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# Effects-Based Operations: The Way Ahead

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## Introduction

The world in which we live is and always has been complex, non-linear, ambiguous, and uncertain, and the most complex and non-linear part of this world is man himself. In spite of this enduring reality, military power and the way in which we use it have tended to focus on providing linear therefore mostly attrition-based solutions to linear warfare problems. Network centric operations exist in this context. They are a means to an end, a tool that can be applied to linear, attrition-based solutions to linear problems that may have little to do with messy, non-linear, "real" world. Or, they can be something more.

Effects-based operations offer an alternative application, one that focuses the power of the network on the most non-linear aspect of combat: human beings and human organizations. In fact, effects-based operations do more than simply address the human dimension of war. They offer a way of applying the power of networking to national power as a whole and not just to major combat but across an entire spectrum of competition and conflict from peacetime deterrence, to crisis response, to hostilities in all their varied forms, to the restoration of peace.

Effects-Based Operations (EBO) are not new. Their ancestry can be traced back to Sun Tzu and effects-based thinking has been evident in the actions of great generals and statesmen throughout history. The way ahead lies not in reinventing these ideas but in applying them to the current security environment and in determining just how the technologies and thinking of information age network centric operations might best be utilized in carrying them out.

## Three "Whys" and a "What"

The impetus toward network centric and effects-based operations is not simply about increasing some ill-defined "combat efficiency." The real driver is the need to deal with a complex and dangerous security environment that demands national and not just military action and mandates a focus on the human dimension of conflict. This driver translates into three "whys".

- *Why #1: The Challenge of Asymmetric Niche Competitors*.

  Although asymmetries are usually defined in terms of size, strategies, and weaponry, the asymmetry that seems most to affect the nature of competition and conflict is that of *will* and *means*. The nature of the Cold War and of the great wars of the last 150 years was driven in large part by a symmetry of will and means between the opponents. Because both sides had the will and the means to regenerate lost armies and navies, no

single battle and no single campaign sufficed to defeat one or the other side, and the conflict became one of physical attrition, gradually wearing down an opponent's physical ability to wage war until the psychological will to do so finally broke. The symmetry of means and will between peer competitors, therefore, tended to drive the conflict toward a struggle that was heavily attrition-based.

In most smaller conflicts, however, a different situation has prevailed. One side, the great power, may have had great means but normally had limited will because it was usually engaged in a far away conflict that did not threaten its homeland. By contrast, the other side, the local power or perhaps insurgency in whose dooryard the conflict occurred, had limited means but what it at least it perceived to be great will. (Figure 1.)

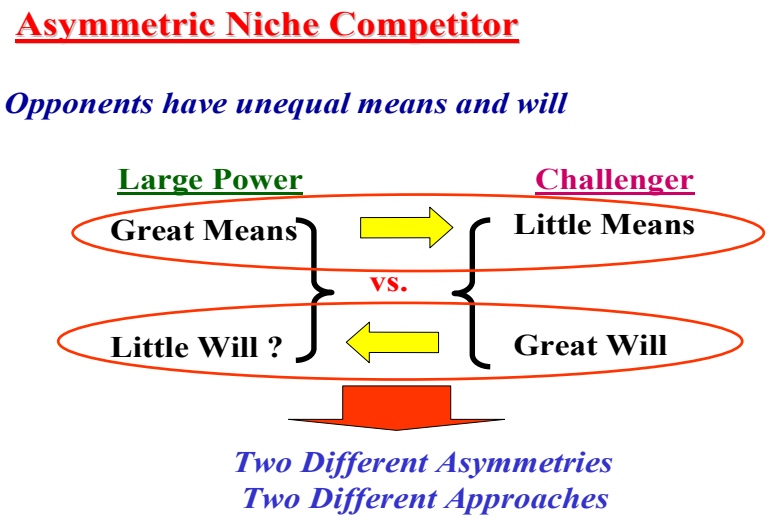


Figure 1

In this case, there are two different asymmetries, one of means and one of will. Since successful warfare is largely about creating and exploiting asymmetries, great powers usually exploited their advantage by waging a contest of *physical* attrition in which the inferior means of its opponent might be rapidly destroyed. The opponents exploit exploited their advantage in will by pursuing a damage infliction strategy directed at the *psychological* attrition of the great power. However, where challengers could somehow minimize reliance on targetable means, they could largely negate great power physical attrition efforts and force an effects-based war focused on psychological rather than physical attrition.

This is indeed the kind of threat currently posed by al Qaeda and a collection of insurgencies in Iraq and elsewhere. But, unlike most previous asymmetric foes, these ter-

rorists have attacked great power homelands and continue to threaten to do so – potentially changing the asymmetry to one in which the great power has both great means and great will making for a long but still effects-based struggle.

- *Why #2: Spectrum of Military Operations*

  Discussions of network centric operations often focus on major combat operations. While such operations are the *sine qua non* of a military, in reality military operations are as much about preventing wars as fighting them and span a spectrum from peacetime operations such as deterrence, peacekeeping and humanitarian operations, to myriad of forms of crisis response, to major combat, and back to peace. (Figure 2.)

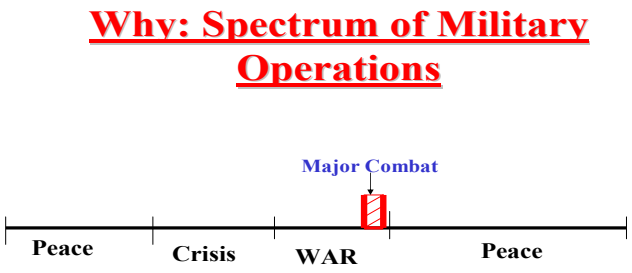


Figure 2

However, this spectrum is an old paradigm born of an era in which wars were between states, began with a formal declarations followed by a start of hostilities, and ended with a surrender and a peace treaty. In today's world, the neat divisions of war and peace no longer seem to apply. (Figure 3.) Hostilities seldom follow a formal declaration of war nor does an end to major combat signify an end to hostilities. Instead, hostilities begin in a gray cloudy area between crisis and war or between law enforcement and military action. Likewise, the end of major combat is now merely an end to one form of hostilities and the beginning of another, e.g. guerrilla warfare or terrorism.[1] This cycle of adapting to defeat by shifting to a different form of hostilities continues until the one side either

[1] This again is not new. In the closing days of the U.S. Civil War, General Robert E. Lee, faced with the inability of the Army of Northern Virginia to continue major combat operations and was urged to disperse the army and initiate a guerrilla war in the nearby mountains – an option he refused as leading no where. Shelby Foote, *The Civil War: A Narrative*, Vol. 14. Time-Life: Alexandria, Va. 2000, p.149.

exhausts all options or loses the will to fight. In this struggle of wills, the resulting cloudy return to peace may only be evident in retrospect.

