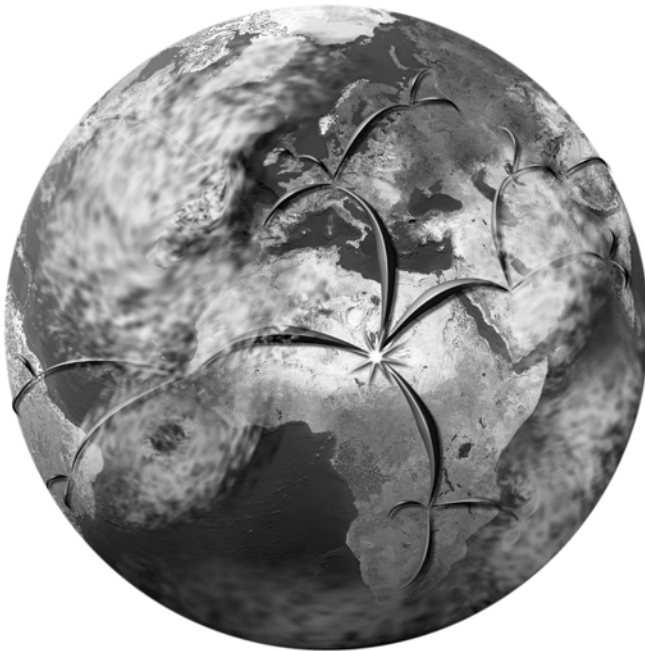


THE FUTURE OF COMMAND AND CONTROL

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COMPLEXITY, NETWORKING, &  
EFFECTS-BASED APPROACHES  
TO OPERATIONS



EDWARD A. SMITH



# About the CCRP

The Command and Control Research Program (CCRP) has the mission of improving DoD's understanding of the national security implications of the Information Age. Focusing upon improving both the state of the art and the state of the practice of command and control, the CCRP helps DoD take full advantage of the opportunities afforded by emerging technologies. The CCRP pursues a broad program of research and analysis in information superiority, information operations, command and control theory, and associated operational concepts that enable us to leverage shared awareness to improve the effectiveness and efficiency of assigned missions. An important aspect of the CCRP program is its ability to serve as a bridge between the operational, technical, analytical, and educational communities. The CCRP provides leadership for the command and control research community by:

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- working to strengthen command and control research infrastructure;
- sponsoring a series of workshops and symposia;
- serving as a clearing house for command and control related research funding; and
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This is a continuation in the series of publications produced by the Center for Advanced Concepts and Technology (ACT), which was created as a “skunk works” with funding provided by the CCRP under the auspices of the Assistant Secretary of Defense (NII). This program has demonstrated the importance of having a research program focused on the national security implications of the Information Age. It develops the theoretical foundations to provide DoD with information superiority and highlights the importance of active outreach and dissemination initiatives designed to acquaint senior military personnel and civilians with these emerging issues. The CCRP Publication Series is a key element of this effort.

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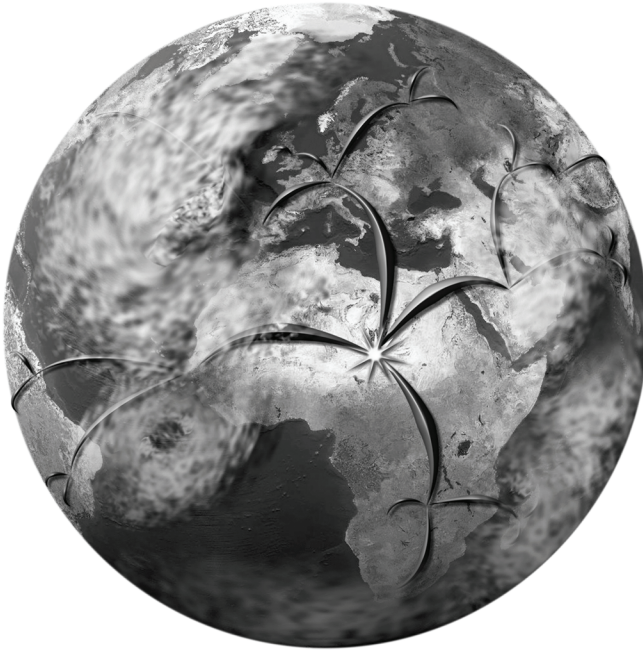
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EFFECTS-BASED APPROACHES  
TO OPERATIONS



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This book is dedicated to the late  
VADM Art Cebrowski, USN,  
who as President of the U.S. Naval War College  
set me on this path and  
who as Director of Force Transformation  
encouraged me in the writing  
of both this book and its predecessor.



# TABLE OF CONTENTS

Acknowledgments .....	i
Foreword by Dr. David S. Alberts .....	v
Executive Summary .....	ix
Introduction .....	xvii
1. IT'S A COMPLEX WORLD .....	1
2. COMPLEXITY: THE PROMISE AND THE PROBLEMS .....	33
3. DEALING WITH COMPLEXITY .....	65
4. COMPLEXITY IN EFFECTS-BASED OPERATIONS .....	95
5. SO, WHERE'S THE COOKBOOK? .....	149
6. SEIZING A DECISIVE ADVANTAGE: NETWORKING AND EFFECTS-BASED APPROACHES TO OPERATIONS .....	195
7. OPTIONS, AWARENESS, AND AGILITY .....	239
8. CONCLUSION: A NETWORK-ENABLED BUT EFFECTS-BASED APPROACH TO OPERATIONS .....	283
About the Author .....	319
Bibliography .....	323
Index .....	331
Catalog of CCRP Publications .....	CAT-1



# LIST OF FIGURES

Figure 1. Symmetric Conflict .....	7
Figure 2. Asymmetric Conflict .....	7
Figure 4. Traditional versus New Model .....	12
Figure 5. New Model of Conflict .....	13
Figure 6. New Model of Competition and Conflict .....	15
Figure 7. Circular Continuum .....	17
Figure 8. Spiral Continuum .....	18
Figure 9. Complicated versus Complex .....	40
Figure 10. Miller's Living Systems Model .....	47
Figure 11. State versus Non-State Living Systems Model .....	51
Figure 12. Multi-level Interaction .....	52
Figure 13. Cross Section: Organizational/Operational Level .....	54
Figure 14. The Action-Reaction Cycle .....	98
Figure 15. The Social Domain .....	102
Figure 16. Social-Cognitive Domain Crossover Points .....	104
Figure 17. Essential Processes .....	111
Figure 18. Awareness Creation .....	114
Figure 19. Sensemaking .....	123
Figure 20. Decisionmaking .....	133
Figure 21. Execution .....	141
Figure 22. Social Influence .....	146
Figure 23. Planning/Action-Reaction Cycle .....	151
Figure 24. Unity of Effect: Coordination of Actions to Mass Effects .....	181
Figure 25. Comparing Cases .....	189
Figure 26. Awareness Creation .....	207
Figure 27. Sensemaking .....	214

Figure 28. Decisionmaking .....	220
Figure 29. Execution .....	227
Figure 30. Social Influences .....	231
Figure 31. Options-Based Decision Space .....	247
Figure 32. Options-Based Decision Space .....	248
Figure 33. Decision Spaces by Level .....	250
Figure 34. Options-Based Decision Space .....	251
Figure 35. Adversary Decision Space .....	252
Figure 36. Adversary Decision Space .....	253
Figure 37. Options-Based Decision Space .....	255
Figure 38. Decision Space .....	256
Figure 39. Decision Space Evolution over Time .....	257
Figure 40. Decision Space over Time .....	258
Figure 41. Varying Context .....	267
Figure 42. Direction versus Guidance .....	274
Figure 43. Adaptation .....	279
Figure 44. OODA Cycle .....	310
Figure 45. OODA versus Action-Reaction Cycle .....	311

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Of particular significance in this regard were three operational commanders: Admiral (ret) Bill Crowe, former Chairman of the Joint Chiefs of Staff and my commander in Viet Nam, Admiral (ret) Dave Jeremiah, former Vice Chairman of the Joint Chiefs of Staff, and Admiral Mike Boorda, the late Chief of Naval Operations, for whom I worked on the staff of the

Battle Force of the U.S. Sixth Fleet during the taking of the Achille Lauro hijackers in 1985 and operations off Libya in 1986 and 1987. I must also acknowledge a debt to Admiral (ret) Harry Train, former Supreme Allied Commander Atlantic and U.S. Commander-in-Chief Atlantic, upon whose example I have drawn for the perspective of a theater commander, and the late Ambassador Bob Anderson, Admiral Train's Political Advisor, who taught me that the political, diplomatic, economic, and social are inextricably intertwined in all that a military does. And finally, I must acknowledge a debt to Rear Admiral (ret) John Butts, former Director of Naval Intelligence, who, like Admiral Crowe, taught me the necessity of making the tough calls on the complex and ambiguous problems of intelligence and whose dictum it was that an intelligence officer who did not put his career on the line every time he answered a commander's queries probably did not have a career that was worth putting on the line.

I also wish to thank Vice Admiral (ret) Art Cebrowski, former President of the U.S. Naval War College and former Director of Force Transformation, who not only encouraged me to try out my budding concepts of effects-based operations at Navy Global War Games in 2000 and 2001, but who urged me to write both this book and its predecessor. Equally, I owe a debt of deep gratitude to Dr. David S. Alberts, Director of Research, Office of the Secretary of Defense, Networks, Information and Integration (NII), who first suggested writing a book on effects-based operations and who has continually encouraged me in writing this book. Thanks are also due to Admiral (ret) Jim Hogg, Director of the Chief of Naval Operations Strategic Studies Group, who insisted that I write this second book and would not take no for an answer.



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It should be noted that all the views expressed herein are my own and do not reflect either upon these sources or upon the Boeing Company.

# FOREWORD

BY DR. DAVID S. ALBERTS

Effects-based approaches to operations are simple, even elegant concepts in theory. Yet this idea has, like network-centric approaches to operations, been misunderstood in a variety of ways. The resulting confusion is responsible for a great deal of unnecessary argument and has hindered progress.

These approaches were conceived to draw distinctions between traditional approaches and new approaches that, to proponents, have significant potential to improve effectiveness. Some current approaches have served well for a considerable time and have become enshrined as dogma rather than doctrine.

At the risk of over-simplification, an effects-based approach is about maintaining a laser-like focus on the “why” of a mission rather than a given approach or means to that end. It is a reminder that although you may have a hammer, all problems are not nails. It is a wake-up call to adequately consider and understand all of the sources of power and influence that can be applied. It is a reminder that we operate in a world that requires constructive interdependence between organizations and agencies.

Effects-based approaches are also inevitably about orchestration, about developing synergies that result in effects greater than those that are additive. It is this aspect of effects-based approaches that makes them a natural partner with network-centric approaches.

Some (including Ed Smith) argue that effects-based approaches are not new. Others argue that they are difficult or impossible to achieve. Still others think that effects-based approaches are tools and find the instantiation at hand wanting. Clearly the idea of focusing on the desired end result and being flexible is not new. The importance of effects-based approaches is not derived from their originality but from whether or not translating this idea into practice will improve our ability to achieve the ends associated with complex 21st century missions.

The 2006 QDR report states the criticality of stabilization and reconstruction operations in no uncertain terms. Just a decade ago, the prevailing view was that the U.S. military “fought our nation’s wars” and did not do “nation building.” The focus for those who made these claims was on warfighting and the destruction of targets. A change of this magnitude in the “why” of our assigned missions requires that we reexamine what it means to understand the situation and our approaches to understanding the dynamics of conflict. This includes the measures of merit we employ. Clearly, battle damage assessments focused upon weapons effects are no longer useful in and of themselves. Effects-based approaches need to be accompanied by more comprehensive assessments.

This second CCRP publication on effects-based approaches to operations begins with a detailed description of the prob-

lem that effects-based approaches are thought to address and explains why effects-based approaches are so important to understand and to be able to do. Ed Smith recounts his experiences as a naval officer and the complex problems he encountered that convinced him of the need for effects-based approaches and the improved infostructure needed to support them. Even though the infostructure has improved, being able to conduct effects-based operations has proved challenging. But is it not the infostructure that is now the long pole in the tent; it is a lack of understanding about effects-based approaches and a lack of a coevolved organizational processes, trained individuals, and appropriate tools. This book will make effects-based approaches more understandable to many and thus will hasten the day when we will be better able to conduct effects-based operations, a capability much needed in our century.

The community owes Ed Smith a debt of gratitude for his efforts to make effects-based approaches understandable and to raise awareness about the urgent need to develop the capability to conduct effects-based operations in concert with our coalition partners.



## EXECUTIVE SUMMARY

Our world is a myriad of ever-changing, interdependent variables whose courses we can never entirely predict. The strength of an effects-based approach to operations is that it squarely addresses these complexities by concentrating on their most nonlinear aspects: humans, their institutions, and their actions. Indeed, the entire effects-based approach can be characterized by four things: a focus on the human dimension of competition and conflict; the consideration of a full spectrum of actions whether in peace, crisis, or hostilities; a multifaceted, whole-of-nation concept of power; and the recognition of the complex interconnected nature of the actors and challenges involved. The human dimension arises because all effects-based approaches are ultimately about shaping human perceptions and behavior, and because they depend heavily on human beings to make the complex estimates and decisions involved. The focus on an entire spectrum of actions means thinking holistically across a peace-crisis-hostilities spectrum. Because the focus is on what observers perceive rather than on what we do and because any action is but one part of an observed whole, all operations are necessarily whole-of-nation or whole-of-coalition. Finally, any effects-based approach must proceed from the recognition that all actions and the reactions they provoke are inextricably linked in a system of ever-chang-

ing and adapting human systems whose complexity shapes both the nature of the problem and the task of assessing, planning, and executing any operation.

The central tenet of an effects-based approach to operations is that we can somehow purposefully shape the interactions of the actors in this complex security environment. Effects-based operations themselves can be thought of simply as “coordinated sets of actions directed at shaping the behavior of friend, foe, and neutral in peace, crisis, and war.” The word *actions* encompasses all forms of military action and all of the diplomatic, economic, and other actions of a whole-of-nation or whole-of-coalition effort. As such, it proposes one basic concept applicable across an entire national effort. Similarly, *behavior* applies equally to physical and human systems, as well as to all aspects of a whole-of-nation effort. This definition underlines the complexity involved. It does not speak simply of an action creating an effect in an if-this-then-that, cause-and-effect relationship, but of *coordinated sets of actions*, i.e. the use of many interdependent actions. And, it does not look to a single well-defined effect as the outcome, but rather to the actions shaping a *behavior* end-state. This is to say that it sees both a process and an end-state that are neither precisely nor solely the product of the actions that we take. And, it does not limit this behavioral outcome to a foe’s reactions, but sees “actions” creating diverse effects on many actors at many levels of many different arenas and a requirement for a single set of actions to be able to create opposite effects on foes, friends, neutrals, and the domestic public. In brief, effects-based approaches are inherently complex.

The complexity that shapes both the security environment and effects-based operations can be seen as a continually changing



array of interdependent variables in which the chain of causes and effects between an action and an outcome will seldom if ever be the same, in which outputs are not proportionate to inputs, in which the whole is not necessarily equal to the sum of the parts, and in which there will be a nearly infinite number of potential outcomes for any action. Living systems theory offers a way of approaching this complexity. It sees the world in biological and sociological terms as an interlocking multi-level system of complex adaptive systems from which no individual system can be extracted without changing both its character and that of the system as a whole. No interaction can be entirely isolated. Each is part of a continuing succession of interactions in which systems coevolve, and each interaction affects all future interactions in some way. However, the systems in this model do have a recognizable order because all are products of an evolutionary process that weeds out systems that do not work. This argues that outcomes are not random and that we can identify enduring “essential processes” that explain why some systems survive and others fail. In the multi-tiered living systems model, we can recognize familiar military organizations from the warfighter to the national leadership and, because the model is generic, we can similarly break down other government agencies, states, and non-states including terrorists. In the model, interactions occur simultaneously on many different levels with each interaction tending to proceed at a pace dictated by local circumstances. These interactions are not just with a foe, but also with different government, non-government, international, and other actors, each of which is part of a different hierarchy/reporting chain but faces similar local problems and timelines and, as a result, tends to evolve local networks of relationships to “get the job done” wherever their formal organization permits.

Each interaction can be described as an “action-reaction” cycle in which a person or organization reacts and adapts to a stimulus—anything from enemy fire to a diplomatic note. The stimulus enters the cognitive process through the eyes and ears of an observer who attempts to make sense of it, apply this understanding to judging options for a response, and choose a course of action or inaction that then becomes both the end-state of that cycle and the stimulus for a new cycle, this time with the other side reacting in a continuing spiral of cycles, each of which builds on what has gone before and shapes those that will follow. Taking a hint from the living systems model, we can identify five “essential processes” without which this cycle cannot function. Logically, each actor in the cycle would need: (1) to achieve some level of awareness of what was going on; (2) to make enough sense of this picture to act or react; (3) to decide on a course of action to deal with the challenges presented; (4) to carry out those actions; and in doing all of this, (5) to be subject to idiosyncratic social influences that shape their sensemaking and decisions.

Good commanders have dealt with the complexities in these processes by inserting a “human in the loop”—whether themselves, subordinate commanders, staff, or watch personnel—to make complex decisions, to assess ambiguous information, and to fill in the blanks where information is wanting. In looking at their real-world operations, we can identify where, why, and what human intervention was deemed necessary, the generic problems, questions, and issues that the interventions addressed, and the requirements for information and knowledge that they engendered. For example, we can break awareness creation into three generic problems—tasking, collection, and analysis—and then break these into successively more specific subordinate questions until we can separate the

problems that are irretrievably complex and require human decisions from those that might be amenable to better information and conventional linear analyses. The object is not to *solve* the complexity. We cannot. It is rather to *bound* it by using the elements that we can know to enable the human in the loop to narrow the set of possible answers to a most likely set and thereby improve his probability of being right. This idea is at the root of *network-enabled* effects-based operations. Whereas success in “classic” effects-based approaches largely depended on the abilities of the humans in the loop to deal with the complexity in their heads, in network-enabled operations they need no longer be left to their own devices. Better and more meaningful support from networking can enable decisionmakers to bound complexities and deal with ambiguities better and thereby increase the probability of a correct decision.

In defining the effects-based problem around the human in the loop, we have made a large complex problem divisible and subject to a step-by-step approach whose common metric is the probability of a correct decision. In placing the human at the center of the solution, we delineate four trade-offs:

- as the uncertainties, ambiguities, and unknowables become greater, more human intervention will be required;
- as the complexity becomes greater, the human role will become greater;
- as the available time for decisionmaking decreases, the likelihood of an unaided human decision will increase; and
- as the available support decreases, the human will be called upon to fill the gaps more often.

Historically, the first three trade-offs have reflected efforts to choose and develop the right decisionmakers and to give them the organizational latitude and agility needed to implement classic effects-based operations. It is the final trade-off that is new: using Information Age networking to supplement rather than supplant human capabilities. But, the term *networking* is significant. Acquiring and conveying a continually changing understanding of complex subjects and situations requires more than networks of technologies and communications; it requires networking people and their expertise and, by extension, agile physical and organizational architectures that continually adapt and are unbounded in scope. In fact, these demands and the above four trade-offs suggest a parallel four-fold metric for success in what might be termed *second generation* network-centric operations:

- as networking reduces the uncertainties and ambiguities, less human intervention will be required;
- as networking bounds more of the complexities of the problem, the human in the loop will be needed less frequently;
- as networking provides faster support or more time for decisionmaking, the human will less frequently be the final resort; and
- as networking provides more support, the probability of a correct decision increases.

The true metric for network-enabled effects-based operations is thus the quality of the human decisionmaking that emerges.

The central issue with effects-based approaches to operations is not whether or not to undertake them. We already conduct them and, in a world of asymmetric foes where traditional

models of attrition-based conflict do not work, we have little choice but to continue to pursue them. The real question is how to do them *better*.

At the core of the “how to” of any effects-based approach to operations lies a paradox: complexity simplifies. If we accept the innate complexity of both our security environment and any effects-based solution, then we implicitly accept as well: that there is no perfect awareness; that we will never have all of the answers nor be able entirely to understand our adversaries (or friends and neutrals); that we can neither “solve” all complex problems nor plot all of the possible consequences of our actions; and, above all, that the human being—a product of biological evolution and a complex adaptive system in his own right—is the key to both dealing with the complexity and making an effects-based approach work. Complexity simplifies because it sets a relative standard. We need not do effects-based operations perfectly, only better than our opponents. And, the challenge is not “all or nothing,” but a series of finite pragmatic steps, each of which promises in some way to improve human decisionmaking.



INTRODUCTION:  
FROM THE “WHAT” TO THE “HOW” OF  
EFFECTS-BASED APPROACHES TO  
OPERATIONS

The basic concept of effects-based operations is not new. Call it what you may, the idea of a human-centered approach to warfare dates to at least Sun Tzu and it is certainly evident in the writings of Carl von Clausewitz<sup>1</sup> and B.H. Liddell Hart. We can trace the fundamentals of what we have come to call *effects-based operations* or an *effects-based approach to operations* through a lengthy history of conflicts and crises, and we can see them in the actions of the best statesmen and military commanders throughout the whole of history. In this rich history of effects-based actions, moreover, we can discern a distinct continuing thread: an insistent focus on the complex

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<sup>1</sup> Both Barry Watts and Alan Beyerchen point out that Clausewitz’ discussion of friction and fog is firmly linked to human factors involved and that, largely because of this human dimension, Clausewitz sees war as a fundamentally nonlinear phenomenon.

Watts, Barry D. *Clausewitzian Friction and Future War*. Washington, DC: National Defense University. 1996. pp. 27-32.

Beyerchen, Alan D. “Clausewitz, Nonlinearity, and the Unpredictability of War.” *International Security*. 17:3, Winter 1992. p. 68.

human dimension of competition and conflict. This human focus looks beyond the destruction of enemy forces and capabilities to an end denominated in terms of the impact of such actions upon the behavior of human beings and human organizations or, much more narrowly, upon the will to fight. The complexity involved has in turn meant looking beyond purely military ways and means to the full dimension of the application of national power in which military power is but one element, and has meant accepting that no decision or assessment will ever be perfect. Indeed, in this book, we will use the term *effects-based approaches to operations* to denote the diverse applications of effects-based thinking to operations, that is, approaches characterized by a focus on: (1) the human dimension of collaboration, competition and, conflict, (2) the full peace-crisis-war-postwar spectrum, (3) integrated national or coalition power, and (4) the complex nature of problems and solutions. The term *effects-based operations* will be used to refer to operations planned and executed with such an effects-based approach. In the United States, an effects-based approach to operations has been reflected in three schools of military thought.

The United States Air Force originated the term “effects-based operations” and can trace its thinking back to the work of the Italian air power pioneer Giulio Douhet. In his seminal work, *The Command of the Air*, Douhet contended that air power could jump across the battle lines to attack an enemy population in the enemy’s chief cities so as to produce a rebellion that would force the government to capitulate. In other words, the targeted physical destruction had the capacity to produce a psychological effect that could win wars.<sup>2</sup> In different guises, this thinking was reflected in the strategic bombing theory developed by the Army Air Corps in the 1930s and in the stra-



tegic nuclear deterrence theory of the 1950s and 1960s. In its current context, it appears in the work of Colonel John Boyd and especially in the precision nodal targeting work of Colonel John Warden, Dr. Maris McCrabb, and Lieutenant General Dave Deptula.<sup>3</sup> While much of this Air Force work has been focused on the targeting process for the use of kinetic weapons, i.e. effects-based *targeting*, more recently there has been a growing movement expanding that targeting to information operations and the use of non-kinetic and non-lethal weapons. However, it is largely silent on the implications for war termination and subsequent operations to fully implement the imposition of National Will.

Another and rather different vein of effects-based thought has been apparent in the United States Marine Corps and the United States Army (primarily Army Special Forces). These efforts were not categorized as “effects-based operations” or as “effects-based approaches to operations” but instead presented a “maneuverist” approach to warfare or, more simply, “maneuver warfare.” Much of this thinking is captured by the thinking of Liddell Hart with the “indirect approach.” The driving factor for both Marines and Special Forces was the need to plan for situations in which their forces would be outnumbered and likely outgunned by an enemy—a scenario in which an attrition-based approach might prove disastrous. Both, therefore, sought to exploit a combination of operational

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<sup>2</sup> Douhet, Giulio. *The Command of the Air*. Washington, DC: Office of Air Force History. 1983.

<sup>3</sup> Fadok, David S. *John Boyd and John Warden: Air Power's Quest for Strategic Paralysis*. Air University: Air University Press. 1995.  
Warden, COL John A. III, USAF. “The Enemy as a System.” *Airpower Journal*. Alabama: Maxwell AFB. Spring 1995.  
Deptula, BG David A., USAF. “Firing for Effects.” *Air Force Magazine*. April 2001.

tempo and movement to surprise and confuse an enemy<sup>4</sup> and thereby gain a psychological advantage over enemy forces that could balance what the Marines and Special Operations Forces might lack in numbers and firepower. In Operation Iraqi Freedom, this approach—now frankly labeled “effects-based”—was a highly visible factor in the speed and surprise of the major combat phase of operations.<sup>5</sup> In the post-conflict stabilization operations, much more attention was devoted to the lessons learned from USMC counterinsurgency experiences captured in “The Small Wars Manual” and the Combined Action Program utilized in Vietnam.

The third school is that of the United States Navy, which likewise has eschewed the use of the term *effects-based* but nevertheless has historically used an effects-based approach to its operations short of major combat. The Navy’s approach is akin to that of the maneuverist thought of the Marines and Special Forces but with an important difference. The Navy, more than any other Service, has been tasked with crisis response operations, literally hundreds of such operations of every size and description over the past 60 years.<sup>6</sup> In all but a few of these responses, the task of the naval forces was to achieve some diplomatic, economic, or military objective without firing a weapon, usually because any form of kinetic or

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<sup>4</sup> In work sponsored by the Office of Net Assessment, Mark Herman dubbed this effort to sow chaos and confusion “entropy-based warfare.” In theory, in battle the side with the least chaos and confusion (entropy) will succeed.

<sup>5</sup> In fact, this is demonstrated on a grand scale in General Tommy Franks’ planning for Operation Iraqi Freedom in which speed and maneuver were consciously substituted for mass to the discomfort of many armchair generals. In this case, as in the stabilization operations that followed, however, the operations were labeled “effects-based.”

Franks, General Tommy, USA. *American Soldier*. New York, NY: Regan Books. 2002. pp. 393-394.

destruction response would have been counterproductive to diplomatic and political efforts.<sup>7</sup> This is to say that the actions the naval forces undertook—movements, reinforcement, and demonstrations<sup>8</sup>—had to achieve a psychological effect that would shape the behavior of a wide variety of observers from those in the Kremlin to those in European and East Asian capitals, local allies, and would-be foes. In short, the naval commanders were required to assess and project not just the military consequences of their actions but also their potential psychological, political, diplomatic, and economic conse-

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<sup>6</sup> Using the methodology established by Barry Blechman and Stephen Kaplan, this figure stood at 331 crisis reactions by United States military forces by 1975 and over 400 by 1990 with over 80 percent involving primarily naval, that is, Navy-Marine Corps forces. Most of these reactions were of small scale and few involved the destructive use of military force although most implicitly or explicitly threatened it.

Blechman, Barry M. and Stephen S. Kaplan. *Force without War*. Washington, DC: Brookings. 1978.

Zelikow, Philip D. "Force without War, 1975-1982." *The Journal of Strategic Studies*. March 1984.

Siegel, Adam. *The Use of Naval Forces in the Post War Era: U.S. Navy and U.S. Marine Corps Crisis Response Activity, 1946-1990*. Alexandria, VA: Center for Naval Analyses. 1991.

<sup>7</sup> The Soviet and American responses to the October 1973 Middle East War, for example, put more than 90 U.S. warships and more than 100 Soviet warships in the Mediterranean Sea as each side moved to protect the interests of local clients. Had any weapon been fired by any ship, the result could have been a rapid and likely uncontrollable escalation, the antithesis of what the ships were supposed to accomplish.

<sup>8</sup> During a crisis, naval forces varied these actions along three continua: increasing or decreasing the size of the force; moving forces toward or away from the crisis area; and the kinds of actions demonstrated by the units involved, from a demonstration of force at one end of the continuum to pulling into a liberty port at the other. The continua gave the force three attributes—flexibility, credibility, and timeliness—that made it useful in effects-based crisis response operations.

Smith, Edward. *Naval Confrontation: The Intersuperpower Use of Naval Suasion in Times of Crisis*. Unpublished Ph.D. Dissertation, American University. 1979. p. 387.

quences in evolving situations that often oscillated between crisis and downright confrontation, often with little guidance as to what these consequences might be.

Given such diverse origins, it should not be surprising that there has been and continues to be a vigorous debate within the U.S. Armed Forces over what effects-based operations are and how they might be employed. In fact, the debate is a healthy sign that the concept has passed from being a meaningless label casually applied to being an increasingly concrete concept that has begun to challenge existing ways of thinking in many ways. This debate centers on two questions:

- How, if at all, do effects-based operations fit into the military's existing warfighting lexicon and doctrine, or conversely, how might effects-based concepts and approaches help that doctrine better address not just warfighting but also the increasingly important post-9/11 concerns with preventing and containing war and restoring peace? and
- How are we to plan and execute operations whose innate complexity prevents clear answers to traditional tests of ways, ends, and means, and whose results are difficult to measure in time to be of use to commanders?

In fact, these two questions were at the root of this book and its predecessor, *Effects-Based Operations*. Both books grew out of a series of three major Navy Global Wargames in 1999-2000 in which the U.S. Navy experimented with what was then still primarily an Air Force concept for precision targeting. In the opening game, the concept quickly posed problems. Because Navy wargames and operational requirements emphasized crisis management and war prevention as well as warfighting,

there was a clear mismatch between the Air Force approach and Navy thinking. Similarly, a highly regimented, target-centric approach to planning appeared to have little in common with naval maneuver “to influence events ashore”<sup>9</sup> short of strike operations. Yet, as VADM Art Cebrowski (then President of the Naval War College) observed, the fundamental logic of the effects-based concept, the link between actions—whether strike, maneuver, or simple presence—and the subsequent behavior, was sound and clearly did apply to Navy needs. However, it was also evident that we were rushing to invent a process for planning and executing effects-based operations without a sufficiently detailed concept of what they were or exactly how they might apply to naval operations in peace and crisis as well as war. Accordingly, I was tasked to help the Navy Warfare Development Command develop a broad-based concept to support further efforts in the 2000 Global War-game. This nascent concept was operationalized with the Global 2000 “battle force commander” during a week-long offsite with RADM Tom Zelibor’s Battle Staff, played at the game, refined, and then replayed at the 2001 Global War-game. At this point, I was asked by VADM Cebrowski and Dr. David Alberts to put the work into book form, a labor that was sharply accelerated by 9/11 and the evolving asymmetric conflicts in Afghanistan and Iraq, and that has now expanded to a second volume.

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<sup>9</sup> Johnson, ADM Jay, USN. “Anytime, Anywhere: A Navy for the 21st Century.” *Proceedings*. November 1997. p. 48.



# CHAPTER 1

## IT'S A COMPLEX WORLD

Pictures of the earth from space can be very striking. We see a bright blue orb upon which the irregular outlines of seas and continents can be discerned beneath an ever-changing swirl of clouds that sometimes obscures the shapes of both seas and continents. There are no straight lines to be seen in this picture. In fact, for all of the beauty of this scene, it is difficult to find anything very orderly in the picture, and we cannot predict exactly what forms the clouds may take in the days, weeks, and years to come.

This image of the earth, with all of its swirling clouds, uncertainties, and irregularities, provides a powerful analogy to a different aspect of the same planet: the human dimension in which people, states, and militaries are continually moving, interacting, and contending. Like the planet depicted, this world of human systems is highly complex, distinctly nonlinear, and always changing as the systems compete, adapt, and coevolve in many different arenas and on many different levels from the individual human being to groups, societies, and the international system itself. Like the partly cloudy world viewed

from space, the boundaries of this human world with all of its social, cultural, ideological, economic, and intellectual dimensions are at best only irregularly outlined. Although this world contains constants, it is fraught with uncertainties and ambiguities and beset by both unknowns and unknowables.

Furthermore, it is continually changing because the living systems in it not only adapt to changes in the environment, but also coevolve with other complementary and competing systems and, in the process, change that environment. The result is a world in perpetual change with the rate of change itself changing unpredictably and often for reasons that we cannot immediately comprehend or that appear to defy logic and rationality as we—the products of our own complex culture and society—might see them.<sup>10</sup> Finally, it is a world in which competition between and among actors is the norm even though the forms this competition takes are many, varied, and themselves continually changing.

This instability and unpredictability shape the global security environment and the nature of military operations in three ways. First, interactions among human beings and the social groups that they create are so complexly interwoven that politics and diplomacy can never be isolated from military operations and battlefield effects. Second, because the security environment is a product of a cumulative history shaped in some way by each action, current efforts will be shaped by the

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<sup>10</sup> For example, during the 1986 naval operations off Libya, I was asked by the Commander of the Battle Force Sixth Fleet whether Libyan leader Colonel Qadhafi was rational, given his actions in support of terrorists. I responded that he was rational even if we as Westerners and Americans did not necessarily understand the rationale behind his actions—a view accepted by the Commander.



history of previous actions and will themselves shape future actions. And third, the world is inherently complex because it contains a very large number of interdependent variables whose collective behavior may be understood and bounded, but not definitively predicted.

## DEFENSE TRANSFORMATION

All of this is important as 21st century nation-states consider how to organize and use military power. The inextricable linkages of the myriad interdependent entities in this complex world mean that we cannot think just in terms of naval or air power, or even of power that is solely military or solely state-derived. Although we habitually think in terms of nation-states, the actors on the world stage range from functioning governments to failed states disintegrating into insurgencies; to tribal, clan, or even criminal organizations; to business, non-governmental, and international organizations that transcend nation-state boundaries; and, yes, to a worldwide confederation of terrorists. In this context, military power cannot be considered solely in terms of state-on-state war or, still more narrowly, in terms of major combat operations. Indeed, the simple existence of a military capability shapes the environment and the roles that nation-states play in it, and any military action will have some impact upon the system to the point that, paradoxically, inaction becomes an action and one that can sometimes create effects as potent and far-reaching as any other action.<sup>11</sup>

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<sup>11</sup> The classic example of such an inaction was the 1938 decision of Britain and France not to come to the aid of Czechoslovakia, a Munich spectre that still haunts world politics.

The complex and unstable post-9/11 world points to a military role: (1) in which the multi-dimensional military operations evident in the post-conflict stabilization operations in Afghanistan and Iraq are the norm, not an aberration; (2) in which military efforts will involve vastly different kinds of interactions from those between global peers to those between asymmetric competitors, both state and non-state, and those between individuals, groups, and communities; and (3) in which interactions will not be neatly divisible into military, social, political, diplomatic, or economic spheres. More than ever, military operations will be complex agglomerations of diverse interdependent variables with each seen from differing perspectives by a wide range of human observers. In these interactions, there may always be but one ground truth, but there will be as many perceptions of it as there are observers and it is those perceptions that will be the key factors in deciding the outcomes.

### *Linear thinking*

The world described above is very complex and nonlinear, yet much of our thinking about warfare and military acquisitions tends to be linear. We expect that the whole will be equal to the sum of the parts, that inputs and outputs will be roughly proportional, that the same action under the same conditions will produce similar results, and that we will be able to trace interactions through a well-established chain of causes and effects. These linear thought processes have been reinforced both by a century and a half of great nation-state wars that were largely attrition-based and by 40 years of the Cold War in which we were able to think in terms of a bi-polar world whose interactions could be reduced to an almost linear

model.<sup>12</sup> The Western military focus has, therefore, tended to be upon finding linear solutions to linear problems—in a world that is manifestly anything but linear. Similarly, proposals for defense “transformation” tend to focus on the tactical level of major combat operations where causes and effects are most linear. Indeed, the contrast between this linearity and the complexity of the security environment indicates that perhaps the greatest and most necessary “defense transformation” is one of thinking.

### *Effects-based approaches to operations*

Effects-based approaches constitute a conceptual gateway to addressing this complex world because they focus on the most complex part of that world: its human dimension. Even more, they frame military and national security problems in terms of complex adaptive systems, the shaping of whose interactions are the real object of military action and the real source of peace and security. The strategic driver for defense transformation is not the prospect of a precisely measurable increase in “combat efficiency,” but the prospect of defeat at the hands of an enemy who not only appears to be well-adapted to the complexity, but is prepared to exploit any inability on our part to do so.

## COMPLEXITY IN THE POST-9/11 WORLD

The post-9/11 world suggests a different set of mechanics for competition and conflict, a new model of conflict, and different operational and tactical problems from those upon which we have grown to focus.

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<sup>12</sup> Czerwinski, Thomas. *Coping with the Bounds: Speculations on Nonlinearity in Military Affairs*. Washington, DC: CCRP. 2003. pp. 8-9.

### *Why #1: The mechanics of competition and conflict*

One driving force behind the interest in effects-based approaches is the rising concern with asymmetric conflict.<sup>13</sup> Although asymmetries are usually defined in terms of size, strategy, and weaponry, the dimension of asymmetry that seems most to affect the nature of competition and conflict is that of *will* and *means*. The great wars of the last century and a half were largely driven by the symmetry of the opponents' will and means (see Figure 1). Because both sides in such conflicts had the will and the means to regenerate lost armies and navies, no single battle or campaign could defeat one or the other side. Thus, these symmetric conflicts tended to be characterized by a strategy of physical attrition that sought gradually to wear down an opponent's overall physical ability to wage war until the psychological will to do so finally broke.<sup>14</sup> In brief, the symmetry of means and will between peer competitors drove the conflict toward a struggle that was heavily attrition-based.

