What Strategic Planners Need to Know

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Abstract   Strategic planners need two distinct intellectual capabilities. First, extensive topical or disciplinary expertise, supported by a broad understanding of the world, is needed for dealing with complex subtleties of human affairs. Second, methodological expertise in decisions under uncertainty is needed for dealing with unique situations involving innovation, discovery, and surprise by friend or foe. Three arguments support this claim. First, the need for decision-theoretic expertise in managing uncertainty results from an inherent indeterminism in human affairs as explained by Knightian uncertainty and Shackle-Popper indeterminism. The second argument for a dichotomy of intellectual capabilities is based on the uniqueness of historical circumstance, which often motivates unprecedented behavior. This emphasizes the importance, and the limitations, of topical knowledge. Strategists need both profound understanding of human affairs, and expertise in managing surprise and uncertainty. The third reason is that consensus of intelligence assessment is demanded by decision makers, but pluralism of models is prevalent in complex uncertain environments. We propose nurturing plurality of assessment, and embedding those assessments in the

analysis of robustness to uncertainty. Specifically, for any proposed policy, the analyst evaluates the robustness (of that policy) to uncertainty (plurality) of assessment. A more robust policy is preferred over a less robust policy. The analyst must have both topical expertise in the disciplines underlying the analysis, as well as decision-theoretic expertise in managing uncertainty. We demonstrate this by applying info-gap decision theory, and the concept of robust-satisficing, to intelligence analysis. An example of intelligence analysis prior to 9/11 illustrates the combination of topical and decision theoretic expertise.

1   The Claim and Its Background

Strategic planning in national security often depends extensively on intelligence assessments of potential threats and opportunities. However, Betts (2007, p.50) writes that

> the unresolvable paradoxes and barriers to analytic and decisional accuracy make some incidence of failure inevitable. Concern with intelligence failure then coincides with concern about how policy can hedge against the consequences of analytic inadequacy.

We will illustrate how the method of info-gap robust-satisficing provides a conceptual tool for the strategic planner to manage the limitations of intelligence analysis.

Strategic planners need two distinct intellectual capabilities. First, extensive topical or disciplinary expertise, supported by a broad understanding of the world, is needed for dealing with complex subtleties of human affairs. Second, methodological expertise in decisions under uncertainty is needed for dealing with unique situations involving innovation, discovery, and surprise by friend or foe.[1]

In this section we briefly present three arguments for these two distinct capabilities: limitations of consensus, historical contingency, and indeterminacy in human affairs. In subsequent sections we explain and illustrate the analysis of robustness to uncertainty, based on info-gap decision theory.

1.1   Consensus or Pluralism?

The dependence of high-level decision makers on intelligence assessment, and their limited time for deliberation, create a strong motivation for consensus — rather than pluralism — in the final products of intelligence analysis. However, Jones and Silberzahn (2014) argue that insistence on consensus, along with other factors, was a major cause of the failed assessment in the Cuban missile crisis in 1962, the Iranian revolution in 1979, the collapse of the Soviet Union 1991, and the terror attacks on 11 September 2001. The problem with consensus is that it eliminates legitimate alternative interpretations of evidence that is invariably ambiguous or incomplete.

One can rarely know the full and unique truth about an important strategic situation. One will invariably have diverse alternative models and explanations. As Betts writes (2007, p.101):

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[1]Many ideas in this short essay are developed more fully in Ben-Haim 2016. See also Ben-Haim 2018a.

Single best estimates can be useful, and often uncontroversial, on secondary matters or when leaders do not have well-formed views of their own already, and when their convictions are not already invested. On matters of high politics, however, producing a consensus estimate is likely to be meaningless because it either rests on negotiated mush or will be bloodily contested, in which case politicization in some measure is the essence of the enterprise.

A single specific decision needs to be made even though a single specific understanding of the situation is lacking. Decision theoretic tools are needed to reconcile this discrepancy.

If consensus is useful or sometimes even demanded by the consumer of intelligence, but if consensus is inimical to the quality of intelligence products, then what is to be done? The solution that we propose is to nurture plurality of assessment, and to embed those assessments in the analysis of robustness. Specifically, for any proposed policy, the analyst evaluates the robustness (of that policy) to uncertainty (plurality) of assessment. A more robust policy is preferred over a less robust policy. What the strategic planner provides to the high-level decision maker is a prioritization of proposed policies based on their robustness to the diversity and uncertainty of assessments. In order to do this the analyst must have both topical expertise in the disciplines underlying the analysis, as well as decision-theoretic expertise in managing uncertainty.