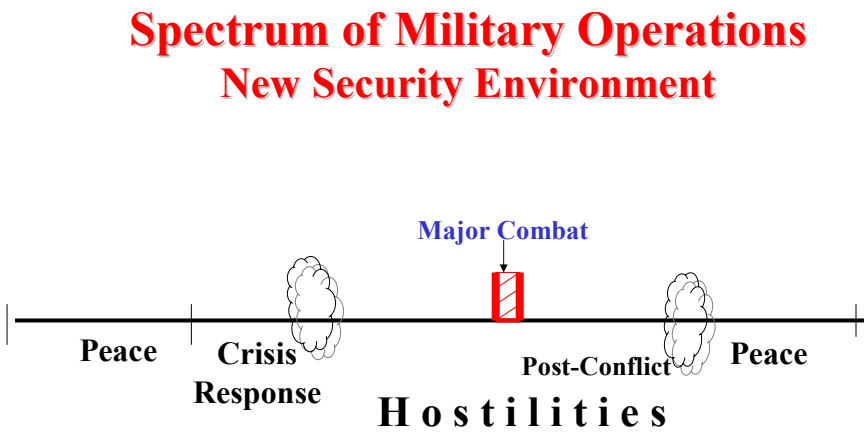


Figure 3

- *Why #3: "Real World" Operations*

Many network centric "solutions" have focused on an Industrial Age targeting problem in which the object is to put the right number of the right weapons on the right target at the right time to destroy or incapacitate it. However, because this process is so successful, opponents are driven to find ways to thwart it in order to survive. One way is for them to create complex identification problems where sensors networks no longer suffice for targeting. Dispersing military units, taking troops out of uniform, and mixing them with civilian populations are means to this end. Their effect is to force troops to make the identifications often under stress and under fire – provoking a higher probability of errors to be exploited in the media as part of the contest of wills.

The new paradigm is a battle for minds in which the object is to take the right actions at the right time to create the right effects. This paradigm implies complex engagements that will be seen differently by different audiences and that will have no precise beginning or end but that are part of a continuing, on-going interaction in which what

was done in the past will shape the current engagement and in which the current engagement inevitably will shape the interactions of the future.

The three "whys" paint a picture of a complex, messy "real world" where attrition-based approaches to conflict no longer work. The result is a move to effects-based operations.

- *The "What": Effects-Based Operations*

  Effects-based operations can be defined as "*coordinated sets of actions directed at shaping the behavior of friends, foes, and neutrals in peace, crisis, and war*."[2] In this definition, "actions" encompass both destruction and all forms of military operations across the entire spectrum of military operations and include as well as the diplomatic, political, and economic "actions" that make up a national response. Effects-based operations focus on a behavioral end state that is scaleable from the tactical to the geostrategic level and applicable to diplomatic, political, and economic efforts as well as military. And, the behavior to be considered is as much the reactions of friends and neutrals as it is the behavior of the foe. In short, effects-based operations are a basic stimulus and response approach to operations that is broad enough to span all of the arenas of a national response, the entire spectrum of competition and conflict, and an array of actors from the individual through the state.

**Operations in the Cognitive Domain**

A stimulus and response approach to operations implies directing actions at the cognitive domain where humans perceive, understand, and make sense of a situation and decide on the course of action that constitutes their behavior. The key to this process is the "observer." The central importance of the observer can be understood by dividing the process into a physical domain where the stimulus of physical actions take place, an information domain where actions are sensed and collated, and the cognitive domain where the decisions are made.

In the below diagram (Figure 4), actions occur in the physical domain, are reported through the information domain, and become part of the shared awareness upon which an observer will draw. The picture reaches that awareness is a function both of what the action was

[2] Note that effects-based operations are not defined here in terms of a 'process' for conducting them but rather in terms of what any process must address.

# Operations in the Cognitive Domain

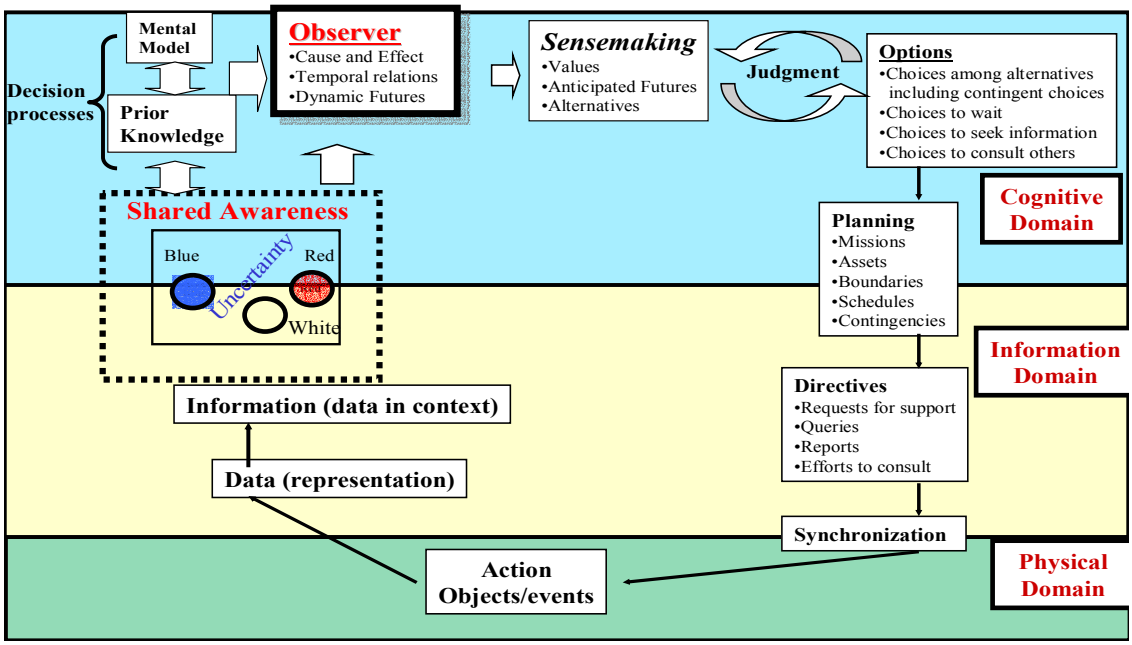


Figure 4

and how it was detected and reported. What the observer perceives will, in turn, be a function of what appears in the awareness, how that balances against what has happened before – the 'prior knowledge' that provides a cause and effect and time context, and the observer's own 'mental model' for understanding what is being seen. The observer will then attempt to make some 'sense' of this picture, evaluate the options available, and decide what action to take -- the re-sponse to the stimulus. This re-action will then become the stimulus to which others will respond in ensuing cycles with the cycles repeated time and again in the course of an interaction.