In more recent conflicts, a different situation has prevailed. One side (the great power) typically had great means but limited will, usually because the conflict did not directly threaten its homeland. By contrast, the other side (a local power or insurgency) had limited means but great will (see Figure 2). This produced two different asymmetries: one of means and

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<sup>13</sup> Smith, Edward. *Effects-Based Operations: Applying Network Centric Warfare in Peace, Crisis and War*. Washington, DC: CCRP. 2002. pp. 28-45.

<sup>14</sup> This is not to say that the participants in the great attrition wars did not use any and all means at their disposal—diplomatic, economic, information, and military—to defeat their opponents. It is rather that, as the extended saga of World War I underlines, these other means proved insufficient to defeat the enemy as long as their military will and means held out.

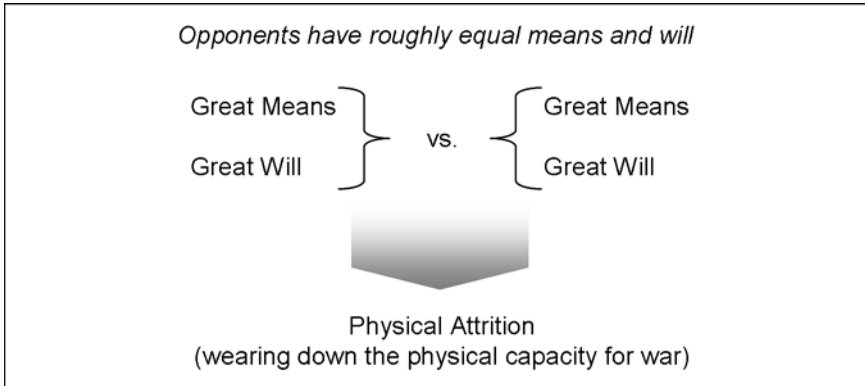


FIGURE 1. SYMMETRIC CONFLICT

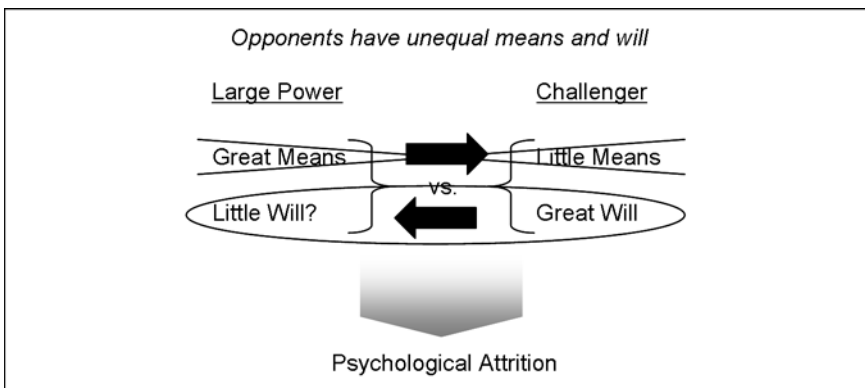


FIGURE 2. ASYMMETRIC CONFLICT

one of will. Because successful warfare is largely about creating and exploiting asymmetries, the great powers usually exploited their advantage by waging a contest of *physical* attrition in which the inferior physical means of the opponent were rapidly destroyed. The smaller or non-state opponents, unable to compete successfully in this arena, exploited what they perceived to be their advantage in will by pursuing a damage infliction strategy directed at the *psychological* attrition of the great power's

will, specifically, the public consensus supporting the conflict.<sup>15</sup> However, wherever such challengers could somehow minimize their reliance on targetable means, for example by blending insurgents and guerrillas in with a local population, they could largely negate great power physical attrition efforts and force an effects-based war focused on psychological attrition.

While this kind of problem has been posed by insurgencies for at least the last 60 years and more, non-state challengers now have both a global reach and a potential for acquiring weapons of mass destruction or weapons of mass effect.<sup>16</sup> Because there is no prospect of effective retaliation against such a foe and thus no prospect of stable deterrence, these foes threaten the survival of the great powers and the international system. Yet, such terrorist weapons, with the possible exception of biological weapons, cannot inflict the same scale of damage as a Cold War nuclear conflagration, nor can they bring the terrorists a traditional military victory. The challenger is still left with the need to fight a war of psychological attrition, but with a new twist: any attempt to actually use the weapons against the great power runs the risk of galvanizing the opponent's will rather than breaking it and thus changing the asymmetry to

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<sup>15</sup> In many respects, this focus on psychological attrition encouraged challengers to exploit abundant asymmetries in the information domain. Typically, this took the form of an information war that cast the great power as the oppressor and bully. That war, if successful, might also force the great power to adhere to a set of restrictive rules of engagement that could be exploited by the challenger in military operations or, where the rules were not observed, left the great power open to further information attacks.

<sup>16</sup> That is, weapons whose mass impact may not derive from their destructive power so much as from their disruptive power, for example, by causing a collapse of the world economy.

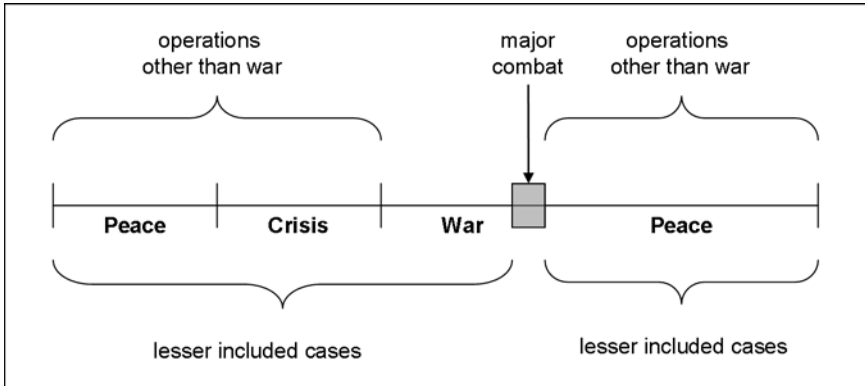


FIGURE 3. TRADITIONAL MODEL OF MILITARY OPERATIONS

one in which the great power has both great means and the will to pursue a long war of psychological attrition.

### *Why #2: The model of conflict*

A second driver toward effects-based operations derives from the increasing prevalence of an unfamiliar model of conflict.

### **Traditional model**

In linear Cold War thinking, there was a tendency (especially in the United States) to divide military operations into two categories: one labeled “major war” and another catch-all variously labeled “operations other than war (OOTW)” or “lesser included cases” (see Figure 3). Yet, these latter challenges in fact embodied by far the greater part of the spectrum of what militaries do, including peacetime conventional deterrence (e.g., forward presence) and war avoidance (e.g., crisis response operations). The dichotomy in this paradigm rested on a critical assumption that any lesser threat could be readily handled with the same military capabilities built for major

war. This division also reflected a European, state-on-state model of war that dated to the middle of the 17th century but that nevertheless continued to shape Western military thinking and public—especially media—discussion.<sup>17</sup> In this paradigm, war is waged by nation-states. Hostilities begin at a precise time after a formal declaration of war and take the form of major combat operations between the regular uniformed military forces of the two sides.<sup>18</sup> When the military forces of one or the other state have been defeated or the state has had enough of the hostilities, then the state and its military forces surrender or seek an armistice and, again at some precise time, the hostilities cease and the two nations return to a state of peace. In short, victory equates to the defeat of a foe's army.

In this rather legalistic model, the spectrum of conflict is clear and marked by precisely timed and unmistakable legal transitions between precise rule sets that govern the conduct of all parties. One rule set applies to peace and strictly mandates the forms of force permitted (e.g., law enforcement activities) and those not permitted (e.g., any violent use of one state's military force against another state), as well as very specific rules for how military forces are to comport themselves in peacetime inter-state relations.<sup>19</sup>

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<sup>17</sup> This paradigm has its roots in the foundation of the European state system in the wake of the Peace of Westphalia in 1648 that ended the brutal Thirty Years War and the equally brutal wars of religion that had dominated the preceding century and more.

<sup>18</sup> The vicious guerrilla warfare conducted by non-uniformed Spanish partisans against the French occupation of Spain between 1803 and 1810 was regarded as an uncivilized aberration rather than an acceptable form of warfare.

<sup>19</sup> The protocol governing a warship's visit to a foreign port is a good example that continues into today.



Another rule set governs how a state might transition from a state of peace to a state of war, including what conditions might be considered grounds for a “legal” war, increasingly interpreted as occurring with United Nations Security Council approval, or a morally and theologically “just war.”<sup>20</sup> A different rule set enters into effect once war is declared and it governs everything from acceptable weapons, conduct, and targets in combat operations to mandates for the proper treatment of prisoners (e.g., the Geneva Conventions), while yet another rule set lays down the duties of neutral states and the rights of non-combatants. Yet, in reality, this neat model of conflict never applies very well to conflicts with non-states such as colonial insurgencies or to wars with non-European states. Historically, such conflicts are seldom marked by formal declarations of war and tend to be fought with different and usually far more brutal rule sets. In short, the paradigm is not (and never was) applicable across the entire spectrum of military operations.

## **New model**

Even though the old model of what “ought to be” continued to dominate our thoughts, plans, and expectations, 20th century wars often followed a different attack-first-declare-war-afterwards model.<sup>21</sup> In late 20th century state-versus-non-state wars, hostilities took many forms, did not end in formal surrender, and could linger for years after regular military forces had been defeated. Conversely, hostilities might begin as ter-

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<sup>20</sup> The concept of a “just war” and many of its criteria date back to St. Augustine's writings in the 5th century.

<sup>21</sup> As demonstrated by the Japanese surprise attack at Port Arthur in 1905 and at Pearl Harbor in 1941, as well as Hitler's attacks on Poland in 1939 and the Soviet Union in 1941, the paradigm of wars being formally declared *followed by* an initiation of hostilities was far from being universally honored.

Traditional Model	New Model
Nation-State vs. Nation-State	Nation-State vs. Non-State
Allies	Coalitions / International Organizations
Declaration of War	Fuzzy Transition to War
Hostilities between Uniformed Military	Military vs. Irregular / Police vs. Terrorist
Peace, Crisis, War	Continuum of Operations
Precise Formal Rule Sets	Contradictory Rule Sets / Rules Observed by Only One Side
Separate Military-Civilian Efforts	Whole-of-Nation Efforts
Physical Battlefield / Attrition Focus	Psychological Battlefield / Media Focus
Victory = End of Major Combat	Victory = Political Defeat of Foe
Victory = Defeat of Opposing Military	Victory = End of Options / Will

FIGURE 4. TRADITIONAL VERSUS NEW MODEL

rorist operations, evolve into guerrilla warfare, and end in major combat.<sup>22</sup> These state-versus-non-state antagonists usually followed different rule sets while the formalized rule sets of the 19th century paradigm were observed only by one side—if at all. The transitions between peace and war, or between lingering states of hot peace and cold war, became fuzzy and difficult to identify. In short, this new model bears little resemblance to “war as it ought to be” (see Figure 4).

The new model reflects a continuum of competition and conflict (see Figure 5). On this continuum, “peacetime” operations encompass *inter alia* all of a nation’s efforts to create and sustain a basic deterrence—actions that stretch from simply maintaining and demonstrating particular sets or configurations of military power (such as forward presence) to strategic nuclear

<sup>22</sup> For example, the Viet Minh operations against the French in Indo-China culminating in the 1954 defeat of a regular French army at Dien Bien Phu.

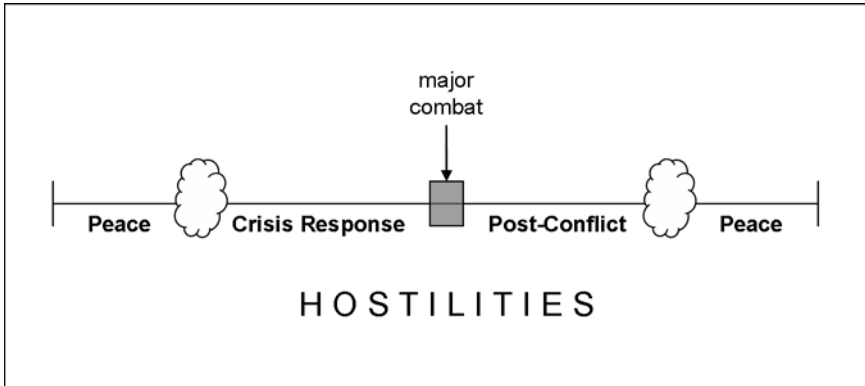


FIGURE 5. NEW MODEL OF CONFLICT

deterrence, and now deterrence of chemical, radiological, and biological weapons of mass destruction—and all of the responsibilities of a wide variety of peacekeeping and humanitarian operations. In this model, the transitions from peace to crisis to war not only tend to be unclear, but the very imprecision of the transitions has become a niche of vulnerability to be exploited by asymmetric adversaries.<sup>23</sup> Along this continuum, we can still pick out the beginning of a crisis<sup>24</sup> and identify the time at which we decide to respond to an emerging challenge or to commit military forces in crisis response operations. However,

<sup>23</sup> Stated differently, asymmetric opponents like al Qaeda have sought to turn a mindset still shaped by the old concept of war to their advantage.

<sup>24</sup> In international relations, the maxim is that a crisis is whatever a great power identifies as one. In the Soviet-American confrontations of the Cold War, newspaper analyses of public announcements by the antagonists show governments turning from crisis avoidance to acknowledgement that a crisis exists in the space of 24 to 48 hours. Smith, *Naval Confrontation*, p. 314.

in a world of asymmetric terrorist and guerrilla challenges, the point at which hostilities begin is far from clear and often lies in a gray area on the dividing line between law enforcement efforts to respond to a criminal act and military action to respond to an armed attack.<sup>25</sup> In the post-9/11 security environment, the linear “state of war” has been replaced by a complex “state of hostilities” that encompasses everything from law enforcement to peacekeeping, limited strike operations by military forces, full-blown military intervention, and lengthy post-conflict stabilization operations. Within this state of hostilities, we can usually still identify the beginning and end of major combat operations (the shaded block in Figure 5) in part because they involve conventional military operations and in part because of the scale of the effort involved. But, the end of major combat operations no longer connotes an end to hostilities. Instead, the foe will “adapt” to defeat in conventional force-on-force warfare by shifting to another form of conflict, and then continue to shift the form of hostilities until he has either run out of options or run out of will.<sup>26</sup> Given the nonlinear complex adaptive nature of this new post-9/11 model, “post-conflict stabilization operations” tend to devolve into a lengthy succession of cycles that end, in T.S. Eliot’s words, “not

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<sup>25</sup> For example, it can be argued that terrorists began hostilities with the United States in the first World Trade Towers attack of 1993 or even before. Yet, the United States treated that attack as a criminal act to be handled by police forces and the criminal justice system. The attack was not regarded as an attack on the United States in the context of the traditional model of war. Similarly, the al Qaeda attacks on U.S. Embassies in East Africa and the USS Cole were treated as separate incidents rather than a continuing state of hostilities. Conversely, in the anthrax attacks in Washington, D.C. and Florida that followed 9/11, there was considerable uncertainty as to whether the attack was another al Qaeda attack to be met with military force or one by home-grown terrorists to be met by local, state, and federal police forces. Lewis, Bernard. *From Babel to Dragomans*. New York, NY: Oxford University Press. 2004. p. 376.

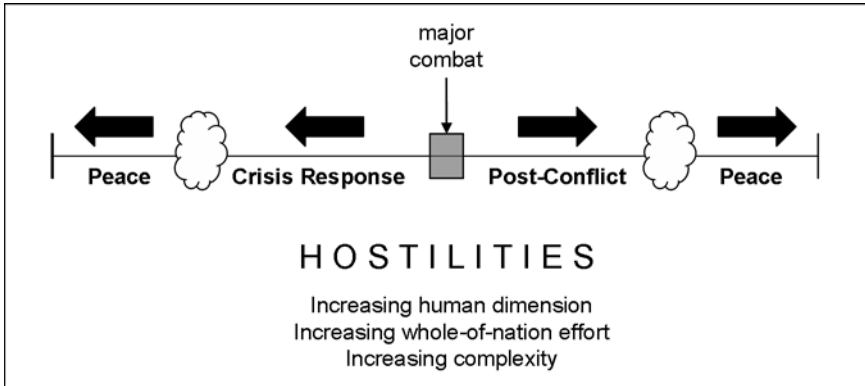


FIGURE 6. NEW MODEL OF COMPETITION AND CONFLICT

with a bang but a whimper,”<sup>27</sup> an end that may only become obvious in the retrospect of a prolonged lack of hostilities or perhaps in some acceptable norm of instability, another cloud in the diagram.

This new continuum model and the reality of current military operations point to three fundamental implications of complexity in military operations. As illustrated in Figure 6, as we move further from major combat operations (whether toward

<sup>26</sup> As complexity theory suggests, this choice has always been present even in the 19th century model. A good example can be found in the closing days of the American Civil War when the Commander of the Confederate Army of Northern Virginia, General Robert E. Lee, found himself chased by one superior Union Army and blocked by another with an additional Union force having captured his much needed supplies. When it became obvious that the Army could no longer continue major combat operations, members of Lee’s staff proposed dispersing the Army so as to enable soldiers to make their ways individually into the nearby mountains of Virginia in order to continue resistance in a guerrilla war. Lee, reflecting both the model of war and his own belief that such resistance would be to no avail, refused.

Foote, Shelby. *The Civil War*. Vol. 14. Alexandria: Time-Life. 2001. p. 149.

<sup>27</sup> Eliot, T.S. “The Love Song of J. Alfred Prufrock.” *The Complete Poems and Plays (1909-1950)*. New York, NY: Harcourt. 1971. p. 3.

crisis operations and peacetime deterrence in one direction or toward post-conflict stabilization and a restoration of peace in the other):

- interactions will focus more on the human dimension of the conflict;
- interactions will be more whole-of-nation or whole-of-coalition, i.e. political, economic, diplomatic, and social vice primarily military in character or will involve non-governmental or international actors; and, as a result,
- the operations will become more complex.

Neither Desert Storm nor Operation Iraqi Freedom was “over” when major combat ceased; the operations simply made a transition from one phase of an ongoing conflict to the next. In the case of Desert Storm, the shift was to sparring contests between Iraqi anti-aircraft batteries and Allied aircraft in no-fly zones accompanied by a continued diplomatic impasse over economic sanctions, both aspects of a wily information campaign of psychological attrition that Saddam Hussein continued to wage. In the case of Operation Iraqi Freedom, the shift to insurgency and terrorism left the “victorious” coalition forces juggling the interrelated economic, social, and political tasks of re-establishing order and dealing with terrorist and insurgent operations in another war of psychological attrition, this time centered on a damage infliction strategy. As in the decade-long aftermath of Desert Storm, Iraqi Freedom operations will only end when the challengers’ will<sup>28</sup> to adapt and

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<sup>28</sup> The “means” of resistance required to sustain a terrorist campaign are so small that a terrorist organization can “live off the land” virtually indefinitely although perhaps at a reduced pace. Mao’s comment on guerrillas swimming in a sea of the peasantry is a case in point. Therefore, it tends to be the *will* vice the *means* for continuing the effort that is pivotal.

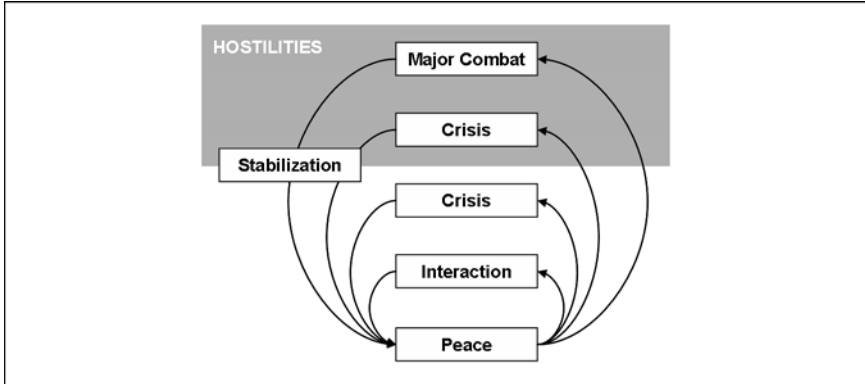


FIGURE 7. CIRCULAR CONTINUUM

resist erodes or when the coalition's will to continue the stabilization effort collapses.<sup>29</sup>

### **A nonlinear model?**

The complexity described above is in many respects about interdependent variables. All actions are interrelated both at a given moment and over time. One action leads to another. Thus, actions taken today are in some way shaped by those that have occurred in the past and in turn shape those that may be taken in the future. This has implications for how we think about the succession of phases in the model above for it implies that it is not a straight line at all but a circle or even a nest of circles (see Figure 7). Each cycle will not necessarily result in major combat or even in hostilities. In the case of the innermost circle of the diagram, the cycle may simply be a movement

<sup>29</sup> It can be argued that, in the case of Desert Storm, the unwillingness to sustain the diplomatic efforts associated with the continued economic sanctions or to properly enforce the United Nations' scandal ridden "Oil for Food" program in the period leading up to Operation Iraqi Freedom indicated an erosion of Western will and presaged a collapse of the entire effort.

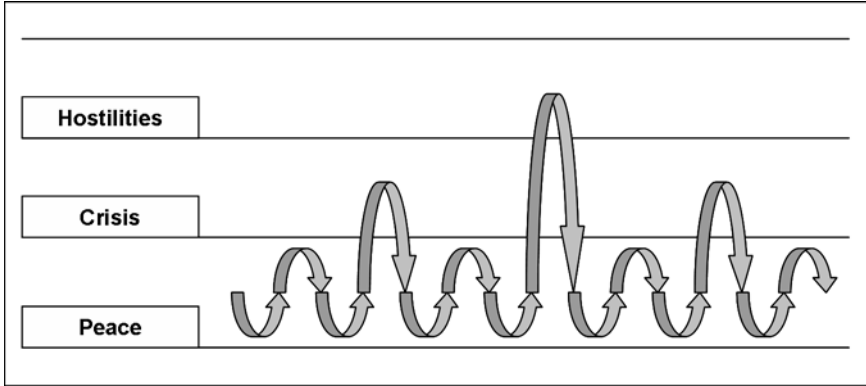


FIGURE 8. SPIRAL CONTINUUM

from peace to some form of interaction, for example, reinforcing a stable deterrence regime with a military presence or diplomatic contacts. Or, as in the next circle out, it may be a reaction to some form of crisis—humanitarian or economic as well as political or military—again with a subsequent return to peace. The cycles may also reflect a crisis, like the next ring, that crosses into some form of hostilities but that involves military action short of major combat operations either in the crisis response itself or in post-crisis stabilization operations. Finally, in the outermost ring, the cycle may include major combat operations deep in the region of hostilities.

However, there is something more to consider. In a system of complex adaptive systems, there can be no return to a *status quo ante* because the very fact that the cycle has taken place alters the starting point for all succeeding cycles. A succession of cycles, thus, presents a continuing spiral of interactions with cycles varying in amplitude according to the size, scope, and nature of the interactions involved, but always returning to a new starting point some distance removed from where it began (see Figure 8).



This is not new. We can trace similar interdependent cycles in the history of crises and conflicts. The history of the period from the Versailles conference “ending” World War I to the “beginning” of World War II is rampant with such cycles reflecting successions of crises and local conflicts, as well as faulty political and economic decisionmaking that gradually built the groundwork leading to the Second World War.<sup>30</sup> Indeed, the same phenomenon is evident in the ups and downs of our daily lives and of our free market economic system. Each interaction tends to shape future interactions in some way and often in a manner that can only be understood when viewed in retrospect.

### *Why #3: The “three block war”*

Former U.S. Marine Corps Commandant General Charles Krulak has used the expression “three block war” to illustrate the complexity of today’s military operations.<sup>31</sup> On one block of that war, he points out, Marines might be engaged in humanitarian operations rendering assistance to local people who have been uprooted or injured in a conflict. On the next block, they might be trying to separate feuding local factions so as to uphold or restore a fragile local peace. And, on the third block, they might be fighting a lethal battle against a deter-

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<sup>30</sup> For example, the Versailles Conference inflicted such harsh economic and military terms on the nascent Weimer Republic of Germany that it laid the groundwork both for the economic collapse of the German middle class, who were the strongest supporters of democratic change, and for the rise of the Nazis amid the further economic turmoil of the Great Depression.

Watt, Richard M. *The Kings Depart, The Tragedy of Germany: Versailles and the German Revolution*. New York, NY: Simon and Shuster. 1968. pp. 501-510.

<sup>31</sup> Krulak, GEN Charles C., USMC. “The Three Block War: Fighting in Urban Areas.” *Vital Speeches of the Day*. Vol 64, Iss. 5. New York. December 15, 1997. pp. 139-142.

mined, entrenched enemy using modern weapons—with all three engagements involving the same troops on the same day in the same town and with each one-block operation intimately linked to the others so that success or failure in one will affect all. The description bears a remarkable resemblance to the post-9/11 experience of coalition forces in Iraq and Afghanistan. It presents a tactical and operational problem in which the transitions from one form of military operations to the next can be messy and sudden, e.g. insurgent attacks on troops attempting to refurbish a school in Iraq. The objectives, rule sets, requirements, and command and control arrangements can thus change radically from one moment to the next.

The primary means of dealing with this complexity and these high rates of change is the “strategic corporal,” a junior enlisted soldier who is at the leading edge of the engaged military force and who is thus often called upon to make tactical decisions that may have a strategic impact.<sup>32</sup>

### **Tactical “real world”**

The messy complexity of the three block war and the complex challenges it poses are perhaps best understood in the context of a familiar situation: a unit of soldiers or Marines approaches a village or urban neighborhood. The unit’s mission may be to seize and hold the area or to capture or kill the enemy forces therein. Although the particulars of the problem may be expected to change from one engagement to the next, its general outlines can be seen in conflicts from World War II to Viet Nam, to Iraq.

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<sup>32</sup> Krulak, Gen. Charles C., USMC. “The Strategic Corporal: Leadership in the Three Block War.” The Commandant’s Page, *Marines Magazine*, Jan 1999.

We can explore this problem in three successively more complex variants:<sup>33</sup> a relatively linear tactical level engagement between regular military forces as part of major combat operations to destroy an enemy strong point and the uniformed enemy combatants in it; a more complex tactical effort including a “shoot/no shoot” problem posed by out-of-uniform combatants mixed with a local civilian population; and a still more complex problem in hostilities short of major combat in which the objective is to restore stability, “win hearts and minds,” and deter would-be adversaries.

- Precision strike

In the first case, we will assume that we can somehow use sensors or other information to ascertain that the village contains only uniformed enemy combatants and that this information has become part of the situational awareness shared by all levels: the forward unit, the targeters and strike platforms, and the operational and higher level decisionmakers. Given such definitive awareness, planners might quickly conclude that the destruction of the enemy strong point could be achieved quickly and with the least risk by using air or artillery strikes called in by forward observers in the unit approaching the village. They might also conclude that the strikes need to be timed so as to optimize surprise and that they need to be precise so as to minimize collateral damage.

The planning and execution of the strike would then follow familiar lines. Planners would find targeting solutions to get

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<sup>33</sup> In my Viet Nam and Navy experience, this kind of tactical problem was equally true of coastal and river patrol boat operations in the Mekong Delta and of post-Desert Storm boarding operations inspecting every kind of shipping from dhows to large freighters for weapons and/or terrorists.

weapons on the target at the right time to meet the requirements. Weaponeers might calculate that, given the known explosive effects and accuracy of the kinds of ordnance at their disposal and the nature of the enemy forces to be destroyed, a specific number of a particular weapon would be needed to achieve the desired effect with a given level of certainty, and planners might then assess which available delivery system (e.g., artillery or various kinds of air) could put those weapons on the target most efficiently in the numbers needed—all within any time constraints imposed either by dangers to the unit approaching the village or by emerging enemy actions. Finally, they might also provide for post-strike damage assessments to determine whether a re-strike is necessary.

In this example, decisionmakers at each level reduce the tactical problem to a linear physical model into which they can feed sensor data and weapons characteristics so as to produce a set of firing solutions, and then use bomb damage assessment data to measure their effectiveness. Network-centric operations including direct sensor-to-shooter links can reduce the timelines involved, increase accuracy, and possibly use available assets so efficiently that fewer forces and weapons are needed to achieve the same impact.<sup>34</sup>

However, all of this works only if the assumptions at the heart of the above are correct and if we assume away much of the

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<sup>34</sup> In major combat operations in Iraq and Afghanistan, this precision and combat efficiency had dramatic pay-offs. Network-centric operations brought together planning, intelligence, surveillance, and reconnaissance capabilities to the point that aircraft could be tasked with new targets in flight and coordinate strikes with forward ground controllers, and ground commanders could take far bolder actions using superior blue force information. Garstka, John J. *Fighting the Networked Force*. London, UK: Battlespace Information 2005 Conference. April 20, 2005.

real-world battlefield complexity such as the connection between physical destruction and psychological outcomes and much of the combat's human dimension, e.g. the problem of identifying combatants. Additionally, the ability to precisely quantify bomb damage assessment exists because the opponent is reduced to almost inanimate dimensions of objects, forces, and capabilities whose destruction simply needs to be cataloged,<sup>35</sup> or because we assume that the destruction can be made so swift and definitive that the adversary can no longer respond effectively. While both may sometimes be true, in a world of competing complex adaptive systems, they are just as likely or indeed more likely not to be so.

- Combat identification

By injecting a “shoot/no shoot” combat identification challenge<sup>36</sup> into the same tactical problem, we significantly increase its complexity. If “enemy combatants” are not in uniform or operating in recognizable military formations but are mixed with the local civilian population, the targeting problem acquires a new dimension that makes the possibility of air or artillery strikes contingent on the ability to identify positively

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<sup>35</sup> Indeed, from the original Lanchester equations through the elaborate Soviet correlation of forces calculations, much of military operations research has hinged on what amount of force or destruction would be sufficient to break the will of an opponent, that is, on the use of linear analyses to provide an index of complex psychological outcomes.

<sup>36</sup> Almost any tactical problem will contain some requirement for combat identification. However, in this case, the challenge is less the state-to-state conflict challenge of identifying a particular type of tank or knowing which mode IFF (Identification, Friend, or Foe) a combat aircraft is squawking, than that of sorting out who is a combatant—and thus a threat—and who is not.

who is a combatant and who is not.<sup>37</sup> We might equally express this in terms of entropy. That is, what the challenger has done by creating new unknowns and uncertainties is to increase the entropy, i.e. disorder, of the situation. From the challenger's perspective, as the entropy and nonlinearity of the problem increase, the great power's Information Age technology will become less applicable; whereas order, fewer unknowns, and less entropy will increase the great power's probability of success.

In practice, these requirements will often translate into a reliance on the ability of the forward human observers to fuse their own visual observations with other often ambiguous, subjective, and/or incomplete local information and any sensor data that may be relevant.<sup>38</sup> Most of these observations are likely to occur at close range and very possibly in the midst of a running firefight when there is little time for reflection, much less for the execution of an elaborate targeting process. Successful fusion of this diverse array of data and information will likely be heavily dependent on context, especially the question of what is or is not normal for the village and the surrounding area.<sup>39</sup> Much of this context derives from the observers' familiarity with the

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<sup>37</sup> I experienced this problem firsthand during the Viet Nam War in trying to observe visually from an aircraft whether non-uniformed personnel on the ground in a Viet Cong-controlled area were armed combatants or unarmed civilians. The debate over the validity of the identification proceeded through multiple iterations at multiple levels of decisionmakers and ultimately resulted in my aircraft being shot down, removing all doubt as to whether the personnel in question were armed.

Lavell, Kit. *Flying Black Ponies*. Annapolis, MD: U.S. Naval Institute Press. 2001. Chapter One.

<sup>38</sup> For example, helicopters running cover for the forward units may end up as both sensor and strike platforms.

<sup>39</sup> This context may be simply knowing a village's normal market day and thus whether a large number of people is normal or not for a particular day.

area and, hence, their ability to fuse apparently unrelated facts, a fusion that implies a different kind of shared situational awareness from that demanded by the targeting problem.

From the standpoint of a would-be foe faced with the inexorable efficiency of great power sensors and targeting, concealing the identity of combatants becomes critical. Taking combatants out of uniform is one way to diminish that advantage. After all, why observe a tenet of 17th century European warfare if it enables your enemy to slaughter your forces at will?<sup>40</sup> Logically, if the rules of war work against you, simply ignore them or change them and use an asymmetric tactic to counter a competitive advantage in technology and processing.

In thwarting the high technology targeting process, the asymmetric foe forces the great power opponent to employ a far more uncertain identification process that hinges on the visual observations of forward personnel and on that observer's successful fusion of a tangled mass of incomplete and ambiguous information so as to distinguish between combatants and non-combatants. Because this process is recognizably subject to human error, especially in the midst of a firefight, it also stands to increase the number of mistakes that the opponent will

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<sup>40</sup> When wars were formally declared and followed a set of rules, the answer was clear. The enemy was the one who wore the uniform or flew the flag of an opposing combatant. During the Cold War with its prospect of nuclear annihilation and the increased probability of a battle of the first salvo in which disproportionate advantage accrued to whomever fired first, it was no longer anticipated that war would be formally declared. Accordingly, the standard for "enemy" was one who took "hostile action" or who demonstrated "hostile intent," a situation worsened by the perceived need to treat attacks on one unit as an attack on all units or potentially a general attack on the homeland. However, the Cold War also brought a model of large-scale guerrilla warfare in which the challenging asymmetric adversary sought to exploit the gray area between peace and war by making "fighters" blend in with a local population.

make and thereby increase the number of opportunities to exploit media reporting of non-combatant deaths and injuries in an ongoing campaign of psychological attrition. In brief, it is in the asymmetric adversary's strategic, operational, and tactical interest to add so much complexity to the situation that not only is the role of the human decisionmaker inescapable, but the decisions can only be made by well-trained and knowledgeable individuals.

- Operations short of major combat

Still more complexity enters the problem if we shift the scenario from tactical operations during major combat to tactical operations in the first two blocks of the “three block war” and thus to the gray areas between peace and hostilities. The task of the unit approaching the village in this latter case would no longer be centered on destroying enemy forces and capabilities but on “winning hearts and minds” or “post-conflict stabilization,” usually in the face of a dangerous, violent, and well-armed adversary who may attack at any time. Expressed in terms of entropy, we have taken the already nonlinear, high entropy problem posed by mixing combatants with a civilian population and have added to it a further level of entropy presented by the need to operate under different rule sets governing how the situation must be treated and how this entropy can be dealt with, and yet another level of entropy presented by the unpredictability of the transitions from one rule set to the next.

In an arena that may be regional or international in scope and political, diplomatic, military, and economic in character,<sup>41</sup> this “short of combat” problem is fraught with an extended array of interdependent variables and a complex set of infor-



mation requirements that demand that the unit have not only a grasp of the terrain, the situation, and the nature and armament of the possible hostile combatants that it might encounter, but also an understanding of the social and cognitive landscape: how individuals are wont to think and perceive; divisions between families, factions, and clans within the village; divisions between tribes, ethnic groups, and religions both in the region and over the society or nation; as well as of the potential reactions of a variety of audiences at successive levels outside the region.<sup>42</sup> Moreover, they will need to be aware that the interactions among the diverse variables will change over time, including how the unit's movements and actions may affect them. It should also be noted that the tactical nature of such rapidly evolving scenarios dictates that the complex decisions involved will not be made by seasoned senior commanders. The interactions are far too rapid and complex for that. Rather, they will necessarily be made by the

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<sup>41</sup> The thrust of the effects-based concept is of course that none of these elements can be entirely removed from planning, even in major combat operations. However, it is evident from the history of crisis response operations that such considerations are much more prevalent in military operations short of combat than they are in major combat operations.

<sup>42</sup> In Operation Iraqi Freedom, for example, this might have included divisions between pro- and anti-Saddam factions with the latter further divided into pro- and anti-Western factions and into activists, skeptics, and neutrals. Each faction might again be subdivided along ethnic lines between Arabs and Kurds, along religious lines between Sunni and Shi'i Muslims, and between Muslims and a small Christian minority. The Shi'i, in turn might reflect divisions between pro- and anti-Iranian factions and between adherents of young radical clerics like al Sadr and older more moderate clerics like the Grand Ayatollah Ali al Sistani. And, all of these divisions would sit uneasily atop ongoing rivalries between generations, social classes, tribes, families, and regions, or between the cities and the countryside, such as the marsh Arabs. Terrill, W. Andrew. *Nationalism, Sectarianism, and the Future of U.S. Presence in post-Saddam Iraq*. Monograph, Strategic Studies Institute. Carlisle, PA: Army War College. p. 13.

troops in contact, be that “contact” humanitarian, peacemaking, or lethal combat.

In each of the above three cases, the unit’s task is inherently effects-based because it revolves about creating effects on human observers. To do this, soldiers and commanders must understand what actions and timing might create the right effect. However, this demands the balancing of many interdependent variables such as the immediacy of the threat posed by hostile elements in the village and the positive and negative impacts upon the village and the wider audience of observers of any actions to deal with that threat—impacts that will vary from one observer to the next and from one interaction to the next. Moreover, neither the unit nor its chain of command is ever going to have a complete understanding of what all of the variables are or exactly how each will be affected by a given action. To make matters worse, the variables and their interactions with each other will change over the course of an engagement to the point that the unit and the chain of command will always be operating with imperfect and usually incomplete information. Yet, uncertainty or not, both will be obliged to take action by the press of events. Choosing not to act or deciding to wait for complete information may simply not be an option.