1.2 Historical Contingency

The second argument for this dichotomy of intellectual capabilities is based on the uniqueness of historical circumstance. Each strategic planning situation has many unique attributes of culture, geography, technology, ideology, etc. E.g. Britain's counterinsurgency (COIN) strategy in Malaya was, in many respects, quite different from its COIN in Northern Ireland, and both were different from British COIN in Kenya, Brunei, Malaysia, Radfan (Yemen) and Dhofar (in Oman).

Similarly, one day after Mohamed Bouazizi's self-emolation on 17 December 2010, Tunisia was profoundly different from one day before. The entire region was astonishingly different within a few weeks, leading to the "Arab Spring" and the fall of several autocratic regimes in the Middle East. Astonishing surprises occur, requiring expertise in decision making under uncertainty in addition to topical understanding of the specific situation.

Likewise, Erbel and Kinsey (2018) refer to the "logistic-strategic nexus" as the impact of grand strategic plans on the military logistic system, while the logistic system itself constrains strategic options. "As the term 'contingency' makes clear, this process is strongly characterised by incomplete information and uncertainty, turning ongoing appraisals of the geostrategic environment into a series of 'what if' scenarios." (p.522)

There are generic aspects of all conflicts. Nonetheless, conflicts are also characterized by the distinctive history of each national or ethnic group, the uniqueness of each specific social context, and the innovations in response to new challenges. This makes the identification of useful generic rules of strategy difficult. (Clausewitz would agree, as we will

explain in section 4.) It also emphasizes both the importance, and the limitations, of topical knowledge. Strategists need both profound understanding of human affairs and societies, and expertise in managing surprise and uncertainty.

1.3 Indeterminism in Human Affairs

The third argument for expertise in managing uncertainty is based on Knightian uncertainty and Shackle-Popper indeterminism (SPI). SPI provides a generic epistemic framework for understanding historical idiosyncracy and the prevalence of non-probabilistic Knightian uncertainty.

Knightian uncertainty characterizes the surprises that face strategic planners resulting from deception or denial by an adversary (e.g., secrets), and resulting from observations that baffle and confuse us (e.g., mysteries). The prevalence of Knightian uncertainty in human affairs is explained by Shackle-Popper indeterminism.

By 'uncertainty' we mean: ignorance or ambiguity or the potential for surprise. The concept of Knightian uncertainty is fundamental to our understanding of uncertainty in human affairs, and is eminently suited to the task of intelligence as discussed by Phythian (2017). Frank Knight's concept of 'true uncertainty' arises from innovation and initiative of entrepreneurs. In this connection, Knight asserts that "there is no objective measure of the probability" because there is little or no experience with new innovations or initiatives from which frequencies or likelihoods can be learned.(Knight, 1921, pp.46, 120, 231–232. See also Knight, 1933, p.120.) Knightian uncertainty arises from the unbounded potential for future innovation, or simply from ignorance of the vastly complex world. Knightian uncertainty may also arise from deception or denial by an adversary.

G.L.S. Shackle (Shackle, 1972, pp.3-4, 156, 239, 401–402) and, independently, Karl Popper (Popper, 1982, pp.80–81, 109), explained a concept of indeterminism that is related to Knightian uncertainty. Human behavior depends on what people (or groups) know: if you know it will rain then you'll take an umbrella; if you know the enemy has chemical weapons then you'll take a gas mask. However, what will be invented or discovered tomorrow cannot, by definition, be known today. Hence tomorrow's behavior will have an element of irreducible indeterminism today. Knightian uncertainty and Shackle-Popper indeterminism (SPI) imply a fundamental and irrevocable limitation in the ability to predict outcomes in human affairs (Ben-Haim 2007).

