when the beliefs are, in principle, easy to present in clear terms as individual numerical values. Many specific strategies are available to reduce the negative effects of such complexity on successful elicitation.
2. This elicitation process can apply to beliefs about any set of variables. With regard to the analysis in this appendix, it might apply

to the subjective probability distributions we associate with alternative futures. But the difficulty many individuals have stating beliefs about something as simple as a mean, much less a variance, of a distribution for a well-understood numerical variable should make us cautious about eliciting beliefs directly about utility or even vaguely defined outcomes. Elicitation of information about more concrete things is usually more successful. The best candidates in our analysis are beliefs about probabilities and magnitudes of loss and about specific factors described in the methods presented in Chapters Three and Five.

3. Practical experience with elicitation appears to help validate methods like those discussed in Chapters Three and Five, which break complex problems apart and try to make the judgments that underlie subjective assessments more transparent. We chose this path mainly to increase the transparency of decisionmaking in a way that would (1) provide an effective set of accounts that documents the key assumptions made in any analysis, (2) allow the testing of alternative points of view with regard to these assumptions, and (3) promote learning over time as new information relevant to various assumptions becomes available. Elicitation experience adds a fourth reason, which appears to indicate that individual experts benefit from such discipline as much as groups. The discipline allows an expert to keep track of all the assumptions he has made, test assumptions to see whether they affect outcomes, and ultimately verify in his own head that the many judgments underlying his final assessments about future uncertainty are internally consistent and compatible with his broader beliefs. Decomposition helps cognition. The literature does not appear to ask how much decomposition is enough. The value of simplicity suggested in other parts of the literature suggests that a little complexity in a model goes a long way. This appears to be compatible with our pursuit of a balanced approach to complexity in the methods we apply.
4. No matter what information we elicit, we seek a statement of decisionmakers' beliefs about that information. Formally elicited information about a magnitude or loss would presumably

include "high" and "low" values and a modal value.[18] To the extent that such information on individual decisionmaker's beliefs ultimately becomes a statement of consensus among relevant players, it might be interpreted as a preferred value based on the mode and a degree of consensus based on the range between high and low relative to the mode. Less consensus would presumably invite (1) greater skepticism about conclusions based on such consensus and (2) sensitivity analyses to test whether the values in questions really matter to policy outcomes.

5. We should expect difficulties eliciting beliefs and then achieving meaningful consensus on the values of probabilities of loss, especially if these probabilities are very small, placing them in the extreme tails of any subjective probability distribution. The broad use among decisionmakers and planners of language about probabilities tells us that strong intuitions exist about how a probability affects risk relevant to decisionmaking. But practical experience with elicitation indicates that we should approach such intuitions with special care.

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[18] Based on a survey of recent literature, Galway (2007) explains a particularly direct and simple way to do this and infer a subjective probability distribution for information about the factor, and his method appears to have broad support in the literature.

APPENDIX B

Balanced Scorecards and Risk Scorecards

The scorecard described in the text inevitably draws to mind the balanced scorecard, which is gaining prominence in DoD and elsewhere among large, complex organizations. How similar are they? What can we learn from experience to date with balanced scorecards, especially in DoD, that might inform the approach described here? This appendix reviews these questions briefly. It first describes what a balanced scorecard is. It then presents some information about recent experience with balanced scorecards in the Air Force. Finally, it compares balanced scorecards with the scorecard proposed here, suggesting that we can, with appropriate caution, learn a great deal relevant to the approach described here from experience to date with balanced scorecards.

What Is a Balanced Scorecard?[1]

The balanced scorecard emerged from best commercial practice in the 1980s as a method to test corporate strategies against the empirical realities that an organization faced and then translate these strategies into specific decisions and actions. Variations on it are now used successfully in a wide range of large, complex public and private organizations around the world. More than half the Fortune 1,000 now use

[1] This section is based on unpublished research by Frank Camm, Rick Eden, and Eric Peltz.

some form of the balanced scorecard.[2] Government users include the USAF as well as the

> United States Army, Defense Logistics Agency, US Marine Corps Logistics, Department of Energy, Department of Transportation, National Reconnaissance Office, Internal Revenue Service, US Navy Naval Education & Training Command, [and] J25–Defense Program Office for Mission Assurance, Australian Defense Ministry.[3]

The word "scorecard" leads some to view the scorecard primarily as a list of retrospective metrics. In fact, the balanced scorecard is primarily a *process* that generates a "balanced" set of indicators. Figure B.1 summarizes how this process works. It is "balanced" in the sense that it includes leading and lagging indicators, financial and nonfinancial indicators, indicators relevant to internal and external stakeholders, and indicators relevant to different functional stakeholders inside the organization. It seeks to integrate these many, traditionally competing perspectives by showing how they affect one another and choosing goals that align them to one another.

The process begins by developing a consensus among the senior executives who will use the scorecard to support their decisionmaking. Typically, they work together as individuals, face to face, to agree on a consensus model of the organization that identifies how each of their specific areas—for example, finance, production, marketing, or

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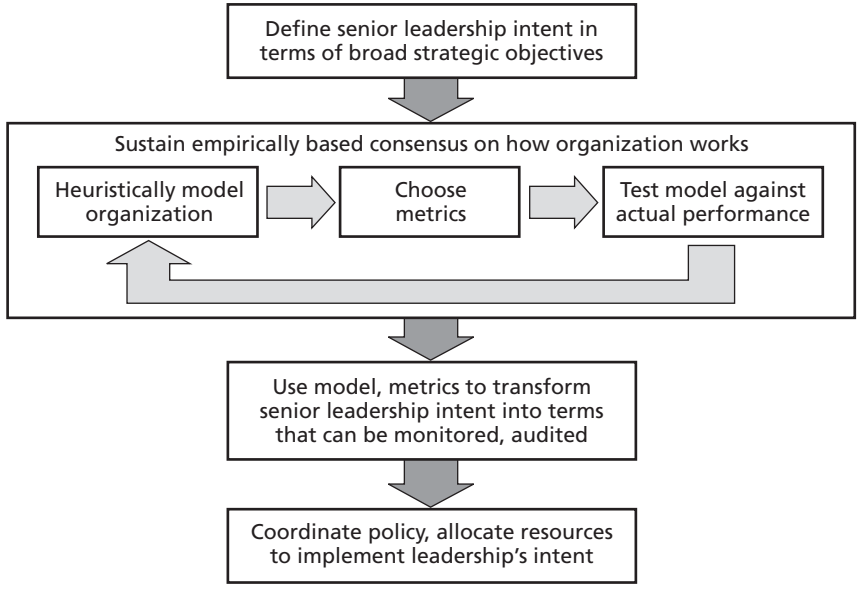
[2] Robert S. Kaplan and David P. Norton synthesized their observations of a number of firms into a framework that helped them describe what these firms were doing, and they presented this framework in Robert S. Kaplan and David P. Norton, "Using the Balanced Scorecard as a Strategic Management System," *Harvard Business Review*, January–February 1996. They elaborated the framework in Robert S. Kaplan and David P. Norton, *The Balanced Scorecard: Translating Strategy into Action,* Boston, Mass.: Harvard Business School Press, 1996a. Since then, David Norton formed the Balanced Scorecard Collaborative, now known as the Palladium Group, as a resource where organizations can learn how to apply the balanced scorecard successfully. The Palladium Group Web site (Palladium Group, 2009) offers an excellent place to get up-to-date information on recent experience with the scorecard in a wide variety of settings.

[3] Douglas Mark Gaskell and Stuart Brown, "Strategy Development with the Balanced Scorecard," briefing, Booz Allen Hamilton, March 10, 2005.

Figure B.1
A Process That Creates and Sustains a Balanced Set of Metrics



RAND *MG827-B.1*

logistics—contributes to the success of the organization. The model is usually a heuristic one that translates high-level measures of success for the organization into measures that each executive uses in his or her area to measure success. In this way, the model subordinates each specific area to the organization as a whole and provides common language that the executives can use to coordinate their leadership in an integrated fashion. Many organizations report that this integrated view is the single most important product of using a balanced scorecard. Often for the first time, the senior executives of the organization recognize the shortcomings of their own areas' metrics and the necessity of pursuing the metrics in a broader, integrated setting.

At the heart of the scorecard is a heuristic model explicitly designed to balance two purposes. On the one hand, it should be simple and high-level enough so that the executives using it can summarize the elements of their activities most important to the success of the organization with about 25 objects of interest. Each "object of interest" provides

a high-level view of a strategic objective or a relevant group of activities. For example, activities that provide deployment capabilities or, more specifically, throughput capability might make up such an object. On the other hand, the model must capture the relationships among these objects with enough specificity and fidelity so that the executives can use empirical information from the organization's ongoing experience to verify that the model is valid. Simplicity demands a summary view of the organization; empirical verification demands a more detailed view. Scorecards typically accommodate this balance in part by creating a simple model that allows drill-down within each object or to more detailed data in the organization's many management information systems.

The model plays two roles in the scorecard. First, it helps the senior executives verify that their understanding of the organization is accurate. They all agree, at a high level, how the organization works in its operating environment, subject to its resource constraints, and how its principal parts fit together. If the organization's actual experience is not compatible with the model, the senior executives must adjust the model until it is. In this role, the model provides an empirical feedback loop that the executives can use continuously to test their understanding of how all the organizational pieces fit together.

Second, the scorecard helps the senior executives predict the effects of changes in policy and resource allocation. If the model accords well with the organization's recent historical experience, the senior executives can act with greater confidence and design change strategies with enough detail to help them track the progress of change and keep change on course. That is, the scorecard provides an empirical feedback loop that the senior executives can use to hold themselves and their subordinates accountable for executing successful change.

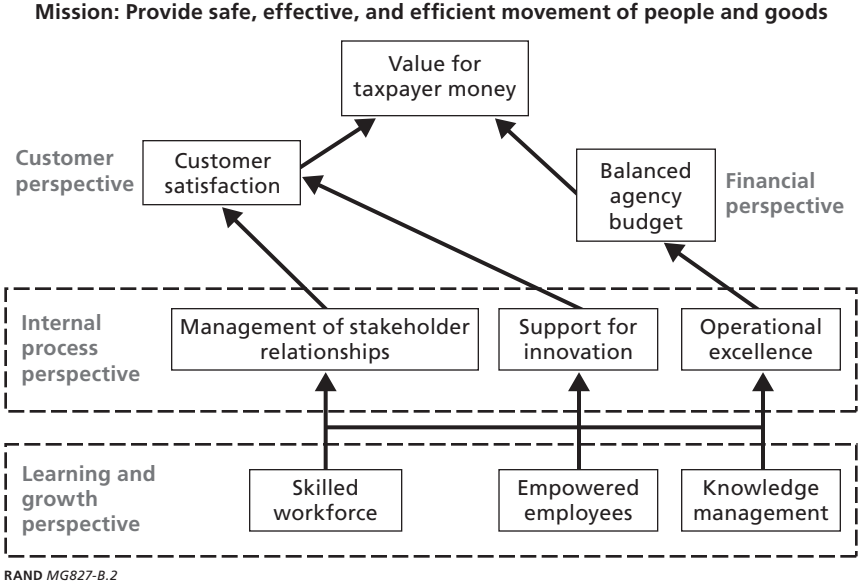
Metrics provide the vehicle for testing the validity of the heuristic model in a balanced scorecard, for predicting the effects of changes in policy and resource use, and for designing, communicating, and then executing changes in accountable ways. In this setting, the metrics provide a common vocabulary for the executives. The more objective the metrics, the more objective discussions can be among executives as they make demanding decisions. The more objective the metrics, the

lower the potential for emotional finger-pointing among the communities that these executives lead. The metrics give the executives' consensual model the hard edge it needs to help the executives continually test their understanding of their organization. And the metrics give the executives a well-defined way to focus and track the implementation of change.

In sum, the metrics in a balanced scorecard play a critical role; the scorecard cannot work without them. But the metrics are meaningless if used or interpreted outside the context of the consensual model that senior executives use to explain the organization to one another and so to negotiate successful change.

Balanced scorecards typically summarize their consensual models in terms of a "strategy" or "mission" map. Figure B.2 illustrates several key attributes of a strategy map.

Figure B.2
Example: Strategy Map for a State Department of Transportation



First, even though the balanced scorecard emerged from private-sector experience, the figure illustrates that a scorecard can be designed for a public-sector setting as well.

Second, the figure shows that a strategy map identifies a central organizing concept—the mission. The mission summarizes the agency's central role. Where a private firm might seek to be best in some particular class to survive competition, this agency—a state's department of transportation—seeks to balance safety, effective provision of transportation services, and cost-effectiveness or efficiency. The highest object in the strategy map, "value for taxpayer money," captures these three ideas in a summary way.

Third, the map identifies different perspectives relevant to successful execution of this mission. The "customer" perspective takes the perspective of the transportation user and asks what increases the satisfaction of that user. The "financial" perspective takes the perspective of the state comptroller, which seeks to ensure that the agency improves customer satisfaction within clearly defined resource constraints. These first two perspectives emphasize views from outside the agency—one of the users of the agency's services, the other of the provider of funds to execute the agency's mission. The "internal process" perspective looks inside at the state processes available to identify demands for transportation services and provide them with existing capabilities. The "learning and growth" perspective looks inside as well, but takes a longer-term perspective by asking where the agency should invest to sustain and improve its internal processes.

These four perspectives or close analogs appear in most balanced scorecards and help explain the notion of "balance." In the end, the agency ultimately cares about more than executing its current mission. To achieve its mission today and in the future, it must stay abreast of and balance concerns inside and outside the agency. It must stay abreast of and balance concerns about performance and about the resources available to provide performance. It must balance its attention to current concerns and to concerns about the future. In effect, the agency can know that it has achieved its mission successfully only after the fact; any metric of ultimate success will be a lagging indicator. The balanced scorecard helps the agency think about how it achieves its mis-

sion and then develop leading indicators of future success associated with all the factors relevant to that future success. The scorecard helps the agency balance all the elements relevant to its continuing success.

Fourth, the map provides a high-level model of how the senior executives believe the agency can best bring the four perspectives together to achieve success. It chooses customer satisfaction rather than some engineering measure, like delay time in rush hour or durability of pavement, to measure performance. In this choice, it effectively prefers a somewhat subjective measure to an objective one, because the subjective measure gets closer to what really matters to success. Similarly, in the financial perspective, the map focuses on balancing the agency budget rather than, say, percentage of requirement funded or relative success of the agency in the competition for budget funding. In this case, the agency is concerned first and foremost with a very simple but demanding comptroller's constraint.

The map identifies two objects relevant to customer satisfaction—management of stakeholder relationships and political support for innovation. These objects identify the heavily political orientation of the senior executives in this agency. These executives see engineering concerns, captured in operational excellence, as being more important to resource management than to the quality of service provided. This perspective may not be accurate, but it captures the consensual beliefs of the senior executives and can be tested against actual experience over time.

Finally, like most balanced scorecards, this one emphasizes efforts to enhance labor and information capabilities to improve the agency's capabilities in the future. The map distinguishes "skills" from "empowerment," presumably to emphasize a commitment to training separate from a commitment to organization and incentives to give employees a more effective voice. And the map highlights "knowledge management," as distinct from information connectivity or data quality, presumably to emphasize a commitment to capturing insights from past experience and making them available to all members of the staff.

