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Abstract: Strategic uncertainty is the disparity between what one knows, and what one needs to know in order to make a responsible decision; it permeates defense decision-making. Because of strategic uncertainty, planners must maximize the robustness against surprise in striving to achieve critical goals. This article describes the decision methodology known as "robust-satisfying" and the integration of this method with other military decision-making processes.

Flipping a fair coin has equal chance of getting heads or tails. Rolling a balanced dice has equal probabilities for each of six known outcomes. But if we take this into the realm of strategic decision-making and consider the 2002 assessment of Iraqi capability with Weapons of Mass Destruction (WMD), how many outcomes should we ponder: what are they and what are their likelihoods? One might say the answer is binary: "Either they do or they do not have WMD." Or, perhaps we should consider multiple possibilities: "They have small (or large) quantities, they are (or are not) developing more, and they intend to use it (or not)." It is as though we are rolling dice without knowing how many faces each die has, and whether or not each is balanced for equal probabilities of all outcomes. This is essentially the problem every strategist faces, and the one this article proposes to address.

We often are justified in thinking probabilistically and in saying something is very likely. For example, Stalin's military advisers in 1941 claimed a German invasion of the Soviet Union was very likely. The advisers had reconnaissance evidence, captured documents, and more.[1] Most analysts (though not Stalin) readily acknowledged the complementary assertion – Germany is not about to invade Russia – was very unlikely.

In binary logic, an assertion is either true or false. If we know an assertion is true, then we know the negation of that assertion is false. There is an "excluded middle" in binary logic. The excluded middle rules out the possibility an assertion is both true and false. Probabilistic thinking is an extension – to the domain of uncertainty – of the binary thinking of pure logic: If we know an assertion is highly probable, then we know the negation of that assertion is highly unlikely. An assertion and its negation cannot both be highly likely when using probabilistic reasoning.

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1 Richard Overy, *Why the Allies Won*, 2nd ed. (London: Pimlico, 2006), 80.

In strategic affairs, we often do not know enough about the situation to exclude the middle as we routinely do in binary logic and in probabilistic thinking. The British during World War II could have viewed the assertion that Germany was trying to build an atomic bomb as "quite likely" (indeed they were). Otto Hahn, who was a war-time professor in Berlin, had visited Enrico Fermi during the latter's experiments with uranium in the 1930s, and Hahn won the 1944 Nobel Prize in Chemistry (awarded in 1945) for his discovery of fission of heavy nuclei.[2] But one could argue the Nazis abjured "Jewish physics," such as relativity and quantum theory, and therefore it is "quite unlikely" Germany would try to exploit this physics in order to build an atom bomb. Indeed, the Nazis never pursued nuclear weapons as enthusiastically as the Allies.

If one needs to say an assertion is both quite likely and quite unlikely, one must abandon the binary structure of probability. This need arises quite often in strategic affairs. One reason is conflicting intelligence reports are common, as the Prussian military thinker Carl von Clausewitz emphasized.[3] Another reason is we often are unaware of, or do not understand, new doctrinal or technological possibilities. For instance, the possibility and implications of massive infantry use of hand-held Sagger anti-tank ordnance surprised the Israelis in the Yom Kippur War, despite their experiences with similar missiles both as users and as targets.[4] Furthermore, prediction is always difficult, especially in war. For example, P.M.H. Bell discusses the unpredictability of Stalingrad as a turning point in the war, whose outcome was uncertain even in 1944.[5]

The uncertainty confronting the strategic planner is often less structured and less well characterized than probabilistic uncertainty. We will define strategic uncertainty as *the disparity between what we do know and what we need to know in order to make a responsible decision.* Strategic uncertainty is a functionally important information-gap, and it has two elements. First, the domain of possibilities is unbounded and poorly characterized. This is different from probabilistic uncertainty where we know the domain of possible outcomes (even though this domain may be huge and complex). The second element of strategic uncertainty is that it is functionally important because it impacts the outcome of a decision. We are explicitly concerned with outcomes, and with uncertainties that may jeopardize critical goals or may be exploited to achieve desired outcomes.