However, this process describes how human beings in general perceive, make sense, and decide. In effects-based operations, there must be something more: a sense of how a particular observer or groups of observers are likely to see and act. That is, we need to consider something more: an idiosyncratic variable, the social context of a particular observer or group of observers – from the tactical unit level to the terrorist group to the national level -- that influences how they will perceive, understand and make sense of an action and what options they will have. This *so-cietal* domain[4] encompasses all of the factors that might influence the mental model coloring how

[4] In their book, *Power to the Edge*, Alberts and Hayes introduce the idea of a fourth "social domain." In this case the author has used the term *societal* vice social to emphasize that the concern here is not with how societies in general perceive and decide, but how specific social groupings of "friends, foes and neu-trals," the objects of any attempt to shape behavior or reactions, will do so.
David S. Alberts and Richard Hayes, *Power to the Edge*, CCRP: Washington, D.C., 2003. p. .

observers perceive and understand an evolving situation, who the observers are and what their experience base is likely to be, the set of values and expectations that will be used to make sense of the situation, and the both the options that will be available and which of those may be deemed viable and acceptable.[5] (Figure 5.) As the multiple arrows in the diagram indicate, a

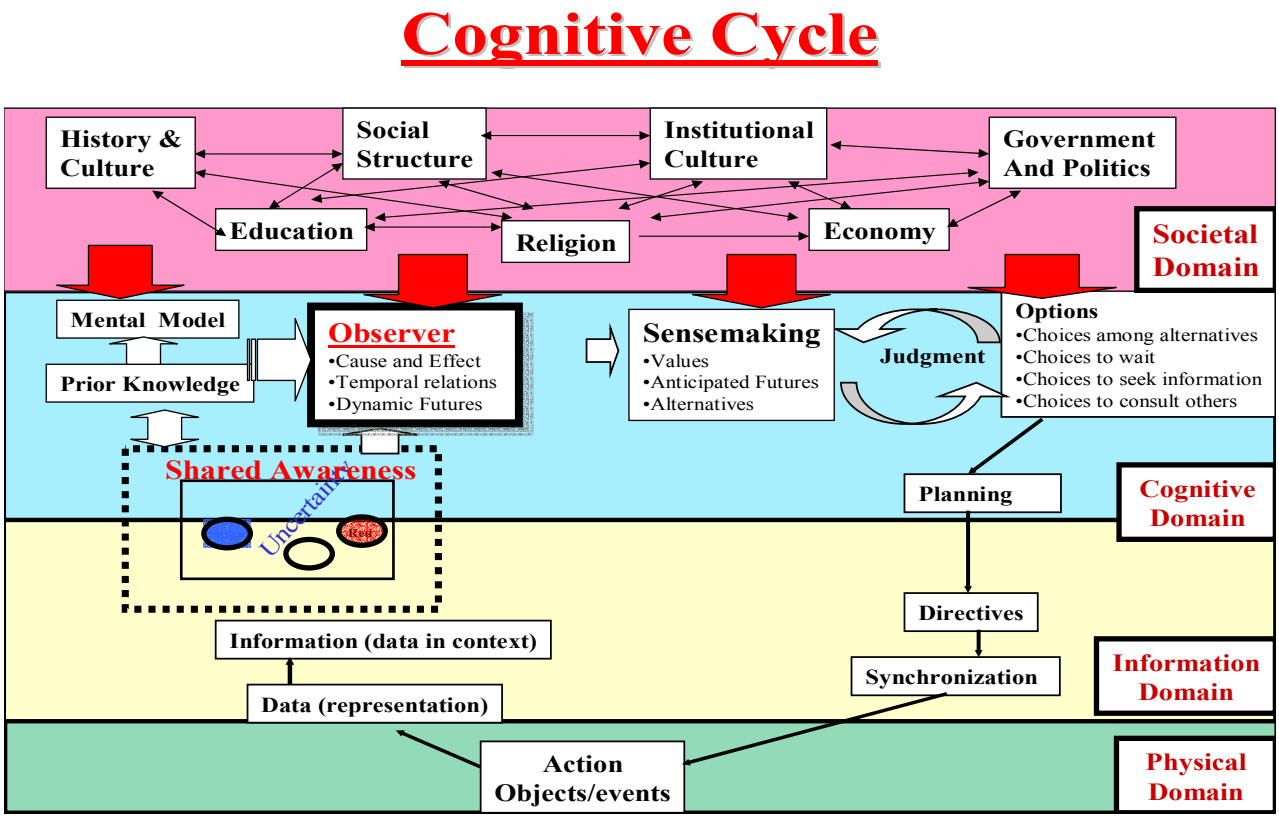


Figure 5

wide diversity of factors from history and religion to politics and education are reflected. In short, the societal domain is comprised of multiple interdependent variables whose relationships continually change as the society adapts and reacts to its environment, an environment that includes but is not limited to the actions comprising a particular military or other effort.

The two diagrams above suggest four general rules for effects-based operations:

- Actions will create effects on anyone who can see them and not just on the targeted opponent.
- These effects will be felt simultaneously on multiple levels – tactical, operational, military strategic, and geo-strategic – and in multiple arenas – diplomatic, political, economic, and military.

[5] These are the kinds of social factors that might have distinguished between a *Waffen SS* division and a *Volksturm* unit in World War II Germany.

- All actions and effects are cumulative and interrelated.
- Effects are both physical and psychological in nature.

In fact, these rules are reflected in a long history of crisis response operations. The interconnectivity of actions so evident in the diagram and the rules also underlines an important point: that effects-based operations are not only inherently "joint" they are also inherently "national" because one action or effect cannot be isolated from another. The rules and the diagram also amply demonstrate both that the objective of effects-based operations is complex and that the process of planning and executing effects-based operations is likely to be complex and non-linear.

## Complexity

The question of complexity quickly shapes any attempt to grapple with effects-based operations in two ways. First, the military and national security problems that drive us toward effects-based solutions, e.g. asymmetric conflict and an intelligent adaptive foe, are themselves complex because they involve a changing array of interdependent variables. Second, effects-based operations themselves involve dealing with and exploiting a cognitive domain that is inherently complex. But what do we mean by "non-linear," "multiple interdependent variables," "complexity," and "complex adaptive systems"?[6] A simple working understanding of these ideas can be derived from making a distinction between the words 'complicated' and 'complex.'

- *Complicated.* The engine in an automobile is complicated; yet pressing on the accelerator pedal dependably produces the same result -- the car moves. Moreover, this output is proportional to the input, the greater the pressure exerted on the pedal, the faster the car goes. This dependable repeatability and proportionality of inputs and outputs comes from the fact that the engine consists of a series of known and linear cause and effect chains. This linearity means that, if the car fails to perform as expected, an auto mechanic can work his way along that chain to determine which particular cause and effect is malfunctioning.

[6] The object here is not to explain these concepts or the mathematics involved, work that is already reflected in James Moffat's *Complexity Theory and Network Centric Warfare*. It is rather to provide a basic working understanding to enable the reader to use what James Rosenau called the "intellectual tool" of complexity.
James Moffat, *Complexity Theory and Network Centric Warfare*, CCRP, Washington, D.C. 2003.
James N. Rosenau, "Many Damned Things Simultaneously: Complexity Theory and World Affairs," in *Complexity Global Politics and National Security* (Alberts and Czerwinski eds.) National Defense University, 1997. pp. 78 and 82.