Effects-based operations are not meant to provide quick answers to all these questions but rather a framework for considering all of these factors that can help decisionmakers at all levels to cope with the complex variables involved.

## Iraq

Operation Iraqi Freedom included all of these situations at one time or another, yet perhaps the most challenging and complex of these have been those short of major combat. A relatively detailed press account of post-conflict stabilization operations in Karbala and Najaf in May 2004 illustrates many of the constraints and considerations of the above discussion. The press account, written by an embedded reporter, details the complex reactions of elements of the United States First Armored Division's 2nd Armored Cavalry Regiment and 2nd Brigade to a rebellion by the Mahdi Army of the radical Shi'ite cleric Muqtada al Sadr in the cities of Kut, Kufa, Karbala, and Najaf, the latter two containing the holiest sites of Shi'i Islam.<sup>43</sup>

In Karbala, well aware that the Polish Government had directed its soldiers not to conduct offensive operations, the rebels had forced the Poles out and seized control of Karbala's city government. The American units were directed to drive al Sadr's forces out of the city while avoiding any damage to or attacks upon the city's Abbas and Hussein shrines, which might further inflame the Shi'ite rebellion. The unit commander initially tried to accomplish this with "a show of force that might frighten off Sadr's men and avoid a pitched battle over the mosques," but when that failed they moved into the city using helicopters to clear snipers from rooftops. The insurgents, who were well aware of the American rules of engagement, set up concentric rings of defenses and concentrated forces in the shrine area, even declaring a former

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<sup>43</sup> Wilson, Scott. "Over 60 Days, Troops Suppressed an Uprising." *Washington Post*, June 26, 2004. pp. A1 and A-16-17.

funeral home used as an arms depot to be “a holy place.” Roadside bombs left by the al Sadr fighters forced soldiers to leave the shelter of the tanks to blow up the improvised explosive devices (IEDs) while snipers fired continuously at American vehicles and personnel from houses and side streets.

In Najaf, American forces faced some 2,500 Sadr militiamen with the resistance centered on the Najaf cemetery and the Shrine of the Imam Ali, the holiest place in Shi’i Islam. Because “U.S. officers knew that damaging the shrines would inflame opinion in Iraq and worldwide against the Americans,” both were declared exclusion areas despite the fact that they served as a “tactical advantage to Sadr’s men, who used them as refuges” and secure fire bases from which to mortar U.S. forces. Even in the areas around the exclusion zones, “the rules of engagement allowed [the U.S. soldiers] to fire only if they could see an attacker.” As the division commander noted, “one private first class with one tank round could have unhinged this whole thing.”<sup>44</sup> In the end, the battle ended in a ceasefire with Sadr withdrawing his forces and later announcing plans to form a political party to run for office in a new Iraqi Government. Regarding the timing of the decision to stop fighting, the division commander noted that “it was clear there was a point at which the people of Najaf would blame the militia for what was happening, and beyond that they would blame us...We watched that point carefully.”

## CONCLUSION

In the above account, we see a real-world embodiment of the complex security environment. Instead of a neat peace-crisis-

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<sup>44</sup> Wilson, “Over 60 Days.” pp. A1 and A-16-17.

war spectrum, there was an ongoing and continuously changing interaction between competing complex adaptive systems that was occurring simultaneously at the tactical, operational, and strategic levels. Exclusion areas designed to avoid exacerbating local and global feelings were incorporated into the rule set of one side and then promptly exploited by the other side as refuges or fire bases. Similarly, although “Sadr militants accused the U.S. forces of killing hundreds of civilians,” the militants also “began using children to shuttle ammunition,” confident that U.S. troops would not open fire on them. Body armor used by the Americans to limit casualties resulted in the other side’s snipers adjusting their tactics to aim at exposed limbs, and so on. In short, each side did its resolute best to thwart the other’s advantages in a give-and-take series of hard fought engagements.

Even though the major combat phase of Operation Iraqi Freedom clearly demonstrated the value and impact of sophisticated targeting systems applied in conventional combat operations, once the conventional Iraqi military forces were defeated, the situation promptly changed to an asymmetric conflict in the mode of the three block war. The interactions in Karbala and Najaf were very much focused on achieving (or avoiding) effects in the cognitive and social domain and thus were inherently effects-based.

The human dimension of the conflict was reflected in the tight American control of civilian casualties and collateral damage to holy places despite the increased risk and casualties to U.S. forces and despite the fact that the U.S. commanders knew that the Mahdi Army was exploiting efforts such as exclusion zones to its advantage. It was also reflected in the recognition that the real battlefield was in the minds of the observers

whether local, regional, across the Islamic world, among allies, or in the international community as a whole, and that success would be determined there and not in any level of damage inflicted. Indeed, the press account highlights one particularly telling example:

a grenade arced over a wall and exploded beneath a Humvee. After the loss of one Humvee a week earlier, sparking a celebration by Sadr's men, the soldiers refused to surrender this one. The resulting firefight turned into a six-hour defense of a burning car. "We weren't going to let them dance on it for the news," said Capt. Ty Wilson. "...even with all the guys they lost that day, that still would have given them the victory."<sup>45</sup>

Overall, the picture is one of an irretrievably complex operational world in which no two interactions are ever entirely the same nor entirely predictable.

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<sup>45</sup> Wilson, "Over 60 Days." pp. A1 and A-16-17.

## CHAPTER 2

### COMPLEXITY:

#### THE PROMISE AND THE PROBLEMS

**I**n the preceding chapter, our world is characterized as *complex*. The multi-level interactions between the living systems embodied in states, communities, organizations, and individual human beings is described both as complex and as spanning a continuum of competition and conflict of infinite diversity. The interactions themselves are said to be difficult to predict or appear to defy a cause-and-effect logic, and are thus *nonlinear*—another attribute of complexity. Logically, therefore, if we are to figure out how to plan, execute, and assess effects-based approaches to operations and how to exploit their non-linearity, we must start by understanding what complexity and nonlinearity are and what role they must play in military operations.

## WHAT IS COMPLEXITY?

Complexity is not a new concept. Nonlinear phenomena have always been part of all human interactions and especially of military operations. In fact, one can easily make the case that good military leadership and strategy have always revolved about the ability to deal with the innate complexity or, in Clausewitzian terms, the “friction” of the battlefield and that the truly great leaders were those who not only managed to deal with this complexity but who were also able to turn it to their advantage so as to impose their will on the battlefield—or in politics. What is new is the emerging body of complexity theory and its formal application to the national security environment and specifically to military operations.<sup>46</sup>

Our purpose here is not to explain complexity theory or, still less, to decipher the expanding field of mathematics that is at its core and that will play a great part in how complexity theory evolves in the future.<sup>47</sup> Others, notably the Santa Fe Institute, Nobel laureate Murray Gell-Mann, John Holland, Charles Perrow, and more recently, Yaneer Bar-Yam and the New England Complex Systems Institute (NECSI), have

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<sup>46</sup> “I am convinced that the ability to thrive in nonlinear environments will have to be among the core competencies of the warrior and statesman of the 21st century...It may be that attaining that ability lies at the heart of the Revolution in Military Affairs that we seem certain is present, but that has proven so elusive.”

Chilcoat, LTG Richard A., USA. “Foreword.” Czerwinski, Tom. *Coping with the Bounds*. Washington, DC: CCRP. p. iv.

<sup>47</sup> An elegant example of these efforts in Professor James Moffat’s *Complexity Theory and Network Centric Warfare* that both explains complexity theory in some detail and relates the still developing mathematics involved.

Moffat, James. *Complexity Theory and Network Centric Warfare*. Washington, DC: CCRP. 2003.



probed that terrain far more comprehensively than I could hope to do.<sup>48</sup> Rather, this work seeks to build on my military background and to begin exploring for military and national security audiences what James Rosenau has described as the “new conceptual equipment”<sup>49</sup> of complexity theory, a conceptual framework for dealing with the problems of the post-9/11 world and for working out the “how to” of effects-based approaches. Indeed, as Atkinson and Moffat note, the “underlying theory of complexity and networks is not mathematics, science, and technology, but people—the way we work and aggregate ourselves.”<sup>50</sup>

To capitalize on the insights offered by this new conceptual equipment, we need to arrive at a working understanding of complexity as it applies to military operations across the spectrum of competition and conflict; to examine the challenge

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- <sup>48</sup> Gell-Mann, Murray. *The Quark and the Jaguar: Adventures in the Simple and the Complex*. New York, NY: Freeman. 1994.  
 Holland, John H. *Hidden Order: How Adaptation Build Complexity*. New York, NY: Helix. 1995.  
 Perrow, Charles. *Normal Accidents: Living with High-Risk Technologies*. New York, NY: Basic. 1984.  
 Bar-Yam, Yaneer. *Making Things Work: Solving Complex Problems in a Complex World*. Cambridge, MA: NECSI. 2005.
- <sup>49</sup> Professor James Rosenau, an eminent scholar of international relations, comments: “if the theoretical strides that have been made are assessed from the perspective of the philosophical underpinnings of complexity theory, it is possible to identify how the theory can serve the needs of us in the academic and policy-making worlds who are not tooled up in the mathematics or computer sciences but who have felt a need for new conceptual equipment.” Rosenau, James N. “Many Damn Things Simultaneously: Complexity Theory and World Affairs.” *Complexity, Global Politics, and National Security*. David S. Alberts and Thomas J. Czerwinski, eds. Washington, DC: National Defense University. 1997. p. 82.
- <sup>50</sup> Atkinson, Simon Reay and James Moffat. *The Agile Organization: From Informal Networks to Complex Effects and Agility*. Washington, DC: CCRP. 2005. p. 13.

that complexity poses in the planning and execution of effects-based operations; to look at how we can deal with it in the current operational environment; and to explore how we might exploit the combination of effects-based approaches and networking to achieve nonlinear impacts in military operations. To accomplish these tasks, as Rosenau suggests, we need not master the intricacies of complexity theory or the mathematics that support it, but rather we need to explore the fundamental nature of complexity, understand its potential impact on how military forces operate, and figure out how best to bound it so as to exploit it.

## UNDERSTANDING COMPLEXITY

A good starting point for the kind of pragmatic understanding of complexity that we need lies in distinguishing between that which is “complicated” and that which is “complex.” Although the terms *complicated* and *complex* tend to be used interchangeably in English,<sup>51</sup> there is a profound difference between the two words that is key to comprehending what complexity is and how to deal with it.

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<sup>51</sup> The dictionary defines *complicated* as “1. marked by an interrelationship of diverse and often numerous parts, elements, notions, phases, or influences difficult of analysis, solution, or understanding...2. having many interconnected units: not simple or easy to fabricate or comprehend.” And, it defines *complex* as “1. an association of related things often in intricate combination...2. a conjunction of varied contributing or interacting factors, elements, or qualities.” *Complex* is listed as a synonym for *complicated*. *Webster’s Third International Dictionary of the English Language Unabridged*. Chicago, IL: Britannica. 1986. Vol 1. pp. 485 and 465.

## *Complicated*

To use a very simple example, the engine of a modern automobile is quite *complicated*, so much so that the average driver would have difficulty explaining precisely how it worked, much less which parts and functions were connected to which. However, in spite of having only a very limited understanding of the engine, we would have no difficulty both in grasping roughly how the car functions and in exploiting the fact that, with the car's engine turned on and with the car in gear, pressing the accelerator pedal will cause the car to move or that pressing the pedal with greater force will result in the car's increasing speed. We would likewise have little difficulty figuring out that lessening the pressure on the accelerator would cause the car to slow down or even stop. In other words, even though there may be a long and not fully understood cause-and-effect chain between our action (pressing the accelerator) and the automobile's reaction (moving and increasing speed), we would quickly develop a definite set of expectations: pressing the accelerator will produce a predictable result; this result will be proportionate to the amount of pressure exerted on the pedal; and this same result will be repeated dependably each and every time that the accelerator is pressed.

We can also carry this analogy a step further. If pressing on the accelerator no longer produced the desired result, we might take the car to an automobile mechanic, that is, to someone who knew and understood the entire cause-and-effect chain involved in making the car move and who would therefore be able to determine which element in the chain was no longer functioning properly. And, we would then expect that the mechanic could repair whatever was not functioning correctly and that, with this repair complete, the car would operate reli-

ably once again.<sup>52</sup> Our expectations, both of how the automobile would respond to pressure on the accelerator pedal and of the mechanic's ability to locate and repair any malfunction, derive from the fact that, even though the system represented by the automobile engine might be complicated, it is based on a fixed set of if-then, cause-and-effect relationships. Because of this basic Newtonian linearity, the engine will deliver a predictable outcome from one use to the next; this output will be proportional to the input each and every time; and the reason for any failure to respond can be identified, understood, and corrected.

### *Complex*

On the other hand, if the car's engine was not complicated but *complex*, the situation would be quite different.<sup>53</sup> In place of the known cause-and-effect chain between pressing on the accelerator pedal and the automobile either beginning to move or moving faster, there would be no consistent cause-and-effect chain.<sup>54</sup> As a result, we would not be able to predict exactly what the car's response to the pressure on the accelerator

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<sup>52</sup> All of this, of course, says nothing about the manner in which the automobile is driven either in the sense of the skills and temperament of the individual driver or in the aggregate of how large numbers of automobiles might circulate and interrelate in traffic. Such an extension introduces a complex human element to the linear dimensions of the machine and thereby practically guarantees that the resulting behavior will be complex and no longer just complicated.

<sup>53</sup> Perrow defines *complex* as "interactions in an unexpected sequence" as opposed to *linear* which he defines as "interactions in an expected sequence." Perrow, *Normal Accidents*. p. 78.

<sup>54</sup> Indeed, there could be any number of causes that could set the chain in motion, and there could be any number of potential ways the subsequent chain of causes and effects might proceed, such that the chain itself could resemble a mesh or a network rather than a straight line of interactions.

would be, nor would the pressure necessarily produce the same result from the automobile's engine two times in succession. Furthermore, there would be not be a well-behaved relationship between the scale of our action (i.e., how much pressure we put on the accelerator pedal) and the scale of the car's reaction (i.e., how rapidly it moved or how quickly it slowed down). And finally, to make matters still worse, there would be no automobile mechanic who could identify the problem and repair the engine because there would be no knowable, reliable chain of causes and effects with which to trace what went wrong.<sup>55</sup>

The root cause of the uncertainties in this complex system is the presence of a large number of interdependent variables, each of which will affect the other variables in the system in ever-changing ways to the point that we could never be quite sure what the outcome of our action would be<sup>56</sup>—an inconvenience that would render the automobile, at a minimum, risky and difficult to use.

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<sup>55</sup> Complexity theorists would point out here that, if we were to aggregate by looking at all complex engines of a given type, we may begin to observe patterns in the changes or spot certain deterministic aspects of behavior, such as the fact that engines without gasoline do not start.

<sup>56</sup> Professor Murray Gell-Mann uses the example of a *nonlinear* pendulum, one with multiple interdependent variables, in this case, magnets that deflect the pendulum from its normally very linear to and fro course. He points out that, no matter how carefully he tried to repeat the same exact action to set the pendulum in motion, each attempt delivered a very different course, with the course then continuing to change as the pendulum continued to swing. Gell-Mann, Murray. "The Simple and the Complex." *Complexity, Global Politics, and National Security*. David S. Alberts and Thomas J. Czerwinski, eds. Washington, DC: National Defense University. 1997. p. 15.

Complicated / Linear	Complex / Nonlinear
Whole equal to the sum of the parts	Whole <u>not</u> equal to the sum of the parts
Outputs proportionate to inputs	Outputs <u>not</u> always proportionate to inputs
Predictable chains of causes and effects	Chains of causes and effects <u>not</u> predictable

FIGURE 9. COMPLICATED VERSUS COMPLEX

### *Complicated versus complex*

In a sense, *complex-nonlinear* is the antithesis of *complicated-linear*, an antithesis defined by a series of “nots” (see Figure 9). It is this antithetical nature of complexity that poses both its challenge and its promise. The challenge arises because complex systems do not function in the linear ways in which we are used to thinking and analyzing. These linear ways rest on “tried and true” assumptions: that the whole will be equal to the sum of the parts; that the outputs will be proportionate to the inputs; that the results will be the same from one application to the next; and most fundamentally, that there is a repeatable, predictable chain of causes and effects. The promise of complexity and, by extension of effects-based operations, arises somewhat paradoxically from the same conditions because it is exactly this nonlinearity that presents the possibility of obtaining a disproportionate leverage from a given action. However, this promise is not without its drawbacks because this disproportionate impact is also an opportunity for adversaries. Indeed, it is this very prospect that offers asymmetric challengers their only real hope of dealing with a larger and more powerful adversary.

## *Complex adaptive systems*

In reality, we must deal not just with a complex system but with a complex *adaptive* system, one that not only changes unpredictably, but also adapts to its external environment in similarly unpredictable ways. This is quite logical. If a system is to survive for any length of time, it must be able to deal with competing systems and with the changing physical environment in which it finds itself. Logically, as the system changes, some of those unpredictable outcomes will turn out to be failures and some will be successes.<sup>57</sup> For example, any design flaw that caused the engine to fall apart or to fail to perform adequately over some range of conditions would ultimately bring the demise of the whole system—a survival of the fittest engines in a sort of mechanical natural selection.

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<sup>57</sup> In defining his “conceptual equipment for policy-makers,” Rosenau points to four basic ideas embodied in complexity theory: (1) self-organization and emergence or the ability of the parts of a complex system to change and deal with change while preserving an internal dynamic; (2) adaptation and coevolution or the ability to adapt to or coevolve with the surrounding environment; (3) the power of small events to throw a system into disequilibrium and thus set off a reaction very disproportionate to the stimulus, e.g. the butterfly effect whereby the flapping of a butterfly’s wings in China might provoke a hurricane in the Atlantic; and (4) sensitivity to initial conditions or the ability of only slight changes in the initial conditions to result in very large downstream changes. Rosenau, “Many Damn Things Simultaneously.” pp. 84-87.

This is to say that to survive and compete, a complex system must also be, in a very Darwinian sense, *adaptive*.<sup>58</sup> In short, it must behave like a *living system*<sup>59</sup> and not like a mechanical system, like a nonlinear system and not a linear system, like a complex system and not just a complicated system.

### *Systems of complex adaptive systems*

The complicated, complex, and complex adaptive systems described above are not just systems but systems of systems.<sup>60</sup> Each is composed of a series of subsystems that act together to produce a result. Thus, each link in the cause-and-effect chain

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<sup>58</sup> Murray Gell-Mann describes the complex adaptive system as one that “receives a stream of data about itself and its surroundings. In that stream it identifies particular irregularities and compresses them into a concise schema, one of many possible ones related by mutation and substitution. In the presence of further data from the stream, the schema can supply descriptions of certain aspects of the real world, predictions of events that are about to happen in the real world, and prescriptions for behavior of the complex adaptive system in the real world. In all these cases, there are real world consequences: the description can turn out to be more accurate or less accurate, the predictions can turn out to be more or less reliable, and the prescriptions for behavior can turn out to lead to favorable or unfavorable outcomes. All of these consequences then feed back to exert ‘selection pressures’ on the competition among the various schemata, so that there is a strong tendency for more successful schemata to survive and for less successful ones to disappear or at least be demoted in some sense...A complex adaptive system (CAS) may be an integral part of another CAS, or it may be a loose aggregation of complex adaptive systems forming a composite CAS. Thus, a CAS has a tendency to give rise to others.”

Gell-Mann, “The Simple and the Complex.” pp. 8-10

<sup>59</sup> See: Miller, James Grier. *Living Systems*. Denver, CO: University of CO. 1995.

<sup>60</sup> In engineering terms, anything that contributes to a larger system but cannot stand on its own would likely be considered a *subsystem* rather than a system. Here, in keeping with the notion of living and especially social systems that do to some degree stand alone and independently adapt to their environment, we have entities that are systems in their own right and at the same time sub-systems of a larger entity.



between the accelerator pedal and the rotation of the wheels (fuel injectors, pistons, drive train, etc.) can be said to be a subsystem of some sort. In the case of the conventional if complicated car, the contribution of each of these component subsystems can be understood to the point that the automobile mechanic can troubleshoot by reducing the system to its components, examining the performance of each, correcting the problem, and then reassembling the system of systems. He can do this because the conventional car engine functions in a linear, if-this-then-that manner with each component in the system of systems providing a dependable and predictable contribution to the whole.

In the case of the complex car, however, one or more of these subsystems would also be complex and, as a result, would produce an output that, like the output of the whole system of systems, would be neither repeatable nor predictable. To make matters worse, these subsystems would function interdependently so that the unpredictable output of one subsystem would cause the outputs of the other subsystems to change in unpredictable ways or even to work at cross purposes in an expanding cascade of complexity. As a consequence, the interactions among subsystems would tend to affect the response of the whole system of systems in unforeseen ways.

There is another factor to consider. Just as the outputs of these internal subsystems change, the system of systems of which they are part also changes as it adapts to an external environment that is composed of other systems of systems, whether they are physical (e.g., ecological) or social (e.g., the actions of other states or human organizations). Because each such adaptation in some way affects this physical and social environment just as changes in the subsystems affect the system of systems,

the result is a continual change or coevolution at all levels—subsystems, systems of systems, and environments that can only be understood as being in a state of continual flux.

The complex adaptive system adds two fundamental ideas to the conceptual framework for understanding complexity in national security and military operations. The first is that the interactions among the actors in a security environment will involve so many interdependent variables that no actor's behavior can be precisely traced, i.e. there is no clearly defined cause-and-effect chain and, as a result, the behavior will be neither quantifiable nor entirely predictable. The second is the Darwinian argument that the complex adaptive actors in the security environment—state and non-state, military and civil—will continually interact with each other and the environment and adapt to change in a coevolution that, in turn, will alter the environment.

Also, because the systems involved in this security environment are all complex,<sup>61</sup> the processes or exact cause-and-effect chains by which the actors adapt will never be entirely definable. Thus, we will not be able to predict precisely either the manner in which individual actors will adapt or the ultimate form the security environment will take. Accordingly, we are limited to either aggregating the systems to the point that we can observe relatively linear or deterministic behavior, e.g. looking at personified “nations” rather than complex internal political interactions, or bounding likely actions and behavior rather than attempting to define actions and behavior in terms of precise rule sets.

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<sup>61</sup> That is, the systems are all either human beings or human organizations and, by virtue of this human element, are complex.

These factors take on a much more substantial character in the context of history. States, alliances, and political or military entities that do not adapt well enough or rapidly enough to deal with a changing environment may not survive. They may wither over time or collapse into chaos as accumulating stress or a particular critical failure dissolves the glue of trust that held them together.<sup>62</sup>

History is rife with such examples, but the history of the First World War and its aftermath is particularly instructive. Three great empires—Russia, Austria-Hungary, and Germany—entered the war. All three had been pressed by the need for political, social, and economic reform in the years leading up to the war and were slowly adapting to meet the problem to the point that they were able to sustain three years of bloody attrition warfare. However, as their military defeat approached, the glue dissolved. Russia succumbed to a radical Bolshevik revolution; Austria-Hungary disintegrated; and Germany, although having almost dissolved into revolution before managing a Weimer revival, finally succumbed to fascism amid the additional stresses of the great depression.

## THE LIVING SYSTEMS MODEL

One approach to dealing with this complexity is to consider it in terms of a system of living systems, i.e. a multi-level, inter-connecting system of complex adaptive systems. James Grier

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<sup>62</sup> British historian Arnold Toynbee, for example, chronicles the fall of a succession of civilizations that failed to meet challenges or could not evolve fast enough to deal with outside pressure. The fall of the Roman Empire between 200 and 500 A.D. is a classic case that Toynbee explores in depth. Toynbee, Arnold. *A Study of History. Volume One: The Genesis of Civilizations*. New York, NY: Oxford University Press. 1962. pp. 183-188.

Miller constructed such a living systems model consisting of “eight levels of living systems: cells, organs, organisms, groups, organizations, communities, societies, and supranational systems. Each succeeding level is composed principally of systems at the level below with each succeeding level, therefore, ‘of increasing complexity.’”<sup>63</sup> These systems in turn evolve and adapt “by a continual interaction with the environment” and “process information which is essential for coordination, guidance, and control of their processes.”<sup>64</sup> In essence, the evolving complex adaptive systems at one level constitute the subsystems of the next higher level. Each of these subsystems must deal with large numbers of interdependent variables and in doing so they themselves adapt and change (see Figure 10).

Although the model is depicted in a hierarchical succession of levels, the system is not hierarchical in the sense of one level controlling the actions of the next level down. Rather, each level represents the sum of all of the interdependent variables of all of the levels below it. As Miller points out, it is therefore a hierarchy of complexity with each successive level representing an aggregation of the complexity of all of the lower levels plus the additional complexity at that level. Thus, the higher the level is, the greater the complexity of the system will be.<sup>65</sup> In other words, the model is very much that of a system of com-

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<sup>63</sup> I have focused on the six highest levels of Miller’s living systems, from the organism (human beings) to the supranational system. However, whereas Miller would insist that, short of a world government, there is no supranational living system, I have elected to apply Miller’s construct of that level to the accepted political science concept of an international system, that is, the framework within which states and both international and transnational organizations interact however imperfectly, in other words, the arena in which the remaining systems interact.

Miller, *Living Systems*. pp. xvi-xvii.

<sup>64</sup> Miller, *Living Systems*. pp. xvi-xvii.

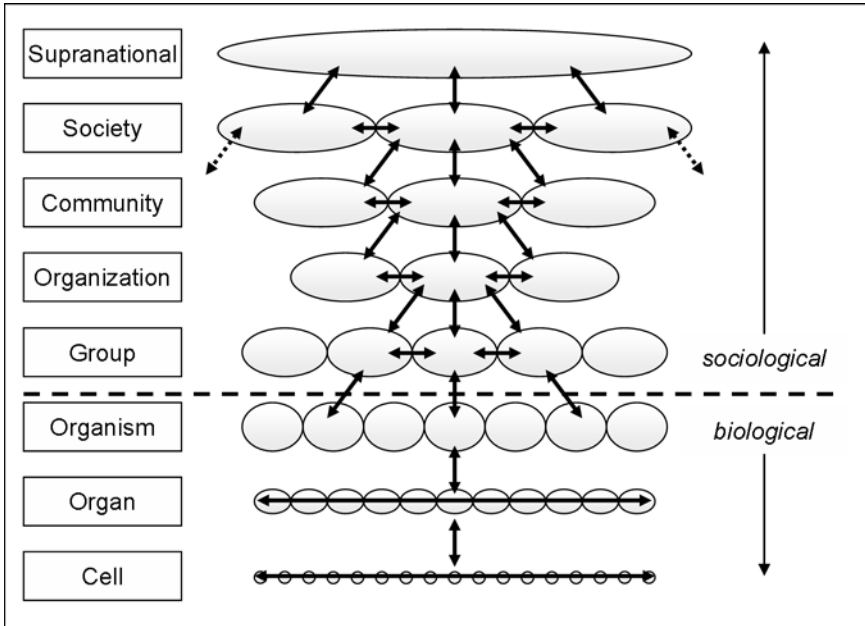


FIGURE 10. MILLER'S LIVING SYSTEMS MODEL

plex adaptive systems. As such, it is a paradigm for the security environment in which statecraft, economics, social development, military operations, and effects-based operations are to be conducted.

In this paradigm, the first three levels of the system of systems, those below the dashed line—the cell, the organ, and the organism—are essentially biological systems whose competition, adaptation to a physical environment, and evolution were

<sup>65</sup> Yaneer Bar-Yam describes increasing complexity in terms of the number of bytes it takes to fully describe a system. Thus, description of each level of the model would be described by a number of bytes equal to the sum of all of those levels below it plus whatever additional bytes were needed to describe its own functioning.

Bar-Yam, Yaneer. *Multi-scale Complex Systems Analysis and Enlightened Evolutionary Engineering*. Cambridge, MA: NECSI. 2002. pp. 25-29.

first described by Darwin. The next five levels—the group, the organization, the community, the society, and the supranational system—are the products of sociological evolution, the process by which human social systems compete and adapt both to the physical environment and to a social environment composed of other human beings and human organizations. Each of these subsystems encompasses large numbers of interdependent variables, and each changes, adapts, and coevolves with the system.

The attraction of the living systems model is that it describes the complex *human* cognitive and social environment of competition and conflict in which military operations and statecraft and effects-based operations are to be conducted. In this model, humans lie at the cusp between the biological and the social systems. On the one hand, humans are the product of hundreds of millennia of biological evolution that have hard-wired much of how they perceive, decide, and react; yet, humans have also created and evolved the successive layers of the social structure. Indeed, like historian Arnold Toynbee, we can trace the evolution of these social structures from a pre-history of family groups, clans, and tribal organizations through the spawning of increasingly complex social structures of communities, states, civilizations,<sup>66</sup> and perhaps to a would-be supranational system<sup>67</sup> over the last few millennia. The distinction between the biological and social products of this

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<sup>66</sup> Arnold Toynbee's 12-volume *Study of History* is a classic and exhaustive account of this process of adaptation and evolution sketched through the history of the rise and fall of 21 different human civilizations and their organizations.

<sup>67</sup> Miller argues that the supranational system does not yet exist but is in the process of being created as the next step in this evolution. Miller, *Living Systems*. p. 904.

evolution is important to understanding the kinds of complexity involved in the security environment. It suggests that the closer we operate to the individual human in the continuum of living systems, the more we will have to deal with the hard-wired primordial factors in human behavior and the more likely it is that we will have to cope with that behavior rather than hope to change it.<sup>68</sup> Moreover, this factor is applicable whether in the conduct of effects-based operations or in learning how to network the actors in a military organization.<sup>69</sup> From a functional perspective, therefore, the apparent hierarchical ordering is not that of an Industrial Age wiring diagram but is more in the manner of an influence diagram in which one level influences a lower level. The variance in these limits to influence are visible in reactions to United Nations' resolutions at one end of this continuum and in resistance to the intrusion of the state into family life or into "local custom" and "individual liberties" at the other end of the spectrum.

Although the model with all of its many interconnections may look overawing, in fact as the product of biological evolution and the inhabitants of the social environment, we know quite well how to deal with its complexities. Partially by intuition and partly by learned behavior, we know how to deal with people (some of us better than others). We know how to deal with the complexities of the small group represented by our families. We know how to function in the organizational environment of an office or military unit. And we also know how to function in the context of a military or professional

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<sup>68</sup> For example, in the complex village situation discussed earlier, any perceived threats to an individual or to family members would be likely to evoke a viscerally hostile action regardless of the politics of the villagers.

<sup>69</sup> Clippinger, John Henry. "Moving to the Edge: Leveraging Trusted Human Networks to Meet Asymmetric Threats." Unpublished Paper. 2004. p. 47.

community and as the citizen of a state. What the model implies for effects-based approaches to operations, therefore, is not a need to master some unknown and exotic task, but a need to tap what we already know of complex human beings and human organizations and to apply it in an effects-based context.

### *State and non-state living systems*

The model described above extrapolates quite readily to the social and political organizations of the current world scene (see Figure 11). We can recognize familiar military organizations from the warfighter as the individual human being to the tactical unit as a group, the operational command as an organization, the military as a whole, a General Staff as a community, the national leadership as the representative of the state or society, and the international arena as a pseudo-supranational system. In other words, we can see the tactical, operational, military-strategic,<sup>70</sup> and geo-strategic levels reflected in the model.<sup>71</sup> We could similarly break out the levels in other gov-

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<sup>70</sup> The term *military-strategic* was introduced in *Effects-Based Operations* to connote the level of operations that fell between the direct operational commander and the geo-strategic level of national decisionmaking typically at the level of a ministry of defense and general staff. In the American case, this was very evident in the interactions between the Secretary of Defense and Chairman of the Joint Chiefs of Staff and the general commanding Operation Iraqi Freedom, interactions that were separate and distinctly different from those with the President and National Security Council, a pattern repeated in many different crisis operations, notably the 1962 Cuban Missile Crisis. It is similarly evident in General Franks' description of his meetings with Secretary of Defense Rumsfeld and the Joint Chiefs of Staff. Franks, *American Soldier*, p. 275.

<sup>71</sup> Atkinson and Moffat make a similar four-tier distinction but label the levels tactical, operational, strategic, and grand strategic. Atkinson and Moffat, *The Agile Organization*, p. 60.



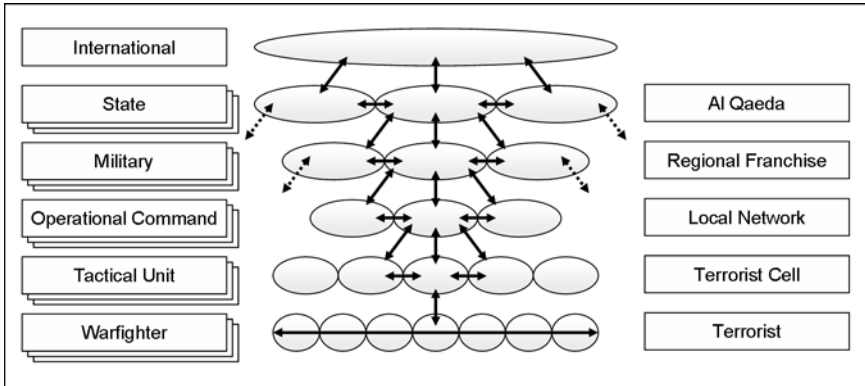


FIGURE 11. STATE VERSUS NON-STATE LIVING SYSTEMS MODEL

ernment departments, for example, from the embassy action officer to an embassy section, to the embassy as a “country team” unit, to the State Department or Foreign Ministry. What is more, we can also do the same with non-state actors, international and non-governmental organizations, and businesses on the one hand and the challenges of the post-9/11 world (such as terrorist organizations) on the other. For example, we can trace al Qaeda from the individual terrorist to the terrorist cell, to a local terrorist network, to regional terrorist franchises, networks, or insurgencies, to a broader al Qaeda terrorist movement that transcends the bounds of a given state or region or cultural and religious grouping or nation-state. In a different direction, we can also point to the individual human minds to be won, the family groups to be convinced, the clans, factions, and tribal organizations to be brought over, the local communities to be enticed, and the nations to be won over.

And, we can see all of these interactions taking place in an international arena that encompasses everything from transnational religious movements to alliance structures like the North Atlantic Treaty Organization (NATO), international

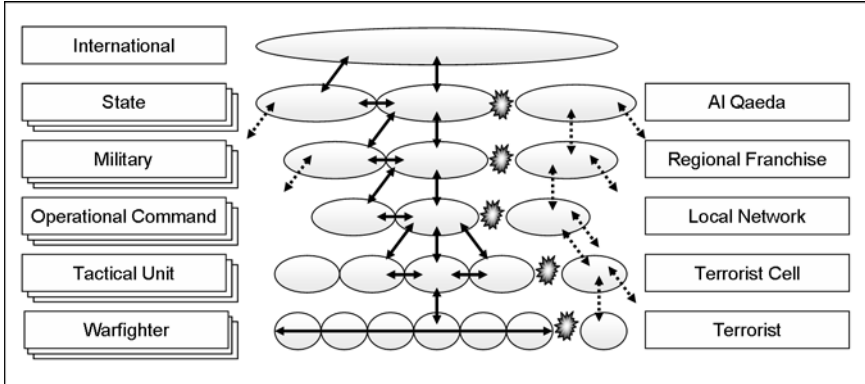


FIGURE 12. MULTI-LEVEL INTERACTION

organizations such as the United Nations with all its myriad agencies, and non-governmental agencies that function across state and societal boundaries. In each of these cases, the relationship between the levels spans a continuum between some degree of control at one end and simple influence at the other, e.g. the ability of the government of a small island state to influence the actions of the United Nations.

This picture of multi-level interaction also has another implication. It suggests that interactions will be occurring not just at one level but rather simultaneously at many different levels of this system of complex adaptive systems (see Figure 12). Moreover, it is to be expected that these interactions will tend to proceed at a rate dictated by the nature of the particular interaction in question rather than the same rate as interactions on other levels of the system because it is the local interaction that most directly affects the immediate survival of the interacting system, for example, a firefight with insurgents in an Iraqi town. In this context, any attempt by a command hierarchy to control the interactions in a classic Industrial Age sense would likely come at the expense of the lower levels' ability to adapt to the exigencies

of their own interactions. It also suggests that, like the complexity itself, the outcomes of these interactions will be aggregative, that is, the outcome of interactions at each successively higher level will reflect the sum of the outcomes at lower levels.

There is another aspect of this networking that is not to be forgotten. The networking at any given level of the system of systems will consist of many different kinds of links. While it is tempting to think in terms of major combat operations in which most of the relevant networking is among military units, as illustrated in Chapter One, the farther we move from major combat the less the operations become about military power and the more they are about a whole-of-nation or whole-of-coalition effort. This implies that there are many different kinds of interactions, that they will involve many different players, and that they will occur on many different levels. Thus, the interaction with a hostile foe may take any form from passive resistance to subversion, terrorism and guerilla warfare, and lethal combat, and it may involve not only different military units but a large retinue of additional actors. We can see this if we take a cross section at a given level of the system of complex systems illustrated in Figure 12, for example, at the organizational or operational level (see Figure 13).