Doing Our Best: Optimization is Not What it Seems

Managing strategic uncertainty is difficult. The successful response to strategic uncertainty is to acknowledge it and to struggle with it, but to recognize that strategic uncertainty is ineradicable.

The pervasiveness of uncertainty has profound implications for what it means to do one's best in many areas, including military

2 Nobelprize.org, "The Nobel Prize in Chemistry 1944: Otto Hahn," http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1944.

3 Carl von Clausewitz, *On War*, Book One, trans. by Michael Howard and Peter Paret (Princeton: Princeton University Press, 1984), 117.

4 Meir Finkel, *On Flexibility: Recovery from Technological and Doctrinal Surprise on the Battlefield*, trans. by Moshe Tlamim (Stanford: Stanford University Press, 2011), 29, 155, 156, 179.

5 P.M.H. Bell, *Twelve Turning Points of the Second World War* (New Haven: Yale University Press, 2011), 95, 231.

strategy. The decision methodology, which could be called outcome-optimization, begins by identifying the best available information, understanding, and insight, including perhaps assessments of uncertainty. We will call this information our knowledge. This knowledge entails information and understanding about friendly and adversarial capabilities, geopolitical constraints and opportunities, terrain, logistics, etc. Outcome-optimization chooses the option whose knowledge-based predicted outcome is best.

Outcome-optimization is usually unsatisfactory for decision-making when facing strategic uncertainty because our knowledge is likely wrong in important respects. Instead, we will advocate the decision methodology of "robustly satisfying" outcome requirements.[6] The basic idea is to identify outcomes that are essential – goals that *must* be achieved – and then to choose the decision that will achieve those critical outcomes over the greatest range of future surprises.

We use our knowledge in two ways. First, to assess the putative desirability of the alternative decisions, and second, to evaluate the vulnerability of those alternatives to surprising future developments. The robust-satisfying strategy is the one with maximal power against strategic uncertainty while satisfying critical requirements. In other words, the outcome will be satisfactory, though not necessarily optimal, over the greatest range of future deviations from our current understanding. Of course, what constitutes a satisfactory outcome can be as modest or as ambitious as one wants.

A simple preliminary example is the robust satisfying response to a surprise attack. The immediate critical goals are to protect and stabilize the attacked force and to assess the strength and deployment of the attacking force. Actions are taken that depend minimally on the limited and uncertain knowledge about the attacker. Uncertainty about the attacker will usually preclude an immediate attempt to achieve an optimal outcome such as annihilating the attacker. Subsequently, the critical goals change and the response evolves accordingly.

Colin Gray expressed something very close to the idea of robust satisfying when he wrote:

> You cannot know today what choices in defense planning you should make that will be judged correct in ten or 20 years' time. Why? Because one cannot know what is unknowable. Rather than accept a challenge that is impossible to meet, however, pick one that can be met well enough. Specifically, develop policy-makers, defense planners, and military executives so that they are intellectually equipped to find good enough solutions to the problems that emerge or even erupt unpredictably years from now. … The gold standard for good enough defense planning is to get the biggest decisions correct enough so that one's successors will lament 'if only ...' solely with regard to past errors that are distinctly survivable.[7]

The goal of the methodology we are calling "robust-satisfying" is to achieve *specified critical objectives reliably*. This is different from attempting

6 Further discussion of ideas in this section are found in Yakov Ben-Haim, "Strategy Selection: An Info-Gap Methodology," *Defense & Security Analysis* 30, no. 2 (2014): 106-119. Robust-satisfying is central in info-gap decision theory. See Yakov Ben-Haim, *Info-Gap Decision Theory: Decisions Under Severe Uncertainty*, 2nd ed. (London: Academic Press, 2006).