- *Complex*. If the engine in the car were complex rather than complicated, there would be no way to know exactly what might happen when the accelerator was pressed. We would not know what all of the interdependent variables involved were much less how they would interact; the chain of causes and effects that produced a particular reaction would be non-linear and probably never be the same twice; and the chain would change in ways that could not be known or predicted. In short, there would be no repeatability and no proportionality between inputs and outputs – and no auto mechanic who could fix it.
- *Complex Adaptive Systems*. If the complex car engine were a "complex adaptive system," this uncertainty would be taken another step. Not only would we be unable to define the cause and effect chains that made the engine react in particular ways, but the engine and its chains would change and adapt independently to any environment in which it found itself -- again in ways that we could not entirely predict. In short, it would act like a living system[7] and not a like a mechanical system, like a non-linear system and not a linear system, like a complex system and not just a complicated system.

The human beings and human organizations that are the core of the security environment and the societal domain of the cognitive diagram are complex adaptive systems. By extension, peace, crisis, and war are interactions between complex adaptive systems in which outcomes are not fully predictable and not necessarily proportional to the amount of effort expended. Indeed, it is this latter potential for disproportionality of inputs and outputs that promises a non-linear payoff for network centric and effects-based operations. *And, it is this same disproportionality that lies at the heart of most successful operations by asymmetric competitors.* Complexity is a factor in planning and executing effects-based operations because they deal with complex threats and the human dimension of peace, crisis and combat and because of the consequent requirement to operate in the cognitive domain.

The diagram of the cognitive cycle and especially the central role of the observer suggest ways in which the complexity of effects-based operations might be broken down into five problem areas: 1) orchestrating actions to create the right perceptions; 2) deconflicting these actions across a multi-level, multi-arena set of actions; 3) defining the effects to be created or encouraged; 4) anticipating the chains of cause and effects that might be set in motion; and 5) ascertaining what effects are actually being created, that is, feedback.

[7] James Grier Miller offers a detailed explanation of the factors at play in and common to such systems from microbe to the international order. James Grier Miller, *Living Systems,* University of Colorado, Denver, 1995.

*1. Orchestrating Actions*

The impact of actions is a function not so much of the action as how the observer sees it. Effects-based planning, thus, must take into account both what action is and how it is executed, that is: the kind of force or national power used; the scale of the effort – and bigger is not necessarily better; its geographic scope; the operational scope or the military and other power it demonstrates; its speed; its duration; and its synchronicity or how well was it coordinated with other actions so as to create a worst case for an opponent. For example, a stimulus involving "boots on the ground" is likely to imply a far greater concern and commitment and thus have a far different impact from a relatively antiseptic missile strike. Equally, demonstrating an ability to act in a given geographic or operational area, to act within a brief time, and to sustain that effort for some duration might set parameters for preventative deterrence. However, there is another consideration: which aspects of these actions are likely to be visible to the observer and how. In brief, there must be enough of an understanding of the observer's information domain and how information is collected and processed in that domain to estimate what that observer actually will see.[8]

*2. Deconfliction and Coordination.*

The observer will see an action, however well orchestrated, as one part of an interrelated whole. Thus, actions in one area or arena can either multiply or negate the effect of actions in other areas and, potentially, produce combinations of stimuli that create either confuse or cause the opposite reaction from that intended. Accordingly, actions need to be deconflicted in the manner of forces on a battlefield so as to avoid action-fratricide and to produce a unity of effects. Given that effects-based operations are not only joint but national in dimension, this deconfliction and coordination problem and the number of potential variables involved can assume enormous proportions. To make matters worse, the actions that interfere may include those unintended or unanticipated actions that are an inescapable part of interactions between complex adaptive systems be they individual combatants or entire governments.[9]

[8] Orchestrating the action and assessing the observer's surveillance system to know what will enter the situational awareness might be assessed as being simply complicated rather than complex save for the fact that the information available is likely to be only a small part of what is needed and will likely be ambiguous, uncertain, or just plain wrong. This implies a complex judgment as to what to include and where among the pieces of information available to place the emphasis

[9] This is where the US Marine Corps' concern with the actions of the "strategic corporal" is relevant. It is not that commanders want the corporal to make strategic decisions, but that some corporals will find themselves in situations where they will be forced to make split-second decisions that will have strategic effects.

While the deconfliction problem might suggest a need to minutely coordinate all aspects of military operations using the network to micro-manage, the reality is quite the reverse. Not only does the sheer complexity, speed, and breadth of the effects-based engagement militate against success in such an attempt, but the nature of operations across the spectrum suggests that a "one size" coordination solution does not "fit all." Instead, there a need to balance coordination and self-synchronization, a balance that will shift during the course of crisis or conflict. (Figure 6 below) The requirement for close coordination of national efforts is likely to be least during normal peacetime operations by the military and other arms of government even though all are by their actions shaping the perceptions of observers. As peace

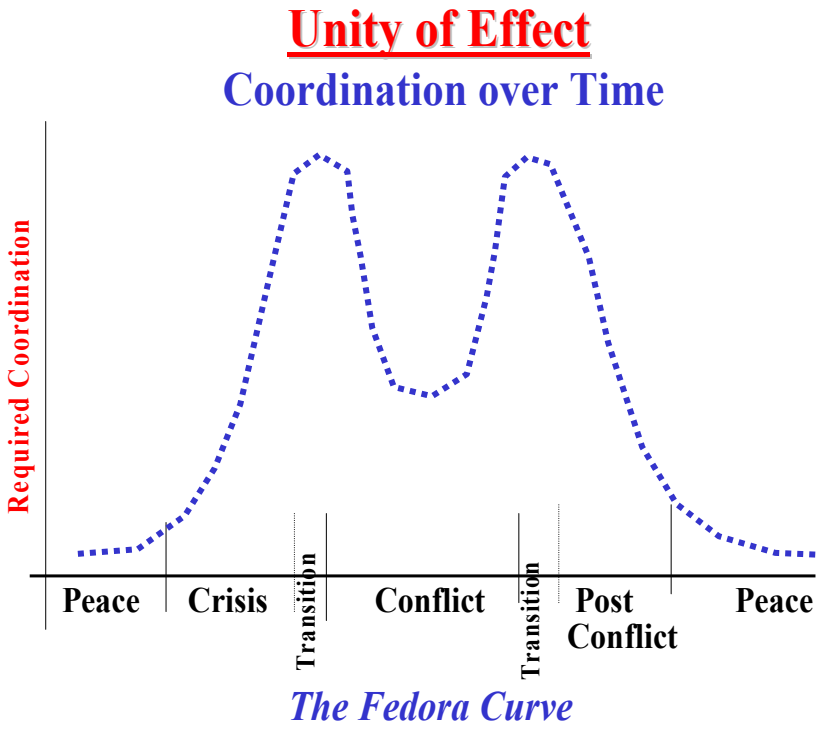


Figure 6

turns into crisis, however, the need to coordinate all of the disparate elements of actions by military, diplomatic, political and economic actors mounts sharply and peaks just as major combat operations are about to be initiated. At that point, complexity theory and military experience indicate the tight coordination must give way to a looser self-synchronization that permits forward actors "on the edge" be empowered to adapt to the rapid changes of the battlefield or they will face in Darwinian terms "extinction." Then, as conflict moves to some form of politico-diplomatic solution, the need for close coordination of all the elements of national power resurges so as, first, to promote the solution and, then, to reinforce it. This co-

ordination requirement, then gradually tails off until a normal peacetime profile is returned. In short, the requirement for deconfliction and coordination is most pressing in the crisis and post-conflict stages of the cycle where the problems are themselves most complex but will change continually along the entire curve.