The objects in this strategy map represent conscious decisions about where to focus the senior leadership's attention. The links among

these objects represent a simple, consensual model of how change in one object is likely to affect performance in another and, ultimately, success relative to the agency's mission. The four perspectives help the agency ensure that its model addresses all the basic concerns that it needs to achieve and sustain success over time; the objects placed within these perspectives identify where the senior executives of the agency want to focus their attention to address each concern.

Because the senior leadership of each agency has a different mission, different priorities, different views about the basic concerns relevant to these priorities, and so on, we can expect each agency to develop its own balanced scorecard and to summarize that scorecard in a strategy map customized to that agency.

Balanced Scorecards in the Air Force

In 2002, in support of the President's Management Agenda, OSD directed all of the components of DoD to develop balanced scorecards that they could use to identify and track performance outcomes.[4] These scorecards would tailor themselves to the four primary sources of risk identified in the 2001 QDR[5] addressing DoD-wide goals for these at a high level and cascading the implications of these goals down through DoD as scorecards developed for lower- and lower-echelon activities. The four sources of risk highlighted in the QDR concerned

- force management (the ongoing creation and sustainment of the force itself)
- operations (the deployment and employment of the force)
- future challenges (the creation of new capabilities in the force)

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[4] DoD, *Establishing Performance Outcomes and Tracking Performance Results for the Department of Defense, Management Initiative 901,* Washington, D.C., December 20, 2002. See also U.S. Senate, Committee on Armed Services, *National Defense Authorization Act for Fiscal Year 2007, Report [to Accompany S. 2766] on Authorizing Appropriations for Fiscal Year 2007*, Washington, D.C., May 9, 2007, p. 285.

[5] DoD, *Quadrennial Defense Review Report*, Washington, D.C., September 30, 2001.

- institutional issues (the creation and sustainment of the oversight and support activities in DoD that do not deploy).[6]

This directive has precipitated the creation of scorecards throughout DoD that vary dramatically to reflect differences in the elements of the department that each activity can affect. Developing scorecards within any DoD activity has been a challenge; coordinating scorecards across related activities—for example, Department of Army logistics (G-4), Army Materiel Command, 4th Infantry Division, the Defense Logistics Agency, and the Defense Finance and Accounting Service, each of which is developing a scorecard—has been even harder.

Within the Air Force, movement is occurring on several fronts. For example, the Headquarters Air Force Deputy Chief of Staff for Logistics, A-4, is developing an "eLog21 Balanced Scorecard" aligned to the OSD guidelines and the Air Force Logistics Enterprise Architecture (LogEA).[7] This effort seeks a "balanced set of perspectives (warfighter, logistics process, resource planning, and innovation and learning)" that reflects

- "Short- and long-term critical success factors
- Financial and non-financial measures
- Lagging and leading indicators
- External and internal performance perspectives."

Meanwhile, two major commands have developed scorecards so far—Air Force Materiel Command (AFMC) and Air Education and Training Command (AETC). They are currently cascading their scorecards to lower-level echelons. For example, HQ AETC committed to developing its scorecard in June 2005 with the arrival of a new commanding general, General William R. Looney III. The effort reached

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[6] Nancy Carpenter, *Department of Defense Financial Management Automated Balanced Scorecard and Department of the Navy Major Command Scorecards*, briefing, Washington, D.C.: Assistant Secretary of the Navy (Financial Management and Comptroller), February 3, 2005.

[7] The information presented here comes from fact sheets on "Balanced Scorecard" and "AF/IL Logistics Balanced Scorecard" by HQ USAF, n.d.

the 14th Flying Training Wing at Columbus AFB, Missouri, in May 2007.[8] A quick review of how AETC has approached developing a scorecard can provide some insight into how such a tool works in an Air Force setting.

Drawing on his past positive experiences with balanced scorecards in AFMC, at the Electronic Systems Center and the Aeronautical Systems Center, Gen Looney devised the strategy for implementing the balanced scorecard in AETC:[9]

- Looney started the process by creating his own straw-man scorecard.
- A third-party specialist in implementing tools like scorecards, RTS Partners, interviewed senior leaders across AETC to find out what they considered most important to the command.
- RTS compiled this information, used it to build a rough outline of the command's scorecard, and compared it with Gen Looney's straw-man scorecard.
- "General Looney then kicked off a four-day workshop where AETC's senior leaders combined these two models into the dynamic map that will be used to monitor the progress of the command."
- The scorecard that emerged viewed recruiting, educating, and training the force as the "operational drivers" that the Air Force needed to coordinate to "develop and support our people"—its strategic mission.
- These drivers yielded 18 objectives. The scorecard used one or two measures to define performance relative to each objective. According to Lt Gen Dennis R. Larsen, AETC vice commander, "The reason this method has proven useful is because it is measurable,

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[8] Tor Dietrichs (Maj, USAF), "BLAZE Team Engages the Balanced Scorecard," Columbus AFB, Mo., Web page, May 24, 2007.

[9] The discussion that follows is based on Megan Orton, "AETC Implementing Balanced Scorecard," Randolph AFB, Tex., Web page, October 4, 2005; the quotes in the bulleted list are also from this source.

the piece that has always been missing from strategic planning in the Air Force."

Implications for an Air Force Force-Planning Risk Scorecard

We are *not* recommending how any Air Force force planning or A-8 balanced scorecard should look. We do note that many of the goals we describe in the text are similar to those that motivate large, complex organizations to use balanced scorecards. That leads us to conclude that it is useful to benchmark our approach to that of a traditional balanced scorecard to learn what we can from the broad range of efforts to date to implement balanced scorecards.

In particular, we note the following similarities:

- Both approaches seek to support high-level decisionmaking, in large, complex organizations, about what organizational policies to maintain and where to place resources to drive desirable future outcomes. Both use carefully organized information to shape decisions within the Air Force and in other parts of the government. A balanced scorecard offers new technological ways of organizing information and bringing it in an integrated form to high-level decisionmakers in a new way to affect their decisions.
- Both approaches seek ways for different parts of a large, complex organization, with different local cultures and priorities, to communicate with one another about their common goals. Both recognize the importance by being able to speak convincingly beyond a stovepipe. The balanced scorecard offers a concrete way to build consensus at each level in an organization, then cascade that consensus down through the organization, and finally keep track of its implementation as specific directives come from the top.
- Both approaches seek ways to understand connections among these different parts of the complex organization to understand better how actions in one place affect outcomes in others. The

balanced scorecard has repeatedly demonstrated that real, complex organizations can focus their goals[10] and create and sustain heuristic models of the connections within themselves relevant to achieving those goals.

- Both recognize that the tasks above are too complicated and subtle to handle with formal tools only; both approaches appreciate the importance of taking advantage of the subjective judgments of their senior leaders to pursue the tasks above. The balanced scorecard has shown repeatedly that subjective models of complex organizations, based on senior leaders' consensus, can provide an effective framework for aligning action within those organizations.
- Both expect that, if they work as planned, they will train the decisionmakers and planners who use them, over time, to sharpen their language, improve their mutual understanding of the organizations in which they work, and improve the performance of those organizations as a result; they will help the organizations themselves learn. Again, the persistent success of balanced scorecards suggests that this is occurring today where they are applied.

In sum, the success to date and continuing broad support for balanced scorecards in large, complex organizations holds open the promise that an approach like the one we propose could succeed in this setting. Opportunities surely exist to use similar methods to elicit information from senior leaders and to iterate that information between staffs and leaders. Similar software can probably manage elicited information, update it over time as new information becomes available, and ground high-level subjective judgments, via drill-down links, in more detailed, objective data. Similar rules may be available to guide the aggregation

[10] For example, balanced scorecards have proven especially useful in implementing Hoshin Kanri methods of managing and controlling a large organization's direction or focus to improve processes and performance. For more information, see Management Coaching and Training Services, "What is Hoshin Kanri?" Web page, n.d.

of detailed data into measures relevant to higher-level, more subjective judgments.

If both approaches were to continue, it would almost surely be appropriate to align them in ways similar to those being used to align the structure and content of balanced scorecards for related activities within DoD. Surely assessments of risk relevant to force planning should reflect the factors being used to translate strategy into concrete guidance for implementation. The two approaches would draw on the same databases and the subjective judgments of the same leaders. So even if we are not speaking of a typical balanced scorecard like those described earlier in this appendix, it would be hard to understand how both would be useful to the Air Force if the Air Force did not coordinate their structures and contents fairly closely.

That said, we emphasize again that we are *not* prescribing the structure or content for a force-planning scorecard. Here is why. We focus on balancing one important but narrow set of concerns—the risks that emerge over some planning horizon in the future from different (1) types of threats, (2) parts of the world, and (3) points of time over the horizon. Planners scan the horizon, looking for evidence on what these future sources of risk might be and what capabilities the Air Force might set in place to mitigate these risks. Where they see gaps, they highlight them to induce changes in Air Force policies, Air Force use of available resources, and, potentially, Air Force access to resources.

Given this focus, force planners emphasize the growth and innovation perspective in a traditional balanced scorecard. The customer, resource, and internal process perspectives frame the perspective of force planners, but mainly by defining the constraints in which planners seek gaps and mitigations. Effective planning benefits from a subtle appreciation of all these perspectives, but, ultimately, the far future is where planners affect outcomes. In this perspective, planners look beyond the time horizons of others in the Air Force and almost anyone outside the Air Force. Balanced scorecards are at their best when they can use feedback on ongoing operations to assess the model of the organization that they support and then use concrete measures to set accountable goals for specific organizational activities. Military activities in general

lack effective feedback on ongoing activities when they are not engaged in active operations. And even when they are engaged, force planners are looking at a world in which operations will differ from those that can be directly observed. Any "feedback" planners get is mediated by subjective models and predictions. The measures we discuss in the text do not offer the same edge that impresses Gen Larsen in his support for balanced scorecards. So we must be cautious about drawing analogies too closely between experience to date with balanced scorecards and the potential of the approach we propose in the text. They raise many similar issues, but, by definition, they operate in different contexts.

APPENDIX C

Analytic Tools for Integrating Measures of Risk Across Futures

The approach described in the text focuses on using Bayesian risk-assessment and risk-management tools to help senior leaders to sharpen their *own* subjective judgments and to work together to yield more clearly stated descriptions of those judgments that *they* can use to design policy decisions and then explain these decisions to others. This appendix describes a set of formal decision rules that senior leaders can use to support such efforts. Improperly understood, these tools might appear to preempt professional military judgment by recommending one policy option over others. Properly understood, these tools give senior leaders an ability to see the implications of stating their priorities in different ways. In the end, none of these tools can dictate a final policy choice. But taken together, they can help leaders see the policy implications of their subjective beliefs from different perspectives.

This appendix describes four different decision rules. It then presents an *illustrative* set of beliefs about the magnitudes and probabilities of loss that senior leaders might associate with alternative policy packages in different futures. Taking this illustrative set of risk measures as valid, it applies the four decision rules to illustrate how they work and how each emphasizes different priorities relevant to senior leaders. It closes with a brief discussion of the findings presented.

Four Decision Rules

This appendix considers the following four decision rules:

1. Minimize expected loss across futures.
2. Minimize maximum expected loss in any future.

3. When probabilities are unknown, minimize maximum loss in any future.
4. When probabilities are unknown, minimize maximum regret across futures.

Minimize Expected Loss Across Futures

The first rule calculates expected loss across futures for each policy package in the following way:

$$L_j = \Sigma_i P_{ij} M_{ij}, \tag{C.1}$$

where L_j is the expected loss across futures for the jth policy package, P_{ij} is the probability that the ith future will occur when the jth policy package is in place, and M_{ij} is the magnitude of loss in the ith future when the jth policy package is in place. The rule prefers the policy package with the lowest value of expected loss, L_j. When loss is measured in utility terms, this is a close variation of the standard decision theoretic criterion, which prefers policy packages that maximize utility. The measure is not precisely the same as this because, as explained in Appendix A, our measures of probability and magnitude of loss consider the level of utility only of outcomes that fall below an "acceptable level" of utility. They do not reflect the full range of outcomes. So the formula in Equation C.1 is a hybrid measure of risk and must be understood in that light.[1] That said, it is the measure that emerges from the standard approach to risk assessment, which focuses only on losses—by definition, only on the probability and magnitude of "unacceptable" outcomes.

[1] One way to make the measure less of a hybrid is to suggest that decisionmakers assign utility only to unacceptable outcomes. That is, they place negative values on unacceptable outcomes and associate no incremental positive utility with acceptable outcomes. Then this metric reliably captures the notion of expected utility prescribed in decision theory. Appendix A discusses such technical issues in greater depth.

Minimize Maximum Expected Loss in Any Future

The second rule calculates the following measure of expected loss in every future:

$$L_{ij} = P_{ij} M_{ij}, \tag{C.2}$$

where L_{ij} is now the expected value of the loss that occurs in the ith future if the jth policy package is in place. The rule prefers the policy package with the lowest value of L_{ij} in any future. This "minimax" rule minimizes the maximum loss that can occur in any future dominated by any threat.

This decision rule explicitly focuses a decisionmaker's attention on the worst event that can happen and supports a decision that ameliorates the risk associated with that risk before addressing other risks. That is, this decision rule is compatible with an approach that focuses leadership in the left tail of the probability distribution for potential outcomes and supports policy options that move that portion of the distribution to the right. From that perspective, this rule is easier to reconcile with the approach described in the text and Appendix A than the first decision rule, associated with Equation C.1.

When Probabilities Are Unknown, Minimize Maximum Loss in Any Future

Suppose senior leaders consider uncertainty about the future to be so profound that they do not want to place subjective values on the probabilities of alternative futures. When such profound uncertainty prevails, this rule focuses on

$$L_{ij} = M_{ij}. \tag{C.3}$$

The rule prefers the policy package that minimizes the maximum loss that can occur in any future. Such a rule is a direct analog to the second rule above—that associated with Equation C.2. It focuses the attention of senior leaders on mitigating losses at the extreme left end of the probability distribution for potential outcomes, even if leaders are uncomfortable placing subjective values on specific futures.

This rule is appropriate for a decisionmaker who wants to identify the policy package that performs best over the greatest possible number of scenarios. Although such a robust policy package might not maximize the quality of probable outcomes in any particular future, it would, ideally, meet some threshold level of performance no matter how events unfold.[2]

This rule cannot reflect any effects of shaping that a policy package might have, because it cannot show how such shaping would alter the probabilities of alternative futures. So, although the rule relieves leaders from having to make judgments about the probabilities of alternative futures, for that very reason, it gives no credit for shaping effects and so inappropriately favors improvements in warfighting capability and capacity at the expense of improvements in shaping capability and capacity.

