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# TECHNICAL REPORT

## Lessons from RAND's Work on Planning Under Uncertainty for National Security

Paul K. Davis

Prepared for the Office of the Secretary of Defense

Approved for public release; distribution unlimited



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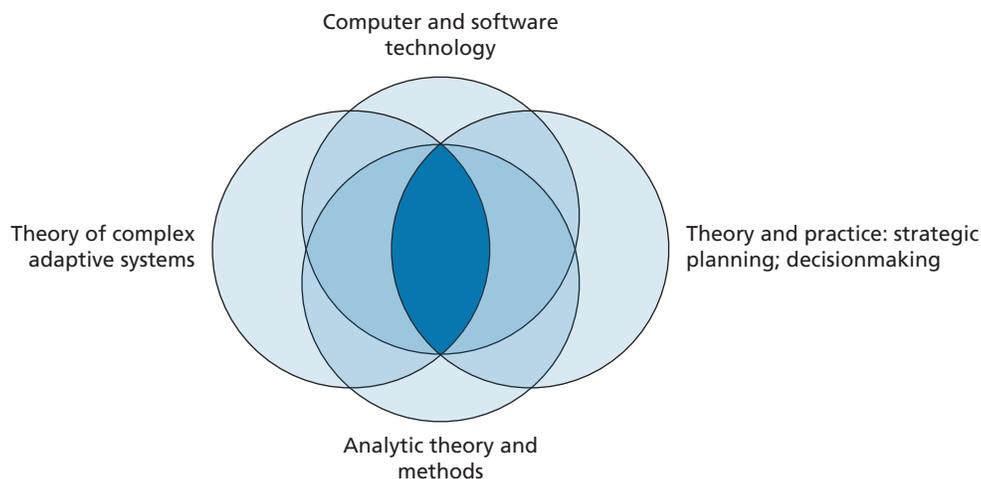
## Summary

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RAND's progress in dealing with uncertainty analysis for national security has benefited from a confluence of developments in four domains, as indicated in Figure S.1. Most familiar perhaps is technology: modern computers and software allow analysis that would have been inconceivable in the early days of systems and policy analysis, such as examining a vast possibility space when considering options for the way ahead. Technology, however, is only an enabler. Developments in understanding strategic planning and decisionmaking, and in analytic theory and methods, have also been fundamental. These, in turn, have been influenced by insights from the theory of complex adaptive systems, which recognizes that behaviors of such systems can be inherently difficult or impossible to predict with confidence. Nonetheless, the behaviors can often be analyzed, anticipated, nudged, and occasionally even controlled.

Much of the paper focuses on “deep” uncertainties, that is, important uncertainties that cannot be adequately addressed by normal versions of sensitivity analysis or probabilistic analysis. RAND's work has emphasized the following: facing up to deep uncertainty in many dimensions; performing exploratory analysis of the possibility space (also called scenario space); identifying regions of that space that pose special risks or opportunities; finding options

**Figure S.1**  
**Confluence of Influences**



RAND TR1249-S.1

to improve capabilities; and using portfolio analysis to conceive and compare strategic options for dealing with the diversity of challenges in an economically acceptable manner.

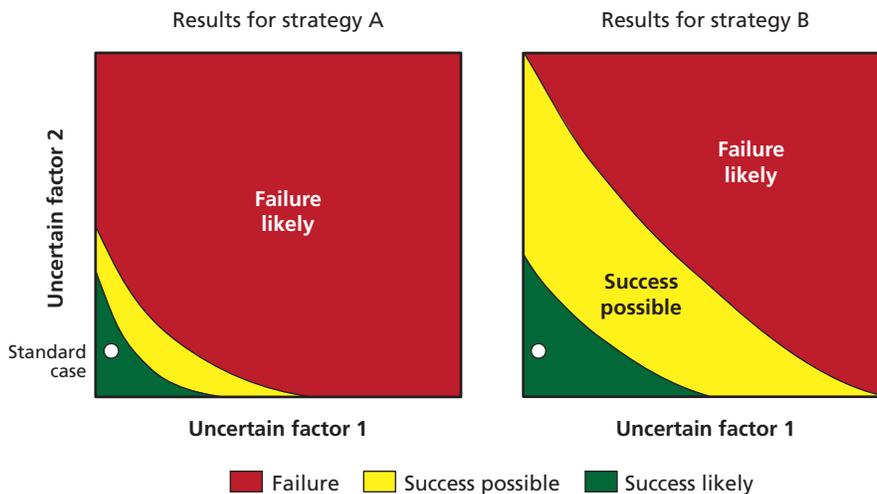
A cross-cutting theme (the “FARNess principle”) is that strategies should provide: future flexibility for taking on different missions or objectives, adaptiveness to deal with unanticipated circumstances, and robustness to shocks such as unanticipated adverse events. RAND authors often use “planning for adaptiveness” or “robust decisionmaking” (with a different meaning of “robust”) to cover all elements of FARNess.

To illustrate this core philosophy with a simple example, Figure S.2 assumes two primary uncertainties, which creates a two-dimensional possibility space. How well a strategy will perform depends on the situation that actually arises, which could be anywhere in the space. Both strategies A and B are likely to succeed in a standard case (the point in the lower left, which is in the green area indicating likely success), but strategy B (right pane) is more likely to be successful or at least to make success possible (depending on other factors) in a much larger portion of the space (green and yellow regions) than is strategy A. That is, strategy B is more robust to uncertainty.

Ultimately, different problems call for different approaches to uncertainty. This is illustrated in the main text for applications to strategic planning, acquisition management, logistics, personnel management (manpower research), crisis decisionmaking, and organization and management. Looking across the research discussed, several themes stand out:

- Uncertainty analysis requires both creative, divergent work to understand the range of possibilities, as well as more convergent work to assist decisionmakers in conceiving and choosing among strategies. In both phases, there is need for both human-intensive work (e.g., brainstorming, gaming, and judgment) and more analytical methods, including computational discovery.

**Figure S.2**  
**Comparing Strategies A and B Across a Range of Conditions 1 and 2**



- Also, there is need for both theory-driven and data-driven approaches. Indeed, competition between such approaches can help stimulate progress.
- Experimentation and iteration are often crucial for uncertainty reduction and discovery.
- In practice, strategy will often be revisited and modified over time, despite the common assumption of once-and-for-all decisionmaking. Where possible, planning should anticipate the need for particular adaptations and identify signals that should trigger them.
- Because major surprises will nonetheless occur, planning should also provide general capabilities and organizational agility that allows for immediate adaptations to unanticipated developments. That is, part of good planning is ensuring the agility to “cope.”
- Policymakers should demand analysis that aids them in finding strategies that lead to flexibility, adaptiveness, and robustness (in short, “robust strategies” or what some call “agile” capabilities). This would be quite different from settling for best-estimate analysis and a list of assumptions.

To elaborate on the last item, a common concept of good analytic practice for dealing with uncertainty when reporting to a policymaker is to show key assumptions, watch for the policymaker to acknowledge the assumptions, and then present results. Unfortunately, even if policymakers know the assumptions and believe them to be reasonable, the approach is inadequate. The appropriate standard for analysts should also include the following:

- Being sure that omitting considerations because of uncertainty does not critically affect study conclusions.
- Being sure that conclusions identify reasonable ways to hedge against consequences of uncertainty, to include preparing for adaptation.
- Sensitizing policymakers to the importance of such hedging, which is more valuable than final increments of fine-tuned optimizing for the baseline case.

The somewhat radical vision of RAND authors here is for policymakers to agree with this and then require their organizations to follow a corresponding analytic doctrine.