In this cross section, the operational commander (e.g., a Joint Task Force Commander) would need not only to interact with the foe in different ways but would need to interact with allies or coalition partners, each of whom would in turn be operating in their own national interests or often under a national chain of command with its own national rules of engagement. The commander's efforts may also involve interactions with neutrals from the level of a state or society all the way down to the individual who has not yet decided which side to support or who

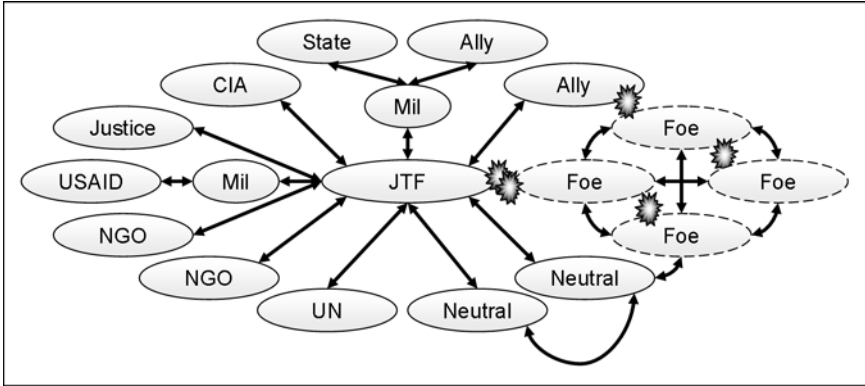


FIGURE 13. CROSS SECTION: ORGANIZATIONAL/OPERATIONAL LEVEL

simply wants to be left alone. They may also include interactions with representatives of different departments and agencies of one's own government, as well as with non-governmental organizations (NGOs) or international organizations such as the United Nations and its agencies.

Each of these other actors will have its own hierarchy of complexity and usually some reporting chain, but each will also face a similar problem of acting in the context of a local problem whose pace will very likely be unrelated to the pace of interactions elsewhere in the reporting chain. For example, local military commanders, local embassy representatives, and local representatives of the NGO and international organization may all be engaged in interactions with a local tribal leader either independently or collectively. Because these interactions would likely proceed at a pace determined by that tribal leader and the local situation and revolve about many of the same issues, it might be expected that the actors would form a natural community of interest and that, given sufficient freedom of action, there would be an emergent self-organizing behavior. Indeed, it would likely be counterproductive to all concerned

to do otherwise. Under these circumstances, the evolution of a local network of cooperating players would appear to be a natural reaction of the local complex adaptive systems.

The picture presented is, therefore, one of multiple cycles of interaction in many arenas and on many levels with each of these interactions proceeding at its own pace and often with changing communities of interest. This image of flexible interconnectivity underscores the role of the network in connecting all of the actors from individuals to groups (tactical units or terrorist cells), all the way to a state or terrorist organization functioning in the international system. In the living systems model, these networks constitute the nervous system over which stimuli are felt and responses are implemented. Although there is an obvious analogy here to communications network architectures, the universality of the model, i.e. its applicability to *all* living systems, suggests something more. It implies that the network can take many forms from individual human beings interacting verbally to the sophisticated Information Age technologies, to a large state's military operations center. Indeed, the analogy is less that of a physical network architecture than it is to the process of *networking* including both social networking and all forms of communication. Also, in this system of complex adaptive systems, stimuli will often be unpredictable and may occur on any level at any time. Accordingly, the networking must not only enable the system to react on any level at any time, but to do so quickly enough to contain any threat, a requirement that more often than not demands local action.<sup>72</sup>

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<sup>72</sup> In this respect, the model reinforces the network-centric operations concepts surrounding the ideas of Alberts and Hayes.

Alberts, David S. and Richard E. Hayes. *Power to the Edge*. Washington, DC: CCRP. 2003. pp. 223-4.

The living systems model provides us (1) with the basic structure of an interconnected complex adaptive system of systems populated with the systems and actors that are the focus of effects-based operations, (2) with a framework for integrating many different disciplines from both the social and physical sciences as well as military thought, and (3) with a way of thinking about the interactions among the multiple actors, layers, and arenas involved in effects-based operations.

## COMPETITION AND CONFLICT: INTERACTIONS BETWEEN COMPLEX ADAPTIVE SYSTEMS

In the interplay among the actors in our messy nonlinear world, competition and conflict<sup>73</sup> are not anomalies but norms that reflect how complex adaptive systems operate. By extension, peace, crisis, hostilities, post-conflict stabilization, as well as bureaucratic “warfare” and individual “one-upsmanship” are all merely facets of the processes by which systems react at many levels to each other and to changes in the environment.

### *Military operations*

This messy reality is clearly at odds with the linear mechanical view of military operations that seems to pervade long-range military planning and acquisition, but it is in an almost uncanny harmony with the view taken by most combat veterans. These warfighters would insist that, “in the real world,”<sup>74</sup> almost none of the assumptions that analysts and planners like to make with respect to the repeatability and proportionality of

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<sup>73</sup> The term *conflict* will be used in its broad international relations sense of the give and take of human interactions. Such conflict may include but is not restricted to armed conflict.

inputs and outcomes are necessarily true. For them, actual military operations are nonlinear, uncertain, and complex with no outcome ever taken for granted. The battlefield presents a grim contrast to the tightly controlled, predictable, and quantifiable operational environment of synthetic models and contains adversaries who are—or must always be assumed to be—intelligent and resourceful. Indeed, the mantra of combat veterans seems to be that, as the elder General von Moltke put it, “no plan ever survives first contact with the enemy.”

This view of a complex reality is at the root of much of the warfighter skepticism about the promises of defense transformation, network-centric capabilities, and revolutions in military affairs. The skeptics note that, despite spectacular advances in information and sensor technologies, there is no such thing as a *perfect* situational awareness nor can there be a *perfect* sharing of awareness. They warn that any assumption that new technologies can entirely rid us of Clausewitzian “friction” and “fog” is a misunderstanding of Clausewitz that

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<sup>74</sup> There is an interesting parallel here with complexity theorists, many of whom repeatedly resort to real-world analogies to explain chaos and complexity. John Holland, for example, uses New York City and the economics of keeping the city alive and functioning as a model of a complex adaptive system. Miller constructs his multiple layers of complex adaptive systems by working all the way from cells to supranational systems. Moreover, many of the analogies are used in much the same manner: to contrast the unknowns and unquantifiable aspects of problems drawn from life with the linearity of engineering and much of “Newtonian” scientific theory, and to underline the differences between conventional linear models of physical behavior and an actuality that is often far from linear. Holland, *Hidden Order*. p. 1.; Miller, *Living Systems*. p. 4.

is prone to potentially deadly consequences.<sup>75</sup> By assuming that we can achieve perfect situational awareness and understanding of command intent, or by thinking in terms of neat and uncluttered “lightening bolt” linkages between sensors and shooters, or by imagining that we can somehow eliminate the uncertainties of the battlefield, they point out, we lay ourselves open to defeat by an intelligent adversary who can use exactly those preconceptions against us. Finally, they also caution against downplaying the complex human dimension of war and note that wars are fought by people and are won in the minds of human adversaries.<sup>76</sup> These misgivings are not entirely new and are not restricted to network-centric operations nor to a putative revolution in military affairs. The objections are also to a linearity of military thought born of the Cold War that all too frequently carries over into technology-heavy approaches to network-centric operations.<sup>77</sup> In fact, if we look at the concerns in light of complexity theory, much of the criticism revolves about the need to deal with the inherent complexity of military operations and the inability of linear solutions (however technologically advanced) to provide all of the answers needed.

The warfighters’ warning is essentially that any revolution must start with the recognition of the complex and human-

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<sup>75</sup> Both Barry Watts and Alan Beyerchen point out that Clausewitz’s discussion of friction and fog is firmly linked to human factors and that, largely because of this human dimension, Clausewitz sees war as a fundamentally nonlinear phenomenon in which situational awareness can never be perfect.

Watts, *Clausewitzian Friction and Future War*. pp. 27-32.

Beyerchen, “Unpredictability of War.” p. 68.

<sup>76</sup> Hammes, COL T.X., USMC. “War Isn’t a Rational Business.” *Proceedings*. July 1998.

<sup>77</sup> Wilson, COL G.I., USMCR. “Judo of Fourth Generation Warfare.” Information Warfare Conference. Washington, DC. 1-3 October 2003.



centric nature of the military problem. Indeed, this is the direction that network-centric warfare theory has taken, most notably Alberts' and Hayes' *Power to the Edge*. However, it is also the thrust of the application of effects-based thinking to ground operations in Operation Iraqi Freedom both in the major combat phase of operations and in the stabilization operations that followed.<sup>78</sup>

### *Complexity in military strategy*

The ideas inherent to complexity are certainly not new to military strategists. Clausewitz, for example, uses the German term *zweikampf*, literally a “two struggle,” to capture the notion of a contest between two opponents. Although this *zweikampf* is sometimes translated as a duel, that is, a rather straightforward and almost stylized form of combat, the example Clausewitz uses is that of two wrestlers.<sup>79</sup> This example suggests a struggle between complex adaptive opponents in which the actions of

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<sup>78</sup> The warfighters' critique is primarily focused on an approach to network-centric operations that has focused on technology-heavy and relatively linear network architectures rather than on the uses to which they are to be put. This criticism will be addressed in depth in Chapter Seven.

<sup>79</sup> Alan Beyerchen notes that “for Clausewitz, the interaction of war produces a system driven by psychological forces and characterized by positive feedback, leading in theory to limitless extremes of mutual exertion and efforts to get the better of one another. The course of a given war becomes thereby not the mere sequence of intentions and actions of each opponent, but the pattern or shape generated by mutually hostile intentions and simultaneously consequential actions. The contest is not the presence or actions of each opponent added together. It is the dynamic set of patterns made in the space between and around the contestants...it is obvious in a match between two wrestlers, which is how Clausewitz himself suggests we imagine the *zweikampf* between two opponents in war: the bodily positions and contortions that emerge in wrestling are often impossible to achieve without the counterforce and counterweight of an opponent.” Beyerchen, “Unpredictability of War.” p. 63.

each adversary continually challenge and shape those of the other and which force that opponent to adapt and respond in ways that neither wrestler could fully envision before stepping into the ring. In a manner reminiscent of a Darwinian evolutionary model, the wrestler who adapts better and faster to the ongoing struggle will win while the one who fails to adapt to the challenge will lose. This analogy can be applied to everything from hand-to-hand combat or two-versus-two fighter engagements to small unit engagements, battles and military campaigns, Boyd's OODA loop (Observe, Orient, Decide, Act), and the collisions between nations and coalitions in war and diplomacy. Moreover, these "two struggles" do not have to be restricted—as the wrestler example might suggest—to a contest between roughly equivalent foes. The analogy applies just as well to asymmetric conflict wherein each side engages in a repeated interaction, trying to discover exploitable vulnerabilities in the other.

The idea behind Clausewitz's *zweikampf* is evident in the description of complex adaptive systems. Complexity theory would argue that a complex adaptive opponent may be expected to pursue a particular line of action only as long as it appears that the course will yield a desired result and that the opponent will adapt to a negative situation posed by the loss of a battle or even the prospect of defeat by switching to a new course of action, perhaps by moving the contest to a different dimension, scale, location, or pace of operations deemed more conducive to success. Complexity theory would also argue that this process will then continue from one engagement or move to the next either until one of these courses of action succeeds or until the antagonist runs out of further options, either because he has exhausted all of the capabilities or options in

his kit bag or because he can no longer generate new options from the intellectual and physical resources at hand.

It should be noted that this process of reacting and adapting is far from being automatic or mechanical, but is rather one of learning and innovating.<sup>80</sup> The better able the complex adaptive system (state, army, organization, or individual) is to learn from successes and failures and the more readily it can innovate to implement what it has learned, the more likely it will be to cope successfully with the ever-changing challenges of its environment, and survive. Such adaptiveness, however, suggest two requirements: (1) a native ability resident in individuals, cultures, and organizations to see and learn and, most importantly, (2) the freedom to innovate and the capacity to implement new ideas.

## CONCLUSIONS

The unpredictability of complex systems behavior provides a point of convergence between complexity theory and combat experience. Like combat veterans, complexity theorists caution that, in a world of complex adaptive players, surprises are normal. We must not only consider opponents at each level to be intelligent adversaries, but must also take into account all of the ways in which intelligent adversaries might use the means at their disposal to counter our actions and thwart our inten-

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<sup>80</sup> Barbara Tuchman's *The March of Folly* includes a series of historical examples in which decisionmakers did not learn or innovate to meet changing conditions and continued to pursue self-destructive policies in the face of mounting evidence to the contrary, despite repeated condemnations in their own time as flights of folly.

Tuchman, Barbara W. *The March of Folly: From Troy to Viet Nam*. New York, NY: Ballantine. 1984. pp. 380-387.

tions including, as Clausewitz's wrestler metaphor suggests, any way in which that opponent might use our own strengths against us. The *adaptive* nature of the opponents likewise suggests that, in any sustained competition or conflict, it will be the diversity of options or moves that one or the other side can generate and the agility that each can manage in moving from one potential option to the next that will be key to victory. It also underlines the value of putting an opponent on the defensive so as to tax his ability to respond and the value of maintaining a pace of operations that prevents the opponent from generating new options.

All of the above suggests that the application of network-centric capabilities (shared situational awareness and self-synchronization based on a common understanding of command intent) and the sheer breadth of options that can be made available through networking can become, in fact, the critical determinants of success. Again, this is not new. Efforts to force the enemy onto the defensive and to maintain an overwhelming pace of operations were very evident during the major combat phases of both Operation Iraqi Freedom and Operation Enduring Freedom. In contrast however, effects-based approaches use the logic of complexity and of the interactions between complex adaptive systems as a framework for understanding how and why those operations work in war and how they might work in peace and crisis.

Equally important, an understanding of complexity and complex adaptive systems also provides a conceptual framework for understanding how friends and neutrals as well as opponents act and react. Just as a diverse range of options and agility can be employed to our advantage in adapting to a changing security environment, opponents also have options

for adapting even if they differ in kind and range, and in the level of agility in which they can be employed.



## CHAPTER 3

### DEALING WITH COMPLEXITY

At first glance, there would appear to be a disconnect between the promise of the effects-based approach and the challenge posed by the seemingly infinite complexity of the multi-tiered security environment. If the interactions among the actors in the global system of complex adaptive systems are nonlinear, unpredictable, and driven by factors that we cannot entirely know or fully understand, then how are we to deal with this complexity well enough to plan and execute military operations? Is an effects-based approach then a “bridge too far,” beyond the reach of the information technologies we now have or are likely to have in the foreseeable future? Or is it so difficult that it requires a military or political genius to undertake?<sup>81</sup>

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<sup>81</sup> Some early depictions of effects-based planning processes featured arrows from all of the diverse factors to be considered converging on a box labeled “commander,” sparking one cynic to remark that it was in this box that the required miracle was to occur and that the only challenge was to identify the military genius who was to fill the position.

The reality is that dealing with the complexity is *not* difficult. We do so every day in a stream of complex interactions from family life to the work place. Rather, our difficulty stems from trying to deal with the *nonlinearity* of our complex security environment using only linear logic, metrics, and thinking. Far from being an indication of the impossibility of effects-based operations, the questions above underline the degree to which we are prisoners of linear thinking and organizational processes and their thirst for precise, quantifiable metrics. In fact we regularly conduct effects-based operations and routinely deal with complexity in military operations and statecraft. The 6-hour firefight over the burnt out remains of a Humvee in Najaf, Iraq is a case in point. From a linear or attrition-based perspective, the firefight would have been the height of folly. But, from a larger real-world perspective, it was the essence of a complex battle for minds and perceptions. The complex cause-and-effect chain involved was clearly and almost intuitively understood by the Army Captain who was the on-scene commander during the engagement:

We weren't going to let them dance on it (the Hum-  
vee) for the news...even with all the guys they lost that  
day, that still would have given them the victory.<sup>82</sup>

The measure of effectiveness applied by the Captain *and* his insurgent foes, as well as by most of the world's media and public opinion, was not that of rescuing a useless Humvee hulk or of a body count offering a comforting illusion of quantifiability. It was rather the perceptions and behavior of a worldwide audience of friends, foes, and neutrals to include the American domestic polity. The Captain not only thought

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<sup>82</sup> Wilson, "Over 60 Days." pp. A1 and A-16-17.



in terms of a complex nonlinear operation, but recognized a battlefield pattern, grasped a “whole” that extended beyond the battlefield to a succession of other complex events, and was able to act upon that appreciation through a succession of tactical action-reaction cycles throughout the 6-hour firefight. For the Captain, taking an effects-based approach was not a bridge too far but an unavoidable necessity. He faced a challenge that could not be answered simply by killing more of the enemy (something that probably would have proven counter-productive in any event) and he was in a situation that did not lend itself to a formal planning process based on linear models, but instead required a series of rapid decisions. He not only managed to deal with the complexity of this situation but continually adapted to the situation as it changed, reassessing and replanning on the fly time and again during the give and take of the firefight. In other words, he was able to bring an agility and adaptability to the problem that a plan or control system never could have produced.

As Chapter One points out, warfare and military operations in general, especially those in both crisis response and what is euphemistically termed *post-conflict stabilization*, are not and never have been simple and linear any more than diplomacy, politics, and economics are linear, even though each certainly may contain linear and deterministic aspects.<sup>83</sup> The complexity involved in these interactions is an inescapable part of our

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<sup>83</sup> In fact, the crisis of the state-planned economies of the Eastern Bloc during the 1980s offers a warning. The insistence on a centralized linear planning process in a complex and nonlinear economic world stifled innovation and condemned the planned economies to at best an arithmetic rate of change, whereas the complex adaptive economic system embodied in free enterprise permitted a geometric rate of change. The Western military parallel today is a linear, centrally planned acquisition process that likewise runs the risk of stifling military ability to adapt to a nonlinear security environment.

security environment and of the conflicts in which we are now engaged. Like the Captain in Iraq, we have no choice because the linear attrition-based approaches of the Cold War have only limited applicability to the asymmetric foes and nonlinear challenges we now face. The real questions are rather (1) how *better* to deal with complexity and (2) how to use our understanding of complexity to plan, execute, and assess effects-based operations. The challenge is most of all about coping with the realities of a complex world.<sup>84</sup>

In this respect, complexity poses a paradox. Applying an understanding of complexity to an effects-based approach actually simplifies the problem. Indeed, it is the key to any pragmatic “how to” because it distinguishes between those problems that are predictable, quantifiable, and thus, solvable in familiar linear ways and those that can only be bounded or limited to a range of most likely outcomes. Complexity theory makes clear that there is no single perfect answer to complex challenges and we must accept “the degree of precision that the nature of the subject admits, and not seek exactness when only approximation is possible.”<sup>85</sup> Military history and theory similarly tell us that it is not necessary to have a perfect, quantifiable response to a given challenge. We need only have one that works and that can be implemented in time to be effective. Dealing with complexity is not difficult just as long as we pragmatically accept what we can know and what we cannot

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<sup>84</sup> Czerwinski’s use of the word *coping* in dealing with complexity is noteworthy. It suggests that complexity is not to be mastered in the same way as linear, Newtonian phenomena but rather requires “*coping with the bounds* in order to command and manage—not in prediction or control.”  
Czerwinski, *Coping with the Bounds*. p. 2.

<sup>85</sup> Aristotle. *Nicomachean Ethics*. Chicago, IL: Britannica Great Books. Volume 8. 1993. p. 339.

know, and then build on what we can know to create a pragmatic understanding sufficient to deal with the challenge. In fact, both complexity theory and military history hold the conceptual seeds for dealing with the complexity challenge. The former offers a structural framework for dealing with complexity, and the latter builds on the extensive knowledge we already have about complexity from living in a world of complex adaptive systems.

## TOOLS FOR DEALING WITH COMPLEXITY

Some good launch points for a practical understanding of how to deal with complexity can be found in the work of John Holland, who points to seven basic attributes of complex adaptive systems: the four *properties* of aggregation, diversity, flows, and nonlinearity; and the three *mechanisms* of tagging, building blocks, and internal models.<sup>86</sup>

The four properties have already been evident in our discussion of complexity and the living systems model:

- The idea of *aggregation* or “the emergence of large-scale behaviors from the aggregate of less complex agents”<sup>87</sup> can be seen in the levels of increasing complexity in the living systems model as less complex subsystems are aggregated into suprasystems of increasing complexity,

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<sup>86</sup> Holland, *Hidden Order*. pp. 10-37.

<sup>87</sup> Czerwinski, *Coping with the Bounds*. p. 13.

This aggregation approach is evidenced in international relation systems theory, which attempts to study the way in which various configurations of nation-states function in an international system even though we may not know the complex interactions in the body politic or specific exchanges between the states in the system.

with the whole forming a meta-system of complex adaptive systems. Thus, individuals aggregate into successively more complex levels of social organization: groups, organizations, communities, societies and states, and into the overall environment of the international system.

- The multiple interdependent variables discussed in looking at these complex systems are at the root of *diversity*, that is, the existence of a sufficient variety of subsystem actors to produce an ever-changing and, therefore, self-organizing and adapting outcome.
- The concept of *flows* or the dynamics of the multiplying and changing interrelationships among the diverse actors and equally diverse sets of independent or interdependent variables is central to the focus on how these subsystems interact both within each level of the living systems hierarchy and from one level to the next with obvious parallels to the international system.
- And, the *nonlinearity* of the firefight in Iraq demonstrates problems with no dependable chain of causes and effects, whose whole (for better or worse) is not equal to the sum of its parts, whose outputs are not proportional to its inputs, and whose results cannot be dependably repeated.

The three mechanisms also offer significant clues as to how complex adaptive systems behave and, by extension, how we might deal with complexity.

- *Tagging*, or the ability to mark or otherwise identify specific kinds of actors in a complex system, lies at the core of any ability to track the kinds of interactions that are to

be found at each level of the complex adaptive system hierarchy.<sup>88</sup>

- *Building blocks*, or the ability to pick out at least loosely the known or knowable elements, functions, or processes of a complex system, can provide a way of building upon what we can know.
- *Internal models*, or the ability to identify patterns, regularities, or influences within an otherwise complex system, might yield an ability to hypothesize likely interactions and outcomes.

All three of these mechanisms are in various ways visible in the living systems model, which offers a framework for putting them together and applying them to complex operations in the security environment international arena. Tagging can permit us to follow a specific stimulus or factor, e.g. “follow the money,” through cycles of interactions. The identification of the building blocks that contribute to the functioning of the system of systems can both identify and tag actors and processes, while internal models such as those inherent in Miller’s essential processes allow us to trace the interactions in one system and extrapolate to another.

### *Self-organization, adaptation, and coevolution*

Taken together, the four properties enumerated above begin to define significant aspects of complexity that must be addressed if we are to deal with the challenge associated with the “how to” of effects-based operations. The three properties of diver-

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<sup>88</sup> John Holland states that while it may be hard to track the movement of one billiard ball amid a large number of similar balls in motion on a billiard table, if the target ball was *tagged* with a stripe, its motion could be easily tracked. Holland, *Hidden Order*. p. 13.

sity, flows, and nonlinearity “guarantee”: that any complex adaptive system will be continually changing as it interacts with the other complex adaptive systems in its environment; that these changes will be uneven to the point that even small alterations or stimuli can disequilibrate the entire system;<sup>89</sup> and that, as a result, we will never be able to know such systems perfectly, much less be able to predict their reactions exactly.

At first glance, the combination of diversity and flows sounds as though the systems and interactions we will face will always be completely random and that there is no way for us to estimate the impact of an event or stimulus or to assess the behavior of a complex adaptive system. This is where the Darwinian *adaptive* element at the core of Holland’s and Miller’s work comes to the fore. Given the diverse possibilities resident in a large system of complex adaptive systems and the unrestricted flows or interactions by which any and all of those capabilities might be combined, the system might theoretically produce an infinite number of potential responses to any given stimulus.<sup>90</sup> However, given the law of natural selection, some

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<sup>89</sup> Czerwinski, *Coping with the Bounds*. p. 48

Glenn James describes this same phenomenon in terms of chaos theory using the analogy of a faucet dripping at a steadily increasing rate as the water flow increases until the slightest additional increase in the flow will cause the dripping to become entirely erratic.

James, Glenn. *Chaos Theory: The Essentials for Military Applications*. Newport Paper Number 10. Newport, RI: U.S. Naval War College. 1996. pp. 14-19.

<sup>90</sup> Self-organization arises from the ability of complex adaptive systems to relate “to each other sufficiently to form recurrent patterns...(and) to self-organize their patterned behavior into an orderly whole.”

Rosenau, “Many Damn Things Simultaneously.” p. 84.

Gell-Mann uses the example of a pile of sand that reaches a certain height at which the addition of a single grain causes an avalanche that changes the pile into a more stable shape. Gell-Mann, *The Quark and the Jaguar*. p. 99.

of these adaptations will fail, others will leave it less able to cope with future stimuli than its competitors, and still others may give it a competitive advantage over those competitors in future interactions with other systems. That is, because of its ability to change, the complex adaptive system will self-organize and adapt. Moreover, this process is cumulative. The import of such coevolution is that the reactions of complex adaptive systems to stimuli are not random but reflect a self-organized natural selection and an adaptation in which each system evolves processes for handling and responding to stimuli—a continual if somewhat “accidental” process of refinement that has resulted in the system’s survival in the past. Thus, as the living systems model suggests, today’s complex systems are the results of coevolution over tens, thousands, or even millions of years.<sup>91</sup>

However, there is a catch. Successful adaptations are likely to work only as long as the conditions that originally shaped them persist. To the degree that an adaptation is fine-tuned to a very specific set of conditions, it is subject to failure due to relatively small shifts in those conditions. These changes can bring down the entire system. To use a Darwinian example, an animal that has adapted so finely to its environment that it can eat only one form of food may face extinction if that food disappears, even though there may be no other change in the ecological system.<sup>92</sup> This in turn suggests that the response of a complex adaptive system to a stimulus is likely to be a more limited and pragmatic subset made up of those responses that meet two

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<sup>91</sup> This indeed is Miller’s thesis and the advantage of his approaching complexity from the standpoint of biological vice engineering models. Miller, *Living Systems*, pp. 854-860.

<sup>92</sup> Waldrop, W. Mitchell. *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York, NY: Simon and Shuster. 1992. pp. 310-311.

criteria: (1) they are within the bounds of physical possibility and (2) they at least appear to aid the system's survival or are, at a minimum, not immediately and overtly self-destructive. In the case of the complex car engine, for instance, we know that the car will not take to flight nor burrow into the ground because it simply lacks the physical capacity to do so. We also know that the car is unlikely to move sideways because the wheels only rotate forward and backward. Moreover, if we knew some additional facts about the car, for example, what power the engine was physically capable of delivering and whether or not it had a reverse gear, we might further narrow the realm of physically possible reactions to a relatively pedestrian list with two major possibilities: that the car might move (however erratically) and that it might not. While even this minimum list would certainly put a crimp in our use of the car, it would at least reduce the range of possibilities to a number against which we could conjure a series of if-then plans.

This is not to say that we are reduced to assuming the existence of a rational decisionmaker, but rather that we can logically bound the problem by understanding the processes involved and the history of the system's evolution.<sup>93</sup>

## PRAGMATIC APPLICATION OF COMPLEXITY THEORY

In most discussions of complexity theory, the properties, mechanisms, and concepts identified above are used to *describe* complex adaptive systems. However, the same descriptors, especially if inserted into the framework of a living systems model, also suggest a tool set of pragmatic ways of dealing with

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<sup>93</sup> Miller, *Living Systems* p. 53.



complexity: bounding the problem; aggregating complexities into a more manageable meta-system problem; and applying some form of reduction analysis or decomposition.

### *Bounding the problem*

The Aristotelian injunction to be satisfied with the precision that the nature of the subject permits is at the core of bounding. The diversity and nonlinearity of complex adaptive systems mean that we will never be able to know a system or its reaction to a stimulus well enough to predict exactly what its behavior will be. The system will change even as we come to know it<sup>94</sup> and it will change in ways that are not entirely predictable, so that even if we could predict actions at a given time this capability would soon be overtaken by events as the system mutated into something different. In the absence of an ability to know, predict, and quantify the behavior of complex systems in the same way as is possible for linear (if complicated) systems, the task is to limit what otherwise might be random or infinitely varied behavior to a subset of those outcomes with the greatest probability of occurring. The three complex adaptive system mechanisms of building blocks, tagging, and internal models offer tools for such bounding.

### **Building blocks**

We might pick out known or recognizable building blocks in a particular complex system or hypothesize such blocks from the

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<sup>94</sup> One can even argue that, in the manner of the Heisenberg principal, knowing the system will cause it to change. For example, in 1940, any demonstrated British knowledge of German codes would likely cause those codes to be abandoned—thus, Churchill’s dilemma in permitting the German bombing of Coventry to avoid indicating that the German code had been broken.

processes by which similar systems function, as Miller's work suggests. For example, while we may not know what a given ship is doing, we would know two basic building blocks about maritime movements: that the ship's movements must be confined to water of a certain depth and that its movements are limited to some maximum speed. From this, we would know where the ship would *not* be and could then estimate a farthest-on circle of where the ship *might* be. Similarly, if we were looking for al Qaeda operatives exfiltrating a country, we might begin by assessing all means of transport that might be used.

### **Tagging**

We might also identify tags or characteristics and indicators to help us identify actors and relationships and to recognize patterns of variables. For example, knowing the home port and flag registration of a ship might enable us to identify links between the ship and certain ports or operating areas. Similarly, knowing the nationality of al Qaeda operatives might help us to narrow down potential sources of support in exfiltration and their most likely movements and destinations.

### **Internal models**

We might also look for internal models, sets of likely relationships between actors and actions that would allow us to estimate various actions and outcomes. For instance, we might use the internal model provided by knowing something of cargo ship operations in general and the ownership of a particular ship and cargo to estimate its movements or to assess how current movements might deviate from demonstrated norms. We might then use the internal model as a springboard to further tagging and identification of additional potential building

blocks in an iterative process of refining each of the three mechanisms.

Note that what we have done here is not to apply a series of precise, linear rule sets to the problem. Given a complex problem with layers of interdependent variables, such an approach would likely yield an endless proliferation of rules to the point that they would become useless. Rather, this approach applies some broad criteria to reason from what we know or can find out in successive iterations that refine and narrow an infinite number of possibilities to a (hopefully) more manageable set of most likely outcomes. In this case, we have largely reasoned from the negative, discarding those possibilities deemed highly improbable (e.g., fishing boats with speeds in excess of 30 knots) to focus on those judged most probable.<sup>95</sup> Again, this is not new. It is and always has been the basis for good intelligence analysis.

From the military perspective, such bounding of the problem offers the advantage of permitting us to plan against a workable number of the most probable potential scenarios.<sup>96</sup> However, (1) this process affords no guarantee that the choices made in bounding the problem will necessarily include the scenario that might actually unfold and (2) the probability of making the right choice rests heavily on two qualitative factors: the quality of the decisionmaking and the quality of the information available to inform that decisionmaking. Indeed, it is in

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<sup>95</sup> Notice that this approach does not remove the possibility of outliers, logical explanations of why a fishing boat might be traveling at such a high speed. It merely accepts that the likelihood of such an eventuality is extremely low.

<sup>96</sup> Military examples of using this bounding technique for planning purposes include the Attain Document Operations off Libya in 1986. Smith, *Effects-Based Operations*. pp. 445-495.

meeting this latter need that the major contribution of network-centric operations to effects-based approaches in general and military operations in particular may lay.

### *Aggregation*

Aggregation offers the possibility that, while we may not be able to understand the behavior of the individual parts of a complex system, we may still be able to understand the behavior of a higher level supra- or meta-system that combines a large number of these complex systems into one with “fewer moving parts.”<sup>97</sup> This has the advantage of focusing on a few dominant variables that are most likely to drive the behavior of the system. Thus, although we might not be able to calculate the potential behaviors of each and every actor in a complex system of systems, we probably could discern some basic rule sets for the operation of the system as a whole and use them to describe the behavior of the whole.

This again is not new and is hardly a mystery. In international relations, for example, we use meta-systems such as nation-states, coalitions, or international organizations such as NATO and the United Nations to capture the behavior of an array of relationships between and among complex adaptive actors that would otherwise be indecipherable. Most of political sci-

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<sup>97</sup> Yaneer Bar-Yam points out that the complexity of a problem is relative and varies with the amount of detail required to describe it and understand it. The greater the precision and detail we require, the more complex the task and data requirements are likely to be. The less the precision and detail are, the less complex the problem will appear to be. Bar-Yam uses the example of the movement of an army. While it may not be possible to know what every individual soldier in that army is doing, it is far less difficult to assess what the army as a whole is doing.

Bar-Yam, *Multi-scale Complex Systems Analysis*. pp. 27-29.

ence and international relations system theory is, to one degree or another, based on such aggregation.<sup>98</sup> For instance, rather than trying to understand how the internal politics of each party in a fractious multi-party government might affect its actions, we aggregate these factors into the personification of a state and its interests. The aggregation does not remove the complexities of the politics involved or any impact that these politics may have on the actions of that state, but it does permit us to deal with a more limited set of variables that may be relatively more linear or subject to some form of deterministic analysis, albeit with a continued reminder of the potential for outlier behavior wrought by party politics.<sup>99</sup>

In military operations and intelligence, we habitually aggregate. We may do so in terms of platforms (e.g., ships, planes, and tanks) and may further aggregate these platforms into units (e.g., battle groups, squadrons, and mechanized infantry battalions).<sup>100</sup> We may not be able to follow the actions and

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<sup>98</sup> A similar use of aggregation is reflected in economics with the aggregations of the micro-economic behavior of individuals into the macro-economic behavior of markets, as in John Holland's famous example of the economy of New York City as a complex adaptive system. Holland, *Hidden Order*. p. 1

<sup>99</sup> In essence, we are creating a convenient fiction in linear terms to permit us to measure something. Again, this is not new. It is in some ways akin to looking at the horizon. It appears as a straight line only because it is a very short section of the very large curve of the earth. In celestial navigation, we can utilize this fiction of a straight horizon as the reference line for measuring the angle of a star, but a ship's navigator would gain little by this unless he also took into account the fact that the line was a circle around his position or that this circular horizon would expand as his height above the sea increased.

<sup>100</sup> The late ADM Mike Boorda once observed to me that admirals usually ended up talking "grand strategy" with their intelligence people because the intelligence people thought in terms of fleets and entire navies rather in terms of ships and the systems aboard them, that is, they thought at a level of aggregation similar to that of the operational commander.

motivations of every individual soldier on the battlefield or every sailor on every ship, but we can follow the moves of armies, ships, and aircraft and make estimates as to what they are attempting to accomplish by their actions. In fact, we often do not *dis*-aggregate the latter unless the ships or aircraft are operating as single units in a detached status.<sup>101</sup> In describing effects-based operations, we similarly aggregated observations of a half century of crisis response operations into a four-property rule set. This is to say, we aggregated a wide variety of individual responses over a protracted period of time and aggregated them into a meta-system of relatively succinct proportions.

Notice once again that, in each of these cases, we did not eliminate the underlying complexity or reduce the number of interdependent variables involved in the problem. States remain complex systems with complex subsystems and contending influences. Military units are still composed of individual actors with their own capabilities, backgrounds, and experience bases. Crisis response operations are still highly complex diplomatic, political, and military interactions whose full details may never be known. What we have done in aggregating is to limit the number of interdependent variables under consideration at any one time so as to draw some useful conclusions.<sup>102</sup>

From an analytical perspective, the key idea in aggregation is that, whereas linear systems are usually better understood by taking them apart so as to assess how the individual parts

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<sup>101</sup> In fact, this platform-centric aggregation shorthand can become counterproductive to the degree that it obscures the human decisionmaking role in military operations and with it the essential complexity of what is being attempted.

function and contribute to the whole, for complex systems we may have to do pretty much the opposite because we can only understand such systems in the context of their wider environment. The aggregation approach, therefore, involves moving up through the tiers of the living systems “tree” until we attain a level at which we can focus on a limited enough set of variables to make sense of the complexities of a given situation and learn from them. This is suggested in the application of the mechanisms—tagging, building blocks, and internal models—to the problem of bounding, but even these applications do not go far enough to afford a real “learning.”<sup>103</sup> As Czerwinski points out, a purely holistic approach focusing solely on finding and explaining some form of macro-linearity has its pitfalls.<sup>104</sup> One is the tendency to limit the assessment to deterministic variables that do not reflect the real situation.

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<sup>102</sup> A good example of this is the approach taken in writing the 1991 Navy-Marine Corps white paper, “...From the Sea.” Aggregates of crisis response operations over the previous 45 years provided the basis for judging the frequency of such responses, their scale, where they occurred, their operational scope, the required speed of reaction, and their duration. These then permitted planners to estimate what kinds and numbers of naval forces would be required for the post-Cold War world. See:

Smith, Edward. “...From the Sea: The Process of Defining a New Role for Naval Forces in the post-Cold War World.” *The Politics of Strategic Adjustment*. Turbowitz et al., eds. New York, NY: Columbia University Press. 1999.

<sup>103</sup> Czerwinski points to six such learning aids: metaphors, Perrow’s quadrants, Van Creveld’s rules, systems dynamics, genetic algorithms, and pattern recognition, the latter of which he categorizes as tacit, low-level models and have “a rough correlation” to the mechanisms of complex adaptive systems. Czerwinski, *Coping with the Bounds*. pp. 52-53.

<sup>104</sup> Czerwinski comments, “Holism insists that a nonlinear system be dealt with ‘in the whole.’ In Holism, everything is connected to everything else, and there is no hierarchy... Such a condition is untenable and useless for the responsible commander.”

Czerwinski, *Coping with the Bounds*. p. 50.

For example, explaining effects-based operations solely in terms of state-to-state interactions would do little for a tactical commander. Another pitfall is the likelihood of forcing the analytical efforts to higher and higher levels of command and, thus, farther and farther from battlefield realities. How then are we to assess and support an effects-based approach to operations?