Knightian uncertainty and SPI result from material and conceptual innovations, inventions and discoveries that are prevalent in human history, including military affairs. They may be minor tactical innovations such as Rommel's use of anti-aircraft weapons against tanks, or they may be major conceptual innovations like Khrushchev's surprising decision to place nuclear missiles in Cuba.[2] Material inventions such as the tank, or doctrinal innovations such as the use of tanks in Blitzkrieg, can suddenly and astonishingly alter the

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[2]The CIA was thoroughly surprised when missiles where discovered by U-2 spy-plane flights over Cuba in October 1962. See Jones and Silberzahn, 2014.

operational balance of power on the battlefield. In short, circumstances change in ways that often surprise strategic planners. Macgregor writes (2016, p.71):

> How the triumphant Wehrmacht of 1941 was crushed in 1944 is a story of two different military transformations. The first was a German transformation that focused on marginal, tactical changes to an existing World War I army; the second was a Soviet transformation focused on integrating and concentrating combat power on the operational level for strategic effect. Of the two, the Soviet transformation produced a decisive margin of victory.

The German transformation totally surprised the French in 1940, while the Russian transformation did the same to the Germans in 1944. Knightian uncertainty is pervasive and influential and the strategic planner needs tools for managing it.

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So, what do strategic planners need to know? They need disciplinary expertise based on broad understanding of human affairs, together with decision-theoretic expertise in managing uncertainty and surprise. Info-gap robust satisficing, to be described in section 2, provides a versatile conceptual framework for managing uncertainty. An example of intelligence analysis prior to 9/11 is presented in section 3, and we conclude in section 4 by relating our claim to Clausewitz's thought.

2 Info-Gap Robust Satisficing

2.1 Generic Discussion

The decision methodology that could be called "predictive optimization" begins by identifying the best available information, understanding, and theoretical and contextual 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, domestic politics, terrain, logistics, and whatever else is deemed relevant. Predictive optimization chooses the option whose knowledge-based predicted outcome is best.

Predictive optimization is usually unsatisfactory when facing strategic uncertainty because our knowledge is likely wrong in important respects, as explained by Knightian uncertainty and by Shackle-Popper indeterminism. Instead, we advocate the decision methodology of robustly satisficing[3] outcome requirements.[4]

The basic idea of info-gap robust satisficing is to first identify outcomes that are essential — goals that must be achieved — and then to choose the option that will achieve those

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[3]To satisfice means "To decide on and pursue a course of action that will satisfy the minimum requirements necessary to achieve a particular goal." *Oxford English Dictionary,* online version accessed 7.4.2016.

[4]Further discussion of these ideas are found in Ben-Haim 2006, 2014, 2015. References to work of many scholars using info-gap robust-satisficing can be found at info-gap.com.

critical outcomes over the greatest range of future surprise. We use our knowledge in two ways. First, to assess the putative desirability of the alternative options, and second, to evaluate the vulnerability of those options to surprising future developments.

The robust-satisficing strategy is the one with maximal robustness against strategic uncertainty while satisfying the critical requirements. In other words, what is optimized is not the predicted quality of the outcome, but rather the immunity to error and surprise. The outcome will be satisfactory, though not necessarily optimal, over the greatest range of future deviations from our current understanding. What constitutes a satisfactory outcome can be as modest or as demanding as one wants, though the robustness decreases as the demands increase.

The method of robust-satisficing acknowledges that objective knowledge about the world can be obtained. Nonetheless, robust-satisficing also acknowledges that vast domains of reality are unknowable and must be managed decision-theoretically in a way that differs from predictive optimization.

For instance, the predictive optimizer would prefer the option that is predicted to have the best outcome, based on current knowledge. Choice of an option with putatively less desirable outcome would be viewed as perverse or unjustified in light of the best current knowledge. In contrast, the robust satisficer would prefer the option that would achieve an outcome that is acceptable or good enough (though perhaps suboptimal) under predicted conditions and throughout the widest range of surprise or deviation of reality from current knowledge.

Knowledge often includes assessments of likelihood. In this case, the predictive optimizer may prefer the option that has the greatest predicted likelihood to succeed. Choosing an option with lower predicted likelihood of success would again be viewed as perverse or unjustified. In contrast, the robust satisficer would prefer the option that has acceptable or good enough (though perhaps suboptimal) likelihood to succeed according to current knowledge and throughout the widest range of surprise or deviation of reality from current knowledge.