When Probabilities Are Unknown, Minimize Maximum Regret Across Futures

When profound uncertainty about the probability of alternative futures exists, senior leaders may want to think about their decisions in another way. Suppose they could know with certainty which future would occur. Then they could easily identify the policy package they preferred by comparing magnitudes of loss across policy packages for that future. If they choose the package with the lowest magnitude of loss in a future, by definition, they cannot do better. If they choose any other package and that future occurs, they may regret having failed to choose the best package for that future. This rule helps senior leaders look into the future and choose a package that will minimize the degree of regret they would feel in any future when they choose any

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[2] Herbert Simon coined the term "satisficing" to describe the concept of accepting a minimum threshold of performance instead of attempting to maximize outcomes. While decision theorists and management experts often disparage satisficing as a frequent cause of suboptimal outcomes in rushed decisionmaking, deliberate satisficing across multiple futures, or "hedging," is the optimal strategy in a highly uncertain environment where maximizing in any one future might leave planners exposed to catastrophic risk in another. For more on satisficing, see March, 1994, pp. 18–23; and Robyn M. Dawes, *Rational Choice in an Uncertain World*, New York: Harcourt Brace, 1988, p. 51.

policy package. The rule defines the loss associated with the *j*th package as

$$L_j = M_{ij} - M^*_i \text{ for } M^*_i = \min M_{ij} \text{ across all } j. \qquad \text{(C.4)}$$

When compared with the rule associated with Equation C.3, this rule is more concerned with the pairwise comparison of any two policy packages than with the absolute performance any one package. It seeks to get close to the best performance that is achievable in any future, no matter which future occurs. Typically, risk analysts define such performance as "robust." The approach to risk assessment that we describe in Appendix A effectively considers robustness in a different way. No matter which future occurs, the approach in Appendix A considers a policy package to be more robust if it limits the magnitude of loss or expected loss that can occur across all futures.

Like the rule associated with Equation C.3, this decision rule cannot reflect any effects of shaping. So it also inappropriately favors improvements in warfighting capability and capacity at the expense of improvements in shaping capability and capacity. As long as decisionmakers understand this, however, they can use it to get insights into the robustness of policy packages across futures, relative to the best outcomes available in those futures.

An Illustrative Set of Subjective Beliefs About Magnitudes and Probabilities of Loss

To examine how these decision rules compare in application, we used some simple elicitation methods to characterize subjective beliefs implicit in the arguments in ongoing RAND analysis. We focus on subjective beliefs that are relevant to futures dominated by the generic threats identified in Chapter Three and the five alternative policy packages described in Chapter Four. *The beliefs presented here are appropriate only for illustrative purposes.* The elicitation process revealed how challenging it is to state subjective beliefs about the probabilities and magnitudes of loss shown below without providing detailed caveats and

explanations for the choices made. In an Air Force setting, as explained in the text, such beliefs would emerge from a far more complex process that documented appropriate caveats and explanations. The beliefs that emerged from such a process would likely differ from those presented here. We offer the example beliefs not to anticipate what beliefs the senior leadership would actually develop through the consensual process described in the text, but *only to illustrate the application of the four decision rules defined above*.

Relevant Futures

This illustrative analysis defines futures in terms of the generic categories of threats that dominate them over the next 10 to 15 years. All futures are dominated by one of the seven types of threats identified in Chapter Three. The elicitation process emphasized the following aspects of these threats:

- **Natural disaster.** For clarity, we considered a disaster on the scale of Hurricane Katrina in August 2005 or the Indonesian earthquake and tsunami in December 2004.
- **State failure.** We considered failure in a state that would immediately affect the national security interests of the United States by inducing regional instability, disrupting access to vital resources, creating a home for transnational terrorism, or potentially allowing nuclear weapons to flow to terrorists. Exemplars would be a collapse in Pakistan, North Korea, or Saudi Arabia.
- **Terrorism.** We considered an attack on the scale of the 9/11 attacks or perhaps the Madrid train bombings in March 2004 affecting the United States or its allies. These attacks could potentially involve nuclear, radiological, chemical, or biological weapons.
- **Insurgency.** Insurgency will be ever-present in the future. We focused on insurgencies that destabilized regimes of allies or invited transnational instability in regions of particular interest to U.S. security. An exemplar is the insurgency on the island of Mindanao in the Philippines.
- **Traditional conventional conflict.** This threat considers a potential enemy with classic heavy armor, artillery, aircraft, and missile

capabilities characteristic of the Cold War. The first Gulf War of 1991 is an exemplar.

- **High-technology conventional conflict.** This threat considers a near peer with sophisticated information-based weapons and the ability to suppress U.S. information-based capabilities. An exemplar would be a confrontation with China over the Taiwan Strait. We assume, when defining such a threat, that the principals refrain from using their nuclear capabilities in any conflict.
- **State nuclear use or threat.** In this threat type, a regional power might threaten the use of nuclear weapons against a neighbor, U.S. or allied deployed military forces, or the U.S. homeland. It might also use nuclear weapons in any of these ways. Exemplars that emerged in the discussions were nuclear threats from or use by North Korea or Iran.

Large differences in magnitudes and probabilities of loss across the different kinds of events that might occur within each of these categories made elicitation of subjective beliefs difficult. The judgments reached in the process inevitably reflect beliefs about the relative likelihoods of different kinds of events within each category, beliefs that were not captured in the process or documented here. The ways in which nuclear weapons might be brandished or used and the consequences of such threats and use made the elicitation of subjective beliefs about threats associated with nuclear weapons especially difficult.

Relevant Policy Packages

The policy packages considered here include (1) current policies and projections of resource use, which we treat as a base case, and (2) five changes in policy and the application of resources that could yield qualitative changes in Air Force capabilities or capacity over the next 10 to 15 years of the following kind:

- **Capability to operate from FOBs in the face of severe anti-access threats.** Such capability is primarily defensive and includes such measures as ballistic missile defense, base hardening, and quick repair and reconstitution capability following any attack.

- **Capability to conduct large-scale COIN operations using U.S. forces.** The exemplar here is an addition of capability that is roughly comparable to current U.S. capacity to conduct operations like those ongoing in Iraq.
- **Capability to build partner capacity for irregular warfare in many nations simultaneously.** This involves low-cost military-to-military contact in the form of training and coordination, as well as limited investment in local tactical capabilities, in many different locations.
- **Capability to conduct offensive air operations exclusively from long range.** In principle, this would ultimately eliminate the need for FOBs and concentrate Air Force–deployed attack and intelligence capabilities in a small number of bases located so that they could quickly and reliably meet any global requirements that arise.
- **Capability to operate from FOBs under nuclear attack from a regional power.** This policy package focuses defensive base preparation on defeating ballistic and cruise missile and air attacks, hardening structures against blast effects, hardening information systems against EMP and other effects, and other measures to mitigate the effects of any nuclear attack on U.S. bases.

Guidelines for Comparison of Decision Rules

The process used to develop these illustrative subjective beliefs employed the following guidelines:

- The futures used are exhaustive and mutually exclusive. Concern about the threat named in each future dominates concern about the others in that future. The elicitation process required that we develop examples, like those offered above, to describe such threats in more detail.
- Each policy alternative to the base case applies the same level of resources in a way that emphasizes different future threats. We never explicitly specify what the scale of this shift in resource use is.

- Elicitation started by seeking information about *relative* subjective values first. We discuss this further below.
- When shaping reduces a probability, the initial set of futures is no longer exhaustive and mutually exclusive. To sustain these conditions, we assumed that, when shaping reduces a probability, it in effect moves the weight of that probability from the future affected to an alternative "low-risk future." We assign the same magnitude of loss to that future that prevails in a future in which natural disasters dominate all other threats. In effect, we treat the magnitude of loss associated with such futures as a basal level of risk, something like an ambient concentration of a toxic chemical in an acceptably clean environment. Sensitivity analysis can be applied to determine whether the basal level of magnitude of loss chosen affects the ranking of policy packages.

Elicitation Process

The process first examined beliefs about magnitudes and then examined those about probabilities. This separation proved to be challenging, but ultimately probably helped parse the effects of policy changes on magnitudes versus probabilities. Although the elicitation process used is described below in a linear way, significant iteration occurred throughout as the consideration of beliefs about new magnitudes or probabilities raised questions about the beliefs reported earlier. Such iteration was especially important after the process passed from magnitudes to probabilities. Explicit consideration of a policy effect from the perspective of a change in probability repeatedly forced reassessments of reported beliefs about magnitudes. Such iteration allowed continual cross-checks within a roughly linear process.

To elicit subjective beliefs about magnitudes of loss, we started with the current policy package, which we treat as an effective base case, looking at magnitudes of loss across futures. For simplicity, we chose to characterize loss in terms of a measure of utility that ranges from 1 to 20 and asked how the magnitudes of loss compare pairwise between alternative futures until an internally consistent set of values emerged for magnitudes in all futures, ranging from 2 to 20. We chose a low end of 2 to leave room for a meaningful reduction in magnitude,

if appropriate, when alternative policy packages were considered. We interpret these subjective measures of magnitude as cardinal and not simply ordinal values.

Once agreement occurred on magnitudes in the base case, we asked, one future at a time, how alternative policy packages might affect the magnitude of loss if a future dominated by each named threat occurred. Such effects are, of course, stated relative to the base case, so this step again effectively elicited information about cardinal values of magnitudes by asking questions above relative levels of loss in pairwise comparisons of policy packages. It may induce some anchoring bias (see Appendix A) that we did not detect. The discussion yielded an intense flow of demands for additional detail on the structure of futures and policy packages.

Once beliefs about magnitudes of loss were complete for all policy packages and futures, a third step then examined relative levels of loss across futures within each policy package. This served as a double check on earlier assessments to verify that they were consistent within each policy package.

The elicitation demanded close discipline and repeated checks to ensure that the beliefs recorded involved induced changes in magnitudes and not those in probabilities. Assessment of probabilities offered a second opportunity to adjust magnitudes to parse effects properly between changes in magnitudes and changes in probabilities.

After a complete set of beliefs about magnitudes existed, we turned to elicitation of beliefs about probabilities and repeated the process. In the base-case policy package, for example, we started with pairwise comparisons between futures of relative probabilities. This process yielded the following subjective assessments:[3]

- Because recent experience has demonstrated how dominant the United States is in traditional conventional capabilities, it is very

[3] A more complete elicitation process could generate many such pairwise comparisons and then use them, perhaps in conjunction with a consensus-building tool, such as a Delphi method, to check for internal consistency and build confidence in the ultimate set of probabilities chosen to represent beliefs. A similar approach could also be applied, in an exactly analogous way, to elicit beliefs about magnitudes.

unlikely that any state would initiate such a conflict with the United States. As a result, future State Nuclear Threat or Use is twice as likely as Traditional Conventional Conflict.
- Another consequence of U.S. dominance in traditional, conventional capability is that future High-Technology Conventional Conflict is twice as likely as Traditional Conventional Conflict.
- Future Major Insurgency of interest to the United States is three times more likely than High-Loss Terrorism of the kind described above.
- Future High-Loss Terrorism is twice as likely as State Failure, mainly because so few potential state failures would be important to the United States.
- Future High-Loss Terrorism is as likely as Natural Disaster as defined above.
- Future High-Loss Terrorism is four times more likely than Traditional Conventional Conflict as defined above.

Taken together with our assumption that futures dominated by the seven threat types named above are exhaustive and mutually exclusive in the base case, the pairwise comparisons above yield a set of implied subjective beliefs about probabilities for the base-case policy package. Table C.1 reports those beliefs in the column labeled "Policy Package 0, Current Force." Beliefs relevant to other policies appear in the columns that follow. Beliefs relevant to different futures appear in different rows.

Once these beliefs were established, we elicited beliefs about probabilities for each future across policy packages. We then double-checked the elicited beliefs by comparing probabilities across futures within each policy package. As with beliefs about magnitudes, some iteration was required to complete this process. The process included iteration that revised beliefs about magnitudes as it continued. Additional analysis often yielded more careful assessment and clarified how much a policy package affected outcomes in any future through effects on magnitude and how much through effects on probability.

How the Decision Rules Work in Practice: An Illustration

If we accept the illustrative subjective beliefs in Table C.1 for what they are, we can use them to illustrate how each of the decision rules works in practice. Table C.2 summarizes the scores and rankings for each policy package when each decision rule is applied. Shaded cells indicate the scores and rankings of dominant policy packages. We consider each decision rule in turn.

For Decision Rule 1—*Minimize Expected Loss Across Futures*—the application of Equation C.1 to the data in Table C.1 is straightforward and yields the ranks and rankings shown in the third column of Table C.2. The scores for Policy Packages 3–5 are essentially tied for first place. Those for the Base Case and Policy Packages 1 and 2 lie a significant distance behind these three. Increasing the basal level of magnitude of loss in the Low-Risk Alternative can remove Policy Package 3 from its highly ranked position, because this outcome depends so heavily on this package's ability to reduce the likelihood that major insurgencies will dominate the future. Otherwise, such a change does not affect basic policy implications of this decision rule. And it is very unlikely to change the high ranking of Policy Packages 4 and 5 relative to packages other than Policy Package 3.

To the extent that decisionmakers favor the perspective reflected in this decision rule, these findings suggest the desirability of seeking a balanced package that promotes an irregular warfare program, long-range strike capability, and hardening of FOBs against nuclear strike. Of course, if the demand for long-range strike and hardening of FOBs both stem mainly from the same concern about the vulnerability of FOBs to nuclear strike, development of greater long-range strike capability would reduce the relevance of hardening FOBs. And any FOBs that remained following such a change could be hardened more against nuclear than against other anti-access threats. Irregular warfare and COIN capabilities share many common resources. This decision rule appears to suggest that the Air Force should favor those that strengthen the capabilities of our friends in many countries, not the capabilities organic to the USAF that are relevant to this mission. For example, the Air Force might invest more in its ability to train foreign air forces

Table C.1
Illustrative Subjective Beliefs About the Magnitude and Probability of Loss

		Alternative Policy Package					
		0	1	2	3	4	5
Future Dominated by Threat Listed	**Risk Measure**	**Current Force**	**Operate from FOB Against Anti-Access Threat**	**Large-Scale COIN with U.S. Forces**	**Partners for Irregular Warfare in Many Countries**	**Conduct Air Operations Exclusively from Long Range**	**Operate from FOBs Under Nuclear Attack**
Natural disaster	Magnitude	2	2	2	2	2	2
	Probability (%)	15	15	15	15	15	15
State failure	Magnitude	4	4	2	4	3	4
	Probability (%)	7	7	7	6	7	7
High-loss terrorism	Magnitude	7	6	6	5	6	6
	Probability (%)	15	15	15	13	13	15
Major insurgency	Magnitude	3	3	2	1	3	3
	Probability (%)	45	45	45	30	45	45
Traditional conventional conflict	Magnitude	4	4	4	4	3	4
	Probability (%)	4	4	4	4	4	4
High-tech conventional conflict	Magnitude	8	4	8	8	5	4
	Probability (%)	7	5	7	7	5	5

Table C.1—Continued

		Alternative Policy Package					
		0	1	2	3	4	5
Future Dominated by Threat Listed	**Risk Measure**	**Current Force**	**Operate from FOB Against Anti-Access Threat**	**Large-Scale COIN with U.S. Forces**	**Partners for Irregular Warfare in Many Countries**	**Conduct Air Operations Exclusively from Long Range**	**Operate from FOBs Under Nuclear Attack**
State nuclear use/threat	Magnitude	20	16	20	20	13	10
	Probability (%)	7	6	7	7	6	5
Low-risk future	Magnitude	2	2	2	2	2	2
	Probability (%)	0	3	0	18	5	3

Table C.2
Scores and Rankings of Policy Packages with Different Decision Rules

		Decision Rule			
		1	2	3	4
		Minimize Expected Value Across Futures	Minimize Maximum Value in Any Future	Minimize Maximum Value in Any Future	Minimize Regret Across Futures
Probabilities Known?		***Yes***	***Yes***	***No***	***No***
0. Current force	Score	5.10	1.40	20	10
	Rank	4	2	4	4
1. Operate from FOB against anti-access threat	Score	4.21	1.35	16	6
	Rank	2	1	3	3
2. Large-scale COIN with U.S. forces	Score	4.36	1.40	20	10
	Rank	3	2	4	4
3. Partners for irregular warfare in many countries	Score	3.97	1.40	20	10
	Rank	1–	2	4	4
4. Conduct air operations exclusively from long range	Score	3.89	1.35	13	3
	Rank	1	1	2	2
5. Operate from FOBs under nuclear attack	Score	3.85	1.35	10	2
	Rank	1+	1	1	1

NOTE: Shaded cells indicate the scores and rankings of dominant policy packages.

than in its ability to execute COIN capabilities itself.[4] The main point of this discussion is to suggest that this decision rule can easily be more useful as a source of insights for further refinement of policy packages than as a definitive justification for choosing a predefined package.