## COMPLEXITY BY CONTAMINATION

There is a hidden assumption in the holistic approach to complexity: there are no parts of a complex system that are not complex. Yet, we know from experience and observation that all parts of a complex system need not be complex. The output of a sensor system and the resulting actions of a weapon such as a guided missile may be quite linear, but if the output of the same sensor were part of a surveillance picture that is used in a complex human decisionmaking process, then the decision output would almost surely be complex and nonlinear.<sup>105</sup> That is, the linear sensor input would become *complex by contamination*.

This suggests a different possibility. If the nonlinearity of the effects-based problem means that we cannot resort to the familiar processes of linear reduction,<sup>106</sup> then might we conduct a different form of reduction for dealing with nonlinear

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<sup>105</sup> Although there has been a temptation here to make the problem linear by removing the human (i.e., the human decisionmaking process) from the loop, the first chapter of this book underlines that this solution is workable only in specific areas of military operations largely at the tactical level of major combat, e.g. the anti-ship defenses of a PHALANX-armed Aegis cruiser. The reality is that there will inevitably be human decisionmaking and that the density of that decisionmaking will increase the farther we stray from the tactical level of major combat.



problems: separating the linear and nonlinear elements of a complex system or process so as to identify and isolate those elements that are inherently complex and thus restrict the areas in which bounding is necessary. We could then apply linear analytical techniques to those elements where it is appropriate and use the results of this analysis to focus and refine the bounding that we must do to deal with the complex elements of the process that are not subject to linear analysis.

Military operations research studies of attrition-based operations already attempt something along this line. Analysis of attrition is used not simply to catalog destruction but rather as a way of determining when, if at all, the enemy's will might collapse—even though there is no linear relationship between the two. To do this, analysts dissect a complex problem (the relationship between a battlefield stimulus and changes in enemy will) into two parts: a linear part that can be measured and analyzed, *attrition*; and a nonlinear part that cannot be readily measure, *will*. The researchers then measure elements (such as the rate, timing, and extent of attrition), make correlations to the measurements and outcomes of past battles or campaigns, and attempt to infer by analogy a nonlinear result.<sup>107</sup> Obviously, this process is fraught with perils. It is highly dependent on the precision of the analogies used (e.g., the attrition that might cause one unit to collapse and run

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<sup>106</sup> Linear reduction is built on suppositions that there will be a predictable chain of causes and effects, that inputs and outputs will be proportional, and that the whole will equal the sum of the parts we analyze. Complex systems are none of these.

<sup>107</sup> Paul Davis points to the need to develop the operations analysis tools to deal with the “full range of direct, indirect, and cascading effects” as the “grand challenge” for the operations analysis community. Davis, Paul K. *Effects-Based Operations (EBO): A Grand Challenge for the Analytical Community*. Monograph. Santa Monica, CA: Rand. 2001. p. 79.

would not have the same effect on another unit or on the same unit at a different time) and additional interdependent variables that need to be taken into account.<sup>108</sup> Likewise, it can result in a tendency to “reformulate” nonlinear problems into linear terms that may have little to do with the realities of the battlefield, much less of effects-based approaches to operations in which destruction is but one possible effect.

While this sort of approach may be fraught with perils, the basic idea of nonlinear reductionism offers the *yin* for the holistic *yang* of aggregation. Where aggregation moves toward looking at larger systems and fewer variables, the separation of the linear aspects of a complex adaptive system implies moving in the opposite direction: attempting to dissect the complex systems to understand better and, by extension, using humans to deal with those elements that are irreducibly complex—and doing so with more agility than linear computing approaches are likely to manage.

## OF METAPHORS, ANALOGIES, AND MEN

Two things stand out in the whole discussion of how we might deal with complexity: the relative cumbersomeness of the processes involved and the continuing need for human judgments in each of the approaches. Both would seem to suggest that effects-based approaches must remain at the strategic or, at a

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<sup>108</sup> One example of a situation in which the normal relationship between attrition and a collapse of the will to fight did not hold is the desperate German defense of Königsberg in East Prussia in the face of Soviet advances in early 1945. The German soldiers had little hope for their own survival but did have some hope of holding the advance long enough to permit the evacuation of civilians, and they fought accordingly.

Hastings, Max. *Armageddon: The Battle for Germany, 1944-1945*. New York, NY: Knopf, 2004. pp. 271-274.

minimum, the operational level of military operations where timelines are long enough, the processes are staffed well enough, and the required human capabilities—both command and subject matter expertise—are available enough to support the planning and execution of effects-based operations. However, such a conclusion would stand in stark contrast to the real-world picture of the Army Captain in the Najaf fire-fight trying to outwit opponents in a tactical level application of effects-based approaches with very short cycle times. How did he do it? Was he the proverbial military genius, or was there something much more basic involved?

The ability of the Captain in Najaf to appreciate the complexities of his situation and mission and to act in a timely manner can certainly be said to have sprung from a tactical necessity, but his actions also say a great deal about what the human being brings to the problem and about another way we might deal with complexity. The Captain's ability to deal with the complexity he encountered argues that the "new conceptual equipment" to which Rosenau refers does not require a great leap into the unknown, or a university professor's understanding of complexity theory or—with apologies to the Captain—a military genius. Rather it intimates that any approach to dealing with complexity needs to build upon an understanding of complexity that human beings (as complex adaptive systems in their own right) already have. This knowledge is substantial and derives from both "nature" and "nurture"; that is, from the biological evolution of the human brain over the past two million years to which Miller alluded and from the learned experience in the complex world in which humans live, from the global economic system to the human languages by which ideas are communicated, and to human society all the way from the individual to the international system.

## *Metaphors*

One of the most telling features about most discussions of complexity theory is the frequent resort to metaphors<sup>109</sup> and analogies<sup>110</sup> to explain one or another aspect of complexity, much as we have done with the analogy to the complex car engine. It is symptomatic of this need to resort to analogy that this entire book is littered with phrases beginning with the words “for example.” In each case, the example attempts to build on an intuitive understanding that the reader already has of some complex subject, such as the history of warfare in the 20th century, to evoke in a few words a parallel understanding of a new “complex” subject. Thus, a phrase- or sentence-long analogy can conjure up an intuitive understanding of a subject that might otherwise require a chapter or an entire book to explain—if indeed the chapter or book could do so without further resort to analogy. Examples, analogies, and metaphors are, in short, integral parts of how we think about complex subjects and the real issue is how best to use this human capacity to deal with the complexities of the global security environment. They are also at the heart of ideas like naturalistic decisionmaking that focus on how military personnel (and Wall Street options traders) make decisions under great time pressure.<sup>111</sup> Complexity theoreticians offer a reason for the frequent resort to analogy and metaphor: metaphors and anal-

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<sup>109</sup> The dictionary defines a *metaphor* as “a figure of speech in which a word or phrase denoting one kind of object or action is used in place of another to suggest a likeness or analogy between them, as in *the ship plows the sea*.”  
*Webster's Third International Dictionary*. p. 1420.

<sup>110</sup> The dictionary defines an *analogy* as “a figure of speech embodying an extended or elaborate comparison between two things or situations.”  
*Webster's Third International Dictionary*. p. 77.

ogies constitute tacit models that capture a complex human understanding of an equally complex phenomenon.

## **Tacit models**

The idea of metaphors and analogies as low-level working models of complex behavior for which there are as yet no other adequate models should not be news. Although currently overshadowed by the linear reductionism of the scientific method, reasoning by analogy is as old as time and, like the use of metaphor, has an academic pedigree that dates back to ancient Greece. It was part of the study of rhetoric, a standard feature of a good education from classical Greece up until the beginning of the 20th century. More recently, science has been gaining a new appreciation of how this reasoning by analogy figures in human thought processes.<sup>112</sup>

Human beings tend to perceive and reason by analogy, that is, they perceive a pattern and then match that pattern either to the same general category of object or event or to a completely different object or event so as to draw inferences and create some hypothesis leading to a tentative understanding. In this reasoning process, we can trace the application of the “mechanisms” of complex adaptive systems. For example, tagging is not just a way of identifying and marking all units of a class but, by analogy, might be extended to explore new relation-

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<sup>111</sup> Gary Klein, in particular, and the Marine Corps Combat Development Command (MCCDC) have focused on the development of naturalistic decisionmaking: how it differs from the linear thinking embodied in military theory and better reflects the way battlefield decisions are actually made. Zsombok, Caroline and Gary Klein. *Naturalistic Decision Making*. Mahwah, NJ: Lawrence Erlbaum. 1997. pp. 4-5.

<sup>112</sup> Clippinger, “Moving to the Edge.” pp. 80-81.

ships between units with similar functions. Similarly, building blocks might draw from what is known of one system to identify the likely equivalent building blocks of another system. Internal models might involve the search for the ways in which the new systems and problems might in some way resemble those we already know. In short, reasoning by analogy and the use of relevant metaphors open a way to expanding the base of analysis from that which we can know and measure to that which is not fully known and analyzed or which cannot be dissected and measured: a tacit model.

### **Insight and imagination**

The second and more intriguing idea is that analogy and metaphor are less models than tools in their own right, tools that can access a complex human understanding of ideas and phenomena that cannot otherwise be handled. Alan Beyerchen calls the metaphor the “essential ‘as’ gate in our cognitive processing,”<sup>113</sup> the “as” that enables us to compare one thing to another and often decidedly different thing. He points out that, in this capacity, “metaphors are networks of meanings and entailments that dilate or constrain both our perceptions and conceptions”<sup>114</sup> and that “metaphoring is a process of exploring some interesting possibility space with contingency and feedback.”<sup>115</sup>

In this context, metaphors and analogies have three dimensions.

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<sup>113</sup> Beyerchen, “Importance of Imagery.” p. 163.

<sup>114</sup> *Ibid.*, p. 163.

<sup>115</sup> *Ibid.*, p. 167.

The first, to which Beyerchen alludes, is the use of metaphor and analogy to expand the horizons of hypothesis, in other words, to engage the human imagination. This imagination, the human ability to extrapolate from what is known or can be known to what does not yet exist is crucial to military operations and statecraft because it is the starting point for the capacity to surprise and shock, or to anticipate the surprises of an enemy. It is noteworthy that the principal fault for which the 9/11 Commission chastised the United States Government in general and its intelligence community in particular was for a lack of *imagination*. Whereas the terrorists were able to imagine using airliners as large missiles, there was a reluctance or inability on the part of the United States' analysts and decisionmakers to explore possibilities that were "out of the box" or beyond the scope of standard, known, state-centered models. There was, in short, a lack of *metaphoring*.

The second dimension is the role of analogy and the human mind in understanding and defining complex relationships that cannot be accomplished in any other way. The social domain is rife with such relationships and it is exactly these relationships that are the keys to planning, executing, and assessing the impact of the operations in the cognitive and social domains that are the core of effects-based operations. John Henry Clippinger makes the point that the human brain is particularly well-adapted to recognizing and assessing just such patterns in social organizations.<sup>116</sup> And again, it is precisely these levels of complex adaptive systems of systems that we seek to address in effects-based approaches to operations.

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<sup>116</sup> Clippinger, "Moving to the Edge." p. 79.

The third dimension has to do with the ways in which human beings think and decide. The United States Marine Corps, in looking at how military commanders actually function, came to the conclusion that the military staff college “school solutions” based on a careful weighing of courses of action were not evident in actual decisionmaking, which instead tended to compare a given situation with some roughly similar situation in an experience base and decide on a course of action that simply sufficed to deal with it. The pressure of short timelines (also characteristic of the Najaf fire) had much to do with this abbreviated approach to decisionmaking, as the Marines’ examination of the rapid-cycle decisionmaking processes of Wall Street options traders highlights. However, the striking aspect of this school of naturalistic decisionmaking is the degree to which it is very much reasoning by analogy.

### ...AND THE RE-EMERGENCE OF THE LIBERAL ARTS

The naturalistic decisionmaking approach to dealing with complexity, including the role of analogy in creating tacit models and of imagination in recognizing out-of-the-box possibilities, as well as much of the thinking in the approaches centered on bounding and aggregation, are exemplified in the arts. The liberal arts encapsulate a divergent but well-trying way of dealing with complexity that is in fundamental ways the opposite of linear reduction. They proceed from a tacit acceptance of the complexity of everything from language and the fine arts to history and many aspects of politics. Implicit in this acceptance is the recognition that the writer, artist, politician, or combat leader practicing the “operational art” has been able to deal with a particular complexity in a special way that affords a special and often nonreplicable understanding of that



subject.<sup>117</sup> Assessing the complex subject in this context proceeds from the recognition of the impossibility of trying to dissect this inherent complexity, e.g. the futility of understanding Shakespeare's *Hamlet* by counting how many times the playwright used a given preposition in that work.

Instead, meaningful assessment depends on the particular capabilities or experience of an individual who has acquired an internalized or tacit knowledge of the work and, with it, an ability to appreciate a larger holistic, subjective, and intuitive side of the work, or perhaps why it has resonated with audiences over the centuries. In many ways this is the antithesis of the scientific approach because the validity of the solution depends not on an ability to use empirical data to dissect and experiment in a way that would be intelligible to any other investigator but upon the tacit and therefore largely incommunicable understanding of a particular expert. The saving grace of this subject matter expert approach is that it can offer a way

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<sup>117</sup> The French impressionist painter Claude Monet, for example, analyzed the complexities of the changing play of light on the ornate façade of Rouen cathedral by using oil paints to create a succession of paintings of the cathedral at different times of the day and different seasons of the year in each painting, trying to capture a shimmering sense of the change of light as it was occurring. None of these paintings is subject to empirical analysis or linear reduction, e.g. how many dabs of various colors of paint each picture took. Yet, each of the canvasses conveys a unique visual understanding of the infinitely changing scene. One appreciation of the complexity of what Monet was attempting pointed out that there was a literally infinite set of variations of this play of light on the already complicated cathedral façade and that what Monet was attempting to capture was not just a picture of different lighting but a picture of the change in lighting as it was occurring. It is significant to note that this particular appreciation of the complexity of the subject was offered by Georges Clemenceau, a friend of Monet's but also France's World War I prime minister and a man familiar with a different kind of complexity: the political and diplomatic complexities of holding together a government of disparate and often feuding factions through four years of war. Stuckey, C.F., ed. *Monet: A Retrospective*. New York: Beaux Arts. 1985. p. 175.

of handling problems whose inherent complexity makes them incompatible with empirical investigation.

The difficulty in using this subject matter expertise lies in communicating the complex understanding to the non-expert. However, here too there is hope. The requirement for successfully tapping the expertise hinges on the ability of the recipient to grasp not the whole mastery of the expert but rather those aspects that may be essential to a particular task at hand. While we may not all be Shakespeares—or Churchills or Pattons for that matter—we have all been observers of and have had to deal with the complexities of human language, society, and interactions and can build on those foundations to understand the basics of the subject expertise presented.

What we seek in an effects-based approach is a way of tapping the understanding of someone like an artist (or a regional or subject expert) who has acquired a rare and perhaps intuitive insight into a complexity of interest, and then exploiting that insight to our advantage. Indeed, our historic approach to dealing with effects-based operations has relied heavily on gifted “artists,” great statesmen like Churchill and military commanders such as Patton who have a unique mastery of a complex situation, to create a coherent course of action amid its knowns and unknowns—a mastery that gave Patton, for example, a unique adaptability and agility as a commander. However, we now face the prospect of turning the capabilities of the information revolution and the greatly expanded knowledge base that it brings to tackling the challenge of complexity in new and potentially better ways. The knowledge supplied by the network is open not just to the political or military genius, but to commanders and decisionmakers at all levels and enhances their innate capacity to handle complexity.

## CONCLUSION: THE COMPLEXITY PARADOX

The picture of complexity we have painted is that of a paradox, a theory that appears more daunting than it actually is and that is equally the key to any practical approach to implementing an effects-based approach to operations. Indeed, in the absence of an understanding of this complexity and its impact on what we are trying to do, effects-based planning would be condemned to such a proliferation of processes and procedures as it attempted to capture the mass of variables at play that it would soon become either unworkable or so time-late as to be unusable. Accepting the innate complexity of effects-based operations, by contrast, opens the door to much more straightforward processes in which human intervention is accepted as a key element in dealing with that complexity.

The main challenge in dealing with complexity and in tapping the human potential is that of thinking differently and less linearly. We have sketched the outlines of a set of basic theory tools that might be applied. The next step must be to examine the specifics of effects-based operations:

- outlining the potential roles of building blocks, tagging, and internal models;
- showing how aggregation might play;
- determining the locus and nature of the complexities involved;
- identifying where bounding and human intervention must occur; and
- putting all of this into the context of the multi-layered system of complex adaptive living systems that is our security environment.



## CHAPTER 4

### COMPLEXITY IN EFFECTS-BASED OPERATIONS

The central tenet in any effects-based approach is that we can somehow purposefully<sup>118</sup> shape the interactions of players in our security environment so as to produce both individual and overall behavior that meets our needs. To do this, effects-based approaches must be able to address a host of complexities.<sup>119</sup> The basic description of effects-based operations as “coordinated sets of actions directed at shaping the behavior of friend, foe and neutral in peace, crisis, and war” underlines the challenge. It does not speak simply of an action

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<sup>118</sup> The word *purposefully* is used here to denote the fact that while all of our actions and inactions, intended or otherwise, will tend to shape the behavior of other complex adaptive systems both in an immediate interaction and in the context of a larger, ongoing history of interactions, what we are concerned with here is how we might shape behavior in a deliberate fashion.

<sup>119</sup> The reality is, of course, that this has always been the case in military operations, as illustrated by Clausewitz’s *zweikampf* in which two wrestlers compete without foreknowledge of the outcome and each one’s actions are in part dictated by the unforeseen actions of the other. Beyerchen, “Importance of Imagery.” pp. 156-157.

creating an effect in a straightforward, if-this-then-that, cause-and-effect relationship, but of *coordinated sets of actions*, that is, the use of multiple interdependent actions. And, it does not look to a single effect as the outcome but rather to the actions *shaping a behavior* end-state. This is to say that it sees both a process and an end-state that are neither precise nor solely the products of the actions we ourselves take. Even more, it does not limit this behavioral outcome to the foe's reactions, but sees coordinated sets of actions creating diverse arrays of effects on many different levels of many different actors in many different arenas and under the very different conditions and rule sets of *peace, crisis, and war*. And, it implies a requirement for a single set of actions to be able to create opposite effects on foes, friends, neutrals, and the domestic public.

Effects-based approaches as defined focus on the six human dimensions of the living systems model including human beings themselves and five successively more complex sets of human institutions: groups, organizations, communities, societies, and an international system—the social arena within which all of these elements interact. In this system of complex adaptive systems, the human being occupies the central position as both the product of long biological evolution and the creator of the five kinds of human institutions.

This dichotomy is central to the “how to” of an effects-based approach to operations for three reasons. First, it underlines that the actions, effects, and end-states with which effects-based operations must deal are all, directly or indirectly, products of human cognitive processes in which “human beings react to stimuli, come to an understanding of a situation, and

decide on a response.”<sup>120</sup> Second, it infers that these human cognitive and social processes are both the hard-wired products of hundreds of millennia of biological evolution, i.e. “nature,” and the products of social evolution and human interactions such as education and experience, i.e. “nurture.” And, third, it argues that the human institutions with which effects-based operations must contend are products of social evolution to the point that they likewise will reflect not all possible responses to stimuli but rather a much more limited if still evolving set of systems and processes that have actually worked in the past and have, hence, survived to try again.<sup>121</sup>

## THE ACTION-REACTION CYCLE

The three points listed above provide a way of understanding what is going on in the effects-based action-reaction cycle<sup>122</sup> introduced in *Effects-Based Operations* (2002) (see Figure 14). In the cycle, the stimulus arises in the physical domain and will be a physical action of some sort: anything from an enemy force opening fire to a presidential press conference, the initiation of a software program, or the presence of a particular unit at the right place at the right time to be seen. Or, somewhat paradoxically, it may also be the result of an *inaction*, such as a

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<sup>120</sup> Smith, *Effects-Based Operations*. p. xv.

<sup>121</sup> Complexity theorists would point out that the successful institutions exist in a precarious equilibrium between order and stagnation on the one hand and chaos and disintegration on the other, and that in this equilibrium, relatively small changes in initial conditions can bring large-scale change, or collapse.

<sup>122</sup> The cycle was originally developed to assess how the shared awareness developed via networking was applied in decisionmaking. See: *Report of the Workshop on Sensemaking*. Tysons Corner, VA: CCRP. 2001.

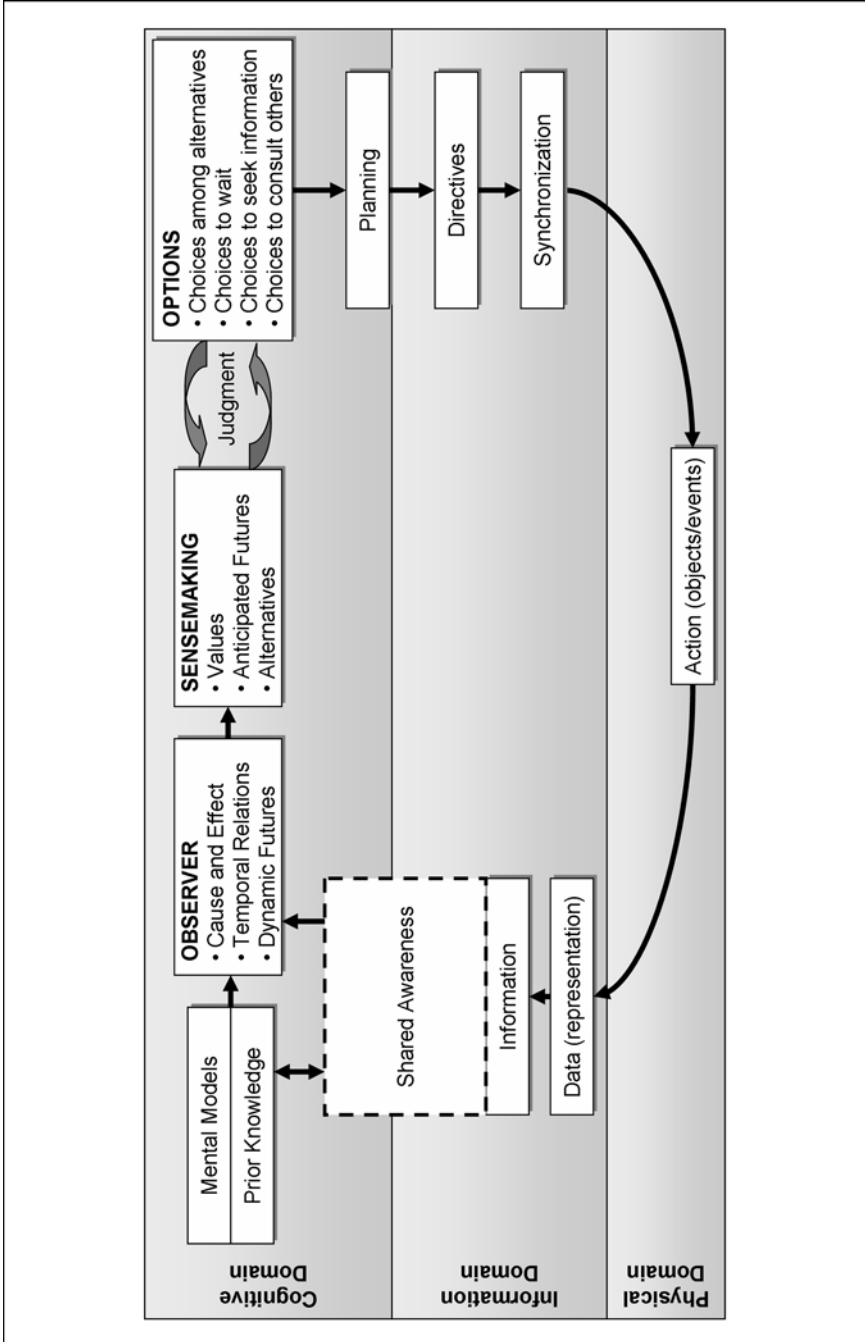


FIGURE 14. THE ACTION-REACTION CYCLE



failure to respond to a provocation.<sup>123</sup> The stimulus is transferred through the information domain to become part of a shared awareness, but for the stimulus to set off a reaction, it must enter the cognitive domain, that is, it must be seen, heard, or sensed by the observers and decisionmakers whose reactions are to be shaped.<sup>124</sup>

The stimulus provided by the action then enters the cognitive processes through the eyes and ears of observers who (1) contextualize it in terms both of a history of similar actions and of their own mental models, (2) attempt to make sense of it, and (3) apply this understanding to evaluate their response options. The chosen course of action is both the behavioral end-state of the cycle and a return stimulus that may set the cycle in motion once again, this time for the other side to react. Although there is a strong temptation to see this cycle as a tit-for-tat, strike-counterstrike give and take, the cycle actually applies to all kinds of interactions. It describes conventional deterrence efforts such as forward presence and port visits,

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<sup>123</sup> During the Cuban Missile Crisis of 1962, much of the decisionmakers' discussion centered on what would happen if the United States failed to respond to the Soviet placement of missiles in Cuba, i.e. the Soviet response to American inaction and the response of the American electorate.

Kennedy, Robert F. *Thirteen Days: A Memoir of the Cuban Missile Crisis*. New York, NY: Norton. 1969. p. 33.

<sup>124</sup> Shared awareness falls partially into the cognitive domain for two reasons. First, the sensors and the process, whether they are part of a carefully orchestrated surveillance system or a simple ad hoc arrangement, will filter the report in some way so that what enters the situational awareness will be some variant of the actual event. Therefore, what will actually enter the situational awareness is a function of cognitive decisions as to how many of what sensors or reporters to support, where they are stationed, and how they are organized and report. Second, to affect behavior, the stimulus embodied in the situational awareness must be seen, heard, or felt by human decisionmakers whether the system is a society as large and diverse as a major state or a group as small and focused as a terrorist cell.

and is as applicable to humanitarian operations, peacekeeping, peacemaking, and post-conflict stabilization as it is to warfare. It also is as applicable to interchanges at the geo-strategic and military-strategic levels as it is at the operational and tactical levels of interaction. This universality is important both because it mirrors the multiple dimensions of the concept of effects-based operations proposed and because it offers a stable framework within which to consider the impact of complexity on any “how to.”

*...and the social domain*

However, there is something missing. This cycle describes how humans and human organizations *in general* decide and act. In other words, it reflects the side of human behavior that is the product of human biological evolution and of early sociological evolution. It is a “rational man” or “rational actor” generalization that may not fully apply to the situation at hand and that can be particularly problematic when applied to asymmetric, non-Western foes for which some of the assumptions underlying conventional and usually Western-based models may not be valid. This is not to say that the behavior of non-Western or asymmetric actors is irrational—something that is seldom the case—but rather that the rationale used is not one that necessarily can be understood outside its own social and cognitive context. It may be tempting, for example, to look at Osama bin Laden as an irrational fanatic, but such a conclusion would leave us unable to bound or understand his behavior, whereas trying to understand that behavior from *his* point of view, however esoteric it may appear, gives us the means to bound the directions that behavior may take and to cope with it. For effects-based approaches to operations, we need to know not only how humans in general might act, but also how the reactions of one individual or group

might differ from others. To do this, we need to add a social domain to the physical, information, and cognitive domains shown in the previous diagram<sup>125</sup> (see Figure 15).

This social domain encompasses not only the primordial factors that govern how human beings relate to each other in social groupings (as a psychologist, sociologist, or a management specialist might study them) but, most importantly, it also encompasses all of the idiosyncratic variables that might influence how *particular* observers or groups of observers will perceive, understand, and make sense of a situation, and view their options for response (much as a cultural anthropologist or regional specialist might study them). This distinction is critical for effects-based operations because the key to deciding which actions might shape behavior in a specific way is understanding how particular groups and particular cultures<sup>126</sup> might react differently to a given stimulus. Moreover, in effects-based operations, this differential is to be applied not just to foes, but also to friends, neutrals, and even one's own public. Under these circumstances (as demonstrated in day-to-day operations in both Iraq and Afghanistan), it is not sufficient to define a social domain in terms of knowing how groups or societies in general behave; the domain must also reflect all of the factors that make them different. In brief, it must have a "nurture" antipode to the "nature" of sociology and cognitive modeling.

This is reflected in the diagram in Figure 15 by the multiple arrows among the wide range of interdependent variables, *inter alia* history, religion, ideology, education, politics, and govern-

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<sup>125</sup> Alberts and Hayes, *Power to the Edge*, p. 113.

<sup>126</sup> This "culture" may be organizational or professional, e.g. differences between military services, as well as ethnicities, religions, political parties, etc.

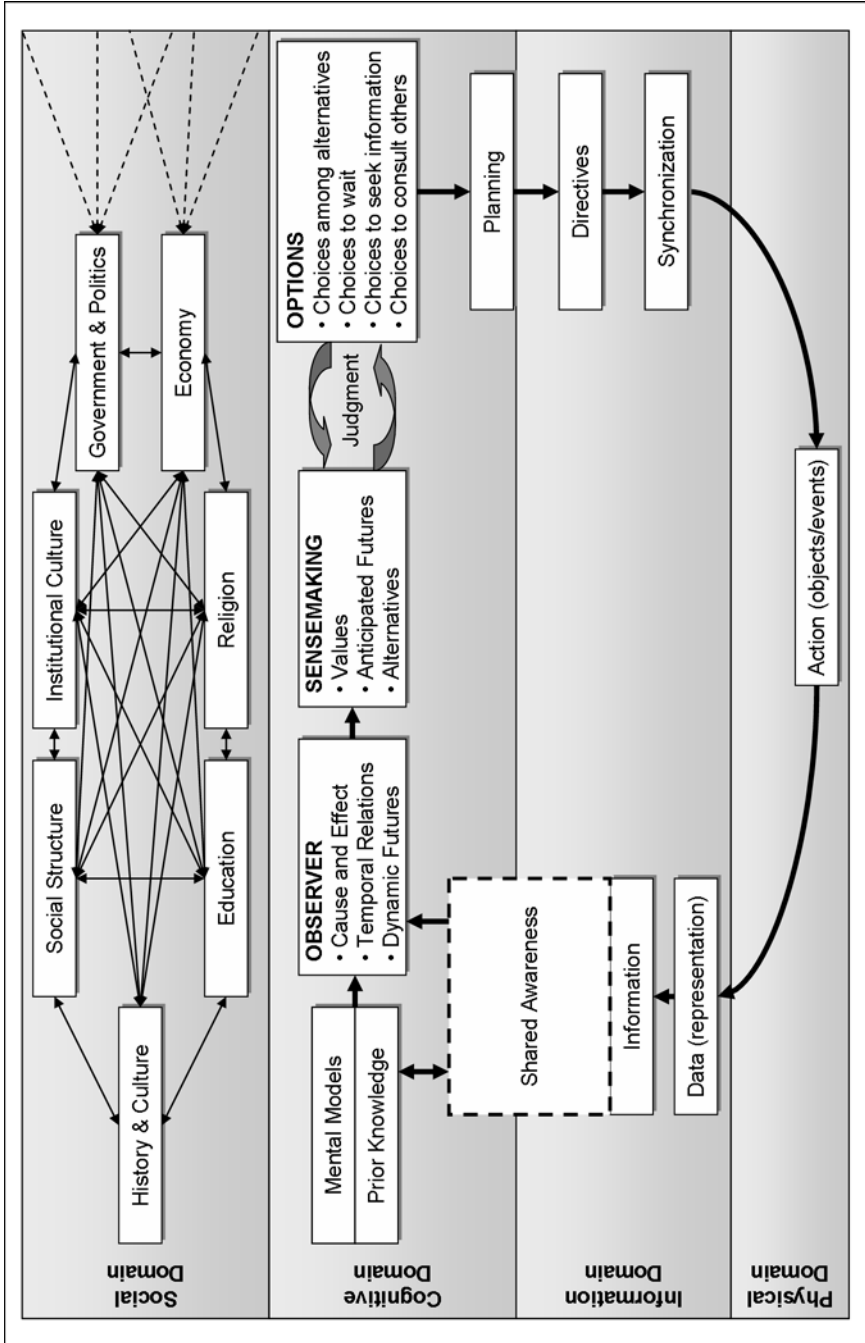


FIGURE 15. THE SOCIAL DOMAIN

ment, all of which are themselves products of ongoing complex interactions. Each social group at whatever level of aggregation will have distinct characteristics that are the products of all of these factors. As in any complex adaptive system, the relationships among these sets of variables will continually change as the groups and the elements within them adapt and react to their environment. Both the variables and the process of adaptation will be unique to a particular social grouping so that no grouping will be exactly the same as another—however tempting it may be to categorize actors on the basis of single variables like religion, ethnicity, or language. All of this indicates that the impact of an action on a given society or a particular decision will vary from one situation to the next and from one stimulus to the next and that each iteration of the action-reaction cycle will affect the relationships among the interdependent variables that give the society its character and, thereby, affect future decisions.

This crossover from the social domain to the cognitive domain is evident in four different areas of the action-reaction cycle indicated by the large arrows in Figure 16.

- The first is the mental model, the analogy library or logical framework used to contextualize awareness. This framework reflects the society's values and self-image as well as its shared view of the environment and its vision and anticipations for the future.<sup>127</sup> The resulting mental model, therefore, must both be consistent with this social context and be able to provide explanations that are suf-

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<sup>127</sup> Toynbee describes this as one of the factors maintaining the coherence of a civilization, the breakdown of which can herald its demise. Toynbee, *Study of History*, p. 5.

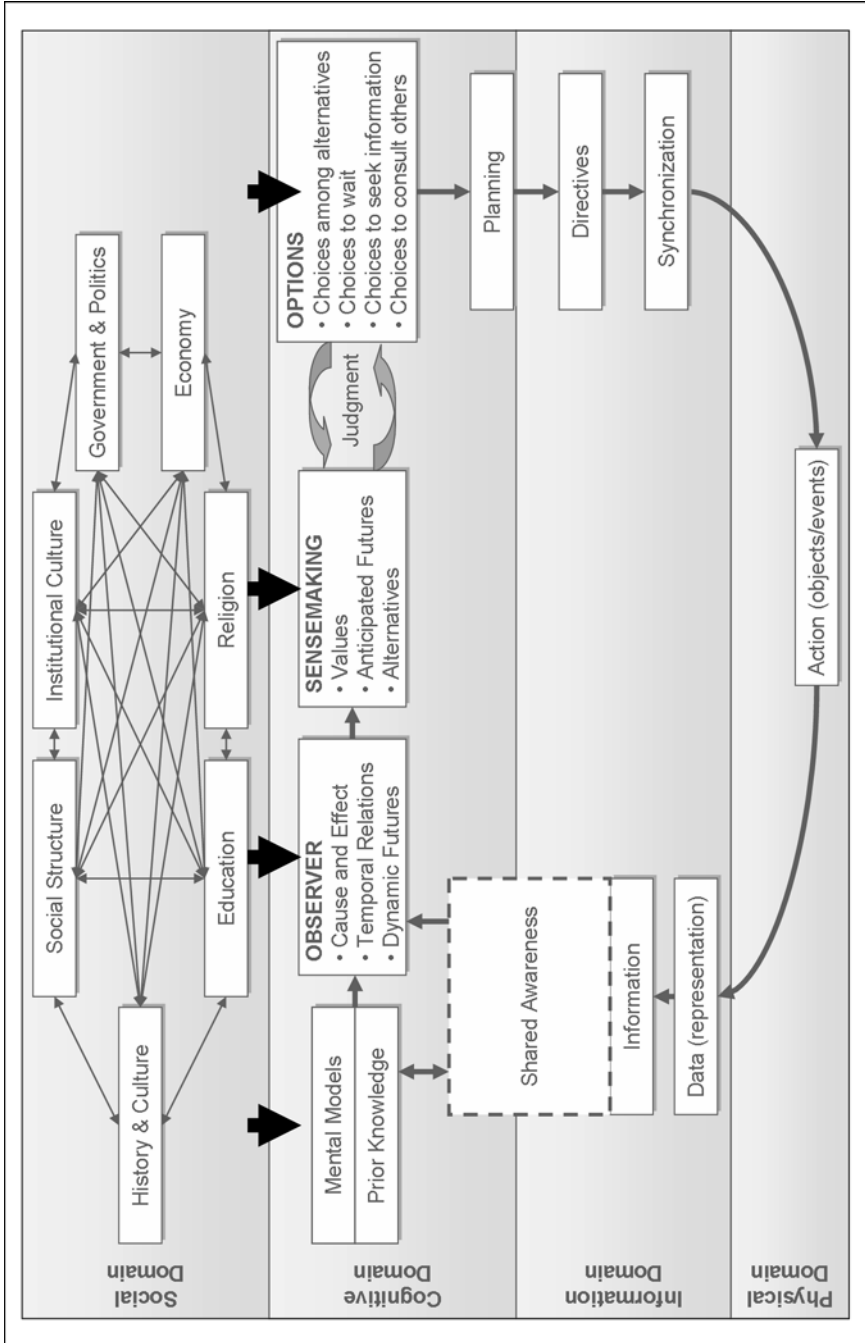


FIGURE 16. SOCIAL-COGNITIVE DOMAIN CROSSOVER POINTS

ficiently detailed to support sensemaking and the remainder of the cognitive decisionmaking process.