2.2   Evaluating Robustness with Conceptual Proxies

The info-gap analysis of robustness depends on 3 components: our knowledge, our uncertainties, and our goals. These components are combined to prioritize our available options in terms of their robustness against uncertainty. The robustness of an option is assessed as the degree of uncertainty or error in our knowledge up to which that option would nonetheless achieve our goals. In other words, an option is highly robust if it would achieve our goals despite great surprise; robustness is low if even small surprise could prevent achievement of the goals.

In some situations we can evaluate the robustness quantitatively: using numerical data and mathematical models.[5] In other situations we must rely on qualitative analysis that is

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[5]Many examples of quantitative analysis of robustness, based on info-gap theory, have been published. See info-gap.com. See also Ben-Haim 2006, 2010.

often supported by analyzing conceptual proxies for robustness.[6]

We discuss six concepts that overlap significantly with the concept of robustness against uncertainty, and that are useful in the qualitative assessment of decisions under uncertainty. Each of these six concepts emphasizes a different aspect of the overall problem, though they also overlap one another. A decision, policy, action or system is highly robust against uncertainty if it is strong in most or all of these attributes; it has low robustness if it is weak in all of them. In choosing between two options, the robust preference (if there is one) would be for the option that is stronger in more attributes. The six proxies for robustness are defined as follows.

1. *Resilience:* rapid recovery of critical functions. Failures and short-falls are likely, so one should build recovery capability to make one's solutions robust against adverse surprise.

2. *Redundancy:* multiple alternative solutions. "Two is better than one, . . . and the three-fold strand will not quickly break" said Solomon.[7] Robustness to surprise can be achieved by having alternative solutions at hand.

3. *Flexibility* (sometimes called agility): rapid modification of tools and methods. Agility, as opposed to stodginess, is often useful in recovering from surprise. A physical or organizational system, or a policy, or a decision procedure is robust to surprise if can be modified in real time, on the fly.

4. *Adaptiveness:* adjust goals and methods in the mid- to long-term. Be willing to adjust as your knowledge changes. The thought process for managing Knightian uncertainty or Shackle-Popper indeterminism is rarely a once-through procedure. We often have to re-evaluate and revise assessments and decisions. The emphasis is on the longer time range, as distinct from on-the-spot flexibility.

5. *Margin of safety* (sometimes called preponderance): excess of the benefits (and deficiency of the drawbacks) beyond what is actually required. A margin of safety is not a maximum (or minimum); it is a buffer between adequacy and failure, a predominance in number, quality, or importance of relevant attributes.

6. *Comprehensiveness:* interdisciplinary system-wide coherence. The outcome of one's decisions can be impacted by technology, organizational structure and capabilities, cultural attitudes and beliefs, historical context, economic constraints and opportunities, and other factors. Robust decisions will address the multi-faceted nature of the problem at hand.

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[6]See Ben-Haim and Demertzis, 2014; Ben-Haim, 2018b.
[7]*Ecclesiastes,* 4: 9–12.

3   Example: Intelligence Analysis Prior to 9/11

3.1   Al Qaeda: Intelligence Background

There was extensive knowledge about Al-Qaeda prior to the terror attacks against the U.S. on 11 September 2001. Following is a brief summary that will underlie our analysis of robustness of alternative actions that the U.S. could have taken at that time.

Al-Qaeda is a militant Sunni Islamist organization founded in 1988 by Osama bin Laden, Abdullah Azzam, and other Arabs fighting against Soviet forces in Afghanistan in the 1980's. It is a network of sometimes quite independent actors or groups operating in East Africa and the Middle East.

Al-Qaeda demands the removal of all non-Muslim influence in Muslim countries, and the eventual creation of an Islamic caliphate ruling the Muslim world based on a strict form of sharia law. In the tradition of Salafist jihad, killing non-combatants, even Muslims, is religiously sanctioned when in support of the long-range goal. Al-Qaeda's leaders regard liberal Muslims, Shias, Sufis and other sects as heretical. Some Al-Qaeda members believe that a Christian–Jewish alliance is conspiring to destroy Islam.

Six attacks or attempted attacks are attributed to or associated with Al-Qaeda (prior to 9/11).