[4] The USAF needs both the ability to train, advise, and assist partner nations and the ability to execute COIN operations. In general, insurgencies are best handled by internal rather than foreign forces, suggesting an emphasis on building partner capacity. On the other hand, local forces may not have the capacity to conduct some critical COIN missions, particularly from the air. Given the difficulty of building air forces in developing countries, there is a strong argument for a robust USAF COIN capacity that could work with both partner nation and U.S. ground forces.

For the beliefs in Table C.1, Decision Rule 2—*Minimize Maximum Expected Loss in Any Future*—has little discriminatory value in and of itself. Table C.2 highlights Policy Packages 1, 4, and 5, but this rule prefers them only marginally over the alternative packages. Changing the basal level of the magnitude of loss in the Low-Risk Alternative future will not affect this ranking.

We need to look behind these scores to see the principal message of this decision rule. Table C.3 does this by displaying L_{ij} from Equation C.2 in each cell. L_{ij}, again, is the expected loss in the *i*th future when the *j*th policy package is in place. The shaded cells in Table C.3 highlight the results from the body of the table that drive the scores and ranks reported in the fourth column of Table C.2 and the last two rows of Table C.3. Doing this shows us immediately that two futures account for the largest expected losses—the future dominated by the Major Insurgency threat, because of the relatively high probability that major insurgencies will dominate the future, and the future dominated by the State Nuclear Threat or Use threat, because it carries such high magnitudes of loss when it occurs. The expected losses associated with these futures are about the same. That is, to the extent that this decision rule reflects priorities relevant to the senior leadership, it suggests the desirability of a balanced policy package aimed at reducing probabilities and magnitudes in these futures, even if it allows losses to rise elsewhere. Table C.3 strongly suggests that considerable room exists to allow expected losses to grow elsewhere as resources are moved and policies adjusted to address these two priorities.

For Decision Rule 3—*When Probabilities Are Unknown, Minimize Maximum Loss in Any Future*—the future dominated by a State Nuclear Threat or Use threat determines all rankings of policy packages, because the magnitudes of loss in this future dominate magnitudes of loss in all other futures. A comparison of the State Nuclear Threat or Use rows near the bottom of Table C.1 and the fifth column in Table C.2 makes this immediately obvious. Large changes would have to occur in the beliefs about magnitudes of loss shown in Table C.1 to change this outcome.

The importance of irregular warfare and major insurgencies reflected in the scores and rankings of the first two decision rules simply

Table C.3
Expected Losses by Policy Package and Future

	Policy Package					
	0	1	2	3	4	5
	Current Force	Operate from FOB Against Anti-Access Threat	Large-Scale COIN with U.S. Forces	Partners for Irregular Warfare in Many Countries	Conduct Air Operations Exclusively from Long Range	Operate from FOBs Under Nuclear Attack
Natural disaster	0.30	0.30	0.30	0.30	0.30	0.30
State failure	0.28	0.28	0.14	0.24	0.21	0.28
High-loss terrorism	1.05	0.90	0.90	0.65	0.78	0.90
Major insurgency	1.35	1.35	0.90	0.30	1.35	1.35
Traditional conventional conflict	0.16	0.16	0.16	0.16	0.12	0.16
High-technology conventional conflict	0.56	0.20	0.56	0.56	0.25	0.20
State nuclear threat/use	1.40	0.96	1.40	1.40	0.78	0.60
Low-risk alternative	0	0.06	0	0.36	0.10	0.06
Score	1.40	1.35	1.40	1.40	1.35	1.35
Rank	2	1	2	2	1	1

NOTE: Shaded cells indicate the results from the body of the table that drive the scores and ranks reported in the fourth column of Table C.2 and the last two rows of this table.

cannot be reflected here. Shaping is irrelevant to this decision rule, as is the relative likelihood of different futures even in the absence of shaping effects. As a result, the insights for decisionmakers available from this decision rule are limited. It tells them to pay attention to potential future regional state threats to use or actual use of nuclear weapons, but the first two decision rules have already made that apparent. This rule

is likely to help decisionmakers only if they refuse to assess their beliefs about the probabilities of alternative futures.

Table C.4 displays the mechanics behind the construction of the measure of loss used in Decision Rule 4—*When Probabilities Are Unknown, Minimize Maximum Regret Across Futures*. The shaded cells in the body of the table show the values of magnitude of loss for the policy packages that perform best in each future. For example, Policy Package 2 performs better than any other in the future dominated by a State Failure threat. So the magnitude of loss for that package and future, 2, is highlighted. *Regret* is the difference between this value and that for each policy in the future for which it applies. Table C.4 shows the value of regret relevant to each policy package beneath the corresponding value of the magnitude of loss in each row representing a future.

For the subjective beliefs shown in Table C.4, the future dominated by a State Nuclear Threat or Use threat determines rankings for all policy packages when this regret-based decision rule applies. In fact, its rankings mirror exactly those provided by Decision Rule 3. They need not. This rule can potentially highlight something missed by Decision Rule 3: It can show senior leaders when large differences exist in the performance of policy packages within any future, even if large magnitudes of loss do not occur in these futures. Where such differences exist, opportunities exist to find "robust" policy packages that approximate the best outcomes in all futures, even if they do not ameliorate the largest losses across futures. For the subjective beliefs shown in Table C.4, no such policy packages exist, because the magnitudes of loss are so high in the future dominated by State Nuclear Threat or Use relative to those for other futures.

That said, this rule shares a weakness with Decision Rule 3. It cannot reflect the effects of probabilities of loss in different futures or of changes in such probabilities that policy packages might induce through shaping effects. As with the last decision rule, a regret-based rule emphasizes the future associated with potential state nuclear threats and use relative to the future associated with major insurgency threats for precisely this reason. Senior leaders must take great care as they study the policy implications of this rule and weigh them against

Table C.4
Computation of Regret and Minimax for Regret

		Policy Package					
		0	1	2	3	4	5
Future Dominated by Threat Listed	Risk Measure	Current Force	Operate from FOB Against Anti-Access Threat	Large-Scale COIN with U.S. Forces	Partners for Irregular Warfare in Many Countries	Conduct Air Operations Exclusively from Long Range	Operate from FOBs Under Nuclear Attack
Natural disaster	Magnitude	2	2	2	2	2	2
	Regret	0	0	0	0	0	0
State failure	Magnitude	4	4	2	4	3	4
	Regret	–2	–2	0	–2	–1	–2
High-loss terrorism	Magnitude	7	6	6	5	6	6
	Regret	–2	–1	–1	0	–1	–1
Major insurgency	Magnitude	3	3	2	1	3	3
	Regret	–2	–2	–1	0	–2	–2
Traditional conventional conflict	Magnitude	4	4	4	4	3	4
	Regret	–1	–1	–1	–1	0	–1
High-tech conventional conflict	Magnitude	8	4	8	8	5	4
	Regret	–4	0	–4	–4	–1	0

Table C.4—Continued

		Policy Package					
		0	1	2	3	4	5
Future Dominated by Threat Listed	**Risk Measure**	**Current Force**	**Operate from FOB Against Anti-Access Threat**	**Large-Scale COIN with U.S. Forces**	**Partners for Irregular Warfare in Many Countries**	**Conduct Air Operations Exclusively from Long Range**	**Operate from FOBs Under Nuclear Attack**
State nuclear use/threat	Magnitude	20	16	20	20	13	10
	Regret	–10	–6	–10	–10	–3	0
Low-risk alternative	Magnitude	2	2	2	2	2	2
	Regret	0	0	0	0	0	0
Maximum regret		10	6	10	10	3	2
Rank		4	3	4	4	2	1

NOTE: Shaded cells indicate the magnitude of loss for the policy packages that perform best in each future.

the implications of rules better able to reflect policy effects related to the probability of loss in different futures.

Closing Remarks

Of the four decision rules discussed here, Decision Rule 2, which seeks to *Minimize Maximum Expected Loss in Any Future*, best matches the approach proposed in the text and explained in greater detail in Appendix A. It helps senior leaders focus on outcomes that will have the most deleterious effects on national security and to mitigate them by reducing the probability that they occur and reducing the magnitude of loss that occurs when they do. In the illustrative set of beliefs presented here, this rule initially appears to have little discriminatory power when comparing policy packages. But looking behind the summary measure of the maximum expected loss in any future, the rule tells us without equivocation that the largest risks occur in two futures—those dominated by the potential for (1) regional State Nuclear Threat and Use and (2) Majority Insurgency. Potential losses are significant in both, for very different reasons; and there appears to be substantial opportunity to shift policies and resources in ways that mitigate these risks, even if they significantly increase the probability or magnitude of loss in other futures.

Decision Rule 1, which seeks to *Minimize Expected Loss Across Futures*, does not match the approach described in the text and Appendix A. But it offers an alternative perspective that can complement the perspective offered by Decision Rule 2, discussed in the paragraph above. In the illustrative set of beliefs presented here, this rule is much more immediately discriminating than Decision Rule 2. It gives strong support to two policy packages that have their strongest effects in the two futures that Decision Rule 2 identified for emphasis—those associated with nuclear and insurgency threats. It identifies a third policy package—one that moves the Air Force toward sole reliance on long-range attack and intelligence capability—that deserves attention. Taken together, these first two rules point to the desirability of

some new policy package that creatively addresses all of these points of emphasis.

Decision Rule 3 (*Minimize Maximum Loss in Any Future*) and Decision Rule 4 (*Minimize Maximum Regret Across Futures*) are seriously limited in their usefulness by their inability to address policy effects associated with the probability of loss in different futures, given that probabilities of loss are unknown. In the illustrative set of beliefs presented here, Decision Rule 3 offers no insights not already offered by the first two. Given that, by definition, it relies on less information than Decision Rule 2, Decision Rule 2 will likely always dominate it unless information on probability required to implement the second rule is simply not available. The fourth, regret-based rule, does offer the potential of additional insights when policy packages can differ markedly in their effects on the magnitude of loss in multiple futures. Because that does not occur in the illustrative set of beliefs presented here, this rule offers no additional insights. Even when it does offer additional insights, however, planners and senior leaders should apply these insights with a full understanding that the regret-based rule cannot reflect policy effects associated with the probability of loss in different futures.

None of these decision rules can displace planners and senior leaders in the design and assessment of alternative policy packages. If used creatively, the first, second, and fourth can inform that design and assessment. The uses discussed here are colored by the illustrative set of beliefs presented here. In closing, we emphasize again that we offer this set of beliefs solely for illustrative purposes. The process described in the text seeks to develop a consensus set of beliefs that will be reliably rooted in the priorities of the senior leadership, in not the substantive but rather the subjective beliefs—no matter how sound or well informed—of RAND analysts.

APPENDIX D

Taiwan Strait Example Exercise

This appendix illustrates the application of our method to the threat of conventional war in a notional scenario: a crisis in the Taiwan Strait. What follows is not intended to be an authoritative treatment of the Taiwan problem,[1] but simply an illustration of how one would apply our method to a real-world problem. It shows how planners can use the algorithm developed in Chapter Five (the "risk engine"), to systematically apply the logic of risk analysis as they evaluate context and the balance of interests; assess threats; survey policy and investment options; weigh the strengths, limitations, and dangers of each option; and tailor policy and investment strategies that mitigate risk most effectively.

Context and the Balance of Interests in the Taiwan Strait

Taiwan's status has been a source of international tension since 1949, when Mao Zedong's Red Army forced Chiang Kai-shek's Nationalist forces off the Chinese mainland, leaving the Nationalists in control of

[1] Three helpful references on the Taiwan problem are Richard C. Bush, *Untying the Knot: Making Peace in the Taiwan Strait*, Washington, D.C.: Brookings Institution, 2005; Thomas J. Christensen, "Posing Problems Without Catching Up: China's Rise and Problems for U.S. Security Policy," *International Security*, Vol. 25, No. 4, Spring 2001, pp. 5–40; and David A. Shlapak, David T. Orletsky, and Barry A. Wilson, *Dire Strait? Military Aspects of the China-Taiwan Confrontation and Options for U.S. Policy*, Santa Monica, Calif.: RAND Corporation, MR-1217-SR, 2000. Also see Roger Cliff and David A. Shlapak, *U.S.-China Relations After Resolution of Taiwan's Status*, Santa Monica, Calif.: RAND Corporation, MG-567-AF, 2007.

only Taiwan and several nearby islands. The United States entered into a mutual defense treaty with Taiwan in 1955. This treaty was terminated in 1980—one year after switching diplomatic recognition from Taipei to Beijing on January 1, 1979. The communiqué establishing diplomatic relations with the People's Republic of China recognized Beijing as China's sole legal government and acknowledged the Chinese position that there is but one China and Taiwan is part of it. Nevertheless, on April 10, 1979, President Jimmy Carter signed the Taiwan Relations Act into law, authorizing unofficial relations with the government in Taipei and allowing the sale of defensive equipment to the island's military forces. The United States does not support Taiwanese independence; however, the Taiwan Relations Act states that Washington would "consider any effort to determine the future of Taiwan by other than peaceful means, including by boycotts or embargoes, a threat to the peace and security of the Western Pacific area and of grave concern to the United States."[2] This statement has been widely interpreted as a commitment to Taipei's defense. That perception was strengthened in 1996, when U.S. carrier task forces were deployed to the region in response to Chinese missile exercises that threatened Taiwan, and again in 2001, when President George W. Bush said the United States would "do whatever it takes" to help Taiwan defend itself against any Chinese effort to forcefully unify it with the mainland.[3]

Given the region's economic and strategic importance and the history of conflict between key actors there, several states have important interests in the Taiwan Strait issue. The first step in strategic risk analysis is to ascertain each actor's interests in the issue at hand in their geopolitical context; we do so in Figure D.1.

The potential for conventional confrontation in the Taiwan Strait is driven by the fact that China's desire for territorial restoration directly opposes Taiwan's sense of national sovereignty. Citizens of both countries are emotionally engaged in this issue, generating pressure on leaders in Beijing and Taipei to take strident positions for fear of domestic

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[2] Public Law 96-8, Taiwan Relations Act, April 10, 1979, Section 2(A)(4).

[3] David E. Sanger, "U.S. Would Defend Taiwan, Bush Says," *New York Times*, April 26, 2001, p. A.1.

