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NATIONAL DEFENSE RESEARCH INSTITUTE

Analysis to Inform Defense Planning Despite Austerity

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Prepared for the Office of the Secretary of Defense

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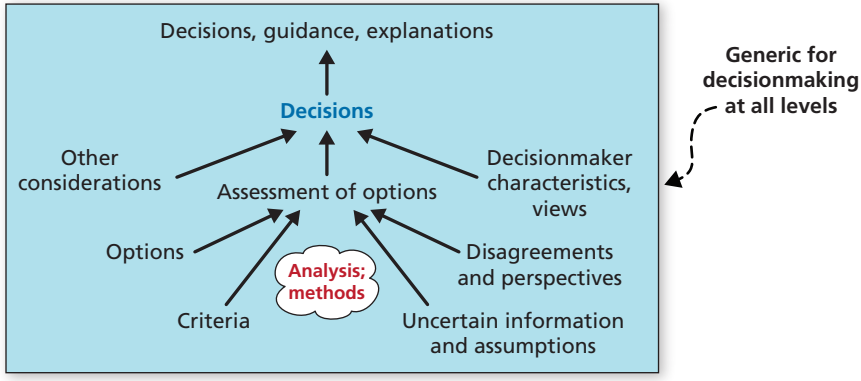
Summary

Overview

This monograph suggests ways for higher-level defense analysis to better serve the needs of policymakers, even in periods of austerity. The suggestions here may be especially significant because current defense planning also has many strategic challenges. A starting point is to see analysis as aiding decisions, as suggested in Figure S.1. Starting at the bottom of the figure, one sees that analysis is not just about evaluating options straightforwardly. Rather, it must (1) ensure that a good set of options are considered, (2) recognize multiple criteria for evaluating options, (3) confront uncertainty about the world, and (4) expect disagreements among policymakers. Despite this complexity, analysis

Figure S.1
Generic Image of Decisionmaking



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should frame and compare options *comprehensibly* with a premium on simplicity and a meaningful "story." Simplifications, however, must be approximately valid. Simplicity is also a relative concept: It may mean describing, at a high level, how options deal with multiple components of a system problem or how they correspond to different ways to balance a portfolio across multiple objectives, including risk-control objectives. Thus, simple should not be simplistic.

The analysis framework should recognize that decisions often depend on considerations beyond what analysis provides. Once decisions are made, analysis should help policymakers to communicate, explain, and convince. It should also help shape implementation guidance with sharpened requirements, forcing functions, and metrics for monitoring, feedback, and adaptation.

To accomplish these aims in a study, *it is wise to plan an analysis campaign*. Experienced analysis managers already do so, but what follows is an enriched conception stemming from the perspective of capabilities-based planning.*

> Capabilities-based planning is planning under uncertainty to provide capabilities for a wide range of modern-day challenges and circumstances while working within an economic framework that necessitates choice.

When done well, then, capabilities-based planning confronts uncertainty and the need to make choices within constrained budgets. Properly understood, it has always considered both generic possibilities and specific threats.

Some of the monograph's guidelines on analysis campaigns will be familiar and even old-hat to readers; others will not be. The intent is to suggest best practices rather than introduce radical ideas, although some ideas were seen as radical not long ago and others may still be.

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* What I describe in this monograph is sometimes referred to as "capabilities-based planning done right" because implementation of the concept has sometimes been troubled (e.g., with complex bureaucratic processes and, ironically, too little emphasis on dealing with uncertainty and making choices). Rather than invent yet a new term, I have opted simply to define my usage. See also Appendix B.

Seeking Flexibility, Adaptiveness, and Robustness

One core theme in an analysis campaign should be confronting "deep uncertainties" such as those spawning what some call "black swan" events. Another is dealing with multiple objectives. The result will inform decisions on how to balance and hedge when planning. Related to this, analysis should include comparing options for their "FARness," i.e., for whether they provide capabilities allowing for

> *flexibility* to take on new or changed missions, objectives, . . .
> *adaptiveness* to new or changed circumstances
> *robustness* to adverse shocks (or even highly positive shocks).

This sentiment goes by such varied names as robust decisionmaking, planning for adaptiveness, and planning for agility.