3. *Defining the Effects to be Created*.

Because it is not possible to trace a cause and effect chain from a specific action to a specific response through complex cognitive and societal domains, it is also impossible to know exactly how the target – or the ally or neutral – will react to a stimulus whether intended or unintended. This implies a need to think of the *kinds* of effects that are likely to be created and how these collectively might drive behavior in one direction or another. The kinds of military effects, for example, might be divided into seven categories: destruction; physical attrition; chaos or a degree of confusion such that a deliberate response is rendered difficult or impossible; passive foreclosure or the continuing presence of a capability or set of options so potent as to discourage any attempt to challenge; active foreclosure or the demonstration of such capability as to force a re-evaluation of a challenge in progress; shock or a total collapse of any hope of creating a successful outcome, e.g. France May 1940; and psychological attrition or the gradual erosion of such hope, e.g. United States 1968-1975. These kinds of effects will be felt by others as an overall effect that will likely include some elements of each category as well as the effects of non-military actions. Moreover, the balance of the kinds of effects derived from the same single action will affect different observers in different way, that is, they will vary from one observer to the next, from one level of interaction to the next, and over time.

*4. Anticipatings Effects Cascadse*

Each effect created will also tend to set off a cascading chain of additional physical and psychological effects. However, given the complex nature of both the interaction and the friends, foes, and neutrals affected, the scope and speed of the cascade cannot be entirely predicted (See Figure 7). In this cascade, moreover, the cascades of physical and psycho-logical effects will function very differently. The propagation of physical effects is more likely to resemble that of a chain of falling dominoes the full scope and dimensions of which may not be known, yet for short sections of which it is possible to trace precise chains of causes and effects. This is indeed one core principle of nodal targeting. The propagation of psychological effects on the other hand is more likely to proceed like the chain reaction set off when a

single ping-pong ball is tossed into a room the floor of which is covered with mouse-traps upon which other ping-pong balls are balanced. The result is an almost explosive reaction whose direction and end-state cannot be predicted. Even more, this psychological cascade can be set off by either the initial direct physical effect or by any of the succeeding cascade of physical effects or by any of the psychological effects.

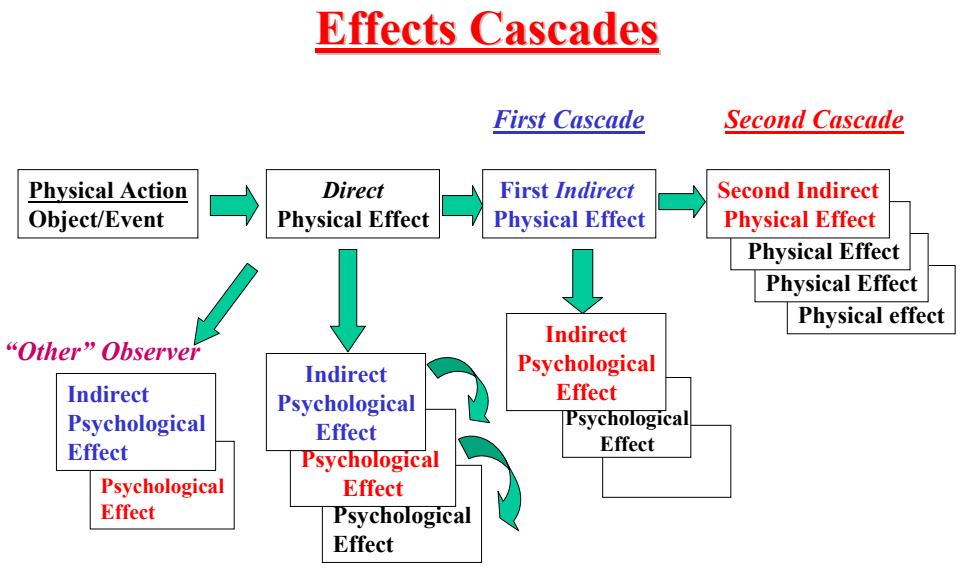


Figure 7

5. *Feedback.*

The ideas of an on-going continuum of actions and operations and of interactions between complex adaptive systems imply that no action however well conceived will ever be definitive. The opponent will always react at some interval and in some way and, in doing so, will endeavor to surprise. Therefore, just as all complex adaptive systems succeed or fail based on how well they adapt, effects-based operations will succeed to the degree that they are able to adapt to the reactions of the observers. In short, feedback to commanders and planners is essential. However, the complex nature of the operation also implies that the reactions of observers are neither entirely predictable nor entirely quantifiable and that the feedback itself is likely to complex. That is, rather than the precise answers of bomb damage assessment, effects-based feedback is likely to involve bounding the likely implications of various sets of indicators and, thus, to come in the form of probabilities. This feedback is likely to take at least three forms: 1) an assessment as to whether the action executed was

"seen" in some way; 2) an assessment as to any changes in the observer's immediate behavior; and 3) an assessment of changes in the actors' overall behavior across multiple levels. The first of these assessments might include but would not be limited to traditional measures like bomb damage assessment, but in the effects-based case, serve not to track damage but simply to determine whether the intended direct effect was achieved. To that end, feedback might include open source reporting and any known reporting from surveillance systems or collectors. The assessment of reactions would focus on identifying and evaluating even slight deviations from norms of behavior both immediate and over time. Such assessment, however, presumes a data base on such behavior, i.e. prior knowledge, that is sufficiently fine grained to pick out relatively small changes and to provide some index of how abnormal a particular behavior or combination of behaviors is, a sort of *index of improbability* of how often an action or combination of actions has been seen before. The third and probably least quantifiable assessment would reflect both the cascades of effects and any changes in decision-making at all levels drawing upon and fusing both open sources and classified sources. In each type of assessment, no single report is likely to be definitive. Instead, the feedback will of necessity be more in the nature of indicators, that is, pieces of information that are individually inconclusive but acquire real value when put together with what may be hundreds of other indicators in a specific context or algorithm. Although this is akin to the Operational Net Assessment process originated by the US Joint Forces Command, it is also akin to what good intelligence analysis from the tactical to the strategic has always done. The history of how commanders have dealt with complex problems and feedback in the past in turn suggests that, in the heat of battle or a rapidly evolving situation, the feedback and assessment process may be conducted in the heads of tactical and operational commanders and their staffs if any. The better prepared the heads, the better the results are likely to be.

The dissection of the complexities of operating in the cognitive domain above represents a way to deal with the complexities of the military operational problem in a variety of ways: reducing the problem to a set of knowables, pruning the complexities to the point that they become manageable, and bounding the problem. None of these approaches is new and each can be traced through historical data bases of how these problems have been handled in the past reflecting the fact that the need to deal with complexity is not new any more than effects-based operations themselves are new.