Figure D.1
Taiwan Strait Example Exercise: Summarizing Taiwan Strait Interests in a Geopolitical Context

Each Actor's Relevant interests		Regional context	Global context
China	• Leadership survival • Territorial integrity • Domestic stability • Economic prosperity	• China's self-image as regional leader – Rapidly modernizing military capabilities and doctrines – Taiwan is China's major remaining territorial dispute • Taiwan has a growing sense of independent identity • Regional stability vital to U.S. security objectives and economic well-being – Access challenges • Historical fear, animosity, and competition between China and Japan – Balance and stability issues • Japan's sense of post-colonial responsibility for Taiwan • Regional desires to engage China in multilateral forums	• Current growth rates project China to become major power • China is a permanent member of the UN Security Council and has growing influence in other international forums • Chinese sense of victimization at hands of the West and Japan • General international consensus that Taiwan is part of China • International concerns about risks of escalation in confrontations between nuclear-armed states
Taiwan	• Sovereignty • National security • Domestic stability • Economic prosperity		
United States	• Regional stability; economic investment • Credibility of commitments • Regional influence • Promote and defend democracy		
Japan	• National security • Regional stability • Alliance relations • National affinity with Taiwan		
Others	• Regional stability • Desire to maintain good relations with both United States and China • IGO viability and credibility		

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opposition if they appear weak. Perceptions of Washington's commitment to defend Taiwan make this issue an important interest for the United States, as the credibility of U.S. commitments to friends and allies may be questioned if China attacks Taiwan and the United States fails to respond. Japan is also an important actor, as U.S. bases closest to Taiwan are on Japanese soil. Japanese leaders would not want to jeopardize their alliance with the United States, but Tokyo's interests, like those of other regional actors, center on ensuring its own national security and maintaining regional stability, concerns that might conflict with allowing the United States unrestrained use of its bases should a crisis escalate to war. However, unlike other regional actors, the Japanese people feel a sense of affinity with the citizens of Taiwan and responsibility for Taiwan's well-being, stemming from its status as a former Japanese colony. Moreover, Japan is the sole regional power with the capability to confront a rising China and, in certain circumstances, may find that course of action preferable to conflict avoidance.

But Japan's involvement could complicate the issue further, because Beijing harbors resentment toward Tokyo stemming from Japanese behavior before and after World War II, and the two countries have a history of bitter competition for leadership in Asia. Add that to China's sense of colonial victimization by the West, as well as its growing military prowess, economic power, and regional and global influence, and a contextual portrait of the balance of interests among regional actors, in particular between China and the United States, begins to emerge. Figure D.2 assesses the balance of interests in this scenario for the People's Republic of China and the United States

Should Washington find itself in a direct confrontation with Beijing over the forceful reunification of Taiwan, the balance of interests would likely be unfavorable to the United States. Washington's stakes in this issue would be high, since the credibility of U.S. foreign

Figure D.2
Taiwan Strait Example Exercise: Assessing Goals and the Balance of Interests

Threat	PRC Goals	PRC Stakes	U.S. Goals	U.S. Stakes	B/I
Chinese attempt to regain control of Taiwan by force	Impose sovereignty on Taiwan • Restore territorial integrity • Reduce domestic dissent • Reduce U.S. influence in the region	**Very High** Regime legitimacy Domestic stability Regional influence and security National "face"	Prevent forceful reunification • Defend principles of democracy and self-determination • Maintain regional access and influence	**High** Credibility of foreign policies and security commitments Regional influence and security	U

Balance of Interest (B/I) Coding	
Favorable (F)	The United States has greater interest in the issue, or the B/I is approximately even.
Unfavorable (U)	The adversary has greater interest in the issue.
Critical (C)	The adversary's interest in the issue is so much greater than that of the United States that the United States is at a serious disadvantage.

NOTE: PRC = People's Republic of China.

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policies and security commitments would be on the line and failure would diminish U.S. influence and security worldwide and particularly in this region. Therefore, the United States would seek to prevent the forceful reunification of Taiwan in order to preserve U.S. credibility and influence, as well as to defend the principles of democracy and self-determination for Taiwan. But as high as Washington's stakes would be, Beijing's stakes would be higher. The reunification issue has become one of such concern in China that, should a confrontation occur, domestic stability and regime legitimacy might be threatened should China fail. Such an outcome would also reduce China's regional influence and security and cost its leaders a great deal of national face.[4] Therefore, Beijing would likely be very committed to its goal of imposing sovereignty on Taiwan to restore China's territorial integrity and reduce domestic dissent. Reducing U.S. influence in the region would also serve China's broader interests.

In summary, the unfavorable balance of interests in the Taiwan Strait significantly limits U.S. shaping options and may make it more difficult to deter Chinese aggression.

Threats in the Taiwan Strait

With context and balance of interests considered, the risk engine then guides planners to assess threats, in terms of both the potential adversary's, or "Red's," current capabilities and those it may reasonably be

[4] While the extent to which national "face"—that is, a collective sense of self-esteem and sensitivity to humiliation—affects the relative behavior of states is debatable, one need only consider the "apology diplomacy" that hindered negotiations with China for the release of the U.S. Navy aircrew after the 2001 EP-3 incident to appreciate that face-saving behaviors can affect international relations. For a balanced discussion on this issue, see Peter Hays Gries and Kaiping Peng, "Culture Clash? Apologies East and West," *Journal of Contemporary China*, Vol. 11, No. 30, 2002, pp. 173–178. For more on the role of "face" in international relations and conflict resolution, see Bert R. Brown, "Face Saving and Face Restoration in Negotiation," in Daniel Druckman, ed., *Negotiations: Social-Psychological Perspectives*, Beverly Hills, Calif.: Sage, 1977, pp. 275–299; Stella Ting-Toomey, *A Face Negotiation Perspective Communicating for Peace,* Beverly Hills, Calif.: Sage, 1990; and Raymond Cohen, *Negotiating Across Cultures: Communications Obstacles in International Diplomacy,* Washington, D.C.: U.S. Institute of Peace Press, 1997.

expected to acquire within the planning horizon. Threats should be assessed in terms of what technologies Red has or may acquire, what resources Red has at its disposal for adding to its capabilities, and whether it appears to have operational concepts for applying those capabilities in ways that might challenge U.S. or allied military operations. Planners should also consider whether Red has the ability to influence other actors in ways that shape the strategic context to jeopardize U.S. operations or threaten U.S. interests more broadly.

Today, Beijing has impressive conventional military capabilities, and given China's growing economic might, it has the resources to add to its military forces considerably over the course of a 10-year planning horizon. Beijing also has considerable influence in the region, and in a crisis it can be expected to wield that influence in efforts to isolate Taiwan and make it difficult for the United States to come to Taipei's assistance. However, because Beijing's ability to deny the United States access to regional bases rests largely on its ability to forcefully coerce other regional actors, planners can evaluate the substance of that threat mainly in terms of China's increasing military capabilities. As Figure D.3 illustrates, Chinese capabilities lend themselves to two plausible COAs for attempting the forceful reunification of Taiwan.

An assessment of China's growing military capabilities might suggest that Chinese military planners are preparing for either a cross-strait invasion or a COA in which they blockade the air and sea approaches to Taiwan, then bombard the island with ballistic missiles in an effort to coerce Taipei's capitulation.[5] As Figure D.3 illustrates, Beijing already has varying levels of capability to perform all the key military actions required of either COA, and its capabilities are increasing in every area. China can already challenge U.S. and Taiwanese control of the airspace over the strait with its growing force of fourth-generation fighters and advanced surface-to-air missiles (SAMs). As Beijing adds to its arsenal and further develops its EW capabilities, China will extend that challenge to ever-increasing ranges over and beyond Taiwan, potentially winning air superiority in important regions during a con-

[5] For a recent authoritative treatment of Chinese military power, see Office of the Secretary of Defense, *Military Power of the People's Republic of China,* Washington, D.C., 2008.

Figure D.3
Taiwan Strait Example Exercise: Assessing Relevant Threats

Plausible Red COAs		Capabilities		Concerns
		Today	10 Yrs	
Cross-strait invasion	Control airspace over strait and Taiwan	MED	HIGH	Rapid deployment of double-digit SAMs, electronic attack caps and 4th-generation fighters
	Impair U.S. access to regional bases/waters	MED	HIGH	Growing ballistic/cruise/antiship missile threat to airbases and CSGs
	Attack USN and ROCN vessels throughout AO	MED	HIGH	Growing size and sophistication of Chinese sub force will strain relatively small U.S. SSN fleet
	Invade and overwhelm Taiwanese defenses	LOW	MED	PRC ground forces superior but lack sufficient amphibious lift
Blockade and coerce	Control airspace over strait and Taiwan	MED	HIGH	Rapid deployment of double-digit SAMs, electronic attack caps and 4th-generation fighters
	Impair USN access to key regional waters and defeat ROCN	MED	HIGH	Growing ballistic/cruise/antiship missile and sub threats
	Interdict shipping traffic in/out of Taiwanese ports	MED	HIGH	Ballistic/cruise/antiship missiles, subs and mines could threaten civilian shipping
	Bombard Taiwan with ballistic/cruise missiles and aircraft	HIGH	HIGH	Large and growing forces opposite Taiwan

LOW: Enemy lacks capability MED: Enemy has some capability HIGH: Enemy has capability
NOTES: AO = area of operations; ROCN = Republic of China Navy; SSN = nuclear submarine; USN = U.S. Navy.
RAND *MG827-D.3*

flict. Similarly, China's ballistic and cruise missile capabilities threaten airbases and vessels in port on Taiwan and, over time, will be able to strike U.S. bases in the western Pacific.[6] Chinese antiship missiles and submarines can threaten naval vessels in the Taiwan Strait and beyond. As these capabilities grow, U.S. air and naval operations will become increasingly imperiled. Chinese submarines can also be used to attack civilian shipping moving in and out of Taiwan and sow mines, closing shipping lanes and harbors to blockade the island. Although all these capabilities would make it difficult for U.S. and Taiwanese forces to operate in the vicinity of Taiwan, they probably

[6] DoD, *Military Power of the People's Republic of China: A Report to Congress Pursuant to the National Defense Authorization Act Fiscal Year 2000*, Washington, D.C., 2008.

still could not impair U.S. direct and standoff attack capabilities well enough to enable a Chinese amphibious force to transit the strait and invade the island. Therefore, while Chinese military theory emphasizes short, swift campaigns over protracted engagements, the difficulty that the People's Liberation Army would likely face in an attempted invasion suggests that a blockade-and-coerce strategy may be a more likely COA should war occur during the 10-year planning horizon.[7]

Policy, Strategy, and Investment Options

With relevant threats identified in their geopolitical context, force planners may then begin surveying what strategy and investment options exist to shape the environment, deter threats to U.S. interests, and, if necessary, secure those interests by force. This section illustrates use of the risk engine's Blue strategy space to assess options to shape, deter, or defeat Chinese aggression in a Taiwan Strait crisis.

Shaping Options in the China-Taiwan Scenario

Shaping is an important tool in U.S. national security policy. The United States conducts shaping operations worldwide through a wide variety of diplomatic, economic, and military channels on a daily basis. Figure D.4 illustrates the range of shaping options Washington might use to avoid a military confrontation with Beijing over Taiwan and to achieve the greatest advantage should one occur.

As the analysis depicted in Figure D.4 illustrates, there are multiple U.S. policy options that might help avoid a Taiwan Strait crisis, but none of them provides reliable leverage, and some of them might even be counterproductive. For instance, the United States might consider offering China trade concessions in an effort to soften Beijing's stance against an independent Taiwan, but considering China's enormous potential for economic growth, with or without U.S. concessions, and

[7] Of course, U.S. strategic planners would need to prepare for either contingency (and perhaps others, as well), but, for the sake of brevity, the risk engine demonstration will proceed with planning against only the most challenging COA.

Figure D.4
Taiwan Strait Example Exercise: Assessing Relevant Shaping Options

Shaping Tool	Possible COA	Strengths, Limitations, Dangers	Utility
Incentives	Offer China trade concessions	Little or no leverage: Reunification interest trumps economic interests	LOW
Assurances	Promise not to support Taipei in bid for independence	Risky: Might appease Beijing and dampen Taiwanese aspirations for independence, but also might encourage Chinese aggression	LOW
Nonmilitary engagement	Engage China and Taiwan in multilateral talks	Possible trust-building benefits, but little real leverage, as Beijing considers Taiwanese reunification a domestic issue and Taipei considers independence a vital interest	MED
Nonmilitary engagement	Discourage Taipei from declaring independence	Critically important, but Taiwanese independence movement might become irresistible	MED
Indirect military engagement	Conduct combined training and exercise with Taiwanese military forces	Provocative and inconsistent with U.S. policy that there is one China with Beijing as its capital	LOW
Direct military engagement	Declare alliance with Taipei and put tripwire forces there	Highly provocative and an open contradiction to the U.S. "one China" policy	LOW
Direct military engagement	Conduct regional exercises and other shows of force	Signals commitment and reassures Taipei, but does little in itself to deter Beijing	MED

HIGH: Strong, positive influence on U.S. interests
MED: Some positive influence, but may be unreliable
LOW: Little or no positive influence, or risks negative influence

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the stakes Beijing has in the unification issue, such offers would not likely have any effect on Chinese attitudes toward Taiwan. Alternatively, Washington could assure Beijing that the United States would not support Taipei in any explicit bid for independence, but that might only encourage Chinese aggression. Other nonmilitary forms of engagement offer slightly more promise, but are also unreliable. For example, the United States might engage China and Taiwan in multilateral talks in efforts to build trust, and Washington could discourage Taipei from officially declaring independence. Both avenues offer benefits, but neither would provide any reliable assurance that conflict would be avoided, considering the growing independence movement in Taiwan.

Moving toward the more coercive end of the shaping spectrum, direct military shaping actions in the Taiwan Strait might better demonstrate U.S. commitment and strengthen Taiwan's ability to resist Chinese aggression, but such actions should avoid appearing provocative or

disingenuous. For instance, U.S. forces could conduct combined exercises and training with their Taiwanese counterparts, but that would damage U.S.-China relations and likely cause Beijing to accelerate its military buildup opposite Taiwan. It would be even more provocative if the United States took this a step further by declaring an alliance with Taiwan. Though such an act would signal total U.S. military commitment to protect the island regime, the United States has acknowledged China's position that there is but one China and Beijing is the capital, so declaring an open alliance would appear to be an explicit reversal of U.S. policy and might trigger the very crisis it would be meant to deter. Alternatively, the United States could signal its commitment to Taiwan in subtler ways, such as by conducting regional exercises and other "shows of force," but such actions by themselves would likely not deter Beijing. They would have to be part of a broader deterrence strategy.

In sum, the Taiwan Strait scenario represents a difficult shaping problem for the United States. Because China's stakes are so high, and because China and Taiwan suffer a seemingly irreconcilable conflict of interests vital to both of them, the United States may have limited shaping options other than deterring Beijing from taking forceful military action. Shaping tools are limited in this scenario by the unique and particular set of stakes and relationships. Most importantly, the United States cannot reliably control what has probably been the most effective shaping tool to date, discouraging Taipei from declaring independence, as domestic events in Taiwan could develop a momentum that U.S. and Taiwanese leaders are unable to control. Therefore, even as Washington encourages Beijing and Taipei to resolve the reunification issue peacefully, U.S. military forces must be prepared and postured to deter Chinese military aggression.