Regardless of the sticker name, this approach implies *a new professional responsibility for analysts*: Instead of merely listing analysis assumptions, analysts should

- routinely show how results vary with all key assumptions and disagreements—the opposite of focusing on a standardized case and perhaps running a few excursions
- routinely assess options for FARness, showing the value of affordable hedges even in periods of austerity when hedges may seem like luxuries
- do the above *comprehensibly* to aid policymakers in converging on decisions and actions.

The last point is crucial because policymakers need good summaries and will not tolerate hand-wringing about uncertainty or "paralysis by analysis."

Simplicity Versus Depth

An analysis campaign will often need a mix of relatively simple and more complex models. Suitable low-resolution models are particularly

good for "capabilities analysis," i.e., exploratory work varying parameters of the problem simultaneously to generate insights and tradeoffs. Such models also frame problems with the higher-level variables suitable for discussion with policymakers. That is, they provide a story. Higher-resolution models are necessary to understand issues thoroughly, to connect with real-world data and operational activities, and to reflect subtleties. Details often matter, and simplicity is, in a sense, only a necessary fiction along the way.

Breadth

The analysis campaign should provide for *breadth* with a mix of models, human gaming, historical analysis, trend analysis, and collaboration with experienced operators. It should reflect both technology-push and demand-pull. Such breadth can be seen as including—beyond "normal" analysis—lines of activity with features akin to work by the Office of Net Assessment in the Office of the Secretary of Defense (OSD), combatant-commander contingency planners, forward-looking planners seeking to exploit technology, and lessons-learned studies.

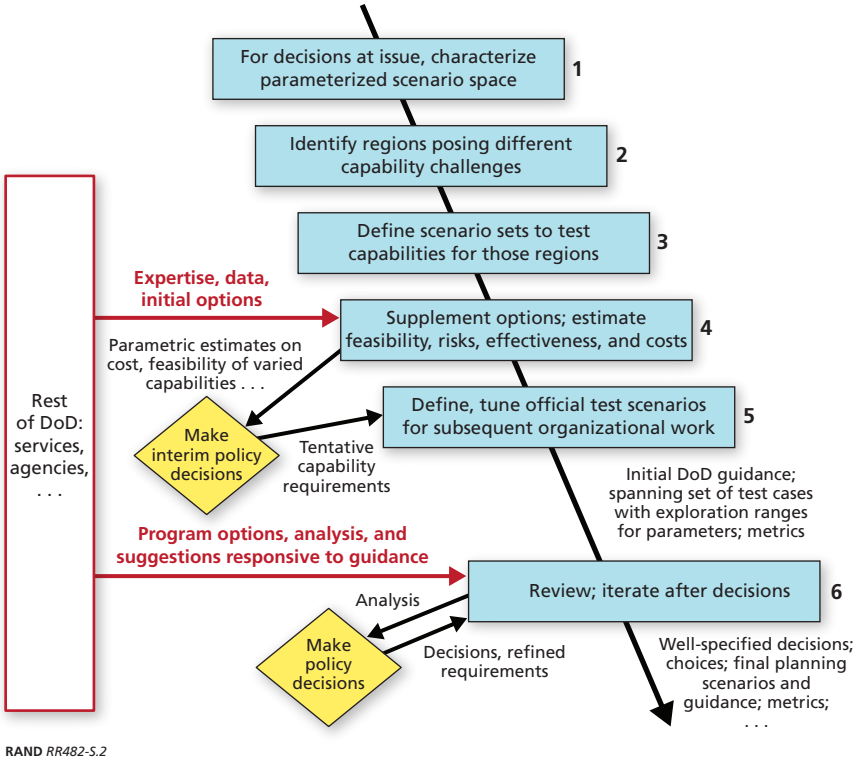
Multiobjective Assessments (Including Risk Management)

An analysis campaign should identify early the many dimensions that need to be considered in constructing and evaluating options. These correspond to multiple study-dependent objectives (including risk-management objectives) in approximate hierarchies of detail. A strategic-level study might have separate objectives for each regional and functional area, as well as such cross-cutting challenges as simultaneous conflicts. It might also have different objectives for the near, mid, and long term. A mission-level study (e.g., of the capability to improve air support of ground-force operations or to improve cyber defenses) might have different objectives for each mission-level scenario with objectives reconsidering military effects, collateral damage, and friendly losses.