7 Colin S. Gray, "War - Continuity in Change, and Change in Continuity," *Parameters* 40, no. 2 (Summer 2010): 6, 9.

to achieve the best possible outcome. Charles Freilich described a closely related idea in analyzing Israeli formulation of military strategy in Lebanon:

> We have thus adopted a different criterion of success as the measure of a DMP [decision-making process]: not the quality of the outcome, but the degree to which decision makers achieved their objectives. The central argument is not that Israel would have achieved better outcomes had the process been better, but that the prospects of it actually achieving its objectives would have increased significantly.[8]

Robustness against strategic uncertainty, or simply robustness, is the core of the methodology we are describing. A strategy is robust to uncertainty if the specified outcome requirements are achieved even if the future evolves very differently from our anticipations. A strategy is highly robust if critical goals are achieved despite great surprise or large error in our understanding. Low robustness means the goals are jeopardized if the future deviates even slightly from the predictions based on our knowledge.

Three components make up an information-gap robust-satisfying decision. The first component is our information, understanding, and insight about relevant situations, what we are calling our knowledge. Second, we specify the goals that must be achieved, without which the outcome is not acceptable or good enough or not distinctly survivable. Third, we identify those aspects of the first two elements – the knowledge and the goals – that are uncertain, about which we might be wrong or ignorant.

These three components – knowledge, goals, and uncertainties – are combined in assessing the robustness of any proposed strategy. The robustness of a specified strategy is the greatest uncertainty that can be tolerated without falling short of the goals. Robustness is the greatest degree of error, in knowledge and goals, which does not prevent achievement of the goals.

First Example: Epaminondas's Feint

We will use the Theban-Spartan Wars of the 4th century BCE as a brief illustration of the method. Keegan describes the situation as follows:

> Thebes won two remarkable victories, at Leuctra in 371 and Mantinea in 362, where its outstanding general, Epaminondas, demonstrated that the phalanx system could be adapted to achieve decisive tactical manoeuvre in the face of the enemy. At Leuctra, outnumbered 11,000 to 6000, he quadrupled the strength of his left wing and, masking his weakness on the right, led his massed column in a charge. Expecting the battle to develop in normal phalanx style, when both sides met in equal strength along the whole front of engagement, the Spartans failed to reinforce the threatened section in time and were broken, for considerable loss to themselves and almost none to the Thebans. Despite this warning, they allowed themselves to be surprised in exactly the same fashion at Mantinea nine years later and were again defeated.[9]

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8 Charles D. Freilich, "Israel In Lebanon—Getting It Wrong: The 1982 Invasion, 2000 Withdrawal, and 2006 War," *Israel Journal of Foreign Affairs* 6, no. 3 (2012): 69.

9 John Keegan, *A History of Warfare* (London: Pimlico, 1994), 258. See also John David Lewis, *Nothing Less than Victory: Decisive Wars and the Lessons of History* (Princeton: Princeton University Press, 2010), 52.

A Spartan robust-satisfying analysis would begin by identifying the Spartan goal. Given the balance of force favoring the Spartans nearly 2-to-1, the goal could reasonably have been routing the Thebans.

One then outlines the relevant knowledge. This knowledge would include intelligence about enemy strength, plans of battle, weapons and tactics, weather, terrain, and so on.

One then identifies the domains of uncertainty, which can be numerous. How confident are we in the intelligence about enemy strength? Might enemy allies be lurking in the region? Is the intended field of battle truly flat and unimpeded?

These three components – the goal, the knowledge, and the uncertainties – are then combined in assessing the robustness to error or surprise of any proposed Spartan plan of battle. This is not a simple task (hindsight is a tremendous aid).

The analysis of a proposed decision centers on the "robustness question" which is: how large an error or surprise can the proposed plan tolerate without falling short of the goal? The question being asked is not "how wrong are we?" but rather "how large an error can we tolerate?" These are very different questions, and only the second question is answerable with our current knowledge. Furthermore, the question is not "what is the best possible outcome?" but rather "what is the most robust plan for achieving our goals?" These questions also differ fundamentally, and the latter is far more relevant when facing strategic uncertainty.