Deterrence in the Taiwan Strait

As explained in Chapter Five, deterring a potential adversary from committing acts of aggression involves either threatening to punish that actor for its misbehavior or showing that one can defeat those actions, thereby denying the aggressor sufficient benefit to make the effort worthwhile. Figure D.5 illustrates prospects of deterring China,

Figure D.5
Taiwan Strait Example Exercise: Assessing U.S. Ability to Deter Chinese Aggression via Threat of Punishment

Capabilities	Limitations	Capability	Resolve
Blockade and interdict • Bomb ports; mine harbors • Destroy shipping	Concerns about collateral damage on civilians and third-party shipping Escalation risk	HIGH	MED
Strike regional military, transportation, and C2 targets beyond those directly supporting war on Taiwan	Concerns about collateral damage High escalation risk	HIGH	LOW
Bomb civilian targets	High domestic and international political costs Very high escalation risk	HIGH	LOW
Current ability to punish PRC for imposing a coercive blockade on Taiwan		HIGH	LOW

HIGH: Strong capability/resolve MED: Some capability/resolve LOW: Little or no capability/resolve

RAND *MG827-D.5*

via threat of punishment, from attempting to force Taiwan to accept reunification.

A brief survey of U.S. conventional military capabilities, vis-à-vis those of China, reveals that the United States has ample ability to punish China for aggressive behavior in any number of ways. However, the viability of deterrence does not depend solely on the ability to inflict cost on an adversary; it depends on one's ability to convince the opponent that one has not only the capability to punish, but also the resolve to do so. The balance-of-interests score from the previous section suggests that Beijing may very well be prepared to accept high costs in its attempt at reunification. Beijing might also doubt that Washington would risk the political costs of inflicting high levels of collateral damage on civilians, so threats to carry out actions that raise such risks may have little credibility in Chinese eyes. Similarly, U.S. leaders would be unlikely to authorize their forces to attack China in ways that risk serious escalation, and threats of nuclear retribution—grossly indiscriminate and disproportionate to China's conventional

threat against Taiwan—would have even less credibility than would threats of conventional punishment. In sum, threats of punishment would probably have little effect in deterring China from attempting to resolve the Taiwan Strait issue by force of conventional arms.

To deter the Chinese from attacking Taiwan, U.S. and Taiwanese forces must have sufficient capability to cause Chinese leaders to doubt whether attempting a forceful reunification would have a high enough probability of success to make the risks worthwhile. Figure D.6 assesses U.S. baseline capabilities—that is, those currently available or programmed—to deter China from attempting a blockade and bombardment of Taiwan during the 10-year planning horizon by threatening to deny Beijing military success in that effort.

Figure D.6
Taiwan Strait Example Exercise: Assessing U.S. Baseline Ability to Deter China from Blockading and Bombarding Taiwan via Threat of Denial

Relevant Threat	Capabilities	Limitations	Capability	Resolve
Control airspace over strait and Taiwan	EW	Advanced SAM may defeat current EW	M	H
	Upgraded 4th-gen fighters	PRC fighters may overwhelm US/ROC DCA	M	H
	Some 5th-gen fighters			
	OCA/attack C2	Escalation risks	M	L
Impair Navy access to key regional waters and interdict shipping	Counterforce • Air strike • Missile strike • Attack C2	ISR—high number of difficult-to-find mobile missiles Escalation risks	L	L
	Antishipping and cruise missile defenses	Capable today, but may be challenged by ASBMs	M	H
	Defend harbors with terminal BMD	Limited capabilities	L	H
Bombard Taiwan with ballistic missiles	Counterforce • Air strike • Missile strike • Attack C2	ISR—high number of difficult-to-find mobile missiles Escalation risks	L	L
	Terminal BMD	Very limited capabilities	L	H
	Passive defenses	Many soft targets	M	H
Overall	Current ability to deny PRC benefit of executing a blockade and coerce CONOPS		L	M

HIGH (H): Strong capability/resolve MED (M): Some capability/resolve LOW (L): Little or no capability/resolve

NOTES: ASBM = antiship ballistic missile; BMD = ballistic missile defense; DCA = defensive counter-air; OCA = offensive counter-air; ROC = Republic of China.

RAND *MG827-D.6*

As Figure D.6 illustrates, the current ability of the United States to deter China from attempting to coerce Taiwan's reunification by denying Beijing success in a blockade-and-bombardment strategy is questionable, and that ability, if not enhanced, will only decline over the planning horizon as China improves its capabilities. In such a strategy, Chinese forces would attempt to gain control of the airspace over the strait and over Taiwan and impair U.S. Navy access to key regional waters while they interdict shipping in and out of island ports. Meanwhile, China would bombard Taiwan with conventional ballistic missiles in an effort to compel Taipei to accept terms of reunification. The ability to deter such a strategy would hinge on convincing Beijing that U.S. and Taiwanese forces have the capability and resolve to defeat the essential elements of that COA. Some capability to do so exists, particularly in regard to denying China control of the airspace over Taiwan, and U.S. and Taiwanese officials would be highly resolved to take most of the actions needed to succeed in that effort. However, China's combination of advanced SAMs and high numbers of fighters may overwhelm Blue efforts to maintain air superiority, and U.S. leaders might be chary about allowing OCA strikes against mainland targets, for fear of excessive collateral damage and escalating the conflict. More seriously, U.S. and Taiwanese defenses would be unable to deny China the ability to use its high number of conventional surface-to-surface missiles to bombard Taiwan and U.S. bases in the region to drive off commercial shipping, hamper air operations, and impose coercive punishment on the Taiwanese, given the limited capabilities of current BMD systems. Today, U.S. Navy defenses are quite capable against China's limited submarine and antiship missile forces, but these defenses will be increasingly challenged as Chinese capabilities grow, particularly if China adds long-range antiship ballistic missiles to its inventory. Additional hardening of fixed military facilities would help reduce the vulnerability of Taiwan and U.S. regional bases, but that may not be enough to discourage China from attacking, given the high number of soft targets available for Beijing's coercive strategy.

Here is where strategic risk assessment begins to pay dividends. By breaking down a potential adversary's probable COAs into their critical elements and assessing U.S. capabilities to defeat those actions,

risk analysts can determine where the greatest potential payoffs exist for investing in capability enhancements. Figure D.7 provides such an assessment for the Taiwan Strait crisis.

The analysis reflected in Figure D.7 reveals that investing in better air defense and, particularly, BMD capabilities would likely yield notable payoffs in raising doubts in the minds of Chinese leaders regarding whether they might succeed in a blockade-and-bombardment strategy to compel Taiwanese reunification. Investing to improve those capabilities that U.S. leaders would most likely have high resolve to employ offers the best potential return in bolstering the credibility of deterrent threats. Consequently, focusing investments on better EW systems, long-range naval SAMs, and more fifth-generation fighters would seem to make more sense than trying to improve or develop new offensive systems to strike mainland targets—capabilities that

Figure D.7
Taiwan Strait Example Exercise: Evaluating Enhancements to U.S. Ability to Deter China from Blockading and Bombarding Taiwan via Threat of Denial

Relevant Threat	Capabilities	Limitations	Capability	Resolve
Control airspace over strait and Taiwan	Advanced EW	Advances in SAM technology may outpace EW	M	H
	More 5th-generation fighters	Numbers and quality of PRC fighters increasing faster than United States	M	H
	Long-range naval SAMs	Cueing challenges; numbers of PRC fighters may saturate	M	H
	More effective OCA and C2 attack capability	ISR challenges Escalation risks	M	L
Impair Navy access to key regional waters and interdict shipping	Layered BMD plus better antiship and cruise missile defenses	Range and access limitations Terminal BMD overwhelmed Stability risks	M	H
	Advances in counterforce	ISR challenges Escalation risks	M	L
Bombard Taiwan with ballistic missile	Layered BMD	See two rows above	M	H
	Passive defenses	Cannot defend everything	M	H
Overall	Enhanced ability to deny PRC benefit of executing a blockade and coerce CONOPS		M	H

HIGH (H): Strong capability/resolve MED (M): Some capability/resolve LOW (L): Little or no capability/resolve

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U.S. forces already have in ample supply but may be constrained from using by restrictive rules of engagement. Similarly, investing in more effective BMD and more passive defenses would seem to offer greater dividends than putting those resources into better capabilities for finding and destroying mobile missile launchers, an effort that will almost certainly be constrained by leaders concerned about escalation and collateral damage. By targeting investments to improve those capabilities that U.S. forces are most likely to be permitted to use, force planners can increase both the capability and resolve of U.S. efforts to deny China the fruits of aggression, thereby making deterrent threats more credible. The results of this analysis are further illustrated in the composite deterrence scorecard presented in Figure D.8.

The composite deterrence scorecard pulls together the results of all the analyses done to this point. The consolidated assessment begins

Figure D.8
Taiwan Strait Example Exercise: Composite Deterrence Scorecard Comparing Enhanced Capabilities with Today's Baseline

Stakes		Projected Threat				
		Red COA				Red Capability
PRC	US	Cross-strait invasion				Medium
Very High	High	Blockade and coerce				High
		Baseline Deterrent Force				
		Red COA	Strategy	Credibility Cap	Credibility Res	Deterrence Outcome P(Fail)
		Cross-strait invasion	Denial	M	H	Low
			Punishment	H	L	
		Blockade and coerce	Denial	L	M	High
			Punishment	H	L	
		Enhanced Deterrent Force				
Balance of Interests		Red COA	Strategy	Credibility Cap	Credibility Res	Deterrence Outcome P(Fail)
Unfavorable		Cross-strait invasion	Denial	M	H	Low
			Punishment	H	L	
		Blockade and coerce	Denial	M	H	Medium
			Punishment	H	L	

NOTES: Cap = capability; P(fail) = probability of a deterrence failure; Res = resolve.

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with a posting of U.S. and Chinese stakes in the Taiwan Strait issue, reminding planners that the balance of interests is unfavorable, presenting a challenge for deterrence. Relevant COA threat assessments are then projected for the end of the 10-year planning horizon. Below that, baseline and enhanced capabilities to deny and punish Chinese aggression are posted, along with the levels of resolve associated with each of those deterrent threats. Finally, the scorecard compares the probabilities of a deterrence failure in the Taiwan Strait over the planning horizon using the baseline force versus the enhanced force. This demonstrates how investment in selected high-payoff denial capabilities can reduce the probability of failure to deter China from attempting a blockade-and-coerce strategy against Taiwan to "medium" from what otherwise might be "high," given projected increases in Chinese capability.

Such an analysis would seem to suggest that the best investments are those that deter an adversary without risking crisis stability or escalating a conflict, should one occur—in other words, investments that strengthen defenses without adding to offensive capabilities. Yet that may not be the case. As explained in Chapter Five, there are times when the United States needs to take positive measures to secure its interests by force. Should deterrence fail in the Taiwan Strait, U.S. military leaders will need capabilities that provide options to take the fight to the enemy.

Compellence and War in the Taiwan Strait

Like deterrence, compellence involves altering an opponent's decisions by manipulating its calculation of costs and benefits via threats of punishment or denial. Should China begin a blockade-and-bombardment strategy against Taiwan, the United States would likely issue threats in an effort to compel Beijing to stop its aggression. However, threats of punishment would probably be even less effective in persuading Beijing to cease an operation already begun than they would in deterring that action beforehand. Chinese leaders will have weighed the potential costs and benefits before embarking on such an adventure, and the fact that they decided to press on with it would indicate that they had either found the credibility of U.S. threats wanting or had determined

that they could bear any cost the United States would be willing to inflict. Given Beijing's high stakes in the Taiwan Strait issue, compelling China to terminate a military operation against Taipei would almost certainly require demonstrating to Chinese leaders that such an operation would not succeed. In this scenario, *compellence is essentially synonymous with limited war*.

Fighting a limited war in the Taiwan Strait would call for many of the same capabilities needed to deter such a conflict. However, the analytical perspective is different. In preparing for war, force planners need to determine not only what capabilities are needed to blunt the enemy's offensive operations, but also what capabilities would be needed to execute all the key tasks called for in existing U.S. operational plans, as well as any other COAs that would likely be considered in crisis-action planning. Figure D.9 assesses representative tasks for a Taiwan scenario.[8]

As in previous assessments, Figure D.9 lists the main combatants' stakes and the balance of interest in the issue to keep consideration of those relationships at the forefront of force planning.[9] Then the assessment compares U.S. warfighters' ability to achieve key operational objectives using today's baseline force against the ability to achieve those objectives 10 years from now, given investments in selected capability enhancements. This example assumes that a possible U.S. and Taiwanese response to China's blockade-and-coerce strategy would be to defeat Beijing's COA while imposing a Blue blockade on the Chinese coast and interdicting Chinese efforts to flow military forces and materiel into the region.

Analysis suggests that improvements in ISR and precision weapons might enhance U.S. abilities to conduct blockade-and-interdiction operations in ways that could reduce risks of collateral damage and

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[8] Clearly, Figure D.9 does not include all the key tasks that might be required in a Taiwan Strait conflict; rather, it addresses a sampling of those tasks to illustrate the assessment process.

[9] For each capability area, we give a score measuring Blue's resolve to use that capability. The overall resolve score for the baseline and enhanced cases is not a sum or average of the resolve scores for the individual capabilities but rather a separate judgment that, given this set of capabilities, Blue's overall resolve is as indicated.

Figure D.9
Taiwan Strait Example Exercise: Assessing Capabilities Needed to Fight a Limited War

Stakes			Key task capabilities		
PRC	US	B/I	Baseline	**Cap**	**Res**
Very high	High	U	Air superiority	M	H
			BMD	L	H
			Defeat Red C3I	M	M
			Blockade and interdict	M	M
			Overall	Med	Med
PRC	US	B/I	Enhanced	**Cap**	**Res**
Very high	High	U	Air superiority	M	H
			BMD	M	H
			Defeat Red C3I	M	M
			Blockade and interdict	H	H
			Overall	Med	High

HIGH (H): Strong capability/resolve MED (M): Some capability/resolve LOW (L): Little or no capability/resolve

NOTE: C3I = command, control, communicatons, and intelligence; U = unfavorable.
RAND *MG827-D.9*

thereby loosen constraints on U.S. forces (as indicated by increasing the "blockade and interdict" resolve score from medium to high). As in the deterrence analysis, this one suggests that improving BMD capabilities would also enhance Blue warfighting resolve, providing better force protection throughout the AO and helping Taiwan withstand China's missile bombardment, all with less pressure on Blue and Green (neutral) forces to conduct risky transporter-erector-launcher (TEL)-hunt operations on the Chinese mainland. In sum, the analysis suggests that selected investments would enable the United States to support Taiwan more effectively in a warfighting contingency and do so with the necessary resolve to see it through to a successful conclusion.

Risk Assessment in the Taiwan Strait Scenario

Assessing strategic risk ultimately comes down to estimating rough probabilities and magnitudes of harm, given alternative force structures and scenario outcomes. In this example, the probability of harm is essentially equivalent to the probability of a deterrence failure—*P(Fail)* in Figure D.8—given such weak and unreliable shaping options. So, if the United States fails to deter China from attempting to regain Taiwan by force, U.S. interests will suffer some amount of harm, whether Washington chooses to respond to that aggression and, if it does, whether U.S. and Taiwanese forces ultimately succeed in defending Taipei's independence. So the question then becomes, What magnitudes of harm should force planners expect, given alternative outcomes? Figure D.10 considers those outcomes and estimates magnitudes of harm in a composite scorecard for the Taiwan Strait scenario.

The composite analysis posts all shaping options assessed to have at least some level of utility along with baseline and enhanced scores for deterring and defeating Chinese aggression against Taiwan. As the scorecard confirms, shaping the strategic environment regarding the China-Taiwan relationship has some value, but none of the available options has enough leverage to avoid a confrontation with China, should the independence movement in Taiwan become irresistible. Current deterrence and warfighting options also suffer critical weaknesses, but the composite analysis suggests that selective investments can reduce the probability of a deterrence failure and fortify U.S. warfighting capabilities. The overall risk score shown at the bottom of the figure posts those findings, showing a reduction in the probability of harm, *P(harm)*, from high (for deterrence with the baseline force) to medium (for deterrence with selected force enhancements).