- The second is in the observer's perceptions and understanding of an emerging situation, the potential cause-and-effect chains leading to and deriving from that situation, and the potential timelines that it suggests. This impact is twofold in that it involves both the society's or the organization's choice of who the observers or decisionmakers will be (e.g., theocrats versus technocrats) and how such individuals or groups of individuals will tend to perceive and think based on education, experience, and upbringing, that is to say "socialization."
- The third social influence lies in putting what is observed into the context of a story or intellectual framework that roughly explains the relationships among a host of interdependent variables. These variables will include but will not be restricted to those relating to the situation at hand and may be so sublimated by the observer that they may not be entirely clear or fully appreciated, for example, American tendencies to think in the linear dimensions and timing of an American football game.
- This "sense" then becomes the basis for the fourth cross-over: the evaluation of options or potential courses of action for responding to the situation with the attendant judgments as to the relative applicability and viability of each option considered. This again is a twofold impact. The capabilities available will be those that the society or organization has chosen to create, e.g. what size and type of armed forces, and the options chosen will reflect the society's or organization's views as to what are acceptable actions and what will work—judgments based on social domain-derived perceptions.

The above description of the action-reaction cycle makes clear the scope of the complexities involved in any effects-based approach. Because the cycle involves both a complex cognitive domain decisionmaking process and complex social influences, the cycle and its behavioral output will inevitably be complex. In a sense, the presence of complex cognitive and social processes in the cycle contaminates all of its linear elements and makes the process and outcomes complex and—ostensibly—unpredictable. How then are we to deal with the complexity, much less figure out how to turn it to our advantage?

## THE ACTION-REACTION CYCLE AS A FRAMEWORK FOR EFFECTS-BASED APPROACHES

At first glance, the idea of constructing a universal frame of reference for effects-based approaches, much less of somehow dissecting the action-reaction cycle to flesh it out, appears to be a bit of a *non sequitur*. After all, complex adaptive systems like the ones whose conduct the action-reaction cycle describes are continually changing to the point that any model of what is going on would never be exactly the same twice. But, what are the alternatives?

We might try to aggregate the processes involved in the cycle into larger and larger meta-systems until we found a level of aggregation that behaved in something approaching a linear, analyzable manner. But such an approach would run into two problems. As we focused on the larger systems and with them the major factors influencing the systems' behaviors, we would implicitly ignore more and more of those factors that, under the right circumstances, might be the real determinants of that behavior—an invitation to being continually surprised. Also, in so doing we would lose sight of the details in the cycle just



reviewed and end up passing by many of those aspects that might individually be most susceptible to analysis even if they cannot be fully understood apart from the whole. Even worse, reliance solely on aggregation could lead us into a dead end because it would tend to leave us with a classic “big picture” effects-based approach in which an understanding of the workings of the complex systems in question would depend on the education, experience, intuition, and vision of individual human decisionmakers: the genius factor.

The Information Age offers another possibility to do better than this. We may be able to apply the power of networking not to eliminate the complexity—we cannot do that—but to help the individual human decisionmaker to bound the complex problems involved and thereby increase the probabilities of success. However, such bounding hinges on dissecting the action-reaction cycle sufficiently to identify areas in which the kinds of information, analytical support, and expertise that networking can make available might be applicable, and this means undertaking some form of functional decomposition of the action-reaction cycle.

Holland’s and Miller’s perceptions of complex adaptive systems as the product of evolutionary processes and, thus, representing not an infinite set of possibilities but a much more limited set of those variations that succeeded offer some hope because they suggest that we can understand why a particular process or system succeeded. This in turn implies that a process like the action-reaction cycle can to some degree be decomposed so as to identify what Miller termed its “essential processes,” the elements and functions it needs to operate and survive. If we apply this logic to the action-reaction cycle, we

should then be able to identify some basic processes without which the cycle could not operate.<sup>128</sup>

We might also be able to carry this effort a step further to identify subcomponents of these essential processes much as Miller did for living systems. Unlike the conventional linear reduction, this decomposition would not proceed with any expectation that the whole would equal the sum of the parts when we put it back together again. Instead, we would undertake what an oil company might call exploratory drilling, working down to a level of detail that captures any elements that might be analyzed or modeled and then using the results to bound the complex assessments and decisions at that level and thereby refine and narrow the scope of the bounding and assessment at higher levels.

In essence, we create an “aggregation rheostat” with which we can iteratively decompose the action-reaction cycle until there are no further linearities to exploit usefully<sup>129</sup> or aggregate the bounded answers into a meta-system that offers an insight as to how the whole functions. Then we can use that insight to guide further drill-downs and so on, with every iteration of the process further refining the problem and more closely bounding the complex decisions that have to be made.

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<sup>128</sup> This apparent order in the midst of complexity should not be surprising. After all, a complex system that could not sustain itself or adapt would not long survive. As a result, what we see today is only that subset that survived by evolving some basic ways of dealing with an often hostile environment. Miller, *Living Systems*. p. 854.

<sup>129</sup> The word *usefully* is used to denote the fact that, although it may be possible to drill down still further in a particular case, that additional analysis may eventually become so voluminous or of such tenuous relation to the question at hand as to obscure rather than aid our efforts to deal with complexity.

In approaching this dissection, I have drawn upon my first-hand observations of how the cycle actually worked in real-world operations as military commanders and staffs dealt with combat and crisis operations first in the Mekong Delta during the Viet Nam War in 1971 and then in the operations of the Battle Force of the U.S. Sixth Fleet in operations off Libya in 1986 and 1987. During these operations, I had the very good fortune of serving as intelligence officer to a series of gifted commanders: during operations in the Mekong Delta, Captain Bill Crowe, later Admiral, Commander-in-chief U.S. Pacific Command, and Chairman of the Joint Chiefs of Staff; in 1986 crisis operations off Libya, Rear Admiral Dave Jeremiah, later Admiral, also Commander-in-chief U.S. Pacific Command, and Vice Chairman of the Joint Chiefs of Staff; and in a reprise of the Libyan operations, Rear Admiral Mike Boorda, later Admiral, NATO Commander-in-Chief South during the Bosnia operations, and Chief of Naval Operations. All of these commanders applied an expansive, forward-focused, human-centered, effects-based approach to deal with the wide variety of challenges their operations presented. Although each had a distinct style of leadership in pursuing what were in fact effects-based operations, there was an observable commonality to their thought processes, to the requirements each saw, to the questions each asked, and especially to the team building and social networking that each undertook both within their own staffs and in reaching out to other joint forces and to allies.

What I have done in attempting to dissect the action-reaction cycle and parse its sub-components is to build on these observations and my own experience in providing the awareness and sensemaking intelligence support that each of the commanders demanded. The result is not intended to be a

definitive “model” in the sense of a cookbook recipe for effects-based approaches to operations, but is rather a frame of reference for examining how the pieces of the effects-based puzzle fit together. In so doing, it provides a type of road map for identifying two elements key to any Information Age solution: where and why ambiguities and complexity occur (and by extension where and why human intervention might be required) and what general types of support might be provided to help bound the ambiguities and complexities to aid the human in the loop. Although the examples and the solutions to dealing with complexity that they represent are drawn from real-world operations and, hence, reflect the constraints of existing organizations, force structures, and capabilities within which innovative commanders had to operate (or circumvent), the processes to the greatest degree possible reflect a generic statement of what needs to be done to implement effects-based approaches, including all of the issues to be addressed. As such, it provides a basis for looking at how these needs and issues might be more flexibly and more responsively handled by new organizations, structures, and capabilities to include a new generation of network-enabled operations focused on supporting effects-based approaches.

## ESSENTIAL PROCESSES

The adaptation and evolution of complex adaptive systems suggest: (1) that the interactions between complex adaptive systems are *not* infinitely varied and can be rationally bounded; (2) that the basic functions of the effects-based action-reaction cycle can be extrapolated to multiple levels of the system of complex adaptive systems; and (3) that we can identify sub-systems of actors, functions, and processes in each part of the system and extrapolate them to other parts of that system as

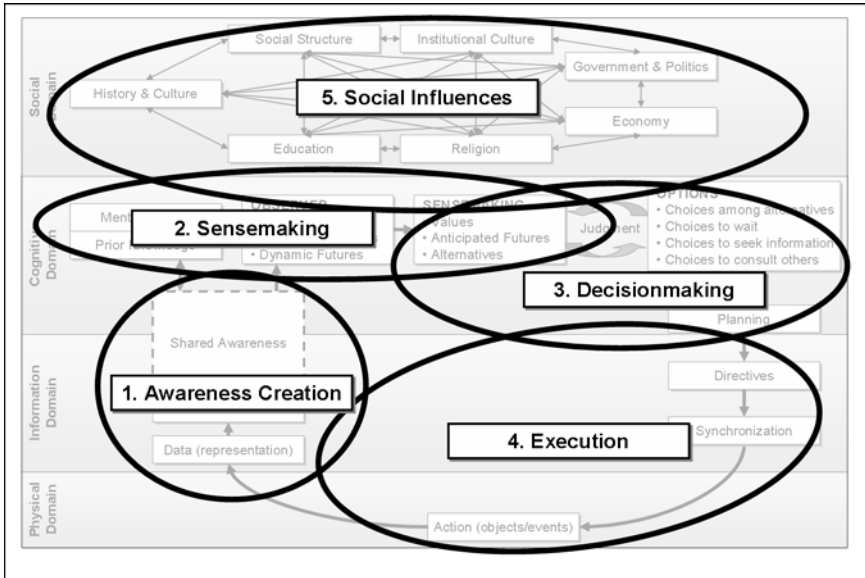


FIGURE 17. ESSENTIAL PROCESSES

well as to other systems. In even a cursory survey of the action-reaction cycle, it is apparent that there are five identifiable essential processes involved in reacting to a stimulus:

1. Awareness creation
2. Sensemaking
3. Decisionmaking
4. Execution
5. Social influences

Clearly, any such functional decomposition is open to debate and this one simply represents my own observations of the basic action-reaction cycle in the context of the real-world combat and crisis response operations described above. In undertaking this dissection, we will assume that these essential processes are applicable to all parties involved in an interaction

and that they thus reflect an assessment both of the opponents' essential processes and our own.<sup>130</sup>

In this dissection, the *awareness creation* and *execution* processes appear to be relatively linear while the *social influence* processes contain the most obvious human dimension and thus probably the most complexity and nonlinearity, and the *sensemaking* and *decisionmaking* processes seem to be amalgams of both linear and nonlinear factors. The dissection can then proceed to examine each process in more detail to ascertain just where and how each is complex or linear, what we can or cannot know by empirical analysis, and whether any additional drill-down to yet more levels of subprocesses may be possible.

The first objective is to identify as closely as possible where and how a particular function is contaminated with complexity and then, by using those aspects of the function that are subject to conventional empirical analysis, pattern analysis, or social and cognitive modeling, to bound this complexity both in each subprocess and in the action-reaction cycle as a whole. In each case, the analysis of what we know and cannot know provides a key to bounding the complex aspects of the problem so as to provide answers to decisionmakers that are adequate for the proverbial 80 percent solution. The five processes and their subsystems thus become a tentative internal model offering sets of likely building blocks with which to undertake an ongoing iterative process of refining and updating, the results of which serve to bound a complex answer to a complex problem sufficiently to plan and implement effects-based operations.

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<sup>130</sup> Atkinson and Moffat note that “to achieve the desired effect on another system ... requires a detailed understanding of one’s own systems.” Atkinson and Moffat, *The Agile Organization*, p. 154.

## *1. Awareness creation*

The awareness creation process encompasses both the process of detecting, identifying, locating, and tracking a stimulus and the process by which this data and information are handled and disseminated, including the way in which they may be (intentionally or unintentionally) filtered. It is important to note that this awareness creation process is not simply a step in a planning process but is continuous and is part of a continuing spiral of action-reaction cycles. This means that its requirements will change from one cycle to the next and are dictated both by the stimulus detected in the current cycle and by what has taken place in the preceding cycles, such as the reporting and requirements generated by forces engaged in an interaction. Awareness creation in different guises is applied by both sides and is, therefore, both a description of the process by which we support our own sensemaking, decisionmaking, and execution phases of the cycle and a framework for understanding how other observers might approach supporting equivalent processes on their side.

It should be underlined that awareness creation is not simply linking vast arrays of sensors to shooters. Such links, however tantalizingly clear cut, are merely the culmination of a far more elaborate process that must first establish the validity and value of the target to be struck. Furthermore, this linkage challenge expands enormously as the awareness requirement becomes one for supporting the targeting of actions, not weapons—the core requirement for virtually all effects-based approaches to operations aside from combat operations by military forces.

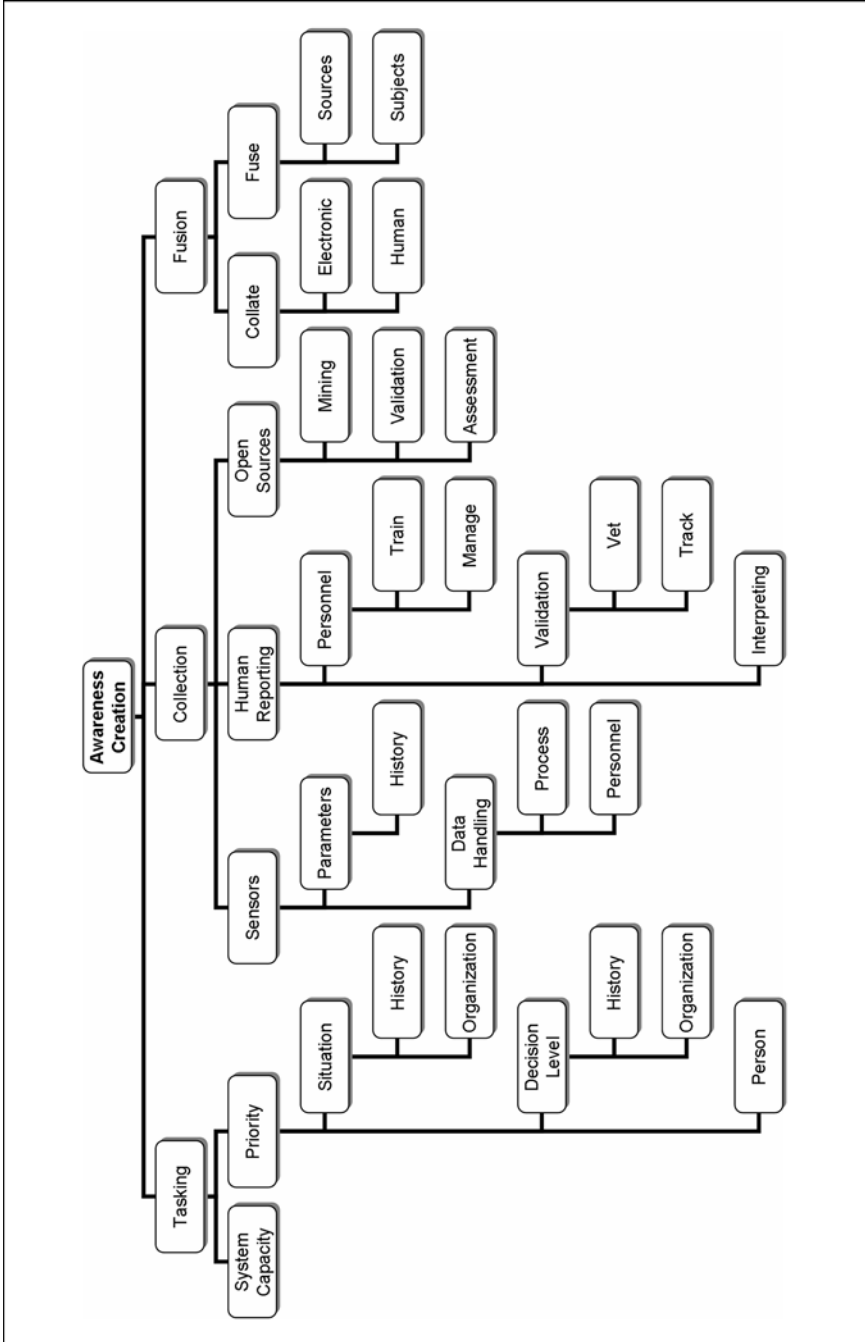


FIGURE 18. AWARENESS CREATION



Overall, the awareness creation process can be broken into three subprocesses: tasking, collection, and fusion.<sup>131</sup>

## Tasking

The tasking process is by nature twofold. It must respond to the needs and demands and thus the *tasking* of those charged with assessing, planning, and executing actions and it must assign assets or *task* the intelligence, surveillance, and reconnaissance assets available to search for and report the relevant information. No awareness creation process no matter how large or sophisticated will offer a capacity for collection that is infinite in numbers, coverage, or variety. Accordingly, some effort will have to be made to use the capacity available so as best to meet the requirements posed by the situation. Although the tasking in question can take many forms, the basic function of the tasking subsystem is to apportion the efforts of available collection assets. This tasking is as much a part of an al Qaeda effort to study a target like the World Trade Towers or to acquire sufficient knowledge of airline security procedures before 9/11 as it is of a major state's intelligence agency's efforts to study al Qaeda. It will also be reflected in a somewhat less regimented way in the processes by which other observers acquire information, for instance, choosing which international news television station or newspaper to monitor. Even though the tasking process may appear relatively linear, e.g. ordering the sensor to provide specific data, any tasking will necessarily involve complex decisions.

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<sup>131</sup> As such, it would include what Miller terms the *input transducer*, a subsystem of sensors and communications that detects information about the environment and brings it into the system, and the *decoder* or analytical subsystem that translates the raw data into information that can be used by the system. Miller, *Living Systems*. pp. xix-xxiv.

To address this complexity, we can drill down yet another level to two component subprocesses: one roughly linear process for assessing the collection capabilities available for tasking, and another nonlinear subprocess that prioritizes the tasking of available collectors so as to respond best to individual decision-maker needs.

- Collection capacity assessment

The number and variety of sensors or other collection assets available to gather information on a given situation or target will determine where and how much of what kind of information can be collected. Determining and monitoring system capacity, therefore, cannot only be a relatively linear problem, but can also provide a relative index of how much prioritizing and how many trade-offs may be necessary in the tasking process—crucial facets of any attempt to bound the probable behavior of a tasking process or the awareness subsequently created. For example, a very limited number of reliable human collectors may dictate a long lead time in planning a terrorist operation or an inability to handle more than a limited number of operations at the same time and thus become a forcing function for the rest of the action-reaction cycle.

- Prioritization

The prioritization of tasking revolves about the question of what decisionmakers will find most urgent in a given time and circumstance.<sup>132</sup> This awareness will not be simply of one

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<sup>132</sup> Logically, the greater the capacity of the collection system, the less pressure there should be to prioritize the tasking. Yet, experience teaches that the demand for information expands with capacity and that prioritized tasking is unavoidable however great or small the system may be.

action but of many diverse actions competing for decision-maker attention and not for just a single decisionmaker on a single level but for multiple decisionmakers on multiple levels, each of whom will have idiosyncratic situational and personal wants. Thus, the nature, quality, and quantity of the awareness to be created will vary with the decisionmakers and their levels. Prioritization considers three sets of interdependent variables: those generated by the situations requiring the collection; those dictated by the function of the decisionmaker being supported; and those associated with the specific personalities involved. The variables point to a need for three further subprocesses: one to create and store the memory of how certain types of situation in certain areas have been surveiled in the past and thus the nature, timing, and geography of potential collection analogies; one related to the function of the decisionmaker(s) to be served and their requirements, e.g. a tactical commander conducting a house-to-house search for insurgents as compared to the casing requirements for planning a terrorist attack; and one revolving about the idiosyncratic requirements of individual decisionmakers. Because each of these functions will have in some way adapted to deal with similar stimuli in the past, it is likely that they will have evolved patterns of operation over time, e.g. al Qaeda's need for long and meticulous study of potential targets. Moreover these patterns will extend to the basic functioning of the collection subsystem, e.g. the way in which human collectors are customarily recruited and rewarded.

## **Collection**

Although the size and nature of the collection system will vary greatly from one actor to the next, we can identify three basic types of input: sensors, human reporting, and media/open

sources. Each input presents different collections of interdependent variables, and each is also likely to have evolved different processes to handle the challenges peculiar to each.

- Sensors

Sensors from tactical sensors to high technology overhead systems are the most straightforward input to awareness creation. The value of each sensor is a function of two factors: what it can collect and how well the raw data it produces can be handled and melded with raw data from other sensors. These two variables point to two subprocesses. One is assessment of the technical parameters of the sensors and thus the speed, scope, efficiency, accuracy, and kinds of information each can collect, a process that deals with relatively linear information and is subject to pattern analysis and modeling. The other is the ability to transform data into awareness, a process that is partially a function of the way the process is organized and partially a function of the humans who must deconflict data from different kinds of sensors.

- Human reporting

Human reporting, as used here, includes everything from local informants during tactical military operations to clandestine agents, the regular reporting of government agencies or, for that matter, of the different affiliates of a non-state terrorist organization. This human reporting is problematic on three fronts. First, the reporting is often on the most complex aspects of a situation, e.g. the perceptions and intentions of a foe, and demands equally complex insights on the part of the source. Second, as this indicates, the value of this reporting is very much a function of complex factors, especially the insight,

knowledgeability, and reliability of the source. And third, the multiplicity of actual and potential reporting sources (e.g., from other government agencies, from non-government agencies, or from contending parties in a conflict) will take many and often mutually unintelligible forms. These realities again suggest the need for multiple additional subprocesses: one for conducting the actual collection with perhaps its own subprocesses for recruiting and training, etc.; one for tracking and assessing the worth of the sources; and one to vet, interpret, and exchange information across institutional boundaries. These problems are by no means limited to the traditional intelligence collection operations; they are just as fundamental to those of a terrorist organization or an insurgency, something that is apparent in the level of attention given by Osama bin Laden himself to the planning of the World Trade Towers attack to include not only studying the buildings but knowing airline security procedures and assessing the likelihood that passengers and crew would see the hijacking as a hostage-taking situation vice the creation of a large air-to-surface missile with them inside. The larger and more complex the actor is, the more complicated these arrangements are likely to be. The difficulty with this human reporting is that much of the analysis is likely to require human judgments and interpersonal interfaces that are themselves complex.

- Open sources<sup>133</sup>

One result of the information revolution has been the growing importance of open sources. Now, any actor (state or non-state)

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<sup>133</sup> For our purposes here, open sources will be considered to encompass the reporting and knowledge base that cannot be directly tasked by the collection system and is available to anyone. In this context, open sources include any and all media reporting and all published material, electronic or otherwise.

can have access to a range, scope, and immediacy of information that would only have been possible in the past with the largest of intelligence systems. In part, this availability stems from the rise of an instantaneous global news media from CNN and BBC News to Al Jazeera, and in part from proliferating Internet sites including those offering electronic access to databases and libraries. However, open sources have many of the same problems as human reporting and two more: the sheer volume of the reporting to be considered and the fact that the media—a large element of the open sources available—is itself a major battlefield in a campaign of psychological attrition. The overwhelming volume of open sources, their indiscriminate availability, the motives and biases of those reporting, and the likelihood of misinformation and disinformation<sup>134</sup> point to at least three additional sub-processes: one to mine the large volumes of data and information for relevant reporting; a second to assess its validity; and a third to assess what other observers and decisionmakers will be seeing in order to include what might be termed a *media damage assessment* tracking the impact of reporting on observers at home and abroad—an Information Age equivalent of bomb damage assessment (BDA).

## **Fusion**

The quality of the situational awareness is not just a function of what information is collected but also of how well the disparate kinds of information cited above can be collated and fused. At its most rudimentary, these collation and

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<sup>134</sup> Misinformation may be defined as information that is unintentionally erroneous, usually from a reporter that did not understand much about what was being reported. Disinformation is deliberately incorrect and used to mislead or otherwise shape behavior.

fusion processes occur inside the heads of the observers and decisionmakers themselves, especially at the tactical level where time is wanting, but it may also occur in a more formal intelligence organization, for example, where the decisionmakers distrust their own information or, again, where time is wanting.

- Collation

The collation subprocess encompasses all of the means by which information from similar sources is correlated either with different individual sensors or from the same sensor over time so as to yield a more complete awareness. The electronic character of much of the sensor-derived information lends itself readily to some form of machine collation, but dealing with human reporting and open sources poses an exponentially bigger challenge. Not only are the comparisons to be drawn themselves more complex, but the reports themselves are usually laden with uncertainties and subjectivities that make meaningful collation anything but easy.

- Fusion

The fusion process is that of putting together all forms of reporting on a subject. Although sometimes referenced as *all-source* fusion, it is really a fusion of all available reporting of whatever type, source, or format. As this diversity implies, awareness creation fusion demands some degree of insight into complex aspects of a subject's actions or inactions, e.g. why a ship under surveillance is headed in a particular direction. Thus, the fusion process is itself complex and often hinges on the role of subject matter experts.

## 2. Sensemaking

The sensemaking process carries awareness creation another step. It begins to analyze a stimulus both retrospectively by putting any action into a context of previous actions and of one or more postulated chains of logical causes and effects, and prospectively in inferring where the chains or interactions appear to be leading and what they imply for the future.<sup>135</sup> This is to say, it involves two major subprocesses: contextualization and analysis. This sensemaking and these subprocesses may be reflected in a formal process by which a military command consciously organizes itself to address the problem or it may be a largely subconscious process undertaken by an individual dealing with a pressing situation. As in the other essential processes, the shorter the time available for decision-making is, the more likely it is that the real-time sensemaking will be conducted inside the head of the observer or decision-maker rather than in a formal staff process.

### **Contextualization**

Contextualization is critical to the follow-on steps of the action-reaction cycle because it provides both a set of norms against which to judge a particular stimulus and a set of experiences or pre-existing models to use in reasoning by analogy. Logically, there are three avenues to be explored in contextualization: (1) putting an object or event into the context of

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<sup>135</sup> Sensemaking encompasses what Miller terms a *memory*, an essential process that stores information on prior actions for retrieval, an *associator* that draws analogies between the new information and previous interactions to provide candidate cause-and-effect models, and a *timer* that assesses the temporal aspects of these analogies and other models to formulate the time constraints to be met by potential responses. Miller, *Living Systems*.



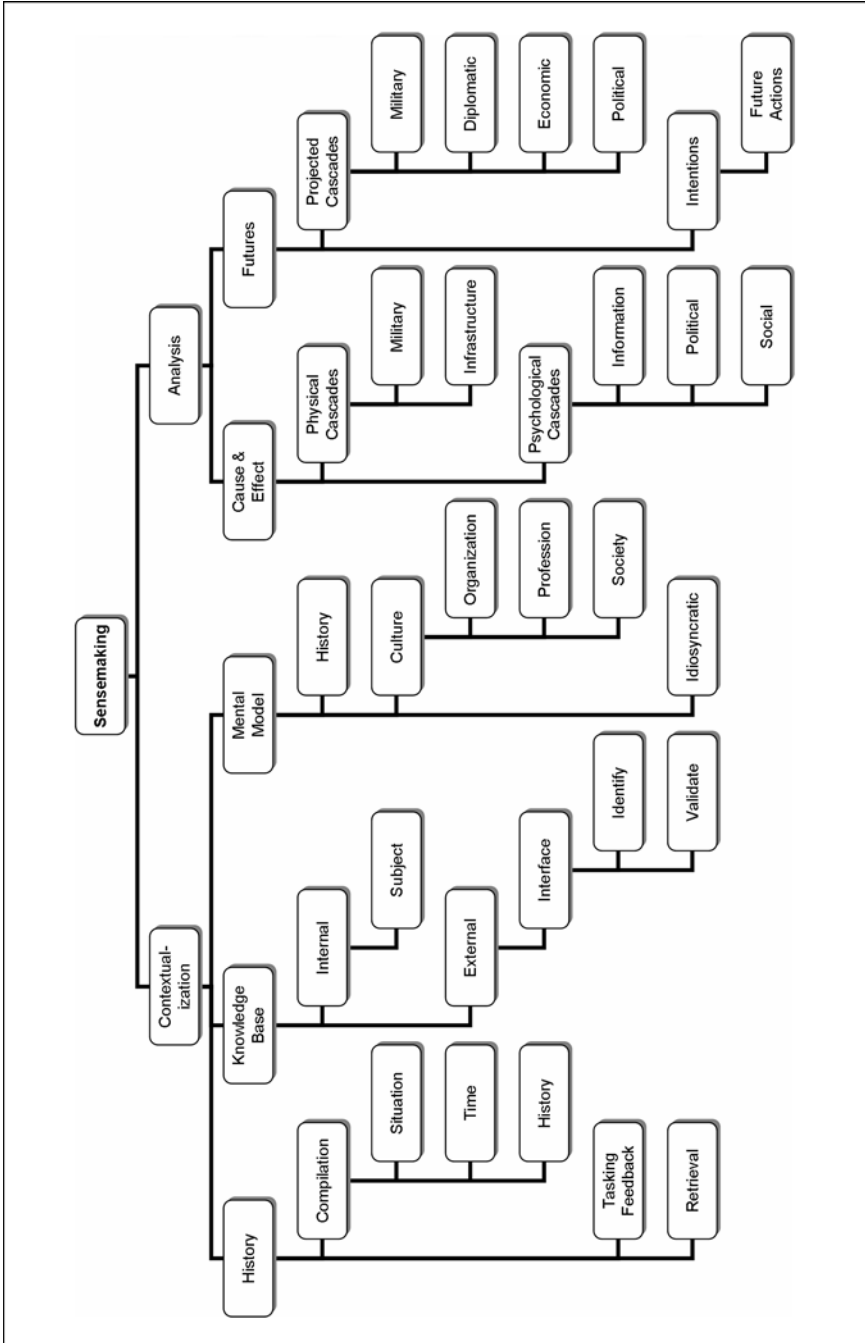


FIGURE 19. SENSEMAKING

similar objects or events; (2) putting one event into the context either of a range of events or of all of the events occurring within a given timeframe (e.g., the incidence of all terrorist actions, improvised explosive devices [IEDs], suicide bombings, assassinations, etc.); or (3) putting the event into a broad historical context that may include everything from the ebb and flow of a running series of interactions to long-term social, political, and economic antecedents of an action.<sup>136</sup> The scope and timeframe required in this contextualization will likely vary with the level and perspectives of the decisionmakers to be supported. In pursuing this matrix of vectors and levels of contextualization, we can identify three essential subprocesses: (1) creating and using a historical database; (2) identifying and retrieving relevant knowledge; and (3) forming the mental models needed to understand the context provided.

- History

The historical database is essentially a cumulative working model of norms from which to determine facts such as: when and how often an action has been seen before; under what circumstances; for what apparent reasons; with what follow-on events; how often; and in what time sequence. The answers to these questions provide both an indication of whether the action is purposeful rather than random or accidental and the basis for analogizing between current and past events and for assessing potential cause-and-effect chains. The history can also suggest possible internal models and building blocks for

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<sup>136</sup> For example, Osama bin Laden's repeated excoriations of Western "crusaders" even though the last crusade, a losing effort to stem a Turkish invasion of the Balkans, ended in 1396.

Tuchman, Barbara. *A Distant Mirror: The Calamitous 14<sup>th</sup> Century*. New York, NY: Ballantine. 1978. p. 538.

deciphering a complex problem as well as enable us to identify tags to help assess both the ongoing interaction and indicators to provide feedback on any reactions. These requirements imply the need for three subprocesses: one for compiling the historical database, another for retrieving the necessary information from that database, and a third for providing the feedback to adapt these processes to a changing situation and environment.

- **Compilation.** The compilation process appears straightforward but can be subdivided into additional subprocesses: one for assembling the data, information, and knowledge to include determining the kinds of information to be inserted into the database and how it is to be organized;<sup>137</sup> and a second for retrieving information or otherwise mining the database created. As the detail and capacity of this historical memory increase, the knowledge base will also tend to expand as will the depth and diversity of the analogies, internal models, building blocks, and tags that are likely to be at the command of the decisionmakers.
- **Retrieval.** Sizeable databases have a downside to them. The larger the set of data, information, and knowledge, the more difficult it tends to be to extract that which is needed in a timely manner. To be sure, this problem can be alleviated by better organization and technology, but the problem is knowing what to retrieve and how to transmute it into answers to the questions outlined above

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<sup>137</sup> Notice that this implies a process that is not operating under a single unchanging fiat but rather a complex organizational process that revolves about a continuing adaptation to a changing environment and problem set, something that is arguably not the case in large intelligence organizations fixed in their ways.

or into analogies between pieces of information and trends that do not necessarily resemble each other so as to support development of potential internal models.

- **Feedback.** Because any worthwhile historical database must adapt to the situation and to the demands of its users, there must be a feedback loop both for how the database is compiled and for how specific kinds of information are retrieved. As the feedback loop becomes faster and more efficient, the historical data that it provides will become more responsive and worthwhile.

- Knowledge base

It stands to reason that a historical database, even if very well compiled, is not sufficient context for sensemaking and that additional knowledge will be required. However, it is essential to make a distinction between two forms of knowledge: *knowledge as the sum or aggregate of pieces of information* (for example, a wiring diagram of a foreign ministry) and *knowledge as the internalized understanding of a complex subject with many changing interdependent variables* (such as the actions and reactions of individuals and groups represented in the wiring diagram).<sup>138</sup> The former is relatively linear, the latter emphatically complex.<sup>139</sup> In attrition-based operations, it may be sufficient to rely on the first form of knowledge. If we know how many tanks or aircraft are in the order of battle, then we would know how many we

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<sup>138</sup> In many languages, this distinction is drawn by using separate verbs for the English “to know.” In French, for example, the verb *savoir* connotes knowledge that is the sum of information, while the verb *connaître* implies the understanding of a complex human interaction. German makes a similar distinction between the verbs *wissen* and *kennen*.

Larousse. *Dictionnaire de la langue française*. Paris: Larousse. 1994. pp. 404, 1697. Cassell. *German-English Dictionary*. New York: Funk and Wagnalls. 1965. pp. 570 and 259.

need to destroy and can track our progress. But in effects-based approaches, our objective is to shape behavior, that is, to produce a complex reaction on the part of complex adaptive systems of various kinds. Even if that reaction were to derive from destruction of an order of battle, estimating when, how, and under what circumstances the behavior of an enemy would be affected clearly involves an understanding based upon knowledge of the actors involved.

Moreover, exploiting a knowledge base is not simply a question of “pulling” information from an infinite base. Such “pull” makes several critical assumptions: that the relevant knowledge will be in the base when needed, that the assessors and decisionmakers will know what to pull, and that they will have the time to explore or manipulate the knowledge base to obtain it. In actuality, any database must be populated and maintained, but in a world of continually evolving complex interactions, the existing database will always be time-late and will likely never cover all of the requirements that will arise. Additionally, the decisionmakers, particularly at the tactical and operational levels, may not have the time to research and pull what is needed, especially when the information and knowledge requirements expand beyond simple, linear locating and targeting data, or as the scale of what might be available grows to the point that it overwhelms those trying to access it. Moreover, this dilemma is by no means restricted to great powers or

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<sup>139</sup> Atkinson and Moffat make the following distinctions: “Tacit knowledge is so deeply embedded in the individual that it is inexpressible. Implicit knowledge is embedded knowledge within mental models and beliefs that can be accessed and expressed. What is shared around the *network* is information. This information is then taken by an individual and given meaning within their individual context. Thus...each person will still have a different perspective on key issues.”

Atkinson and Moffat, *The Agile Organization*, p. 90.

major intelligence agencies. The more observers have to depend on open sources, for example, the greater their pull problem is likely to be.

- Internal/external

From a functional standpoint, the knowledge required will reside in two places and will require two separate processes to tap it. One source is the knowledge internal to the organization either in information already amassed on a given subject, e.g. an Operational Net Assessment (ONA), or in the knowledge and expertise of the actors in an organization, such as a Standing Joint Force Headquarters (SJFHQ). However, in interactions with complex adaptive actors, the rule of thumb is likely to be a variant of Murphy's Law: that the problem posed will be one that is *not* in the knowledge base, no matter how good that knowledge base may be. That is, the knowledge base must extend to knowledge external to the organization, for example, in academia or industry. In each case, accessing this knowledge will require some way of identifying where the knowledge resides, of tasking it, of assessing its worth and validity, and of fusing it with other information. Because this knowledge will often be heavily qualitative or subjective, the validation process itself will likely include complex judgments as to the relative reliability of one or another source.

- Mental model

Mental models are in many respects the libraries of analogies, potential frameworks within which human decisionmakers will see the history of a specific problem, and as such, the intellectual basis for understanding the contextualized situational awareness. In effects-based operations, this analogizing is

important because analogies are often the only way to succinctly impart an understanding of complex situations and, as students of naturalistic decisionmaking point out, the shorter the available decision time is, the more likely it becomes that decisionmakers will rely on the most relevant analogy in their own mental library.<sup>140</sup> Although this analogy library is by nature idiosyncratic, it will also reflect a base of understanding that is common to the decisionmaker group—a logical shorthand that permits the rapid communication of complex ideas. In its absence, an entire logic tree of explanations would have to be built from scratch at each interface between the decisionmakers dealing with each new event. The mental model is complex by nature, yet if we drill down we can identify two distinct inputs. One is the bounded pattern of perceptions built by the history of past actions—with the attendant possibility that the most ready analogy may be the fruit of a well-crafted perception management campaign.<sup>141</sup> The other is the result of culture—organizational, professional, or societal—that is, a highly idiosyncratic individual experience or societal influence. This second input is the complex thought process applied to understanding what a particular action actually means, an understanding likewise shaped by societal and personal idiosyncratic variables. Again, what is or can be known of the former can be used to bound estimates of the latter.

## **Analysis**

The analysis process translates the contextualized awareness into a basic understanding or sense of the situation. This sense

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<sup>140</sup> See: Klein, Gary. *Sources of Power: How People Make Decisions*. Boston: Massachusetts Institute of Technology Press. 1998.

<sup>141</sup> Manthorpe, William. “Perception Management Today: The Need for Coordination and Consensus.” *Defense Intelligence Journal*. No.1. 2003. p. 10.

revolves about the answers to three basic questions: What is happening? What is likely to happen next? And, what does all of this imply? The questions suggest two sub-subprocesses: one to discern some chain of causes and effects leading to the action observed and another to project this chain forward.