Exploratory Capabilities Analysis

The campaign must, of course, include analysis itself. Although analysis organizations commonly focus on scenarios established by policy offices, an important analysis role is to help identify and design possible planning scenarios, discuss implications with policymakers, and subsequently tune the scenarios so that they accomplish what is intended in the rest of the planning process. Figure S.2 describes the desired process schematically, a process with good historical precedents in Department of Defense (DoD) planning over the years. Blue items are analysis tasks that should, however, be accomplished in an *integrated* partnership (not a sequential process) among OSD (Policy), OSD

Figure S.2
Capabilities Analysis to Inform Interim and Subsequent Decisions



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(Cost Assessment and Program Evaluation), the Joint Staff, and OSD (Acquisition, Technology, and Logistics). These offices would have core responsibility, but many aspects of the process should be as open and collaborative as possible, something much valued by all DoD participants. The services would have major roles because of their expertise, knowledge of relevant data, and inherent interests.

Referring to numbered items in the figure, in this approach, analysts take a broad scenario-space view to recognize the many objectives, constraints, and uncertainties (Step 1). This stage of the analysis campaign confronts deep uncertainties. It involves "divergent thinking" that departs from standard thinking in recognizing issues often glossed over. It then discovers how the scenario space breaks the scenario space into regions posing different challenges (Step 2). Depending on the circumstances of a given region, the challenges might involve, e.g., response time, technical capabilities, force size, and plausible but unexpected adversary strategies. The challenges might also be political, economic, or social, as in "complex endeavors" in general or as illustrated in recent wars in particular. The next part of the analysis campaign should be convergent. Analysts can identify representative parameterized scenarios for each challenge region (Step 3). Given suitable models, they can then do first-cut capabilities analysis to estimate what is needed to meet the various challenges as a function of cost (Step 4). Since cost and feasibility depend on the stringency of challenges, parameterizing stringency (i.e., showing implications as a function of stringency) becomes part of the analysis.

The process in Figure S.2 next envisions going to policymakers (top yellow diamond) to discuss what capabilities they wish to pursue further given results of the first-cut analysis. Policymakers then make initial decisions, giving up on some capabilities but pursuing others. That is, they decide tentatively on "requirements." This requirement-setting must be detailed enough to define intent. Thus, analysts translate qualitative desires (e.g., "deter," "achieve an early halt," or "achieve persistent surveillance") into parameter settings within the test-case scenarios to be used subsequently (Step 5). Parameter settings may differ, for example, for evaluation of Program Objective Memorandum

issues, training and exercising, and suggestions to combatant commanders for operational planning.

In response to guidance, the services and defense agencies develop various proposals and evaluate them against the test cases and uncertainty ranges. The results are then reviewed and analyzed (Step 6) to aid decisionmakers in making "final" decisions on forces, weapon systems, and other matters. Given decisions, analysts then adjust prior guidance, test-case scenarios, metrics, and goals accordingly. The process continues and further iteration occurs in subsequent years (not shown).

Table S.1 illustrates capabilities analysis of the sort assumed throughout the process of Figure S.2. It uses a purely notional example of comparing two options for homeland ballistic-missile defense as discussed in Chapter Three, based on prior publications. The message for policymakers is that Option 2 would cost twice as much, but its value would be limited largely to weak threats (the bottom two rows). Given a tight budget, this analysis might suggest proceeding with Option 1 while continuing research and development on the capabilities asso-

Table S.1
Ballistic-Missile Defense Capabilities, by Threat and Objective (Notional)

Class of Threat	Option 1 ($100B)			Option 2 ($200B)		
Objective	Minimum Defense	Moderate Defense	Near-Perfect Defense	Minimum Defense	Moderate Defense	Near-Perfect Defense
Massive attack, near peer	R	R	R	R	R	R
Small attack, near peer; or multiple missiles, advanced rogue	O	O	R	Y	O	R
Multiple missiles; simple rogue	Y	Y	Y	G	G	LG
Single missile; simple rogue	LG	LG	LG	G	G	G

SOURCE: Davis, Shaver, and Beck, 2008.
NOTES: Red = very poor, orange = poor; yellow = medium, light green = good, and green = very good. These capabilities might be quantified in terms of the probability of intercepting a high fraction of attacking missiles.

ciated with Option 2 if they had enough upside potential. The story explaining such a decision would be straightforward from the table. Significantly, this analysis preemptively addresses the natural "what-if?" questions rather than focusing simply on a nominal threat. To some, the analysis would also suggest the need for additional (albeit more expensive) options with greater potential against advanced threats.