1. Al-Qaeda operatives bombed the Gold Mohur hotel in Aden, Yemen on 29 December 1992. U.S. troops had been staying there en route to Somalia, though the troops had left before the explosion. An Austrian tourist and a Yemeni citizen were killed. The bombers also attacked a second hotel, the Aden Movenpick, where U.S. Marines had been staying, injuring several non-Americans.

2. The World Trade Center in New York City was bombed for the first time on 26 February 1993, killing six people and injuring 1,500 others. The attack was not an official Al-Qaeda operation though the attack's mastermind, Ramzi Yousef, trained in Al-Qaeda camps.

3. Al-Qaeda operatives bombed the U.S. embassies in Nairobi, Kenya, and Dar es Salaam, Tanzania on 7 August 1998, killing more than 200 people and injuring more than 5,000 others.

4. Al-Qaeda planned to attack the U.S. Navy guided-missile destroyer *The Sullivans* on 3 January 2000 while in port at Aden, Yemen, but the effort failed due to excessive weight on the boat that was intended to bomb the destroyer.

5. Al-Qaeda bombed the U.S. Navy guided-missile destroyer *Cole* on 12 October 2000 while at port in Aden, Yemen, killing 17 sailors.

6. A grenade was thrown at the British embassy in Yemen on 13 October 2000, blowing up an electric generator.

In 1996 the CIA set up a special "virtual station," called Alec Station, intended to focus on Osama bin Laden. The station was in Virginia but not located in the main CIA headquarters at Langley Air Force Base. The first head of Alec Station, Michael Scheuer, reported great difficulty in convincing CIA colleagues of the seriousness of the Al-Qaeda threat to the U.S.

In 1999 Scheuer sent an email directly to the Director of Central Intelligence, George Tenet, and numerous of Tenet's deputies, warning of the Al-Qaeda threat and stating needed actions. This circumvention of the chain of command was viewed as insubordination, and Scheuer was immediately removed from Alec Station and moved to an innocuous job in the Langley library (Jones and Silberzahn, 2014).

Al-Qaeda was mentioned numerous times in the President's Daily Brief (PDB), with a sharp rise in attention to Al-Qaeda during 2001 (prior to 11 September). The PDB of 6 August 2001, entitled "Bin Ladin Determined to Strike in US", contains the first statement that Al-Qaeda intends to attack within the U.S., though it did not provide tactical specifics of when, where or how the attack would occur.[8] This PDB does state that Al-Qaeda "apparently maintains a support structure [in the U.S.] that could aid attacks" and states that a "clandestine source said in 1998 that a Bin Laden cell in New York was recruiting Muslim-American youth for attacks". The PDB also states that "FBI information . . . indicates patterns of suspicious activity in this country consistent with preparations for hijackings or other types of attacks ... [including] attacks with explosives." (PDB 6 August 2001). There was scattered evidence of potentially suspicious individuals attending a flight school in Arizona, but this was not pursued (Betts, 2007, p.107).

3.2 Robustness Analysis

The info-gap concept of robustness combines 3 components: our knowledge, our goals, and our uncertainties. In qualitative applications we assess the robustness by evaluating conceptual proxies, as we explained in section 2.2. We now demonstrate this analysis.

Our **knowledge** is summarized in section 3.1.

The **goal** is to diminish injury or damage to people and property in the territory of the United States. The goal can be stated in varying degrees of severity, from total prevention to minor reduction. We will assume that the goal is to completely prevent, or at least to greatly reduce, injury or damage to people and property in the U.S.

The **uncertainties** are identified by reviewing our knowledge about the plans, preparations, and capabilities of Al-Qaeda to inflict injury or cause damage. Specifically, there is vast uncertainty about *who* will do *what*, *where* and *when*? The *'who'* could be sleeper cells, or rapid incursion of foreign agents, or incitement of U.S. citizens or residents. The *'what'* could be hijacking, planted explosives, attacks with firearms, or attacks with unusual weapons (possibly artillery or WMD), though all 6 known Al-Qaeda attacks employed planted (or in one case thrown) conventional explosives. The *'where'* could be attacks on governmental or military personnel or facilities, or prominent institutions or individuals, or possibly any site with potential for large casualties such as schools or hospitals. The *'when'* could be 6 to 12 months after initial formulation of plans by Al-Qaeda, or possibly sooner or later. The first Al-Qaeda attack (Aden hotels) was in December 1992, and the sequence of subsequent attacks occurred after durations of:

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[8]A redacted version of this PDB was made available on 10 April 2004.