## Implications for Network Centric Operations

A "real" world of ad hoc, unpredictable, and complex challenges from asymmetric "niche" competitors whose chances of success depend on avoiding traditional combat leaves little choice but to pursue effects-based operations. The real question is how to improve upon what has historically been done in the heads of gifted leaders. This is where network centric operations come in. They offer help in the planning, execution, feedback, and assessment of effects-based operations. Network centric operations cannot make effects-based operations perfect. The complex, human centric nature of the operations makes precision and perfection unattainable. What networking can bring are three contributions: an expanded range of options, the ability to mobilize knowledge wherever it may reside, and agility.

### *1. Options*

The paradigm for operations in a world of ad hoc challenges is the saga of the Apollo 13, broken, alone, and unreachable in the depths of space. Any solution to the space ship's problems had to come from those capabilities already available on board and the challenge was to find a combination of those capabilities – sometimes in ways never intended -- to repair the ship and bring the astronauts home. Challenges from complex adversaries are much the same. There will be little advance warning of the exact threat, and there will be a need to create viable options from the capabilities at hand.

Effects-based operations expand the "tool kit" of available capabilities into a national response by the full power of a state. The law of requisite variety says that the greater the number of possible responses a system has, the greater its chances of survival.[10] Since the number of possible combinations of capabilities or potential responses grows geometrically as new capabilities are added, an effects-based approach can dramatically increase the size of the tool kit available. But, such combinations are only feasible if the capabilities can be networked together. However, this networking is more than communications infrastructure. The complexity of threats and potential solutions require men in the loop and, hence, social as well as communications networking. This might be expressed in equation form as:

$$\underline{\text{Options}}$$

$$C^{(N-1)} \cdot (N_s \cdot N_c) = \text{Options}$$

[10] W.R. Ashby, *An Introduction to Cybernetics*, Chapman and Hall, London, 1957.

C to the n-1 is all combinations of capabilities possible and, thus, all the options potentially available. However, it is multiplies by two networking quotients, the quality of the social networking, N sub s, and the quality of the network connectivity, N sub c, where each is on a scale from a zero to one. Thus, the number of options that might be created in a given circumstance depends on how well networked the actors are in terms both of their ability to understand each other and coordinate and of their communications networking.

This set of options in turn defines a *decision-space*, that is, the range of all possible responses available to a decision-maker from which to fashion a course of action. Because our "observer" will see the totality of what is done political, diplomatic, and economic as well as military, and because networking lets decision-makers put the various attributes of these national capabilities together in different ways and, thus, to make them more than individually additive, it is possible to look at a decision space defined by the aggregate of all of the attributes of all the capabilities taken together, that is, an overall scale -- the how much?; an overall scope -- the "how?", the "where?", and the "with what?"; and the timing -- the "how fast" and the "for how long". (Figure 8.)

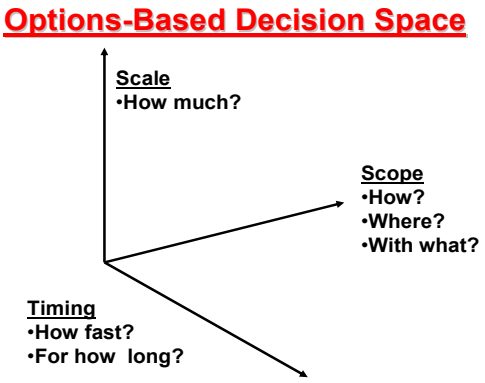


Figure 8

With networking, the individual elements of a national response can be treated as wholes. Thus, the scale of the maximum response possible is the scale of all of the actions -- military, political, diplomatic, and economic -- that might be taken. A country at war, for example, might be expected to undertake a maximum military, political, diplomatic, and economic effort the overall scale of which – apples and oranges together – would be seen by friends, foes and neutrals. Similarly, the maximum scope of the national action would include the full global range of national efforts whatever and wherever those might be. Finally, the overall timing would be a function of the speed with which new actions might be executed and of how long a given combination of actions might be sustained. To the degree that these vari-

ous elements can be networked so as to multiply the possible combinations, the resulting decision space might resemble the below. (Figure 9.)

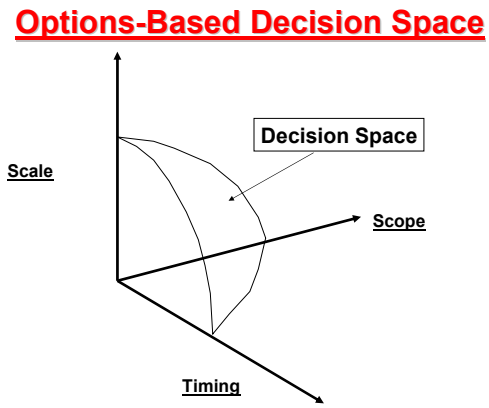


Figure 9

This options-based decision space generated by the capabilities and the ability to network them would comprise the tool kit available in a national Apollo 13 capsule. Where an ad hoc challenge (Threat #1) could be handled within the scale, scope, and timing of available options, e.g. how fast could a military force of a given scale and capability be moved to an area and then sustained, the tool kit might be judged adequate (Figure 10). When the challenge (Threat #2) requires a response that is too fast, too big, too long, or too different for the tool kit, then reassessment and rebalancing would be in order.

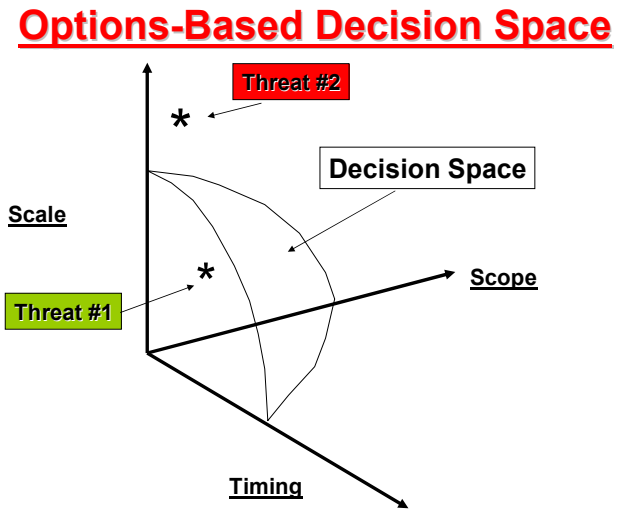


Figure 10

A key question here is whether a nation's networking and capabilities tool kit is sufficient to deal with the challenges likely to arise during a long interaction with complex adaptive foe either to meet immediate challenges or to create a broad based deterrence. However, the decision space construct applies equally to foe. They as well as allies and neutrals would also have decision spaces defined by the political, diplomatic, economic and military capabilities that they could network and bring to bear. By identifying what that decision space might be and overlaying the two decision spaces, therefore, it should be possible to identify a range of potential actions or challenges from a foe for which there is no viable response – an assessment that could force a revision of tool kit networking and capabilities. (Figure 11.)