We will not perform the robustness analysis on all the dimensions of uncertainty. We will focus on the Spartan uncertainty about Theban tactics. The standard tactical model, as Keegan explains, was uniform frontal assault of phalanxes leading to close fighting with swords and spears. The robustness question for the Spartans is: how large a Theban deviation from this combat model would deny Spartan victory? If the Spartans were confident that a 2-to-1 force ratio was sufficient for victory, then a local 2-to-1 Theban force concentration entails significant Spartan vulnerability. Given the overall Spartan force advantage, a robust tactic for the Spartans would be to hold significant reserve to either bolster Spartan forces against Theban concentration or to exploit points of Theban weakness.

The point of this example is not to claim that holding force in reserve is a good tactic. The point is the type of reasoning: identify goals, knowledge and uncertainties, and then maximize one's robustness against surprise. Do not ask for the best outcome; ask for the best robustness in achieving specified outcomes (that may be very ambitious). One is optimizing something (the robustness) but not what is often the aim of optimization (the substantive outcome).

Strategic uncertainty motivates the robust-satisfying methodology: optimize one's immunity against surprise, rather than trying to optimize the quality of the outcome. Routing the Thebans on the day of battle is less than a Spartan general might desire: totally destroying their force, their will to fight, their allies' support, the economic base of their future resistance, etc. Routing the Thebans, we suppose in this example, would constitute success or victory or at least be good enough, and the aim of the robust-satisfying analysis is to achieve this outcome as reliably as possible. What one optimizes is the reliability of a good enough outcome (which can be chosen as ambitiously or as modestly as one wants).

The analysis would continue by examining the vulnerability to additional uncertainties and the robustness obtained from alternative plans of battle. The analysis is neither simple, nor fast, nor free of the need for deliberation and judgment. However, the process identifies a plan that will achieve the specified goals over the widest range of surprise by the adversary and error in our knowledge.

Trade-off in Force Development: An Israeli Example

Military planners often face a trade-off, given limited budgets, between the ability to apply force, and the ability to identify threats and targets for that force. Neither alone would be effective. More generically, the trade-off is between different but complementary military capabilities. For example, John Gordon and Jerry Sollinger write that "the Army's essential problem is the changing relationship between air and ground forces at the high-end of the conflict spectrum, especially the appeal stand-off (usually air-delivered) precision munitions have to risk-averse decisionmakers."[10]

The attractiveness of airpower over landpower was illustrated in the Israeli "Defensive Pillar" operation in Gaza (November 14 to 21, 2012). Massive landpower was deployed at the border, but operations were terminated after eight days of precise aerial munition and naval artillery attack without land action. As Lukas Milevski explains in a different context, "Landpower exclusively may take and exercise control," but "landpower, of all tools of power, faces the greatest impediments, risks, and dangers in its use."[11] Critics of Israel's cease-fire pointed out Hamas retained considerable assets – rockets and launchers hidden in civilian areas – that could be destroyed only by invasion. The response to these critics was that invasion would entail significant civilian and military casualties and international condemnation.

Choosing between two options, motivated by the Israeli experience, will illustrate the robust-satisfying methodology in response to strategic uncertainty.[12]

1. Massive investment in aerial delivery systems and instrumented intelligence sources, as well as sensor capabilities for threat detection and munitions control, would enable effective focused use of aerial and artillery power. Landpower is needed only in a supporting role. We will call this option "aerial intel and delivery." This would leverage the strong Israeli hi-tech capabilities.
2. Extensive landpower with supporting airpower are essential for defense and control of territory because Israel has almost no strategic depth separating major civilian populations from international borders, and is thus extremely vulnerable to invasion. We will call this

10 John Gordon IV and Jerry Sollinger, "The Army's Dilemma," *Parameters* 34, no. 2 (Summer 2004): 43.

11 Lukas Milevski, "Fortissimus Inter Pares: The Utility of Landpower in Grand Strategy," *Parameters* 42, no. 2 (Summer 2012): 14.

12 More extensive discussion of this example is found in Ben-Haim, "Strategy Selection: An Info-Gap Methodology."

the landpower option.

An Israeli strategist might reason as follows in selecting between these options, drawing on experience in Lebanon and Gaza over the past decade.[13] We will not present a comprehensive analysis of these operations. We consider a simplified planning problem in order to illustrate the robust-satisfying method for strategic planning. Different judgments might be made in a real-life situation.