- 2 months (World Trade Center)
- 5 years and 6 months (U.S. embassies in Kenya and Tanzania)
- 1 year and 5 months (*The Sullivans*)
- 10 months (*Cole*)
- 1 day (British embassy in Yemen)

Two of these incidents involved coordinated attacks at separate locations (Aden hotels and U.S. embassies), and one involved attacks separated by only 1 day (*Cole* and Yemen embassy). The last known Al-Qaeda attack was on 13 October 2000, 10 months prior to the PDB of 6 August 2001.

For conciseness we will limit our consideration to the following three **options,** on the assumption that all three will be implemented but with predominant emphasis on only one option. We must choose which option to emphasize.

1. Surveillance and reconnaissance of U.S. Muslim institutions and populations (SRM). Surveillance involves electronic and overt human monitoring, while reconnaissance involves agents who covertly gather information.

2. Enhanced border control (EBC) based on technological and manual inspection, and profiling of suspicious identity or past and present behavior of individuals seeking entry to the U.S.

3. Physical protection of vulnerable sites and individuals (PPS), entailing armed patrols, video surveillance, and communication between units.

We now consider the 6 **proxies for robustness.**

Resilience: rapid recovery of critical functions.

1. SRM will be unable to focus on all Muslim centers or populations, so some important targets will receive low priority due to insufficient resources and due to uncertainty about where threats will originate. Recovery of surveillance is rapid when intelligence is revised by rapidly reallocating surveillance resources. Reconnaissance is slower to recover due to the time required to insert covert agents.

2. EBC can cover all official points of entry, and profiling protocols are considered efficient and can be revised fairly rapidly as experience accumulates. However, implementation of revised procedures, after failure, is slow because this requires re-training a large number of agents. Illegal entry through land or sea borders is far more difficult to detect or prevent because where or how infiltration would occur is unknown, so EBC provides little or no protection in this regard.

3. PPS cannot cover all potential sites or individuals, so some important targets will receive low priority due to insufficient resources and intelligence. Recovery during an incident is sometimes possible. Learning and recovery from one attack, in anticipation of the next attack, is possible but limited by uncertainty about what the next attack will entail.

Redundancy: multiple alternative solutions. SRM entails electronic and human methods, both overt and covert. EBC entails redundant modes of inspection. PPS uses various protection methods. Thus all options have redundancy, each within its own domain: the

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Proxy	SRM	EBC	PPS
Resilience	Low	Low	Medium
Redundancy	Medium	Medium	Medium
Flexibility	Low	Low	Medium
Adaptiveness	High	High	High
Margin of Safety	Low	Low	Medium
Comprehensiveness	Low	Low	Low

Table 1: Summary of proxies for robustness of three options.

U.S. Muslim community (SRM), border vulnerability (EBC), or real-time response to attack (PPS). However, which domain is most vulnerable is uncertain because of uncertainty about what threats must be managed.

Flexibility (agility): rapid modification of tools and methods. All three options entail the use of large numbers of trained agents and units. Re-assignment of agents or units to different targets is rapid in all cases (except the reconnaissance element of SRM which requires inserting covert agents). However, re-training is slow. PPS agents are somewhat more versatile and agile in response to new challenges.

Adaptiveness: adjust goals and methods in the mid- to long-term. All three options entail the use of large numbers of specialized trained agents and units. Re-training is slow and requires long durations but is feasible given the required institutions and budgets. Introduction of new technologies is feasible given appropriate budget. All options are adaptive in the long term. The difficulty is knowing what capabilities need to be strengthened in the light of uncertainty about future threats, for which past incidents are of uncertain relevance.

Margin of safety: preponderance of capabilities. Both SRM and EBC are preventive or preemptive but, unlike PPS, do not provide protection at the time of attack. SRM acquires intelligence that can alert officials or agencies thus enabling preparation and prevention, but lacks real-time response capability. PPS can sometimes delay or retard a strike, even if not preventing it, thus sometimes enabling enhanced response with additional forces. In this sense PPS has some margin of safety, but uncertainty about what specific modes of attack will occur impedes the development of an operational margin of safety. All three options have considerable "porosity", each in its own domain, and will fail at times.