- Causes and Effects

In even a relatively simple attrition-based tactical military action, it is not enough just to report that, for example, the enemy blew up the bridge. We must also understand why. Contextualization can put the action into some perspective, but ultimately we will need to extrapolate the situation backwards through the spiral of causes and effects to understand the action of a friend, foe, or neutral and the likely reasons behind it. This retrospective chain will have two dimensions: one of physical actions and effects in which one physical action leads to another; and another that is cognitive in nature where one observation or decision leads to the next. Because interactions between complex adaptive systems will inevitably involve a large number of interdependent variables, it is unlikely that we will ever know either the physical or the psychological chains completely.<sup>142</sup> However, although we can usually trace the relationships between military, infrastructure, and economic effects, the cognitive chain presents a particular challenge because it is not a single linear chain but a web of interacting chains that reflects an amalgam of diplomatic,

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<sup>142</sup> One good example here is the predicament of options traders in a major stock market who must act rapidly and decisively on the basis of information that will inevitably be incomplete and, at best, cover only a small number of a very large set of interdependent variables.



political, military, and perhaps economic influences.<sup>143</sup> To make matters still more challenging, the behavior we must consider is not only that of a foe, but also that of friends, neutrals, and our own public—behavior that the cognitive chain as a whole will resemble more a web of interactions than a single chain.<sup>144</sup>

- Futures

The definition of the likely thinking and cause-and-effect chains by which an enemy or other actor arrived at a particular action would mean little to a decisionmaker unless it also offered clues both to what actions might come next and what further cascades of physical and psychological effects might derive from the initial direct effect and the chain it set in motion, as well as from the spreading web of psychological cascades. It is in essence a mapping of the likely further cascades of physical and psychological effects, again both internally and across other friends, foes, and neutrals involved in an interaction either directly or peripherally. This is significant to decisionmakers because it begins to lay the foundations for any risk analysis, e.g. the greater the adverse consequences of not containing the cascade, the greater the risk that may be accepted in stopping it or shaping it in a different direction. This estimate revolves about questions as to the intentions of the actor or actors involved, how these might be manifest in further actions, and how these further actions might affect other players both internally and externally.

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<sup>143</sup> This is to say it may have impacts across the Political, Military, Economic, Social, Information, and Infrastructure or PMESII construct.

<sup>144</sup> For further discussion of physical and psychological cause-and-effect chains and their behavior, see: Smith, *Effects-Based Operations*. p. 302.

### 3. *Decisionmaking*

The *decisionmaking* process is where the awareness and sense that is made of a situation are translated into action.<sup>145</sup> Logically, there are two major subprocesses: (1) a continuation of the sensemaking, but this time projecting it forward to test what impacts various responses might have on the ongoing interaction and the actors involved and (2) the process of choosing and planning an option to be executed. Both parts will inevitably involve complex assessments and decisions.

#### **Projected sensemaking**

Projected sensemaking revolves about three sets of evolving interdependent variables: (1) desired end-states, (2) the actions and direct and indirect effects required to achieve such end-states, and (3) the capabilities available to undertake the actions in question. These variables are not subprocesses in the same sense as dealing with the human reporting in awareness creation, but are rather the three central elements in an iterative assessment process by which a series of “what ifs” by possible responses are considered to see which might best achieve the desired end-state. In this process, prospective desired end-states are balanced against the capabilities that are or might be made available and the actions that might achieve these end-states. In essence, the planners and decisionmakers

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<sup>145</sup> As such, they embody Miller’s *decider* function, the “executive subsystem that receives information inputs from all other subsystems and transmits guidance, coordination, and control of the system.” It also includes Miller’s *internal transducer* to transmit internal information, e.g. the capabilities available to form an option, an *encoder* to translate decisions into plans and policy for internal and external consumption, and a *net* to pass within the system. Miller, *Living Systems*. p. xix.

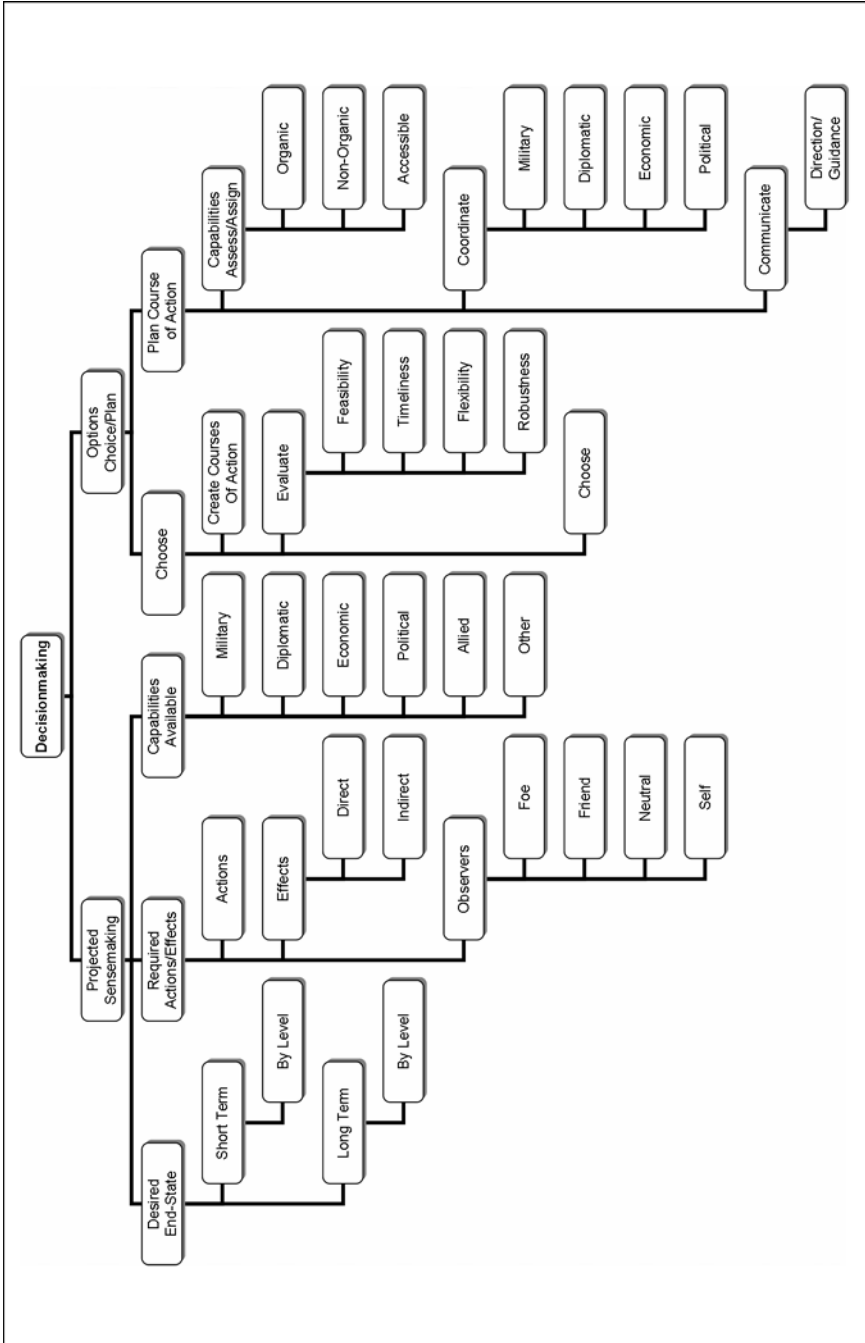


FIGURE 20. DECISIONMAKING

are asked to “wargame” the variables as they examine various combinations of capabilities, actions, and effects.

The complexity here derives not only from the intrinsic complexity of the interdependent variables but also from the fact that any estimates of the cognitive and social processes involved will be fraught with uncertainties and ambiguities.

- Desired end-state

In discussions of effects-based approaches to operations, there is a tendency to treat the desired end-state as a given unitary objective directed by a more senior commander or a national command authority. The decisionmaking reality is a bit more complex. The multi-level, multi-dimensional model of a system of complex adaptive systems underlines the fact that interactions between actors occur not just at one level but at multiple levels, in fact, at every point that one system is in contact with another, and it tells us that the pace of these interactions will vary both from one interaction to the next and from one level to the next. Logically, each of these action-reaction cycle interactions will have an end-state of some sort, that is, a short-term or immediate end-state that is the result of a particular action-reaction cycle, e.g. the result of a two-versus-two fighter interaction. The interconnected nature of the system of systems means that this impact will be reflected both in succeeding cycles at that level and in the aggregate end-states reflected at higher levels of complexity just as the outcome of a succession of fighter interactions is reflected in the outcome of an air battle. This combination of short-term and long-term impacts of the desired end-state has multiple dimensions: one immediate end-state at the conclusion of each action-reaction cycle; another at the end of some number of

such cycles, e.g. the results of an engagement or campaign; and another as the sum of all the interactions at lower levels, e.g. the outcome of a war as the fruit of multiple military operations, tactical engagements, and the efforts of many individual warfighters. Thus, the planner must create a desired end-state for an individual interaction but ensure that this local and immediate end-state contributes to a larger whole both over succeeding cycles at his own level and in reinforcing the desired end-states in other arenas and at successively higher levels of the national, coalition, or organizational system of systems. The desired end-state of a tactical engagement may, for example, be to destroy the opposing aircraft, thus contributing to an operational desired end-state denominated in terms of air superiority and a geo-strategic end-state in which the opponent ceases aggressive actions.<sup>146</sup>

- Required actions and effects

The effects required to drive behavior toward a desired end-state are the products of “coordinated sets of actions” with end-states deriving both from the direct effect and from the cascade of indirect physical and psychological effects. As earlier discussions of effects-based approaches indicate,<sup>147</sup> there are three complex problems to be addressed in this process: the nature of the action to be undertaken; the kinds of effects it will likely create; and how they will likely cascade. The first is com-

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<sup>146</sup> The first two Attain Document Operations off Libya in January and February 1986 each lasted about one week and involved a succession of probes and air-to-air interactions calculated to produce a desired behavioral end-state. The two operations together created an aggregate desired behavioral end-state that served as the foundation for the conduct of more forward Attain Document III Operations that in turn met an overall national or geo-strategic desired end-state.

<sup>147</sup> Smith, *Effects-Based Operations*. pp. 231-330.

prised of *what* is done and all aspects of *how* it was done that might be observable. Eight such observables appear obvious:

- what the action was;
- what kind of force or other application of power was used to execute it;
- on what scale;
- where;
- over what operational scope or dimensions of national power;
- how fast;
- for how long; and
- with what demonstrated degree of coordination or ability to present a worst case—or best case—situation for observers.

Given the nature of complex interactions, it is unlikely that any option to be examined can be confined to a simple cause-and-effect equation, i.e. a single action creating a single effect. Indeed, the multiplier in the effects-based approach derives from the ability of a single action to create cascades of effects that together will achieve the desired end-state. Even more, the fact that the effects-based approach encompasses diplomatic, economic, and political capabilities and not just military capabilities says both that the actions undertaken are likely to take many forms and that they will tend to create not just one particular effect or one cascade but rather multiple effects in different arenas and will set off multiple diverse cascades. Determining which actions, effects, and cascades are required to achieve a desired outcome therefore assumes some way of evaluating potential actions, effects, and cascades across two time dimensions (short-term and varying longer terms), multiple arenas, and a set of actors that include other governmental,

international, non-governmental, civil, and economic actors. In brief, what is required is less the identification of an action to take than it is the identification of a multi-faceted course of action within which any individual action and the effects it creates will be but one part.

- Capabilities

The reality check in the projected sensemaking process is the question of what capabilities are available to create the effects or cascades of effects that might lead to the desired end-state. The applications encompass the combinations of available military and non-military capabilities that might be used to create the direct effects and cascades of indirect effects to achieve the desired behavioral end-state(s). Because entirely new capabilities are not likely to be able to be created quickly enough to deal with a short-term challenge, responses must be engineered from those capabilities already on hand. What is different in the effects-based approach is that the available capabilities in question are not restricted to military actions but extend to the political, diplomatic, economic, and the full spectrum of national and coalition power. These broad capabilities define a tool-kit in which the value of a given system derives as much from how well it fits with other forms of national power as from its own intrinsic capability.

All of the above underline that the forward projection process is not a one-time endeavor, but rather an iterative exploration of which different combinations might produce which results, to include the negative and unintended consequences. One outcome of this process may be that the desired end-state is simply not realizable with the assets at hand, prompting a revisit and proposal of alternative end-states that might be

achievable. In either case, the objective is to narrow the field of possible options to a few feasible courses of action for still more detailed examination and choice.

## **Options choice and planning**

Having dissected and projected potential options, the decision-making shifts to choosing and implementing a particular course of action.

- Choose

If the projected sensemaking process were to yield a clean-cut, quantifiable way to measure which option was best, then the process of choosing a course of action would be simple and quite linear. However, as the foregoing discussion makes clear, the results of the projected sensemaking are more likely to require a careful balancing of a large number of interdependent variables: short-term versus long-term end-states; local end-states versus aggregate higher level end-states; various forms of military power; potential combinations of military, diplomatic, and economic action to include the political impacts of each; one versus another direct effect as the agent for setting indirect effects in motion; the positive versus negative effects of these direct and indirect effects on the opponent and upon friends, allies, partners, and neutrals locally, regionally, and globally; the likelihood of unintended consequences; and so on. A good real-world example of this was the Singaporean Government's effort to deal with the Severe Acute Respiratory Syndrome (SARS) epidemic in 2003 in which the Government drew multiple ministries (health, foreign affairs,



defense, interior, etc.) into an effort to assess all of the repercussions of the epidemic and to plan a tightly coordinated whole-of-nation response.<sup>148</sup> As this list indicates, the kinds of assessments and decisions involved can rapidly become complex. Not only will they involve the assessment of the relative operational feasibility of the action required given the available resources, but they are also likely to involve the evaluation of the relative risk of an option and attempts to foresee and adapt to any response both in the current cycle and in the following cycles, and the tolerance of unknowns and the absence of a single point of failure—all of which demand complex judgments.

- Planning

Although the process of planning a response may be a relatively straightforward by-the-numbers evolution in an attrition-based targeting process, in an effects-based endeavor, it entails dealing with complex challenges. First, the capabilities to be coordinated in a plan will include some that can be directly tasked by the commander (organic assets), some that may be allotted to the commander for control of a specific duration or action (non-organic assets such as theater reconnaissance or national overhead assets or forces from an ally), and some to which the commander may have access but cannot control or task (accessible assets such as those from another agency or third country support). Second, because the interactions between complex adaptive systems will occur in multiple arenas, the diverse and varied capabilities to be applied need to be coordinated in some manner so as to deconflict efforts

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<sup>148</sup> See: Tay, Chee and Whye Mui. *An Architecture for Network Centric Operations in Unconventional Crisis: Lessons Learnt from Singapore's SARS Experience*. Master's Thesis, Naval Post-Graduate School. December 2004.

and attain a unity of military, diplomatic, political, and economic effects.

#### 4. *Execution*

The execution of the option chosen is the final step or response to one action-reaction cycle and, simultaneously, the action/stimulus that may set off an additional cycle or cycles of interactions either in the original actor or in a host of other observers.<sup>149</sup> As the foregoing discussion indicates, there are three major aspects of effects-based execution that distinguish it from conventional “bombs on target” execution:

- first, the actions to be executed are as varied and complex as the entire spectrum of military and whole-of-nation and whole-of-coalition operations, and in most situations will *not* involve bombs on target as in, for example, peacekeeping operations;
- second, their success across this spectrum is ultimately denominated in human-centered terms of perceptions and behavior; and
- third, the actions executed are but one fleeting part of an ongoing multi-level, multi-arena spiral of successive action-reaction cycles.

Accordingly, the execution process involves adapting the planned action to a situation that will never be quite the same as the one initially considered. This problem points to three

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<sup>149</sup> *Execution* would include Miller’s *output transducer* to manage the reaction and communicate it to “friends, foes, and neutrals,” an *extruder* to physically project the action to the exterior, and a *motor* to manipulate the external environment, e.g. military forces.

Miller, *Living Systems*. p. xix.

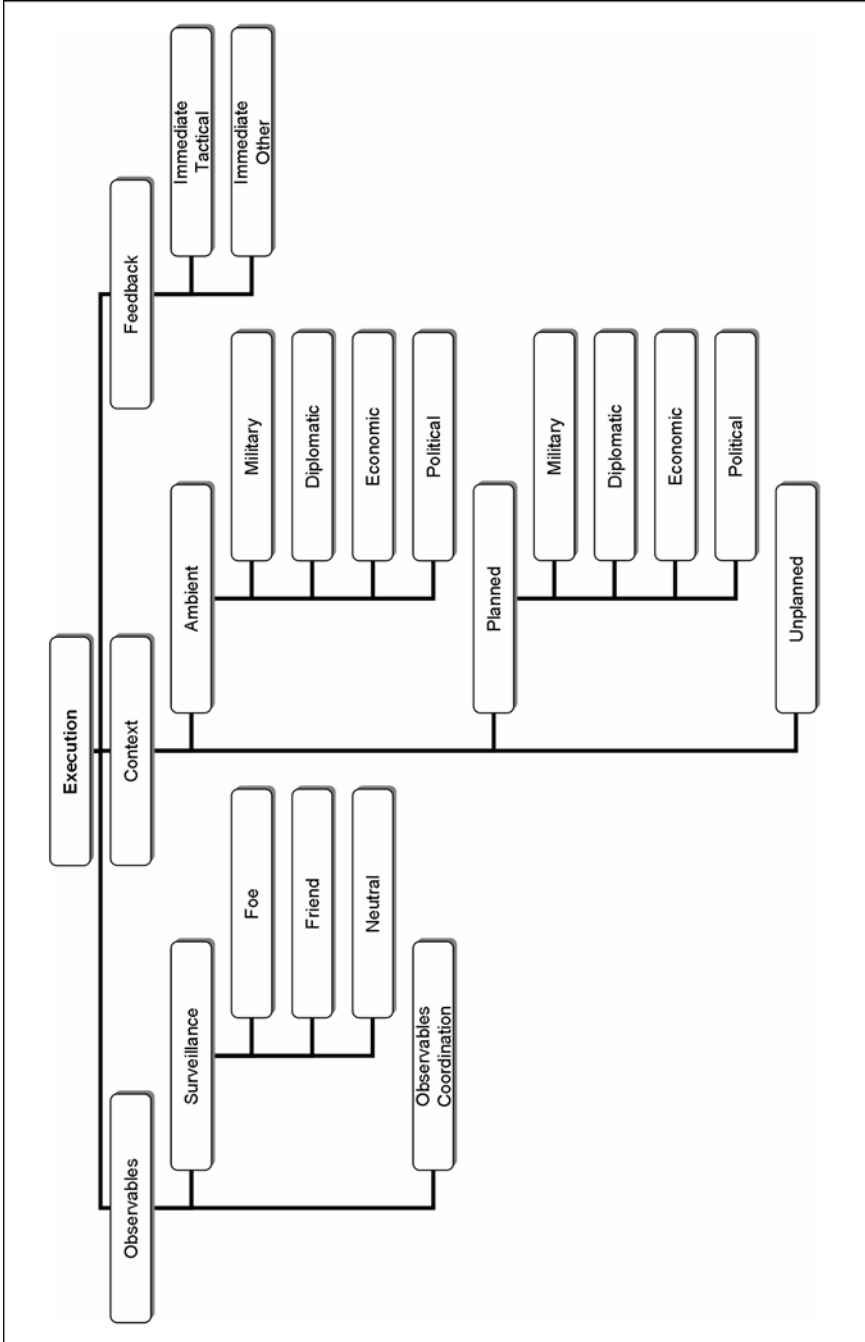


FIGURE 21. EXECUTION

subprocesses: one focused on how the action is executed; another on the context within which it is executed; and a third on the first operator feedback as to what actually happened.

## **Observables**

Because effects derive from what observers see, the decision process will have reduced the action to be taken to a set of observables, i.e. which attributes of the action must be seen by which observers for it to succeed. Although the planning process will have adapted the actions directed to known observer monitoring capabilities so as to ensure that the right aspects of the actions are seen by the right observers, monitoring efforts are not static and must be expected to change continually. Accordingly, those executing the plans will need to adapt their actions to observer surveillance at the moment of execution even as they carry out the action. To this end, those executing the action must have a sufficient understanding of how the observers (whether a large military command or a man on the street or a diplomat) will see the action that is to shape their behavior and, to this end, of which aspects of an action (e.g., scale, scope, and timing) will be seen when and by whom. This suggests at least two further observable subprocesses: one to track how the observers' surveillance systems, from simple visual observation to elaborate sensor grids, will see any action; and one to coordinate the actors and forces involved to ensure that each creates the right impact. One example of the need for executing forces to monitor reactions and adapt is the situation in which Army Lieutenant Colonel Chris Hughes found himself in Najaf during the major combat phase of Operation Iraqi Freedom. He had been directed to make contact with the Grand Ayatollah al-Sistani as part of U.S. efforts to calm a local situation. He and his soldiers were surrounded

by an angry mob that apparently saw their presence in a different light and feared that the Americans were attempting to take the nearby holy places and/or the Ayatollah. His widely televised improvised reaction was to direct his troops to assume a non-threatening, respectful posture and gradually back off. Hughes clearly understood from the local situation that pursuit of the original task would have a wildly disproportionate opposite effect and he adapted his actions accordingly.<sup>150</sup>

## **Context**

Because observers will see not only the planned actions but everything within their collection range, there are no actions that are not joint, no actions that are solely military, and no actions that are not national—or, in the case of al Qaeda, organization-wide. Any action, therefore, will be seen in a particular context. In planning, three such contexts will have to be taken into consideration: the ambient context against which the action will be observed (e.g., sentiments in a village on the day of a patrol); a planned context (e.g., the impression that the patrol is intended to leave); and, Murphy's Law being always with us, the potential actual context to include any unplanned eventualities that might change the direct and indirect effects actually achieved. As in the case of observables, the ambient context will continually change—and in ways that may not be predictable. Thus, the executing actor will need to observe and adapt to change as it occurs. However, the real complexity arises from the fact that this context will vary not just over time but also from one observer to the next and with the level of the observer.

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<sup>150</sup> Baum, Daniel. "Battle Lessons: What the generals don't know." *The New Yorker*. January 17, 2005.

## Feedback

In the feedback process, the execution phase begins to turn into the awareness creation phase of the next cycle. The first feedback on any action logically will come from those executing the action. Although we tend to think of this feedback in terms of pilot debriefs after an air strike or reports from a scouting unit, in cross-spectrum effects-based operations the feedback will take as many forms as the operations themselves, to include a simple “feel” for local reactions. The principal feedback from those executing a plan will be threefold:

- whether the action was carried out or not,
- any evidence that the action was seen, and
- any indication of how it was seen.

Those executing the plan may also be in a position to provide a range of ancillary indications such as any differences in the reaction of villagers from those to previous patrols, or a subsequent state of alert of local military forces, or potentially the subsequent movements of leaders.<sup>151</sup> Together, these would comprise an initial input to the larger assessment process. Indeed, when mapping psychological reactions, such feedback may be the only indicators initially available for looking at the next cycle.

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<sup>151</sup> As this implies, the feedback from interactions with a local populace is heavily dependent on language skills sufficient to communicate with that population, as well as some capacity to understand the cultural context of the interaction. Grossman, Elaine. “Wielding a velvet fist: Strong on fighting skills, cavalry strives to grasp Arab perceptions.” *Inside Defense*. January 31, 2005.

## 5. *Social influence*

The social influence is particularly complex because it encompasses a seemingly infinite number of interdependent variables that are themselves continually evolving, e.g. religious, educational, political, and economic factors. These social influences are an essential process and hence an unavoidable part of the interactions that shape the decisionmaking in each of the four crossovers indicated in Figure 22, but also because they circumscribe and define the limits to a human institution's or organization's ability to adapt to a stimulus or situation without undergoing a transformation that might radically change the relationships among its subsystems.<sup>152</sup> The social influences are, therefore, at once the measure of the degree to which the system must change in order to adapt and the process by which that change is carried out or in which it fails to do so.

This is where the distinction between the diplomatic and political arenas of action becomes essential. It stands to reason that the ability to respond to a stimulus or challenge depends not only on what impact any response will have on friends, foes, and neutrals, but also on what that response might do to our own group, organization, community, or society. A Pyrrhic victory is by definition self-defeating. While this is true in even

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<sup>152</sup> In the living systems context, these interactions are part of a boundary maintenance process by which the system maintains its identity and cohesiveness. Miller's model also includes several overarching functions in the model such as the *boundary* that maintains the physical and informational separation between one system and another, something particularly evident in the post-9/11 security environment. Finally, there are a series of functions, the *reproducer*, *ingestor*, *distributor*, *converter*, *producer*, *storager*, and *supporter*, which, depending on the level, might be considered to equate to the processes needed to sustain the governmental, economic, or perhaps military logistics infrastructure required by a system. Miller, *Living Systems*. p. xix.

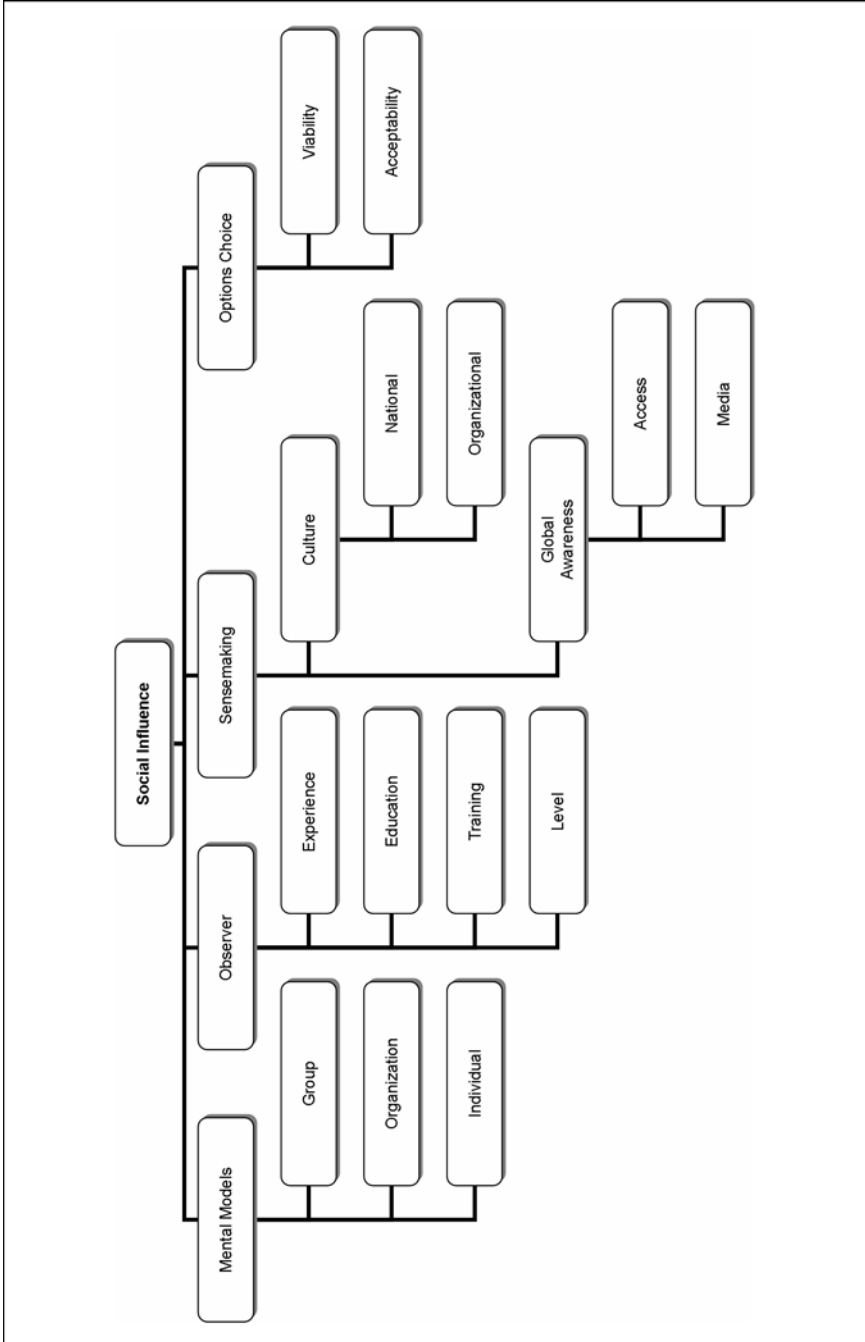


FIGURE 22. SOCIAL INFLUENCE



a single action-reaction cycle, it is of paramount importance in a war of psychological attrition, the whole point of which is to challenge the ability of the opponent to sustain an institutional consensus through the course of what may be a lengthy succession of action-reaction cycles. In a nation-state system, this function would fall to the political leadership. One example is the role of President Franklin D. Roosevelt in the period between Hitler's 1939 attack on Poland and Japan's 1941 attack on Pearl Harbor. Roosevelt knew that any direct American participation in the war would depend on changing a deep isolationist streak in the American societal self-image and that any change in that mental image and societal boundary would require substantial preparation. His introduction of "lend-lease" to aid a flagging Britain after the fall of France therefore resorted to metaphors that used a different aspect of the self-image "neighborliness" to explain the aid in terms of a lending a garden hose to a neighbor whose house was on fire. Similarly, the Atlantic Charter sought to portray any impending conflict in terms of traditional societal goals of freedom and democracy.<sup>153</sup>

## CONCLUSION

In a sense, the breakdown into essential processes and subprocesses provides a sort of generic logical tree on which we can begin to hang the "how to" problems of effects-based operations. The utility of this tree, moreover, is not limited to military operations just as effects-based operations cannot be limited just to their military dimension. The processes and drill-downs apply as well to states as to international terrorist

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<sup>153</sup> Burns, James M. *Roosevelt: Vol.2 The Soldier of Freedom*. Norwalk: Easton Press. pp. 25-29.

organizations, to the diplomatic, economic, and political as well as the military, and to the civilian world as well as to that of governments. In short, they should be applicable in one extrapolation or another across the breadth of complex human interactions.

This roadmap should not be construed as a definitive rendition of all of the ways in which we might dissect the action-reaction cycle, or all of the linear and nonlinear elements we might identify, or all of the analytical approaches that might be applied. It is intended instead both to be illustrative of the fact that such drill-downs are possible in a wide variety of areas and can contribute to limiting the scope of the bounding needed to deal with complex behavior.

We now have to take this model another step to explore how it might apply in assessing, planning, and executing effects-based approaches under a variety of different exigencies. We will do this in the following two chapters, first putting the dissection into three different contexts, and then examining where and why human intervention might be required and how the tools of the Information Age might aid effects-based operational planning in the case of a Joint Task Force.

## CHAPTER 5

### SO, WHERE'S THE COOKBOOK?

As intellectual children of a linear world view and of an approach to warfare that was both quantifiable and “model-able,” our first inclination is to treat the assessment, planning, and execution “how to” of effects-based approaches as another—if somewhat more complicated—linear planning problem that simply requires an appropriate “cookbook” of recipes. Indeed, much of the discussion of the conduct of effects-based concepts to date has focused rather straightforwardly on trying to define a cookbook of effects-based planning processes and the attendant information network architectures. Yet, it should be clear that effects-based approaches pose a complex challenge that is not only more than any “how to” recipe can address but is also one for which there is not and never can be a true “cookbook.” In fact in many respects, the very idea of a cookbook of recipes is the antithesis of what is required for dealing with complexity. Recipes assume a basic linearity in which the same ingredients will yield the same results each time, in which the whole will equal the sum of the parts, in which the output will be proportional to the input, and in which the same cake will always emerge

from the oven. What we seek to address in effects-based endeavors is instead a dynamic problem centered on human will and perceptions in which we will not or cannot know all of the ingredients, in which the whole could be much more (or less) than the sum of the parts, and in which we will never be entirely certain what will emerge from the oven. This predicament is very much evident both in real-world operations in Iraq and Afghanistan and in the complexities of the action-reaction cycle. The complexities involved offer little hope of a “cookbook solution” and at best only permit us to bound a set of most likely effects and outcomes.

## ASSESSMENT, PLANNING, AND EXECUTION

Our challenge in approaching the “how to” of an effects-based approach to operations is to translate the action-reaction process and problem sets discussed in the previous chapters into an assessment, planning, and execution process that can be applied to real-world decisionmaking at the “speed of battle.”<sup>154</sup> The tasks themselves are no mystery. We know quite well how to do them successfully in conventional attrition-based operations. But, this success results at least in part because the traditional state-on-state conflict operations involved are relatively linear and, at least on the surface, susceptible to familiar reductionist analysis. In a post-9/11 world where the complex human and whole-of-nation dimensions of competition and conflict have become the centerpiece, success has come to be defined more in psychological terms than in physical terms. This is to say that the process also reflects the

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<sup>154</sup> U.S. Joint Forces Command defines a fourth function called *adapting* that reflects the need to take enemy reactions into account. In this work, this adaptation function will be treated as an integral part of the whole cycle.

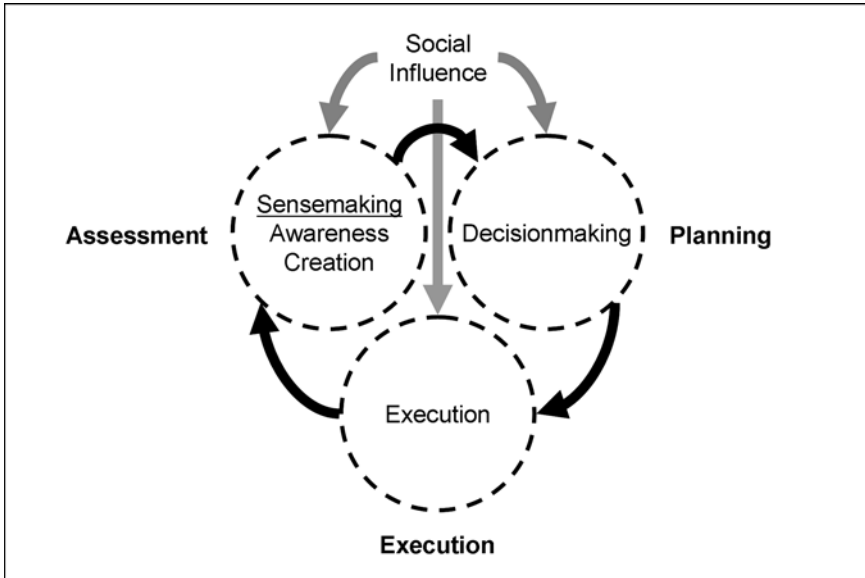


FIGURE 23. PLANNING/ACTION-REACTION CYCLE

essential steps of the action-reaction cycle with the awareness creation and sensemaking functions embodied in the assessment phase of the planning cycle, the decisionmaking process in the planning phase, the execution function in the execution phase, and the social influences a factor in all (see Figure 23).

Because these operations are ultimately about shaping the interactions in a multi-level system of complex adaptive systems, any approach to their assessment, planning, and execution must also take into account some basic complexity rules of thumb:

1. Interactions will include:
  - a. Interactions with similar actors at the same level, e.g. opposing tactical units or operational commands;

- b. Interactions with similar actors in other arenas at the same level, friends, foes and neutrals, diplomatic, economic, political, military and with media, international, and non-governmental actors; and
    - c. Interactions with actors at successive levels of the system of systems: tactical, operational, military-strategic, geo-strategic or of the group, organization, community, society, or even international hierarchies.
  2. No action or interaction can be entirely isolated from other interactions at other levels or in other arenas.
  3. Interacting systems and their component subsystems will self-organize and evolve so that no action will have exactly the same effect twice.
  4. Any action can create disproportionate and potentially destabilizing effects, and:
    - a. Such effects may ricochet throughout the multi-level system of complex adaptive systems in unexpected ways; and
    - b. These ricochets have the potential to push one or more of the systems to lapse into chaos.
  5. There will be no definitive beginning or end to the interactions.

To these rules of thumb must be added a sixth, a variation on Ashby's Law of Requisite Variety: as the number of actors involved at any level or across the multiple levels of the system of systems increases, the number of potential outcomes and the

diversity of the potential threats or stimuli we are likely to face will also increase. Conversely, the more diverse our own actors and capabilities are, the better our chances of dealing with diverse and ever-changing challenges will be.

As the repeated allusion to the living systems model indicates, these rule sets are not restricted to effects-based approaches to operations but are characteristic of our international security environment and affect *all* military operations and all whole-of-nation actions. What the effects-based approach offers is the possibility of exploiting complexities in shaping the behavior of friends, foes, and neutrals. However, to do this we must consider the intended actions and effects at multiple levels and in multiple arenas of interaction and the potential cascades of additional effects and reactions that the intended actions may set off across all the levels and arenas of interaction. It also entails a recognition that, in any such complex interaction, we will never have complete information or be able to predict exactly what will happen.

## PUTTING THE EFFECTS-BASED APPROACH INTO CONTEXT

We can begin to see how the generic elements discussed in the previous chapter translate into an assessment, planning, and execution process in three varied examples. The first is a relatively fundamental effects-based problem: a village elder dealing with the arrival of a government patrol. The second looks at the problem from the standpoint of an asymmetric challenger, al Qaeda. And the third embodies the more formal process of a Joint Task Force commander engaged in a crisis response operation. The first two provide a picture of what might be termed a *classic* effects-based approach while the lat-

ter begins to outline the dimensions of the challenge in applying the effects-based approach to modern military operations across the spectrum of conflict.