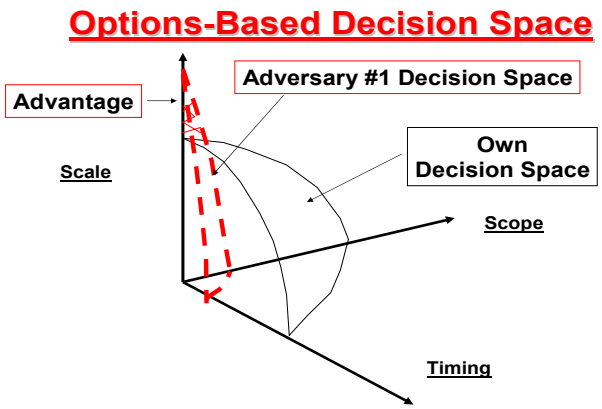


Figure 11

The revision to the tool kit needed might comprise some form of capabilities based planning for the military component of national power, but it could equally point to a need to build alliances or other relationships with other countries to redress the situation. (Figure 12.)

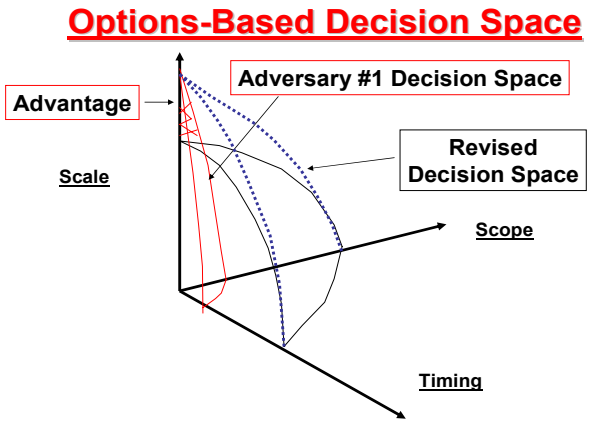


Figure 12

This approach is not limited to potential face-offs between states in the mode of planning traditional military acquisition strategies. It applies equally to asymmetric non-state foes such as al-Qaeda. The same principle applies. The decision-space available to al-Qaeda is also defined by scale, scope, and timing constraints aided or hindered by an ability or inability to network and thus coordinate actions. (Figure 13.) In the case of al-Qaeda, for example, it might be judged that – excluding the possibility of weapons of mass destruction in al-Qaeda hands – the scale of actions possible was limited to that of a World Trade Towers attack or perhaps one or two orders of magnitude greater. It might also be judged that, while

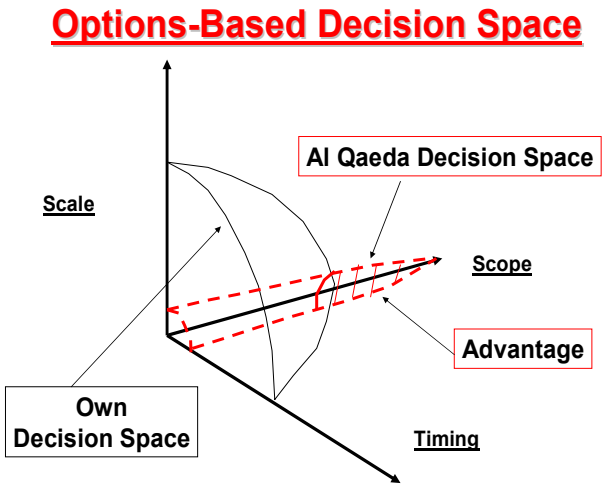


Figure 13

the terrorists could control the timing of an attack so as to create surprise, they required some considerable time required to plan an execute an attack. By contrast, their advantage might be seen to lie in the geographic and operational scope of the actions they could undertake, a scope that would include military, diplomatic, political, economic, and cultural targets around the globe and that was bounded by no rules of war. This comparison of decision-spaces might then lead us to focus on generating more diverse and flexible options and on exploiting advantages in speed and scale, e.g. the advantages of networking.

2. *Knowledge Mobilization*.

It is one thing to have options and quite another to pick the right ones. Much has been made of the ability of networks to get the right information to the right decision-maker at the right time to make the right choice whether in planning an operation or in a succession of

rapid action-reaction cycles. However, what happens in the case of an ad hoc challenge whose entire purpose is surprise, and what happens in a contest with a complex adaptive adversary whose actions and logic are by definition neither fully apparent nor entirely predictable? Network centric operations must supply the wherewithal for making the right choices, but for the planning, execution, and feedback evaluation in effects-based operations, information and data alone are not enough; it is *knowledge* that is critical. This knowledge, moreover, is not simply an aggregation or collation of data and information but an internalized working understanding of a complex problem of which the sensor-derived data is but one part. Similarly, the ideas of complex adaptive opponents and the ad hoc nature of likely challenges – as well as the experience of operations from Grenada to Iraq -- suggest that almost any existing "data base" will not contain all of the data or knowledge needed. Therefore, the challenge will not be one of managing data and information, but of somehow mobilizing that knowledge from across a government, a nation, or a coalition to answer commander's needs, a challenge that is much that of organization and thinking as of technology.

It is in knowledge mobilization that effects-based operations pose the greatest challenges for network centric thinking: fusing very different kinds of information and knowledge; and dealing with some very different kinds of interfaces.

- Knowledge Fusion. Creating knowledge and understanding to support effects-based operations requires the fusion of three different kinds of information inputs: the sensor-derived electronic or mechanical information, human derived reporting, and expertise. Of these, the sensor derived data are relatively clean cut and amenable to present data and information networks. However, the human derived information[11] so necessary to operations in Iraq and elsewhere has a very different character. By nature, it is at once subjective, ambiguous, and uncertain and usually can be validated only by putting it into some context whether that of the subject and situation or that of the experience, knowledge, and past reporting by the same source, all of which require some form of human evaluation. Expertise again has a distinctly different character that derives from an individual's mastery of some complex subject, a mastery that often seems almost intuitive but is very likely based on an internalization of a large variety of complex factors. Although there is a tendency to think of such mastery in terms of subject matter experts, there is an equally pertinent expertise exercised by those in the field who are closest to an evolving situation

[11] The author uses the term human-derived information to encompass all that information, e.g. press reporting, that would not normally fall under the better known heading "human intelligence."

and have the best "feel" for the situation. Understanding the societal domain, for example, would require expertise.

- Interfaces. Fusion is more than linking dissimilar information sources. It is equally about the interfaces that enable the fusion a complex array of information to occur.[12] Successful fusion involves three such interfaces: machine-machine, man-machine, and man-man – the 3M2. The machine-machine interface has been the staple of most discussion of network centric operations and despite the challenges involved is the easiest of the three. The man-machine interface is a greater challenge but has been the focus of effort and experimentation both military, notably at the US Joint Force Command, and civilian, notably in industry efforts in ergonomics. However, the interface, between one man and another, poses the biggest problem because it involves the communication of different perspectives of a complex subject from an expert in one field, e.g. the forward commander, to one in what could be a very different field, e.g. the regional expert or a worker in a non-governmental agency, when there is no common short hand.[13] Networks can provide the connections that permit experts to talk, but the organization, training, and social networking are the keys to making the interface work. Indeed, it is the human requirements that will dictate the form that any network takes.

The above suggests a requirement for an effects-based situational awareness for individuals, commands, and governments that include complex knowledge and expertise as well as data and information and a flexible networking both social and physical to form and sustain that awareness.