Comprehensiveness: interdisciplinary system-wide coherence. None of the options are comprehensive. SRM would be stronger in this regard if it included programs to encourage integration of Muslim communities into American society and adoption of American values, but this is not included in the current SRM option.

The assessment of the 6 proxies for robustness, for each of the 3 options, are summarized in table 1. All three options have at least moderate redundancy (each in its own domain), and high adaptiveness, but are not strong in any of the other proxies for robustness. PPS has moderate resilience, flexibility and margin of safety, while the other options are low in these attributes. The assessment is that no single option would be robust to the uncertainties that impede the achievement of the goal, so combination is essential. Em-

phasis on PPS in the combined solution seems most robust to the uncertainties, especially if this emphasis would strength the flexibility of the PPS response.

4   Clausewitz

Our argument for supplementing disciplinary expertise with decision theoretic expertise is, in part, a response to Clausewitz's skepticism about the value of theory. His skepticism illuminates the challenge that disciplinary experts face, so we will briefly examine Clausewitz's position.

Clausewitz wrote:

> Efforts were therefore made to equip the conduct of war with principles, rules, or even systems. This did present a positive goal, but people failed to take adequate account of the endless complexities involved. As we have seen, the conduct of war branches out in almost all directions and has no definite limits; while any system, any model, has the finite nature of a synthesis: An irreconcilable conflict exists between this type of theory and actual practice. (Clausewitz, 1832, Book 2, Chapter 2, p.134)

We cannot ascribe to Clausewitz explicit recognition of Knight's concept of true uncertainty. Nonetheless, the unbounded and unstructured nature of Knightian uncertainty is implicit in Clausewitz's statement that "the conduct of war branches out in almost all directions and has no definite limits". As we have explained earlier, the prevalence of Knightian uncertainty is a major motivating factor for equipping strategists with decision theoretic capability.

Likewise, Clausewitz wrote that

> the rules and regulations [of theory] are ... absolutely useless.
>
> They aim at fixed values; but in war everything is uncertain, and calculations have to be made with variable quantities.
>
> They direct the inquiry exclusively toward physical quantities, whereas all military action is intertwined with psychological[9] forces and effects.
>
> They consider only unilateral action, whereas war consists of a continuous interaction of opposites. (op. cit., p.136)

Clausewitz bluntly rejects theory as "absolutely useless" for three reasons: the prevalence of uncertainty, the prominence and limitations of human mental processes, and the nature of strategic interactions with an adversary. Clausewitz would seem to call for extending the strategist's knowledge beyond a specific military discipline, or even beyond all military wisdom, to include a broad grasp of the human condition. War, writes Clausewitz, "is part of man's social existence." (op. cit., Bk 2, Chap. 3, p.149)

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[9]Clausewitz did not use the word 'psychological' though, in modern parlance, that was his intention. The German original of this sentence is: "Sie richten die Betrachtung nur auf materielle Grössen, während der ganze kriegerische Akt von geistigen Kräften und Wirkungen durchzogen ist."

Finally, Clausewitz opines that

> the realm of genius ... *rises above all rules.*
>
> Pity the soldier who is supposed to crawl among these scraps of rules, not good enough for genius, which genius can ignore, or laugh at. No; what genius does is the best rule, and theory can do no better than show how and why this should be the case. (op. cit., p.136, original italics)

Clausewitz distinguishes between descriptive and prescriptive use of knowledge. He asserts that theory can at best describe war, but cannot reliably prescribe actions for the military commander. Only genius can hope to consistently succeed in war. Physical science can successfully predict outcomes and prescribe interventions in the realm of physical phenomena because of the time-invariance and universality of attributes of the physical world. But human affairs, including war, are fundamentally different from the inanimate physical world, as explained by Knightian uncertainty and Shackle-Popper indeterminism. Theory, says Clausewitz, can describe war, but lacks the degree of truth that would enable useful prediction and prescription for the commander. Theory fails prescriptively in war because of the prevalence of innovation, change, and surprise that underlie all human affairs, and that distinguish war from the physical world. In addition to disciplinary expertise (and genius), the military commander needs the ability to model and manage the deep uncertainties of human conflict.

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