The major security challenges in coming years arise from missile bombardment of Israeli cities and towns by non-state actors. The threat of land invasion by a national army is small though not negligible. Consequently, the preferred response by risk-averse elected officials, and due to international constraints, focuses on neutralizing incoming missiles, extensive intelligence on the adversaries' capabilities, and pin-point aerial capability for eliminating enemy assets. In short, the best current estimates indicate a clear preference for the aerial intel and delivery platform over the use of landpower.

However, the best current estimates of future security challenges are highly uncertain. The fluid nature of geo-politics in the region can cause rapid change in the dominant security challenges. Degradation of conventional landpower would be disastrous in the case of major theater war against several regional states. Under-development of landpower could even induce traditional war as deterrence erodes, even though current understanding makes such a scenario unlikely. Unanticipated threats (e.g., attack tunnels or massive rocket capabilities) could necessitate response by ground forces. In short, the most reasonable option – aerial intel and delivery – is also the riskiest given the strategic uncertainty about future political and military developments in the immediate region and beyond.

We now outline the three elements of the robust-satisfying analysis: the knowledge, the goal, and the uncertainties. We then specify two alternative options available to the planner and draw conclusions about robustness and the prioritization of the options.

Our understanding of the situation – the knowledge – is that adversaries have two alternative modes of attack. The much more plausible mode is to support informal non-state actors engaging in frequent but fluctuating missile bombardment of civilian populations. Large arsenals can be provided to these non-state actors, who have high motivation and ability to cause injury and damage and to seriously disrupt civilian life. The much less plausible mode of attack is conventional war with land forces and supporting air power. Major injury and damage would result from unrestrained conventional war.

The goal is to maintain, in the civilian population, a sense of personal security and normality in daily life or, equivalently, to prevent what Shamir and Hecht called psychological exhaustion of the populace.[14] This is operationalized by requiring a low level of loss of life, injury or damage to property. (We ignore other goals in this analysis.)

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13 2nd Lebanon War, 12 July to 14 August 2006; Operation Cast Lead, 27 December 2008 to 17 January 2009. Operation Pillar of Defense, 14 to 21 November 2012. Operation Protective Edge, 8 July to 26 August 2014.

14 Eitan Shamir and Eado Hecht, "A War Examined, Gaza 2014: Israel's Attrition vs Hamas' Exhaustion," *Parameters* 44, no. 4 (Winter 2014-15): 85.

Four issues are subject to strategic uncertainty. First, the likelihood of conventional war seems small but non-negligible and it is imprecisely known. Neighboring countries maintain substantial standing armies with offensive capabilities. Future geo-political developments could quickly change the likelihood of war. What seems implausible might actually be quite likely due to unknown future developments. Second, future missile range, payload, accuracy and quantity employed by non-state actors will improve at unknown rates. Third, instrumented intelligence can greatly enhance weapon effectiveness. However, the extent to which instrumented intelligence provides thorough understanding of the adversary is highly uncertain. The adversary's goals, morale or organization may change in unknown ways. These first three uncertainties relate to the knowledge. The fourth uncertainty is that the civilian population may, in the future, become less tolerant to loss of life, injury or damage. Thus the goal is uncertain.

Having outlined the knowledge, the goal, and the uncertainties, we now specify two alternative options, and subsequently assess their robustness.

The first option, aerial intel and delivery, is designed to reduce drastically the disruption of civilian life from non-state missile bombardment by continuous interdiction of missile attack and by targeted elimination of enemy assets. Supported by solid land capability, the knowledge predicts that this option plausibly provides acceptably low loss of life, injury or damage in response to either mode of enemy attack. Ignoring uncertainty for the moment, the knowledge indicates that this option would be acceptable.

The second option, landpower, is primarily designed to repulse a conventional invasion and to bring the conflict into enemy territory quickly. This option is less effective than aerial intel and delivery against low-level non-state missile attack. Major landpower can be employed to eliminate such activity by invasion and control of territory, but the threshold for action is necessarily rather high. Consequently our knowledge predicts that more loss of life, injury or damage is the plausible outcome of landpower. Again ignoring uncertainty for now, our knowledge indicates that landpower is less acceptable than aerial intel and delivery. If we knew the knowledge to be correct, we would prefer aerial intel and delivery over landpower. Aerial intel and delivery would be the preferred option based on the outcome optimization methodology discussed earlier.