### *3. Agility*

In the Apollo 13 example, it was not enough to know which capabilities were aboard the space ship; NASA scientists and engineers had to figure out ways to use those capabilities differently and the astronauts had to carry out their suggestions, all against a short time and potentially tragic line. The same is true of translating options into actions. The whole idea of a contest between complex adaptive systems is that each side will adapt to the actions of the

[12] The author is here drawing upon the experience of 30 years in Naval Intelligence including tours of duty in the Navy's Ocean Surveillance Information System and as the deputy director for intelligence in the Office of Naval Intelligence.

[13] Notice that this does not assume that the forward commander needs to be a regional specialist, especially since adequate training in a regional specialty to make the commander the "expert" would likely come at the expense of his mastery of combat or other military operations and likely not be exportable to a different region. The requirement is rather for sufficient familiarity with the region or subject area to appreciate and take action upon what the expert can provide.

other in new and unpredictable ways and that this interaction and change is not a one time engagement but an on-going process that continues until one or the other runs out of options or will.[14] In such a face-off, having a wide range of options from which to fashion actions and being able to mobilize the knowledge needed to make the best choices must be accompanied by a third element: agility.

In *Power to the Edge*, Alberts and Hayes point to six "dimensions of agility": robustness, the ability to maintain effectiveness across an range of tasks, situations and conditions; resilience, the ability to adjust to perturbations; responsiveness, the ability to react to change in a timely manner; flexibility, the ability both to use multiple ways to succeed and to move smoothly between them; innovation, the ability to do new things or to do old things in new ways; and adaptation, the ability to change processes and organization.[15] Applied to interactions between complex adaptive systems that are at the center of effects-based operations, this concept of agility takes added meaning. Agility in this context is all of the six dimensions embodied in an ability to create options that deal with the unexpected and then to adapt the options chosen and actions undertaken continually as a multifaceted interaction unfolds. It is the ability to adapt to a rapidly changing situation very much the same manner as other complex adaptive systems with the added impetus of a Darwinian caution that those systems that those systems that do not adapt well enough or fast enough are doomed to extinction.

All three of the network centric contributions come together in this process of adaptation and survival. (Figure 14.) The tool kit of options knitted together and enabled by networking, provide a range of options, the decision space encompassing all the actions that might potentially be taken. The knowledge comprises both a situational awareness sufficient to support effects-based operations and a continuing of sensor and human derived information and expertise that enables the informed choices that increase the probability of success. The agility provides the speed, flexibility, responsiveness, robustness, innovation, and resilience that permit a course or multiple courses of action to be altered to deal with new permutations of the threat.

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[14] Alan Beyerchen pints out that Clausewitz uses the example of two wrestlers to describe a complex interaction the course of which neither wrestler can know in advance but which is instead shaped by the response of each to the other as the match evolves.
Alan Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War," *International Security*, Winter 1992, pp. 63ff.

[15] David S. Alberts and Richard E. Hayes, *Power to the Edge*, CCRP, Washington, D.C., 2003. pp. 128 ff.

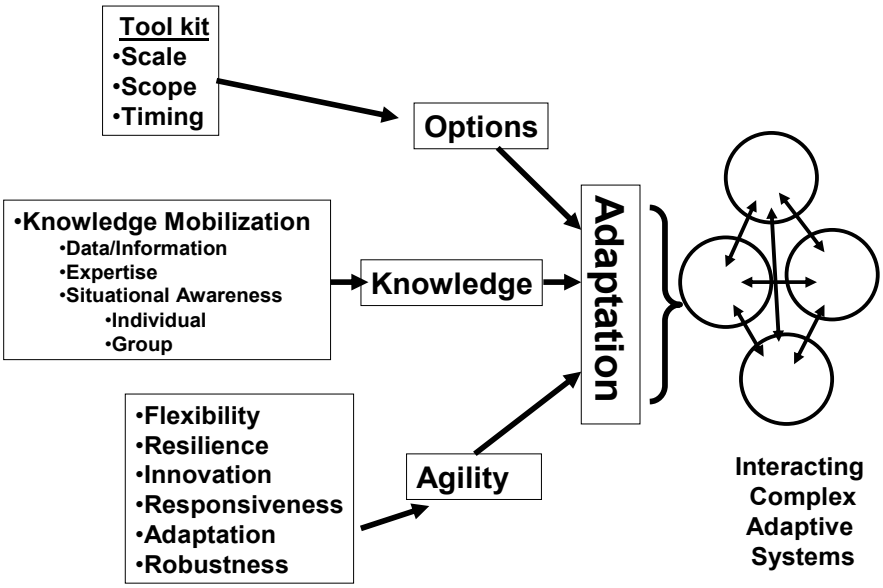


Figure 14

**Conclusion:**

**Effects-Based operations and *Second Generation Network Centric Operations***

Effects-based operations are not new, but they do represent a way of thinking about competition and conflict that differs from the attrition-based focus with which warfighters, operational research analysts, and acquisition personnel are most familiar. More to the point, effects-based operations are peculiarly suited to the kinds of military operations mandated by the post Cold War/ post 9-11 security environment. Because they are human-centric, they offer a way of confronting the complexity inherent in a struggle minds and a way of dealing with challenges that know no border between peace and war or between the political, diplomatic, military or economic. However, this inherent complexity and the need to operate in the cognitive domain point to the need to rely more on one complex adaptive system – man – to deal with other complex adaptive systems – men, states, and non-state actors.[16]

[16] Paul Davis has pointed to the inability of existing operations research models to deal with complex adaptive systems and described the challenge of supporting effects-based operations as the "grand challenge" of the operations research community, one that will require "changes of mindset, new theories and methods, and a new empirical base."
Paul K. Davis, *Effects-Based Operations: A Grand Challenge for the Analytical Community*, Rand, Santa Monica, 2001. p.79.

In many respects, the turn toward a more human centric view of military operations mandates a change in how we have tended to view network centric operations. Whereas most discussion of network centric and Information Age operations over the past five to ten years has centered on targeting and on removing man from "the loop" so as to speed up a "time critical strike" targeting process, complexity and effects-based operations demand that the networking address the role of man *in* the loop and the role of the network in supporting him. This role can no longer be defined simply in terms of supplying machineable data and information from "sensor to shooter" but now must extend to creating understanding and providing complex knowledge the ambiguities and uncertainties of which can no longer be evaded.

This challenge suggests that we are the cusp of a new, second generation of network centric operations focused on the human side of networking and how to give decision-makers at all levels and arenas the information and knowledge needed to make informed choices in a complex environment. The need is immediate. Like it or not effects-based operations are a part of day-to-day operations in Iraq, Afghanistan and elsewhere. The challenge, therefore, is not to find perfect models, links, or decision aids or to conduct perfect effects-based operations. In a world of competing complex adaptive systems, true perfection and precision are probably unattainable. Rather, the challenge is to conduct effects-based operations better and better as the concepts and technologies mature and our experience expands. The result will be second generation network centric operations concepts and technologies that are shaped by and in turn shape the effects-based operations to which they must be applied.