The overall risk score also assesses the two magnitudes of harm specified in the risk engine: M_1*(harm)*, the harm that U.S. interests would suffer if China attacked Taiwan and the United States failed to respond, and M_2*(harm)*, the overall cost the United States would incur in responding to a Chinese attack. In this scenario, we estimate M_1*(harm)* to be high in both the baseline and the enhanced force assessments, as failure to fulfill a commitment to defend a friendly

Figure D.10
Taiwan Strait Example Exercise: Composite Scorecard for Strategic Risk Analysis of the Taiwan Strait Scenario

Policy Tool	COA	Strengths, Limitations, Dangers	Util
Shape	Engage China and Taiwan in multilateral talks	Possible trust-building benefits, but little real leverage, as Beijing considers Taiwanese reunification a domestic issue and Taipei considers independence a vital interest	M
Shape	Discourage Taipei from declaring independence	Critically important, but Taiwanese independence movement might become irresistible	M
Shape	Conduct regional exercises and other shows of force	Signals commitment and reassures Taipei but does little in itself to deter Beijing	M
Deter (baseline)	Posture forces for denial and threaten punishment	TBM threat may limit access to AO; advanced SAM threat and ISR limitations problematic; risks of escalation and collateral damage undermine threats of punishment	L
Defeat (baseline)	Control air and sea; defend Taiwan; attack C3I; blockade coast and interdict lines of communication	Questionable ability to operate in airspace over the strait or control regional waters; almost no defenses against ballistic missile attacks; attacking C3I risks escalation	M
Deter (enhanced)	Posture more capable forces for denial	Advanced EW, more 5th-generation fighters, and a layered TBM defense may increase denial capability and credibility	M
Defeat (enhanced)	Control air and sea; defend Taiwan; attack C3I; blockade coast and interdict lines of communication	Improved ISR for precision engagements and kinetic attack on Red C3I; improved BMD enhances force protection	M

Overall Risk Score			
Shape + deter (baseline)	P(harm) = H M1(harm) = H	Shape + deter + defeat	M2(harm) = H
Shape + deter (enhanced)	P(harm) = M M1(harm) = H	Shape + deter + defeat	M2(harm) = M

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democracy would be a serious blow to the United States' standing in the world. We also scored M_2*(harm)* as high for the baseline warfighting force. Given China's growing capabilities and limitations in Blue missile defenses, it will be increasingly difficult for the United States to defend Taiwan against a concerted Chinese effort to compel Taiwanese reunification. Doing so, even if successful, would likely be costly and would pose serious risks of escalation, given the limited ability of U.S. and Taiwanese forces to defend the island without attacking the mainland in depth. Enhancing U.S. capabilities, however, with better ISR for precision engagement and, especially, more effective missile

defenses, would improve the ability of U.S. forces to prosecute a limited war in the Taiwan Strait, making a successful outcome more probable at less cost. Therefore, we score M_2*(harm)* as medium for the enhanced warfighting force.

Conclusion

In a strategic environment characterized by danger and uncertainty, investing in the right mix of capabilities is a critically important challenge. Resources are limited, and investments in systems that enhance some capabilities may undermine important shaping and deterrence policies, ultimately increasing the probability and magnitude of harm from violent conflict. The logical framework embodied in the risk engine offers a tool to systematically and transparently show how capabilities and investments affect a scenario at multiple levels of resolution by disaggregating concerns, assessing the strengths and limitations of relevant options, and compiling these options into coherent strategies. The strategic risk assessment then organizes the analyses in a format that decisionmakers can easily comprehend, weigh, and act upon. The Taiwan Strait example exercise offers a simplified example of such an analysis.

APPENDIX E

Solomon Islands Example Exercise

This appendix demonstrates the risk engine's use in assessing alternative policy options for mitigating a risk of insurgency. The case used in this illustration is the 2003 Australian-led Regional Assistance Mission to Solomon Islands (RAMSI)[1] intervention to quell instability in that small southwest Pacific island nation.[2]

Context and the Balance of Interests in the Solomon Islands

On July 24, 2003, RAMSI arrived in the Solomon Islands to restore law and order to a society rent by domestic violence and to stabilize a government paralyzed by corruption and factional strife. The RAMSI intervention was done at the invitation of the Solomon Islands' prime

[1] All details on RAMSI used in this illustration of the risk engine are drawn from Russell W. Glenn, *Counterinsurgency in a Test Tube: Analyzing the Success of the Regional Assistance Mission to Solomon Islands (RAMSI)*, Santa Monica, Calif.: RAND Corporation, MG-551-JFCOM, 2007.

[2] This case is different from the Taiwan Strait scenario in two principal ways. First, although RAMSI is still ongoing, it is largely a historical case study, as we already know that stability operations in the Solomon Islands have been successful. Second, the Blue actor in this analysis is Australia, rather than the United States. Nevertheless, RAMSI is a useful example for demonstrating the risk engine's utility for assessing strategic options in response to a threat of insurgency. For the sake of analysis, readers are asked to look beyond the bounds of what actually happened in order to consider the full spectrum of tools in the Blue strategy space, using Australia as a proxy for the United States.

minister, with unanimous approval of the country's National Parliament, and was endorsed by the Pacific Islands Forum.

In the years leading up to the RAMSI intervention, the social fabric on the islands was being torn apart by violence and weak governance. Tribal and ethnic differences, criminal violence, and police and authority corruption had given rise to a general sense of lawlessness and government ineptitude. In 1998, the principal island of the Solomon Islands, Guadalcanal, witnessed an eruption of organized violence fueled by decades of ethnic tension and land disputes. The two predominant ethnic communities, the native Gwales and immigrant Malaitans (from the nearby island Malaita), had given rise to an array of militant groups. Chief among them were, on the Gwales side, the Istabu Freedom Movement (IFM) and the Guadalcanal Liberation Force (GLF) who competed for land holdings and intimidated local Malaitans, and, on the Malaitan side, the Malaitan Eagle Force (MEF) militia. The MEF, which included many members of the chiefly Malaitan Royal Solomon Island Police (RSIP), was formed partially as a response to Gwales-inspired violence (the MEF declared war on the IFM in 2000), though it also bullied residents on their own home island of Malaita.

The ensuing years brought only more violence and corruption, much of which can be attributed to the RSIP, despite the efforts of both the International Peace Monitoring Team (IPMT) that sought to disarm opposing militant factions and a new, democratically elected government. The continuing rampant crime and organized violence forced the newly elected prime minister, Albert Kamakeze, to seek outside assistance in 2003. His call for help was answered shortly thereafter by the Australia-led RAMSI team. Figure E.1 provides an assessment of each actor's interests in their geopolitical context.

The key actors in this case include the native population (further divided into the two main quarrelling ethnic groups, the Gwales and the Malaitans) and the RAMSI nations led by Australia. Other local state and nonstate actors share interests in regional stability and the continued viability of IGOs. The ethnically divided militias, represented most conspicuously by the GLF, IFM, and MEF, fight for land holdings and control over island resources, while the rest of Solomon Islanders must

Figure E.1
Solomon Islands Example Exercise: Summarizing Interests and Context

Each Actor's Relevant Interests		Regional Context	Global Context
Gwales (GLF, IFM)	• Land holdings • Control over resources • Unjust compensation	• Virtually no government: no provision of services; politicians align themselves with political gangs • Disparate criminal groups fight over land and money • Not as stark as "Gwales versus Malaitans" for state control – GLF and IFM compete for control of the Weathercoast – MEF also commits acts of violence against Malaita • Violence, police corruption, criminal activity, and lack of infrastructure or control ravage the population and tear the island society apart • Elections in 2001 could not restore law and order	• Previous international intervention efforts ineffective • IPMT in 2000 unable to permanently halt violence • In 2003, situation was so bad that the Prime Minister and parliament sought outside assistance
Malaitans (MEF, RSIP)	• Land holdings • Control over resources • State control		
Other Solomon Islanders	• End of violence • Stability and safety • Infrastructure		
Australia (RAMSI nations)	• Regional stability; economic investment • Regional presence • Credibility of commitments		
Others	• Regional stability • Regional presence • IGO viability and credibility		

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endure the resulting violence in the face of an increasingly corrupt and inept government. It is truly this overwhelming sense of lawlessness and feckless governance, rather than open conflict between opposing militant factions, that drives the saliency of this scenario. Australia, called on by the Solomon Islands government itself, seeks to bring about regional stability by rebuilding legitimate and necessary government institutions while weeding out corrupt officials and criminals. RAMSI actually represents the second international intervention since 2000 to bring peace and stability to the Solomon Islands. The first attempt, the IPMT, had a more modest goal of disarming opposing militias but failed because of insufficient staffing and a limited mandate and authority. But the true cause of the IPMT's failure was that the IPMT did not significantly address any of the root causes of the violence and corruption. Most of the IPMT's efforts, therefore, were quickly nullified.

In this scenario, only the multinational shaping context is important. Interests are so intermarried that pairwise relationships do not add contextual information: Australia (RAMSI) is not concerned with any one group over another, nor is the interaction of any two militant

groups particularly special. Additionally, the shaping analysis will show that RAMSI cannot afford to single out a particular militia or criminal gang due to the danger it faces in potentially politicizing its efforts and alienating some of the native population.

Shaping Options in the Solomon Islands Scenario

The Solomon Islands example offers an opportunity to employ a multitude of positive shaping options that stem most basically from a collective desire among a large part of the native population to end internal divisions and violence and to build a stable and safe society. That deterrence, compellence, and warfighting are of limited value in this scenario follows only in part from the above argument. It is the preexisting sensitivity among the population to violence and aggression that really diminishes the effectiveness of more coercive policy tools, and the Solomon Islands risk analysis is therefore based primarily on shaping actions. Figure E.2 illustrates the range of options available to RAMSI for shaping the strategic environment in the Solomon Islands.

Given the high levels of civil violence prevalent in the Solomon Islands, disarming militants will be an essential step toward establishing peace and social stability in that country. This step should be made in as visible way as possible so that it avoids offering yet another avenue of corruption for officials. As an incentive, for example, RAMSI could offer "money for guns" to disarm opposing factions. Though this may be enough of an incentive for some to relinquish arms, the IPMT's effort to do exactly this two years earlier was eventually halted because corrupt officials and leaders pocketed the money, and many weapons returned to the streets. To be a fully legitimate enterprise, RAMSI must also instill public confidence and build a trusting, long-term relationship with leaders and populace alike. From the start, RAMSI has to make assurances as to its commitment and to its status: RAMSI is not a force of occupation; it is a peaceful initiative that ultimately seeks to put power back into the people's hands.

Figure E.2
Solomon Islands Example Exercise: Assessing Relevant Shaping Options in the Solomon Islands Scenario

Shaping Tool	Possible COA	Strengths, Limitations, Dangers	Utility
Incentives	Offer "money for guns" to disarm opposing factions	May encourage people to relinquish arms, but IPMT's effort to do exactly this was eventually halted because corrupted officials and leaders pocketed the money and weapons returned to the streets.	MED
Assurances	Statement and actions: RAMSI commitment; RAMSI is not an occupation force	Would instill public confidence and build a trusting, lasting relationship with leaders and civilians. Would seek to ultimately put power into the people's hands.	HIGH
Nonmilitary engagement	Humanitarian aid and relief efforts: NGOs	Would alleviate suffering and generate "good feelings" toward RAMSI involvement but alone would not curb violence. NGOs are not a permanent solution.	MED
Nonmilitary engagement	Multinational aid in infrastructure reform: Institution building, laws, organization	Essential, but cannot be done before militias are neutralized. Put early emphasis on reforming police and restoring public confidence in law and governments.	HIGH
Indirect military engagement	Information gathering—cross-breeding information across agencies	Again, necessary to bring criminal organizations and militias down and bring those who commit violence to justice.	HIGH
Indirect military engagement	Train, advise, equip, and aid local police forces	Central component of permanently halting violence and restoring public confidence. Warning: military personnel must behave responsibly and only in a supporting role to the RSIP.	HIGH
Direct military engagement	Show of power via exercises and visible air and naval assets	Would signal RAMSI's commitment, but must be careful to convey competence rather than aggression.	MED
Direct military engagement	Engage hostile militias, insurgents, criminal gangs, etc.	Necessary but risky and may politicize by "choosing sides." Must try to engage with as little physical force as possible; treat all militias and gangs equally.	MED
Deterrence: explicit threats	Threaten to militarily punish or pursue noncompliant militias	Overly aggressive as a first COA. Need to explore other methods of disbanding criminal gangs.	LOW

HIGH: Strong, positive influence on Blue interests

MED: Some positive influence, but may be unreliable

LOW: Little or no positive influence, or risks negative influence

NOTE: NGO = nongovernmental organization.

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Of course, incentives and assurances can go only so far; otherwise, the initial IPMT might have made more headway. Such assurances do nothing for the many who are left to suffer in the wake of militia and criminal violence. Humanitarian aid, relief efforts, and NGOs may be employed to address some of the most immediate human suffering,

and though this may also serve to engender goodwill toward RAMSI, such measures alone do not curb violence, nor are they a permanent solution. In fact, to be most effective, these NGOs would ideally aid infrastructure reform that broadly includes rebuilding legitimate institutions, implementing laws, and organizing enduring governing bodies. These are essential objectives of RAMSI that most likely can be achieved only once criminals and corruption are eradicated from existing governing bodies, especially from the RSIP, which needs to be counted on to uphold those laws.

To truly eradicate the criminal element from the Solomon Islands society, Australia must project some element of power by indirect and direct military engagement means. Interagency cooperation, effective ISR, and sharing information across RAMSI's services and groups are necessary tools to capture criminal leaders. Training and advising the local RSIP force is a central component of permanently halting violence and restoring the public's confidence in its government, but Australia must be cautious to not let its military personnel behave recklessly or aggressively. That said, some overt shows of force, such as visible air and naval assets and military exercises, may have a place in shaping, so long as these activities convey a sense of competence rather than aggression. RAMSI could then use this projected sense of competence to deter armed struggle when it seeks out and engages militant groups, but again it must be careful to not overproject its force. RAMSI may, at some point, want to threaten noncompliant militias, but only as a last resort: The physical capture of militants presents a particularly difficult challenge specifically because RAMSI cannot afford to act aggressively. Aggressive actions carry a political price if outside nations perceive RAMSI as doing more harm than good, and aggressive actions are a tax on effectiveness if they raise doubt among Solomon Islanders that RAMSI is there to help. Moreover, RAMSI must treat all gangs equally; it cannot leverage one group against another without potentially politicizing the situation.

In sharp relief to the China-Taiwan scenario, the shaping analysis in the RAMSI example gives the strategic planner a number of promising options that can be layered into effective shaping strategies. Whereas the China-Taiwan crisis may depend on how well Blue can

deter or defeat Chinese aggression, the same analytical framework that assesses context and shaping tools applied to the Solomon Islands scenario shows that deterrence and warfighting capability would add only a small, rapidly asymptotic value to the perception of RAMSI competence. In fact, in some cases, these coercive capabilities could be grossly counterproductive. For that reason, we give both traditional deterrence and warfighting negative utility scores in the overall risk assessment. Such tools should be used only as a last resort, lest they undermine the broader shaping strategy.