Assessment

We are now in a position to assess the robustness (to uncertainty) of each option, for achieving the goal despite strategic uncertainty in both the knowledge and the goal. The discussion will briefly focus on four general and inter-related conclusions.

First, predicted outcomes are not a reliable basis for selecting an option. Our knowledge is quite likely wrong, so knowledge-based predictions may err greatly and thus are not a reliable basis for prioritizing the available options. Like the Spartans' error in their war against Thebes, it would be an error to suppose that the future can be reliably predicted from the past or from what now looks most plausible.

Selecting aerial intel and delivery because it is predicted, by our knowledge, to yield a better outcome than landpower, is unreliable because the knowledge is uncertain and likely wrong in significant ways. In contrast, the robust-satisfying approach is to select the option that would achieve the specified goals with the greatest robustness against uncertainty in the knowledge.

Second, goals that are more numerous or quantitatively more demanding, are also more vulnerable (less robust) to strategic uncertainty. For example, if the goal is to prevent both civilian casualties and property damage, then more contingencies can prevent achievement of the goal, than if the goal is only to prevent casualties. Similarly, the goal of preventing all civilian casualties can fail in more ways, and is thus less robust, than the goal of keeping casualties below a threshold, say 5 per year. We can summarize this by saying that more demanding and ambitious goals are more vulnerable to surprise. We are not saying that more audacious actions are necessarily less robust. We are saying that striving to achieve more ambitious outcomes can fail in more ways than striving to achieve less. A standard approach – optimizing the substantive outcome – would favor achieving more rather than less. In contrast, the robust-satisfying approach tries to achieve specified goals despite inevitable surprises along the way.

Third, the option that is preferable, based on its predicted outcome, may in fact be less robust than other alternatives for achieving the goal. This was true in the Theban wars, where uniform deployment of the Spartan phalanxes was disastrous for Sparta. The choice between aerial intel and delivery, and landpower, is more complicated. Aerial intel and delivery looks better than landpower because the knowledge predicts better outcomes with aerial intel and delivery. If the goal is very demanding (e.g., no casualties), then aerial intel and delivery may be the only feasible option and it will be more robust than landpower which would not reach the goal even if the knowledge is correct. This has two implications. First, the robustness of aerial intel and delivery for achieving a very demanding goal will be small, so perhaps the goal should be re-examined. The robustness analysis reveals situations in which existing capabilities can't reliably deliver the goals; consequently, the goals may need to be modified. Second, as a goal is relaxed (e.g. accepting greater loss of life or property), landpower becomes more robust against surprise. In short, the robust prioritization of options may differ from the prioritization based on outcome optimization. That is, landpower may be more robust than aerial intel and delivery for achieving specified goals, even though aerial intel and delivery is predicted (by our knowledge) to have a better outcome. Furthermore, the actual choice depends on the goals. Very demanding goals (very low civilian injury and damage) will indicate aerial intel and delivery, while less demanding goals will indicate landpower.

Finally, the analysis identifies and clarifies the implications of central judgments that must be made. The info-gap robust-satisfying analysis is a conceptual framework for deliberation, judgment, and selection of an option.

Conclusion

The future will often be surprising because current knowledge and understanding are incomplete or deficient in functionally important ways. Strategic uncertainty is the disparity between what one knows, and what one needs to know in order to make a responsible decision. Strategic uncertainty permeates defense policymaking and strategic planning.