In earlier years, the proposed requirement to do such uncertainty-sensitive parametric analysis was resisted by those in analytic organizations, who argued that they were unable to develop and coordinate the massive databases allegedly needed. Their assertion, however, depended on the particular models used and the processes for coordinating data across all DoD stakeholders. The ponderousness of the models and process have not paid their way for higher-level decision-aiding, although they have great value for other purposes as described in the main text. Organizations should modify their analytic tools and processes to permit such capabilities analysis. No excuses should be permitted, since such analysis has long been demonstrated and underlay many of DoD's major capability decisions over the decades.

Developing Capability Models

The "capability models" referred to above (used in Steps 4 and 6 of Figure S.2) can be defined as follows:

> A capability model is a causal model that allows us to understand how the ability to accomplish a mission depends on system variables, circumstances, and goals expressed parametrically.

Such a model contrasts with, say, a large campaign model that describes developments over time in a single scenario with a single set of assumptions represented by scores of parameters and complex databases that are agreed upon but highly uncertain. A capability model can be developed from scratch by someone who understands the problem area, by generating "motivated metamodels" from a more detailed model (Chapter Four), or by using a "big model" (even certain campaign models) with modular, multiresolution features that allow it to be used

for exploration. All three approaches are well precedented. The requisite skills are less common than in earlier years, but there is no shortage of talent—even if some "reeducation" is needed.

A special challenge occurs when the model-building involves social-science considerations. In addition to applying traditional social-science methods (e.g., comparative case studies) to gain insight, several model-building approaches are worth mentioning, as discussed with references in Chapter Four. First, such qualitative models as factor trees and influence diagrams can be valuable in an analysis campaign. Second, some of these can be turned into capability models using recently developed methods. Third, campaign models can include political and economic considerations. If such a model is modular, transparent, vetted, and possessed of some multiresolution features, it would be a good candidate for certain kinds of parametric analysis of social-science issues.

Developing the Options

Evaluating options presupposes having options to evaluate. An analysis campaign should provide a suitable range of options as part of Step 4 in Figure S.2. For higher-level analysis (e.g., for the Secretary of Defense), this will include creating composite options from lower-level building blocks. The composite options should attend, to a greater or lesser degree, to all of the objectives that must be addressed. The effort to provide such options could include the structured use of independent experts, human gaming, and requests for information from industry. Some of this should be technology-push in nature and may call for major changes. Such efforts are especially important in periods of austerity when doing more with less will typically require a combination of using technology and changing both concepts of operation and organizations. The options arising in more usual ways may be less imaginative, call for unacceptable dropping of important missions, or have organizations clinging to as much of their legacy structure as possible, rather than cutting even more so as to leave room for innovation. This problem is familiar to DoD currently.

At a more technical-analytic level, Chapter Five describes a new analytic method that can generate a vast number of options and then filter for only the small subset that are potentially attractive in the multiobjective, uncertainty-laden context. The method generalizes classic "efficient-frontier" methods to deal with uncertainty and multiple objectives.

Putting It All Together: Portfolio Analysis for Integrative Decision Support

The last part of the analysis campaign should "put things together." A natural mechanism is portfolio analysis of options that vary in how they use mixes of instruments to address multiple objectives while working within a budget. The analogy is to having alternative portfolios of such financial instruments as stocks and bonds to deal with such multiple objectives as long-term capital gain and reliable current income. For DoD, options may differ in the relative emphasis on ground, air, or naval forces, in the relative emphasis on different regional and functional theaters of operation, in the relative emphasis on short-term and longer-term problems, and so on. Striking the right balance (which does not imply evenness) is the challenge for the Secretary of Defense, President, and Congress.