The careful reader may note another significant departure from the Taiwan Strait risk analysis—the Solomon Islands options component neither projects Red capability nor explores any Blue enhancements. But both projected capabilities and enhancements are grounded in deterrence and warfighting, and because the shaping assessment strongly advises against the coercive use of force, the risk algorithm does not ask the user to consider these components of the Red threat. In the setting of this example, this departure makes sense. The capabilities of the rogue militants on the Solomon Islands are limited and unlikely to increase. The real threat comes from how deeply embedded these groups are in their isolated land holdings, the guerrilla tactics with which they can defend their turf, and the persistent balancing act of prying the militants loose and bringing them to justice without exciting more violence. The relatively small number of militants located on small and remote islands does not necessitate Blue "enhancements," as is traditionally implied by technology investments, novel CONOPSs, or heavy deployment. The question of whether an initiative like RAMSI would work was more a question of whether the participating nations would make available the necessary resources and whether RAMSI would best use the instruments it has at its disposal according to the unique context outlined above.

Although this is a deviation from the circumstances and subsequent higher-resolution analysis steps in the China-Taiwan scenario (Appendix D), it by no means negates the universality of the risk algorithm. Quite to the contrary, by following the algorithm step by step, planners are led to some intermediate conclusions that subsequent assessments may not require deeper, higher-resolution analysis because

a top-level utility score can already be drawn. The risk model we present in Chapter Five is built to accommodate any scenario derived from any future, and therefore may contain more steps and structure to higher fidelity than any given scenario may take advantage of.

Risk Assessment in the Solomon Islands Scenario

The final risk assessment in the Solomon Islands scenario must be tailored to this individual example. Figure E.3 lists all policy options

Figure E.3
Solomon Islands Example Exercise: Scorecard for Strategic Risk Analysis of the Solomon Islands Scenario

Policy Tool	COA	Strengths, Limitations, Dangers	Util
Shape incentives	Offer "money for guns" to disarm militants	May encourage people to relinquish arms, but may encourage corruption and put guns back on the streets.	M
Shape assurances	Statement and actions: RAMSI not an occupation force	Would instill confidence and build trust; would seek to ultimately put power into the people's hands.	H
Shape nonmilitary engagement	Humanitarian aid and relief efforts; NGOs	Would alleviate suffering, but alone would not curb violence. NGOs are not a permanent solution.	M
Shape nonmilitary engagement	Multinational aid in infrastructure reform: institution building, laws, organization	Essential, but cannot be done before militias are neutralized. Put early emphasis on reforming police and restoring public confidence in law and government.	H
Shape indirect military engagement	Information gathering—cross-breeding information across agencies	Again, this is necessary to bring criminal organizations and militias down and bring those who commit violence to justice.	H
Shape indirect military engagement	Train, advise, equip, and aid local police forces	A central component to permanently halt violence and restore public confidence. Warning: RAMSI personnel must behave responsibly and only in a supporting role to the RSIP.	H
Shape direct military engagement	Show of power via exercises and visible air and naval assets	Would signal RAMSI's commitment, but must be careful to convey competence rather than aggression.	M
Shape direct military engagement	Engage hostile militias, insurgents, criminal gangs, etc.	Necessary but risky: may politicize by "choosing sides." Must try to engage with as little force as possible; treat all militants equally.	M
Overall Risk Score			
Inaction	P(harm) = 1 M_1(harm) = M	Action	M_2(harm) = L

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assessed to have a probable utility in the RAMSI effort and estimates magnitudes of harm for the strategic risk analysis of this scenario.

The probability of harm in this scenario can be thought of in two different ways, both of which lead to the same outcome: (1) harm to the Solomon Islanders is already a certainty due to the preexisting corruption and violence committed against them by militant groups, and (2) that Blue would "engage" is, for the most part, ensured as soon as Prime Minister Kamakeze initiated outside assistance. The corruption and violence in the Solomon Islands do not fundamentally threaten Australian security. Australia does, however, see itself as a regional leader with responsibilities to use its power to meet humanitarian needs and contribute to peacemaking missions. Furthermore, if the situation in the Solomon Islands spiraled downward, it might undermine regional stability and create refugee or other humanitarian crises. So here the assessment of probability is certain (i.e., $P = 1$), and though the first magnitude score is meant to measure harmful dynamics of the scenario without Blue intervention, it is still worthwhile to evaluate it as a baseline against which one can measure the second magnitude score.

A senior leader may then ask him- or herself, If the militant groups and weak governance in the Solomon Islands goes unchecked, what is the magnitude of harm to Australian interests? Without intervention, the already persistent violence could worsen, perhaps even leading to an all-out civil war, and, in this case, the blow to Australia's image as a regional leader would be nontrivial. We rate that magnitude as moderate ($M_1(harm)$ = M). To score $M_2(harm)$, the senior leader must then determine how well positive shaping options, as offered up by the options analysis, can mitigate this moderate level of harm. The abundance of good utility scores speaks to the fact that RAMSI has the potential to greatly improve this magnitude score. If RAMSI's efforts can successfully gain the trust of the native population, project a sense of competence without being overly forceful, and bring some of the most nefarious criminals to justice without overt or excessive force, then there is no reason to believe that RAMSI cannot push this magnitude-of-harm score all the way down to 0. However, even with so many viable shaping options, some level of uncertainty always exists between strategies and the implementation of those strategies. There-

fore, we take the slightly safer bet and score the second magnitude of harm as low ($M_2(harm)=L$).

Conclusion

The Australia-led RAMSI intervention in the Solomon Islands offers a good template for assessing strategic risk in a regional instability threat environment. Just as in the China-Taiwan example, the reader can see how the risk engine framework supports both the evaluation of given strategies by piecing them out into tasks and actions and the identification of alternative strategies to confront the scenario-based threat. This algorithm supports users at every level of the planning process; each step offers more resolution and insight into the scenario nuances, while the final risk-assessment step offers a clear and meaningful way for senior leadership to communicate thoughts and judgment on overall risk.

Lastly, it should be noted that one can certainly go through more rigid threat, deter, and defeat analyses of the Solomon Islands example to mirror the steps executed in the China-Taiwan study (Appendix D); however these exercises would be less interesting given the circumstances on which Australia and RAMSI have been asked to act. Most importantly, we must again emphasize that the omission of higher-order threat, deter, and defeat assessments in no way invalidates our risk engine model. In general, because one application does not fully employ all a model's variables and inputs does not imply that the framework is unfit. Only the final output matters, and to this end, our risk engine succeeds. To draw a parallel with fully analytic mathematical models, certain assumptions and priors may be interpreted as "zero" inputs.[3]

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[3] See, for example, Henry H. Willis's model in *Capabilities Analysis Model for Missile Defense*, Santa Monica, Calif.: RAND Corporation, TR-218-MDA, limited distribution, 2006a. Here, an immature technical component carries a zero weight in subsequent calculations (p. 15).

APPENDIX F

The Parade of Terribles and Threat Taxonomy

This appendix contains the complete listing of challenges and threats in the "parade of terribles" compiled by the study team from various unclassified sources, as described in Chapter Three. The second section presents a listing of the challenges sorted according to the taxonomy of threat types, also described in Chapter Three.

The Parade of Terribles

The following is the complete list of challenges and threats compiled primarily from our survey of high-level unclassified sources described in Chapter Three. The source(s) of each challenge is provided at the end of each item. The individual threats and challenges are presented in no particular order.

- Tsunami inundates coastal areas (QDR[1]).
- Hurricane causes storm damage and flooding (QDR).
- Earthquake causes damage and death (QDR).
- Transnational terrorist networks attack the United States and its allies (NMS,[2] QDR, International Institute for Strategic Studies [IISS][3]).

[1] DoD, 2006a.

[2] Office of the Chairman of the Joint Chiefs of Staff, 2004.

[3] International Institute for Strategic Studies, 2006.

- Drug cartels subvert Colombia (QDR).
- Political violence erupts in Haiti (QDR).
- Venezuela threatens Colombia (IISS).
- Democracy erodes in Russia (QDR).
- Proliferation of nuclear weapons (NMS, QDR).
- North Korea exports nuclear technology to Iran (RAND[4]).
- Failure of Iraqi state leads to civil war (IISS).
- Turkish and Iranian forces enter Kurdistan to suppress Kurdish independence movement (IISS).
- Taliban and drug lords threaten Afghanistan's future (IISS).
- Al Qaeda attacks United States or its allies with nuclear weapon (QDR).
- Al Qaeda attacks United States or its allies with biological weapon (QDR).
- North Korea attacks Japan with nuclear weapon causing EMP (RAND).
- China blockades or invades Taiwan (QDR).
- Islamic rebels seize nuclear weapons in Pakistan (RAND).
- Iran sponsors terrorist attacks in Middle East and attacks U.S. forces with nuclear weapon causing EMP (RAND).
- States combine technologies from multiple sources into new capabilities—for instance, SAMs and fire-control systems (HASC CDR[5]).
- Regional powers use large numbers of ballistic missiles against forward bases and deny access (HASC CDR).
- Some states may use EMP weapons (HASC CDR).
- China uses force against Taiwan, including use of ballistic missiles against airfields (HASC CDR).
- North Korea threatens peace and stability on the Korean peninsula and has an interest in intercontinental ballistic missiles (HASC CDR).
- Islamic Republic of Iran attacks shipping in the Persian Gulf using submarines, sea mines, and fast boats (HASC CDR).

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[4] Various RAND brainstorming sessions.

[5] U.S. House of Representatives, 2006.

- Al Qaeda conducts a terror campaign on U.S. soil; targets include symbols of national power and key economic arteries (HASC CDR).
- Radical Islam attempts the violent overthrow of the international system (HASC CDR).
- Other states attack U.S. space systems—for example, by jamming, anti-satellite weapons, standoff weapons, or detonation of nuclear weapons at high altitude (HASC CDR).
- Other states or cyberterrorists attack U.S. cyberassets (HASC CDR).
- Terrorists, possibly sponsored by Iran, Syria, or North Korea, attack the United States with nuclear or biological weapons (HASC CDR).
- Near-peer competitor conducts a large nuclear assault on U.S. cities (HASC CDR).
- Terrorists conduct small biological attack in an urban area, resulting in 1 million fatalities (HASC CDR).
- Conflict requires U.S. forces to conduct peacekeeping, stability, and reconstruction operations (HASC CDR).
- Response to natural disasters require resources of the U.S. military (HASC CDR).
- Hurricane strikes a densely populated area on the East Coast (HASC CDR).
- Earthquake strikes Southern California or San Francisco area (HASC CDR).
- Earthquake strikes lower Mississippi Valley, causing flooding (HASC CDR).
- Global pandemic produces a staggering death toll and causes travel and trade to drop precipitously (HASC CDR).
- Rogue nation or nonstate actor employs nuclear weapons or "dirty" radiological bombs (HASC CDR).
- Terrorists find safe harbor in ungoverned spaces and from state sponsors of terrorism (HASC CDR).
- Extremists might gain control of Pakistan's nuclear weapons (HASC CDR).

- Iran closes or seriously disrupts shipping in the Strait of Hormuz temporarily and threaten neighbors (HASC CDR).
- North Korea invades South Korea with conventional forces (HASC CDR).
- United States and China have military confrontation over Taiwan (HASC CDR).
- Chinese develop submarine-launched cruise missiles (HASC CDR).
- Chinese develop ballistic missiles with "steerable" warheads (HASC CDR).
- Chinese develop sophisticated integrated air defense systems (HASC CDR).
- Regime collapse in Pakistan leads to loss of control over nuclear weapons (HASC CDR).
- Enemy detonates a nuclear weapon in low earth orbit causing all satellites in that orbit to cease to function within four to six months (HASC CDR).
- Insurgency continues in Iraq (NSC: Victory in Iraq[6]).
- Terrorists attack oil facilities in Saudi Arabia, Mexico, and Venezuela (RAND).

Taxonomy of Threats

The following is a listing of challenges from the "parade of terribles" sorted according to the taxonomy of threats developed in Chapter Three. Some of the threats were rephrased slightly for the sake of brevity. Others were combined with similar-sounding threats to eliminate duplication.

Natural Disasters Cause Humanitarian Emergencies

- Tsunami inundates coastal areas (QDR).

[6] National Security Council, *National Strategy for Victory in Iraq*, Washington, D.C., November 2005.

- Hurricane causes storm damage and flooding (QDR) .
- Hurricane strikes a densely populated area on the East Coast (HASC CDR).
- Earthquake causes damage and death (QDR).
  - Earthquake strikes Southern California or San Francisco area (HASC CDR).
  - Earthquake strikes lower Mississippi Valley, causing flooding (HASC CDR).
- Global pandemic produces a staggering death toll and causes travel and trade to drop precipitously (HASC CDR).

States Fail During Internal Conflict

- Political violence erupts in Haiti (QDR).
- Failure of Iraqi state leads to civil war (IISS).
- Conflict requires U.S. forces to conduct peacekeeping, stability, and reconstruction operations (HASC CDR).
- Islamic rebels seize nuclear weapons in Pakistan (HASC CDR, RAND).

Terrorists Attack U.S. and Allied Interests

- Al Qaeda attacks United States or its allies with biological weapon (QDR, HASC CDR).
- Al Qaeda attacks United States or its allies with nuclear weapon (QDR, HASC CDR).
- Al Qaeda employs "dirty" radiological bomb (HASC CDR).
- Al Qaeda conducts terror campaign in United States, attacking symbols of national power and key economic arteries (HASC CDR).
- Cyberterrorists attack U.S. cyberassets (HASC CDR).
- Radical Islam attempts the violent overthrow of the international system (HASC CDR).
- Terrorists attack oil facilities in Saudi Arabia, Mexico, and Venezuela (RAND).

Insurgencies Threaten Friendly Governments

- Taliban and drug lords threaten Afghanistan's future (IISS).
- Insurgency continues in Iraq (NSC: Victory in Iraq).
- Drug cartels subvert Colombia (QDR).

States Wage Traditional Conventional Conflict

- Turkish and Iranian forces enter Kurdistan (IISS).
- North Korea invades South Korea (HASC CDR).
- Venezuela threatens Colombia (IISS).

States Wage High-Tech Conventional Conflict

- China blockades or invades Taiwan (QDR, HASC CDR) in conjunction with
  - attacks on U.S. satellites (HASC CDR)
  - cyberattacks on U.S. networks (HASC CDR)
  - ballistic missile attacks against forward bases (HASC CDR)
  - ballistic missiles with terminally guided warheads (HASC CDR)
  - submarine-launched cruise missiles (HASC CDR).
  - sophisticated, integrated air defense systems (HASC CDR).
- Iran disrupts shipping in the Strait of Hormuz (HASC CDR).
- Democracy erodes in Russia (QDR).

States Brandish or Use Nuclear Weapons

- North Korea attacks Japan with nuclear weapons, causing EMP (HASC CDR, RAND).
- Iran attacks U.S. forces with nuclear weapons, causing EMP (HASC CDR, RAND).
- North Korea attacks United States with nuclear-tipped intercontinental ballistic missile (HASC CDR, RAND).
- North Korea exports nuclear technology to Iran (NMS, QDR, RAND).

- Near-peer competitor conducts large nuclear assault on U.S. cities (HASC CDR).
- Enemy detonates nuclear weapon in low earth orbit, disabling all satellites in low earth orbit in four to six months (HASC CDR).

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