Planners and decision-makers for strategic issues must do their best, but this does not mean achieving the best conceivable outcome. Political rhetoric aside, strategic planners must identify critical goals – outcomes that must be achieved, without which the result would be unacceptable – and then choose a decision that will achieve those goals over the widest range of surprise. Referring to the aerial intel and delivery/landpower example discussed earlier, we can contrast conventional outcome-optimization, with the proposed robust-satisfying approach. Conventionally one says: Use your best knowledge to predict outcomes, and then adopt the plan whose outcome is predicted to be best. Aerial intel and delivery was predicted to have lower cost than landpower, and thus to be preferred by the outcome-optimizer. However, the prevalence of strategic uncertainty means that our knowledge is wrong is important and unknown ways. This undermines the reliability and usefulness of such predictions. The robust-satisfying approach in choosing between aerial intel and delivery and landpower begins by imagining how our knowledge could err. One then chooses the option that would cause no more than acceptable loss over the widest range of deviation between our expectations and what the future could bring. Because of strategic uncertainty, planners should maximize the robustness against surprise in striving to achieve critical goals. It is unrealistic, and may be irresponsible, to try to maximize the substantive value of the outcome itself.

We described the decision methodology of robust-satisfying and its three components (knowledge, goals, and uncertainties), and illustrated the prioritization of decision options with two examples. The methodology is relevant to many challenges facing the United States.

Consider US coordination with a friendly state, in competition with a neighboring state that can project both land and marine power. A "competitive strategies" model argues that landpower development by the friendly state could threaten the competitor's border and draw the competitor away from maritime competition with the United States. In contrast, a "strategic partnership" model argues that friendly maritime development could assist US efforts to protect the maritime commons against the competitor.

Difficulty in establishing a US policy preference derives in part from uncertainty in the relative validity of these two models. Friendly landpower buildup could, unlike the competitive strategies prediction, drive the competitor to maritime buildup as a path of least resistance for power projection. Or, friendly maritime growth could, unlike the strategic partnership anticipation, lead to re-doubled maritime competition in response to augmented maritime challenges. Strategic uncertainty dominates this policy selection, and weighs against choosing the strategy with the best predicted outcome. The robust-satisfying approach chooses the strategy that can tolerate the greatest error without jeopardizing specified outcome requirements.

A robust-satisfying analysis is readily integrated with other tools for military decision-making. For example, in identifying "prudent risks to exploit opportunities" the commander must "analyze and minimize as many hazards as possible."[15] This hazard analysis can be operationalized by assessing the robustness against uncertain threats. Likewise, assessing the risk of a threat can be based on the estimated "probability of occurrence and the severity of consequences once the occurrence happens."[16] These estimates are uncertain and their robustness to error can be evaluated. Similarly, Courses of Action (COAs) can be compared by using a decision matrix of weights and ratings of each COA for each relevant criterion.[17] The COA assessment can be evaluated for its robustness to uncertainty in these numerical weights and ratings.

Joint Publication 5-0, *Joint Operation Planning*, recognizes that a COA should "provide the most flexibility to meet unexpected threats and opportunities."[18] Flexibility can be assessed systematically in terms of robustness to uncertainty in these threats and opportunities. For instance, the assessment of "advantages and disadvantages" of each COA should include evaluation of their robustness to surprise.[19] Finally, our skepticism about outcome-optimization suggests caution in interpreting the task of defeating "the enemy COA that is of the most concern to the commander."[20] It is usually unrealistic to think that one has identified the most dangerous threat; doing so probably rests on the untenable assumption that the future will mimic the past. Furthermore, countering the most dangerous enemy COA does not guarantee effectiveness against the full range of enemy capabilities because answering the most dangerous threat may not answer other threats at all. A robust-satisfying analysis provides a more systematic approach to the management of strategic uncertainty.

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15 US Department of the Army, *The Operations Process*, Army Doctrine Publication (ADP) 5-0 (Washington, DC: US Department of the Army, May 17, 2012), 14. See also US Department of the Army, *The Operations Process*, Army Doctrine Reference Publication (ADRP) 5-0 (Washington, DC: US Department of the Army, May 17, 2012), 4-2.

16 US Joint Chiefs of Staff, *Joint Operation Planning*, Joint Publication (JP) 5-0 (Washington, DC: US Joint Chiefs of Staff, August 11, 2011), IV-11.

17 Ibid., G-1.

18 Ibid., IV-39.

19 Ibid., IV-37.

20 Ibid., IV-36.