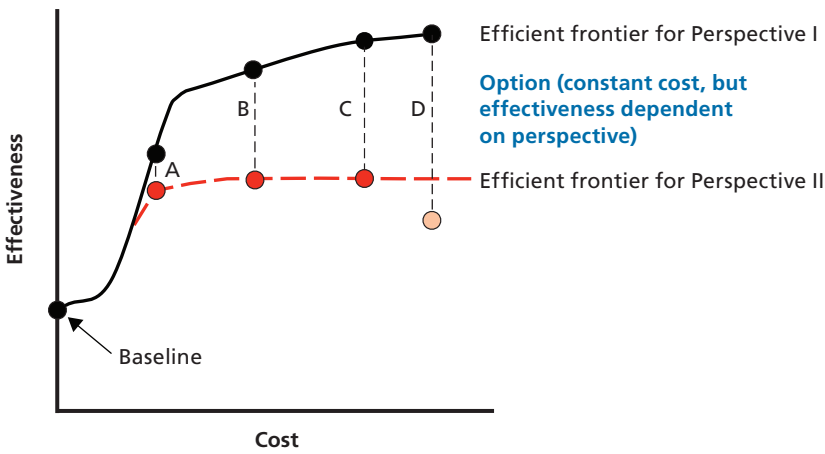
Analysis should therefore discuss strategic options so that policymakers can see how the options deal with the various objectives (including risk-control objectives) and how much they cost. This suggests the use of policy scorecards (even the sometimes-maligned stoplight charts) rather than the kinds of bar charts or graphs appropriate in other types of analysis. It is crucial, however, that policymakers *understand* why the options perform as shown in the scorecards. They must be allowed to ask, e.g., "Why is Option 2, which I like, performing so poorly against Objective D?" They should be able to zoom in—even within a briefing context—to see the underlying logic. The zoom may bring up another scorecard that allows visual explanation at a glance. For example, the evaluation may depend on several factors, most of which are favorable, but one of which is a "killer," such as

excessive vulnerability to a countermeasure or excessive dependence on a notoriously unreliable ally. If the policymaker asks about changing an assumption (e.g., the weight given to a worst-case scenario), analysts should be able to draw on their previous capabilities analysis to show tradeoff curves or other responsive depictions.

Most top officials will use the zoom option only rarely, as in testing the mettle of staff or depth of analysis, or because of concerns about a particular issue. Deputies and staff, however, will often go into substantial detail. Further, experience shows that structuring the analysis campaign to generate material for such a layered presentation of results is an excellent way to ensure solid credible analysis.

Once policymakers have made choices, analysis can help to tidy and simplify. As one example, they can define a composite measure of effectiveness and generate cost-effectiveness charts as shown schematically in Figure S.3. This represents the aggregate significance of major uncertainties and disagreements as one compares investment Options A, B, C, and D. The effectiveness of each depends on underlying assumptions that are assumed to cluster in two "strategic perspectives." Perhaps Perspective I reflects an emphasis on technology-push, the

Figure S.3
Cost-Effectiveness Landscape, by Strategic Perspective



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future, and optimism that friendly developments will outpace counters. Perspective II might be more near-term oriented, might believe that the capabilities of Options B, C, and D could be readily countered, and might believe that Option D has a concept of operations that would be counterproductive. The perspectives agree only that Option A is well worth the investment. As a variant, even someone with Perspective I might agree, if funds were tight, to stop with Option B. The example is notional, but dramatic differences across perspective have been demonstrated in past studies as cited in the main text.

Next, we come to implementation. The same capabilities modeling discussed above identifies key parameters and metrics at different levels of detail. It should allow analysts to fine-tune the nominal parameter settings and ranges in the test-case scenarios and to define metrics for follow-up monitoring and adaptation. This is no small matter, since it is common for organizations to generate metrics in more ad hoc ways, which often creates confusion and counterproductive incentives.

To wrap up (see also Table 7.1 in the main text), the monograph describes an approach to dealing effectively with uncertainty. The approach envisions demanding more from higher-level analysis and analysts, particularly routine evaluation of options for flexibility, adaptiveness, and robustness, and also finding simple but credible ways to aid decisionmaking, explaining decisions to and convincing others, and defining implementation plans with metrics. All this will require new analytic methods with reduced dependence on detailed models and massive databases, although those should remain important for establishing the common base of knowledge and for integrative work. The approach urges streamlined processes in which select analysts from OSD (Policy), OSD (Cost Assessment and Program Evaluation), the Joint Staff, and OSD (Acquisition, Technology, and Logistics) work together rather than sequentially. They would, of course, continue to depend heavily on the services and combatant commands for expertise and suggestions.