### *The village elder*

All of the elements discussed in the preceding chapters—complexity, the action-reaction cycle, and the planning process—can be seen in the reactions of a village elder to the approach of a government patrol during an insurgency.<sup>155</sup> The elder must deal with multiple observers: the government, the insurgents, surrounding villages, and the families in the village. His objective is not so much to aid the government or the insurgency as to ensure that the village does not become a battleground for contending parties. To this end, he seeks to plan and execute “coordinated sets of actions directed at shaping the behavior of friends, foes, and neutrals”—an effects-based operation.

### **Assessment (Awareness creation and sensemaking)**

In determining what these actions ought to be, the elder’s first task will be to assess the situation and to do this he must first make himself aware of what is going on. He will want warning of the patrol’s arrival to be sure, but he will also need to know something more about the patrol and its movements: the kind of patrol (e.g., on foot or in armored personnel carriers) and their numbers, equipment, location, speed, direction, and

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<sup>155</sup> This example reflects a gaming of effects-based interactions using a sensemaking framework that I worked out in the Mekong Delta of Viet Nam over the course of 1971-1972 after numerous discussions with South Vietnamese personnel including my intelligence counterpart and one *Hoi Chanh* former Viet Cong officer.



demeanor. He will have some idea where and how to obtain this information (i.e., the capacity of his collection apparatus and his ability to task it). Although he may not have electronic sensors, he may know something of the situation outside the village through the media, such as radio reports of insurgent attacks or of a government offensive. More importantly, he will have an informal network of observers, perhaps villagers in the fields or friends in villages along the patrol route, and he will have some idea of the varying knowledgeability, reliability, and self-serving intent of these reporters. He will then have to collate and fuse all of this information in his head or with the help of an informal decisionmaking council in the village to create a situational awareness.

To make sense of all of this, the elder will have some observed historical context: what has been the nature of past patrols, how frequently have they visited the village, with what variations, and with what reaction from the insurgents. Using this norm, he can develop a sense of whether the current patrol conforms to the existing pattern or, if not, how it is different. He and the other village decisionmakers can inject their own knowledge of the local situation and terrain and, time permitting, may mobilize additional knowledge from those in neighboring villages—all in the framework provided by the elder's own mental model of the relationships in the village and with the government and insurgents. With this and some sense of government and insurgent decisionmaking, e.g. the subordination of the patrol and of the insurgents, he can assess possible chains of causes and effects that might explain why the patrol is heading for the village and can postulate their intentions, the patrol's impact on the local balance, and the implications for the village both today and over the longer term, e.g. insurgent reactions to any perceived cooperation.

## **Planning (Decisionmaking)**

The elder can then use this sense of the situation to evaluate possible courses of action. To do this, he must project his sense of the situation into a series of dynamic futures: by identifying what outcomes or behavior by all parties would be most beneficial or least damaging to the village both in the interaction at hand and over the longer term; and by determining both what effects might produce such outcomes and what specific actions he and the villagers might take to that end with the limited capabilities available. Having chosen a course of action, he might then have to create a consensus among the village decisionmakers to implement it and communicate this to those who will play a part in executing it.

## **Execution**

In implementing the chosen course of action, the elder and villagers would have to ensure that the patrol and insurgents observe what is intended. In part, this would entail knowing roughly how each of the intended observers would see and report actions (e.g., who in the village reports to the insurgents), and in part it would mean anticipating the context in which observers would see the village's actions. The elder would likely recognize from experience that this interaction could not be entirely planned in advance and that many aspects of the patrol's behavior or perhaps that of the insurgents' local representative would be unpredictable and that there inevitably would be aspects of the village's reactions that he could not control. Therefore, he would also need to adapt as needed even during the interaction with the patrol. Accordingly, he might require feedback as to observer reactions so as to shape those reactions while there is still time to do so. When

the interaction is done, the elder might want feedback, perhaps the impressions of trusted advisors or observations of follow-on actions by government or insurgent forces.

### **Social influences**

Although the above processes are framed in terms of the village elder making decisions, the reality is that his position is less that of a commander than that of a consensus builder in a process in which family heads and other persons of standing would have a say. That is, although he may be deferred to by virtue of his wisdom and experience, the elder is in fact circumscribed by an array of social influences and, thus, by a large number of unseen interdependent variables that might play affect what is or is not an acceptable response.

In this example, the village elder has few resources and must work with a consensus-driven structure that reflects personal, family, and other relationships that have evolved over decades. These limitations are to some degree balanced by a span of concern largely confined to the immediate area around the village where the knowledge of decisionmakers is likely to be deep and comprehensive and in which the few resources available can be deployed to the degree that they might even be said to equate to a relative information advantage.

### *The asymmetric challenger: Al Qaeda*

We can also postulate what these same basic steps of the planning and action-reaction cycles might look like in the case of an asymmetric challenger such as al Qaeda. The asymmetric challenger's problem is to set off cascades of indirect psychological and physical effects that can shape the behavior of a

regional or even global power. The extended scale and scope of this desired end-state necessitate an approach to effects-based planning that is much less *ad hoc* than that of the village elder and depends heavily on surprise or shock for its impact.

### **Assessment (Awareness creation and sensemaking)**

The attacks of 9/11 demanded a detailed awareness of the targets and the security measures that might detect and thwart the effort. Because al Qaeda controlled the timing of the attack, it could also control the pace of the tasking, collecting, and fusing of information so as to provide the level of detail required for planning and to adapt it to the limited capacity of the collection assets. Most of these assets would have been human and open sources, some organic (i.e., tasked directly by the al Qaeda leadership), others non-organic derived from sympathizers, and some information accessible from Internet sites or the media. The dependence on human and open sources would have posed problems in validating the knowledgeability and reliability of sources and information and in collating and fusing information into a detailed awareness—factors mitigated by the ability to delay the operation until a sufficient awareness was created.

Al Qaeda's approach to sensemaking in the case of 9/11 would have been similarly aided by its control of the timing. The fused data and information could be wed to expert knowledge of security procedures and of the targets (e.g., bin Laden's own engineering estimate that the World Trade Towers would collapse) to form a contextualized "operational net assessment" that could be updated as planning proceeded. This assessment apparently also reflected estimates of the American mental model: that, as in previous terrorist hijack-

ings, there would be no passenger resistance; that American reactions would be limited to ineffectual missile strikes; and most importantly, that in the long run neither America nor the West could sustain a war of psychological attrition.<sup>156</sup>

This awareness created and sense made of the situation contrast sharply with the reactions of al Qaeda to coalition operations in Afghanistan and Iraq. In the latter, essentially a clash between insurgents organized along military lines and regular military forces, time was of the essence and reliance on relatively slow human and open source reporting imposed some handicaps despite the apparent scope and scale of the human informant networks involved.<sup>157</sup> This handicap was probably most evident in the rapid cycles of tactical interactions in quasi-conventional operations such as the defense of Tora Bora and the American storming of Fallujah. However, al Qaeda affiliates to some degree adapted to these limitations. For example, al-Zarqawi's campaign of suicide bomber attacks in Iraq exploited a perceived insurgent advantage in human reporting to pursue engagements that could be initiated by the terrorists at a time and place of their choosing with

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<sup>156</sup> It seems clear that, for his part, bin Laden viewed the impact of the West on the Islamic World as a continuing cascade of political, economic, and cultural effects that constituted an attack on Islam to be resisted by all Muslims by any and all means.

Lewis, *From Babel to Dragomen*. pp. 375-376.

<sup>157</sup> By all reports, this advantage was less pronounced in Afghanistan where coalition members had a network of contacts and experience dating from operations during the Soviet occupation of Afghanistan. In Iraq, there does not appear to have been such a network on either side initially, but there was a substantial Sunni Muslim community and Ba'ath infrastructure sympathetic to the cause of the local affiliate under al-Zarqawi to offer a distinct advantage that persisted through at least the first 2 years of the occupation.

Anonymous. *Imperial Hubris*. Washington: Brassey's. 2004. pp. 29-30.

much less preparation.<sup>158</sup> Yet, the general rule remains: the greater the time pressure on the al Qaeda awareness creation structure becomes, the more fragmentary and time-late the awareness is likely to become. This time pressure is also a factor in sensemaking. The less time and manpower available to compile information into a meaningful database, or to integrate the information with an expert knowledge base, or to assess the opponent mental models that might be exploited, or to explore the cause-and-effect chains that might produce a particular cascade, the lower the quality of the awareness will be and the less effective actions are likely to be.

### **Planning (Decisionmaking)**

The same dichotomy between surprise attacks and sustained operations applies to the planning/decisionmaking process. Clearly, planning the 9/11 attacks involved extensive forward projection of al Qaeda's "sense" of how the United States would respond to the attack and then to ensuing cycles, and of how the larger Muslim world would react. Each projection would have identified desired end-states, available capabilities, and the actions, direct effects, and cascades of indirect effects that might lead to those end-states. Al Qaeda's desired end-states likely revolved about inflicting the greatest possible destruction and casualties at the tactical level so as to optimize "shock and awe" and set off the physical and psychological cascades at the operational and strategic level that would shape American military, political, diplomatic, and economic

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<sup>158</sup> This reliance on knowledgeable human sources was not an unadulterated advantage as such reporting can be a wasting asset. Because human reporting is often based on the ability of agents to infiltrate decisionmaking infrastructures, the agents are subject to attrition both as the insurgent actions point back to the agent or as the sympathy for the cause diminishes.

behavior and generate an American backlash that might be used to provoke a general jihad against the West as a means of disconnecting the Islamic world from the seduction of the “great Satan.”<sup>159</sup> There seems to have been only limited concern as to the potential negative consequences of this course of action or as to where these cascades of effects might lead. Indeed, in a manner reminiscent of earlier fascists, they appear to have stereotyped and underestimated American and Western players by looking at them through a lens of, in this case, religious rather than national or racial determinism. Planners simply assumed that they were carrying out God’s work and that, in whatever cascades ultimately took place, His will would be done. Their task, then, was merely to set the cascade in motion and leave the rest to divine intervention. In spite of this potentially vulnerable reasoning framework, the planning process seems to have been relatively formal with options and capabilities evaluated and lists of possible targets whittled down to one course of action involving four aircraft and two sets of targets. To this course of action was assigned a cadre of suicide bombers who were recruited by al Qaeda but trained and supported through a network of non-organic al Qaeda sympathizers.<sup>160</sup>

Al Qaeda operations in Afghanistan, by contrast, were a reaction to American and coalition assaults that resembled conventional combat as al Qaeda and Taliban forces attempted to hold territory first in the Tora Bora region and then in the ethnic Pashtun areas of southern Afghanistan and

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<sup>159</sup> Anonymous, *Imperial Hubris*. p. 152.

<sup>160</sup> Because the operation was limited in scope and the organization operated in a decentralized cell structure, there appears to have been little to coordinate save the tactical operation itself.

Anonymous, *Imperial Hubris*. pp. 62-65.

northwest Pakistan. These operations were patterned on those of the lengthy struggle against the Soviet occupation and seem to have reflected a similar projected sensemaking and end-states with actions focused on inflicting casualties in the hopes of creating a psychological cascade that would erode public support for further coalition efforts. In Iraq, al-Zarqawi conducted analogous urban guerrilla operations in Fallujah in 2004 as fighters attempted to hold their base of operations against an American assault,<sup>161</sup> but al-Zarqawi focused primarily on a form of “tactical terrorism” in which the shock and awe derived from grisly beheadings first of Westerners and then of Iraqis and later from persistent and apparently indiscriminate attacks on the new Iraqi government, Iraqi Shi’i, and then Sunni Arabs. In these cases, the geo-strategic end-state remained the same: wearing down coalition will—and in the latter case, Iraqi support—with the long-term end-state deriving from a desired cascade of political effects.

## **Execution**

In this example, al Qaeda conducted operations with a keen eye to what would be seen by observers at multiple levels of multiple arenas. In both the execution of surprise attacks and in tactical interactions, success seems to have been denominated in terms of perceptions and the impact that they would have on an ongoing spiral of interactions. This emphasis on cascades of indirect psychological effects focused attention on what aspects of any executed action the global and regional media would see. This made the media not only the bat-

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<sup>161</sup> A distinction needs to be drawn here between the operations of Sadr’s Shi’ite Army of God in Fallujah and elsewhere, which often fell into the category of “conventional” guerilla operations and the operations of Zarqawi’s Sunni and foreign fighters.



tespace of choice but also the “surveillance system” to which the al Qaeda actions were to play. However, when it came to coordinating either the observables to be seen or the context in which they would be seen, the franchised and decentralized nature of the organization became something of a weakness.

Al Qaeda provided a unifying banner for a movement of the disgruntled and, in Osama bin Laden, it offered a totem to represent the whole, but neither al Qaeda nor bin Laden could really “control” any more than a small portion of the movement. From the London Underground and bus bombings to the Madrid train bombing, the Bali bombing, and the attack on the Australian embassy in Indonesia, regional franchises appeared to act independently or, in the case of al-Zarqawi, adhered to al Qaeda *ex post facto*—likely only after their own autonomy had been assured. Sometimes the consequences of these independent actions fell in line with al Qaeda aims, notably in the defeat of the Spanish government and Spanish withdrawal from Iraq after the Madrid bombing. Sometimes the reverse was true in the case of the Australian reaction to the Bali bombing and the embassy attacks. However, in both cases, al Qaeda was simply left to accept the consequences. This lack of control was perhaps most visible in the murder of revered aid worker Margaret Hassan despite pleas by both bin Laden and al-Zarqawi who apparently saw its negative consequences—so negative that even al Jazeera refused to air the usual videotapes of the “execution.” As the above hints, the tactical feedback from many al Qaeda operations—whether they are blessed by bin Laden or not—appears to come from some form of media reporting. This feedback provides the immediate reporting that the action took place as planned and the report on “enemy” reactions that provides the basis for planning the next round of interactions.

## **Social influences**

It also seems evident that al Qaeda has to be careful to operate within the bounds of what the Islamic world will tolerate. Bin Laden obtained religious rulings or fatwas from sympathetic clerics to cover any actions that might be seen as crossing the boundaries of Islamic rectitude such as the wholesale killing of women and children or the use of weapons of mass destruction. His offer to guide Americans in converting to Islam, for example, observes Islamic laws that require enemies to be offered an opportunity to convert to Islam before being put to the sword.<sup>162</sup>

Overall, al Qaeda has more resources to deploy than the village elder. However, unlike the elder, the resources are applied to a far wider problem spanning the entire Islamic world—both past and present—and aspire to influence events on a global scale. On this scale, al Qaeda’s resources afforded a capability sufficient to permit intermittent offensive shock and awe, surprise terrorist operations across the world, and sustained terror campaigns in some parts of al Islamiya, notably in Iraq, but not sustain major combat operations.

### *The Joint Task Force (JTF) commander*

The foregoing examples provide a backdrop for a more detailed look at the comparable effects-based planning problem of the Joint Task Force commander, one level closer to the tactical “how to” problem of a theater commander but with a staff of sufficient size and with sufficient connectivity to under-

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<sup>162</sup> Anonymous, *Imperial Hubris*. p. 154.

take a detailed formal planning process<sup>163</sup> and with a level of resources and span of operations analogous to most allies and coalition partners. In assessing the Joint Task Force's tasks and requirements, I will work from my firsthand experience as staff intelligence officer first with U.S. Navy forces in the Mekong Delta, and then on the staff of the Battle Force of the U.S. Sixth Fleet. The JTF Battle Force operations were particularly instructive in this regard in that they included three multi-battle group operations in the Attain Document Operations off Libya in January, February, and March of 1986 and a reprise of those operations again with multiple battle groups with the same staff but a different battle force commander in 1987.<sup>164</sup> The JTF represents a reaction capability that is global or regional in scope and, as such, able to act throughout that area as directed, adapting to shifting situations and players over the course of an interaction and able to coordinate with other elements of a whole-of-nation/coalition effort to that end.

### **Assessment (Awareness creation and sensemaking)**

In a purely linear approach to the Joint Task Force planning problem, the requirement for assessment would appear twice: once at the beginning to serve as the basis for planning, and again at its end as a post-operation feedback such as a "bomb damage assessment." However, if we view the JTF task as an

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<sup>163</sup> Recent efforts by the U.S. Joint Forces Command have been directed at supplementing forward commands with a Standing Joint Force Headquarters (SJFHQ) to bring increased manning, expertise, and networking to forward commanders on short notice.

<sup>164</sup> In the case of the 1986 Libyan Operations, the JTF commander's Battle Group had started its 7-month deployment in the Mediterranean with operations that included the intercept of the *Achille Lauro* hijackers, then had moved to take up duties in the Northern Arabian Sea, and then returned to the Mediterranean for the Attain Document Operations.

ongoing spiral of action-reaction cycles, then assessment is simultaneously the end of one cycle and the beginning of the next with the feedback on enemy and neutral responses serving as the basis for the JTF's planning for the next cycle in a continuous process.

### **Awareness creation**

For the JTF commander, the requirement for awareness takes two forms. One is an awareness of the immediate operational environment that answers the question: "What is happening in the Task Force area of responsibility?"—an awareness centered on the detection, location, identification, and tracking of units of interest whether military, irregular, or terrorist. A second form of required awareness is that of the political, diplomatic, military, economic, and social aspects of a wider security environment (e.g., the potential economic impact of an action) that includes both the commander's own area of responsibility and a larger regional and world scene to include the intentions and vulnerabilities of foes, friends, and neutrals and how each will observe Task Force actions.

The latter is particularly important in conflict with asymmetric adversaries seeking to fight a war of psychological attrition because it addresses the broad spectrum of non-military factors that an asymmetric foe might hold dear. For example, al Qaeda might not be concerned about the loss of a large number of suicide bombers, but it might be very concerned about its access to world and regional media, about the reactions of the Muslim world, or about its access to the means of financing an extended operation. The JTF commander's ability to attack these vulnerabilities then would revolve less about conventional sensor architectures than awareness of the wider

security environment. These two forms of awareness demand different inputs. The first looks to relatively linear and quantitative data and information from sensors while the second looks to information and knowledge that is usually complex, qualitative, and subjective.

### **Tasking, collection, fusion**

Because Joint Task Force interactions will vary from one cycle to the next, the command's efforts to acquire the data and information must be a continuing endeavor. The faster the cycle time of JTF efforts is, the faster the tasking and feedback process must be.<sup>165</sup> As in the case of al Qaeda, assets available to the JTF fall into three categories: organic, non-organic, and accessible. Most of the command's ability to detect, locate, identify, track, and target (and hence its data and information on and awareness of its immediate operational environment) will come from organic, mostly tactical sensors. However, human reporting may be a command's sole means to detect, locate, identify, track, and target insurgent groups and terrorists who are submerged in a civilian population. It may come from capabilities integral to the command (e.g., prisoner interrogation), or from national, theater, and allied assets. Human and open source reporting will also provide most of the command's awareness of the social and cognitive dimensions of its operational environment to include media and observer reactions as well as its awareness of the larger national and global dimensions of its actions. Realistically, JTF needs will never be

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<sup>165</sup> Because the speed with which any given requirement will be met is also a question of how long that requirement will wait in the cue before being tasked, this logic might be taken another step to say that the faster the cycle time desired is, the more extensive the applicable collection or intelligence, surveillance, and reconnaissance capabilities are likely to have to be.

entirely satisfied. The collection assets available are not and will never be infinite in number or continuously ubiquitous in coverage; moreover some sources will need to be kept closely held so as to preserve their utility; and not all of the information available will be known, e.g. reporting from other agencies or international and non-governmental organizations. To make this information into a logically cohesive awareness, the JTF team must also put together the pieces of the puzzle by collating information from like sources and fusing it with that from vastly different reporting. The problem is that this puzzle is comprised of many pieces that do not quite fit, some that may be from entirely different puzzles, and in some cases, two quite contradictory pieces may fit in the same space.

## **Sensemaking**

Sensemaking, like awareness creation, is a continuous process. Indeed, in any interaction with a complex adaptive foe, it would be folly for a JTF commander to cling inflexibly to one sense of the situation when additional information or interactions have changed the suppositions upon which it was based.<sup>166</sup> In an effects-based approach, the JTF commander needs to think in terms not of action against a non-reacting target that is over when the target is destroyed, but of an interaction among intelligent actors (friends, foes, and neutrals) that will not be limited to the events of a single cycle but that both grows out of past cycles and affects future cycles. To this end, the JTF commander must understand the complex *why* of

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<sup>166</sup> The British, American, and Polish assault against Arnhem in 1944 is a classic example of a commander pursuing one sense of the situation, i.e. that the area was lightly defended and that resistance would be light, when a change in that sense was indicated by new intelligence.

Hastings, *Armageddon: The Battle for Germany*. pp. 35-37.

opponents' actions and where they might lead.<sup>167</sup> This sense, moreover, cannot be limited to the interactions at the commander's own level but must include a sense of the tactical level actions he directs, of the military-strategic or other higher level decisionmaker whose intent he is implementing, and of the national or meta-system level where his actions may well have their most significant impact. Thus, command sensemaking entails: (1) translating awareness into an understanding of the situation sufficient to support planning and decisionmaking at the tactical and campaign levels; (2) obtaining some idea of the direction of the effects cascades the situation has set in motion; and (3) estimating the implications both of the actions that provoked the situation and of the cascades of physical and psychological effects that have proceeded from it. Such sensemaking involves two processes: contextualization to put any awareness of actions into a meaningful framework and analysis to estimate the most likely cause-and-effect chains involved.

- Contextualization

It stands to reason that no action or situation can be understood if shorn of its context. This is especially true of complex systems that are by definition bundles of interconnected and interdependent variables, no single element of which can really be considered in isolation. Contextualization provides the commander with a norm against which actions can be measured to determine how they differ from or are similar to what has gone before. The more extensive and detailed the provided context is, the better the understanding will be and the more tightly bounded the commander's assessments and

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<sup>167</sup> In the Libyan case, this discussion revolved about attempting to understand Col. Qadhafi's rationale for provoking the confrontation and how he might react to Task Force moves.

decisions will be.<sup>168</sup> It also opens a mental model basket of analogies upon which the commander can draw to fill in the gaps in information, to estimate the likely directions of the cascading effects that an action has or may set in motion, or to reach a quick decision in a time crunch.<sup>169</sup> Again, the richer the set of potential analogies is, the better the fit between a known analogy and the current situation is likely to be. These elements are particularly important for a Joint Task Force from outside the region reacting to a situation because of the lack of an integral experienced-based analogy library for the area.

The contextualization that the JTF will require depends on: a database that puts actions into a context of history, situation, and time; a knowledge base to add complex meaning to the actions; and some way of estimating the mental models of both the actor and the observers. The database is likely to be divided between an organic base of expertise within the command and a non-organic external source, but with the most comprehensive immediate tactical history database probably

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<sup>168</sup> For example, in the operations off Libya in 1986 and 1987, I was able to draw upon the detailed context for Libyan actions provided by the Fleet Ocean Surveillance Information Facility (FOSIF), which had closely monitored activity for decades, and could therefore assess what the actions were, when, with what frequency, under what conditions, etc.—a context that was the basis not only for an understanding to support effects-based planning but also for feedback to the immediate impact of our own actions.

<sup>169</sup> The role of analogies is evident in “naturalistic decisionmaking,” which examines the decisionmaking processes of commanders in terms of a new theoretical model in which a library of mental models serves as the basis for recognizing patterns that are explored and matched to find the one pattern or analogy closest to the situation at hand.

Serfaty, Daniel et al. “The Decision-making Expertise of Battle Commanders.” Zsambock and Klein. *Naturalistic Decision-Making*. Mahwah, NJ: Erlbaum. 1997. pp. 235-237.



residing in the command itself.<sup>170</sup> The knowledge base will likewise be mixed. Non-organic assets can provide long-term, indepth, or specialized inputs while organic assets will provide an ongoing tactical and operational appreciation based on the evolving local situation. Finally, estimates of observer mental models would most likely come primarily from non-organic assets such as subject matter experts or from accessible information in open sources,<sup>171</sup> but might also be developed by local commanders over a series of action-reaction cycles. In the Libyan operations of 1986, for example, the observations and lessons learned from Attain Document I in January 1986 fed the estimates for Attain Document II in February and both in turn fed those for Attain Document III in March.<sup>172</sup>

- Analysis

The analysis function encompasses the JTF commander's attempt to understand not only how a particular chain of causes and effects has unfolded to date but also how both physical and psychological chains are most likely to continue to unfold and what this might imply for Task Force missions. This cause-and-effect analysis should be dynamic enough to reflect not just what has happened but also the continuing cas-

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<sup>170</sup> In the Libyan case, while the historical database resided at the FOSIF, the detailed accounts of each interaction with Libyan aircraft derived from pilot debriefs were compiled within the Battle Force, updated with each encounter, and provided to pilots on the following sorties. These internal and external efforts combined to yield a running *sense* of the situation including factors such as the changing aggressiveness of Libyan pilots from one encounter to the next as well as from one Attain Document Operation to the next.

<sup>171</sup> In the Libyan operation, this involved my reading Col. Qhadafi's *Green Book* and open source speeches to obtain a sense of how he thought and might react to various proposed actions.

<sup>172</sup> Smith, *Effects-Based Operations*. p. 448.

cade of new effects and new information. And it should consider how the ongoing cascades might affect the Task Force itself, forces in contiguous commands, and higher commands. Such considerations are particularly important to planning because the gravity of a continued unchecked evolution of a particular situation or cascade of effects begins to define the level of risk that a commander might be willing to accept in a course of action. The prospect of a nuclear or biological attack on coalition homelands, for instance, would have a considerable impact on a commander's assessment of what risks to his forces would be "acceptable."

### **Planning (Decisionmaking process)**

The decisionmaking process that is entailed in Joint Task Force planning begins with a *forward* projection of the above sense to evaluate options for shaping a desired end-state, and continues with the choosing and planning of a course of action.

- Projected sensemaking

For the JTF commander, projected sensemaking embodies a "what if" exploration of actions that might be taken to alter the course of an evolving situation.<sup>173</sup> In exploring these "what if" options, Task Force planners will start by defining the desired behavioral end-states and then work iteratively through the actions possible with the combinations of capabilities available, the direct effects that such actions might achieve, to the cascades of indirect effects that might bring this to a desired direct effect and the potential unintended consequences of the cascading effects.

- Desired end-states

In the multi-level interactions of a system of complex adaptive systems, the desired end-state will not be unitary but will reflect the impact of actions on different levels and in different arenas of interaction. For the JTF planners, this means considering how short-term tactical end-states over the course of multiple cycles of action and reaction<sup>174</sup> might add up to an aggregate end-state supporting some broader statement of higher level command intent.<sup>175</sup> For example, the commander might accept a short-term negative result to attain a

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<sup>173</sup> In the Libyan operations, the JTF commander and staff had to project a sense made of past Libyan actions into estimates of the probable Libyan reactions to the specific demonstrations of force under consideration. The staff bounded these probable reactions by looking at the various actions that Libya was physically able to undertake (e.g., military capabilities and proficiencies) with estimates of the Libyan decisionmaking structure and of the personalities involved, especially that of Col. Qhadafi himself. This bounded forward sensemaking yielded five “most probable” Libyan reactions that served as the basis for the proposed Battle Force responses. These proposed responses then became the basis for another round of forward sensemaking considering potential Libyan reactions to each of these proposed responses and what the Task Force/theater responses to these in turn might be. This is to say that the planning process did not follow the standard prescription of generating three courses of action to be evaluated and tested *ex post facto* by wargaming or red team analysis. Instead, the effects-based focus on Libyan reactions necessitated an approach in which action-reaction cycles were iteratively projected through a series of follow-on cycles.

<sup>174</sup> In the Libyan case, this meant projecting first to the short-term end-state of a particular tactical cycle, then to the aggregate interactions of a particular day, of a given operation, i.e. Attain Document I, II or III, as well as to a longer term end-state defined in terms of realizing the geo-strategic end-state set out by the White House.  
Smith, *Effects-Based Operations*. Chapter 10.

<sup>175</sup> Prisoner interrogation methods in the Afghanistan and Iraq operations are a case in point. The interrogations may have produced desired tactical end-states by providing counterinsurgency intelligence, but they also produced repercussions that hampered the overall effort to win popular support.

more important long-term goal or accept a negative result in one arena to attain a long-term goal in another. The commander's challenge is therefore to assess what tactical and operational level end-states (both short-term and long-term) contribute to the military-strategic or geo-strategic end-states defined in command intent.

- Capabilities

The Joint Task Force's capabilities assessment is the "what can we do" *yin* for the "what are our options" *yang* of effects assessment. Like surveillance assets, the JTF operational capabilities fall into three categories: organic, non-organic, and accessible. The importance of this distinction becomes apparent when we consider that, given our broad definition of effects-based operations, the capabilities that may be potentially considered by a JTF commander may extend across the spectrum of the nation's political, military, diplomatic, and economic power, as well as across those of allies and coalition partners.

In an effects-based approach to operations, the JTF must address not only the question of *what* capabilities might be applied but must take another step and address the critical question of *how* the capabilities are to be applied. Given the nature of complex adaptive systems, it is unlikely that Task Force planners will be able to identify a single action creating a single direct effect that produces the desired end-state. Indeed, the multiplier of the effects-based approach derives from the ability of a single action and direct effect to create a cascade of indirect effects that will as a whole achieve the desired end-state. Moreover, because the effects-based approach encompasses diplomatic, economic, and political capabilities, actions are likely to take many forms and to create different cascades

of indirect effects in different arenas. Determining which actions, effects, and cascades are required therefore demands evaluating potential actions, effects, and cascades in different time dimensions, across multiple arenas, and over different sets of actors: friend, foe, and neutral; state and non-state.

In effects-based endeavors, this task presents three challenges. First, because the end-states desired will result from what observers see, all observable aspects of an application must be taken into account: what the action is, the kind of force used, its scale, operational and geographic scope, and its speed, duration, and synchronicity—with planners assessing how each aspect might shape observer reactions.<sup>176</sup> Second, because an action or effect at one level of one arena can create effects at different levels of completely different arenas,<sup>177</sup> and because any negative consequences will not be limited to the Task Force's own arena, the Joint Task Force must somehow mesh any proposed action with those of the other elements of national and alliance power on different levels and in different arenas. Finally, because the impact of any proposed action will affect future cycles of interaction, the Task Force planners will need to project the cascades of physical and psychological indirect effects that they create—both good and bad—through future cycles of interactions.<sup>178</sup>

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<sup>176</sup> This is explained in more detail in: Smith, *Effects-Based Operations*. p. 234.

<sup>177</sup> Indeed, it is the very ability of military action to set a political and diplomatic effects cascade in motion that has historically provided much of their value in crisis response operations.

<sup>178</sup> Some of history's most bloodthirsty conquerors have sought to create a reputation for terror in order to quash any future resistance. Tamerlane or Timur-il-link's 14th century conquest of India and the Middle East involved beheading all of the inhabitants of any city that resisted (20,000 in Baghdad in 1401) as a warning against any defense.

- Required actions and effects

Given a set of available capabilities, the JTF planners must figure out which capabilities or combinations of capabilities used in which way might produce the direct effects and subsequent cascades of indirect effects that might lead to the desired end-states. In the case of a cascade of physical effects, these relationships are relatively linear. For example, we might track all of the power lines emanating from a power plant to be attacked so as to identify the facilities they support and thereby assess the physical impact of a power cut-off. However, effects have both physical and psychological dimensions and each indirect physical effect in a cascade has the capacity to spawn new cascades of psychological effects, each of which will create perceptions that may vary with the individual observer. The options evaluation, therefore, quickly becomes a balancing of trade-offs between desired physical and psychological effects and probable or even possible unintended consequences likely to be created at various levels. A good example of this balancing is the history of the 1944 Allied air campaign in northern France prior to D-Day in which planners needed to destroy railways that might be used to move armored forces to the invasion beach without giving any indication that Normandy rather than the Pas de Calais was the target of the planned invasion.<sup>179</sup>

However, the Task Force planners must also consider that indirect effects and behavioral outcomes are by no means confined to the foe, but will occur in other observers: friends, neutrals, and our own domestic public. For example, an option that succeeds in creating the desired effects and behavior in the foe but

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<sup>179</sup> For a more detailed account, see: Smith, *Effects-Based Operations*. p. 356.

that, at the same time, creates adverse effects in key neutrals or sufficient political problems in allies to cause a coalition to fall apart would probably not be judged to be viable.<sup>180</sup> In these latter cases, the criterion is less the efficacy of the option in shaping the behavior of the foe so much as it is its impact on the behavior of other observers. This is equally true of the domestic public for whom the acceptability of an action is also a function of how that action squares with its societal self-image. For example, beheading insurgents might be judged to be an effective way to deter an insurgency but would be so much at odds with Western societal self-images as to undermine support for continuing the conflict within a domestic public or within a coalition.<sup>181</sup>

- Options choice/planning

Translating feasible options into courses of actions involves a choice as to which options offer the best prospect of achieving the effects and outcomes sought in a given situation and time. This means assessing prospective courses of action in the context of an ongoing interaction between complex adaptive

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<sup>180</sup> The classic example of this is Melos' declaration of neutrality, which incited the Athenians to besiege, massacre, and enslave the island in 416 BC. McKenzie, Kenneth F. *The Revenge of the Melians*. McNair Paper No. 62. Washington: National Defense University. 2000. pp. ix-x.

<sup>181</sup> The definition of what is or is not an acceptable response option is a function of perceptions and culture and, thus, of societal influences on multiple fronts: those of the planners, the opponent, partners and allies, and neutrals both in the region or across the globe. Because all of these constituencies will see a given action differently and because it is unlikely that an action can be optimized for all observers, any acceptability assessment is also likely to involve complex trade-offs balancing the need to create a set of desired effects in one direction against the potential deleterious effects in another. The wider the scope of these considerations, the higher in the systems' hierarchy the acceptability assessment will ultimately be made.

systems in which each cycle is only one iteration in a succession of cycles in a spreading web of interactions that extends in many different directions and over time. JTF planning will therefore need to consider at least four successive cycles: the cycle that produced the stimulus, the cycle being planned, the cycle encompassing immediate observer responses to that action, and the cycle that would constitute the JTF response to that reaction, i.e. the “what do we do then?” However, logic tells us that wherever and whenever possible, good effects-based planning ought to extend well beyond these four cycles, backward to the succession of cycles or interactions leading up to the stimulus, and forward to the succession of additional cycles by the foe and ourselves and by friends and neutrals that may flow from the four-cycle interaction described.

- Choose

The process of choosing the correct course of action entails fleshing out the options examined and applying of a set of qualitative metrics comparing aspects such as the feasibility of the prospective course of action. For example, which course of action would make the best use of the assets at hand? Which poses the least risk given the estimated threat or at least a risk commensurate with the gravity of the task? Which is most tolerant of the inevitable unknowns? Which have some single point of failure? Similarly, courses of action might be compared with respect to their flexibility and robustness, and thus their relative ability to adapt to opportunities created by the action and to change in the face of the widest range of possible responses both in the current cycle and in following cycles. And, they might be compared with respect to their relative timeliness, their ability to be conducted quickly enough to meet the requirements for the desired effect, and/or to be sus-



tained for long enough to achieve the effects, and perhaps to provide actions that can be synchronized with other actions in other arenas. Notice that in this, the Joint Task Force's planning process would differ little from the standard approach to military planning save in one regard. The metrics for assessing the worth of one option over another are denominated in terms of the attributes of the actions to be undertaken as they would be seen by other observers and not simply the ability to destroy a given target.

One crucial difference in this process of choosing actions is that the choice is no longer limited to military actions but extends to the political, diplomatic, economic, and even cultural potential of a whole-of-nation or whole-of-coalition effort. That is, it extends across all of the agencies of a government and only slightly resembles the traditional, military-only, "cookbook" approach to planning. The sheer breadth of this endeavor also imposes a need to consider how all of the elements of the whole will interact to create the needed unity of effect and, by extension, to gauge how all of the cascading effects will interact. Indeed, because actions in one arena or by one actor can add to or detract from those of another, the choices and planning needed *cannot* be restricted to one or another arena or one or another actor but must ultimately extend across a whole nation or coalition. This means that any process for choosing a course of action must provide ways of identifying possible effects (e.g., fratricide) and deconflict actions to create a unity of effect.

- Coordination

Because observers will put any action or set of actions into a context that includes other similar actions, other national, coa-

lition, or organizational actions taken at the same time, each action by each actor has the potential for either adding to or nullifying the effects created by other actors. If these actions and effects can be deconflicted, then the effects can be made additive. Even better, if the actions in an option can be made to work with each other, then each action may be able to build synergistically on the effects of the others so as to push observers toward the same behavioral end-state. On the other hand, if we fail to deconflict them, then actions may cancel each other out, producing no discernable direct effect and a confused foe. Worse still, the actions in aggregate may produce synergies that are completely the opposite of what was intended. The real goal is to operate synergistically upon the perceptions of the observer and to create the unity of effect that involves all agencies and coalition partners (see Figure 24).

Although blue-on-blue deconfliction is a familiar part of military planning, effects-based approaches add two new dimensions by requiring: (1) that the deconfliction apply to political, diplomatic, and economic actions and effects as well as to military actions and effects; and (2) that it applies to the psychological as well as physical effects. Although the complexity of these challenges represents a major headache for planners, the variety and depth of the potential responses it can generate can pose a still greater challenge to would-be opponents who must now stand to be surprised by the response as they hoped themselves to surprise by their actions. This breadth of possible responses is particularly significant when confronting the suicidal adversaries of the post-9/11 world for whom a threat of retaliation is meaningless because deterrence of such opponents is likely to hinge on the terrorists' assessment simply of whether or not their actions can

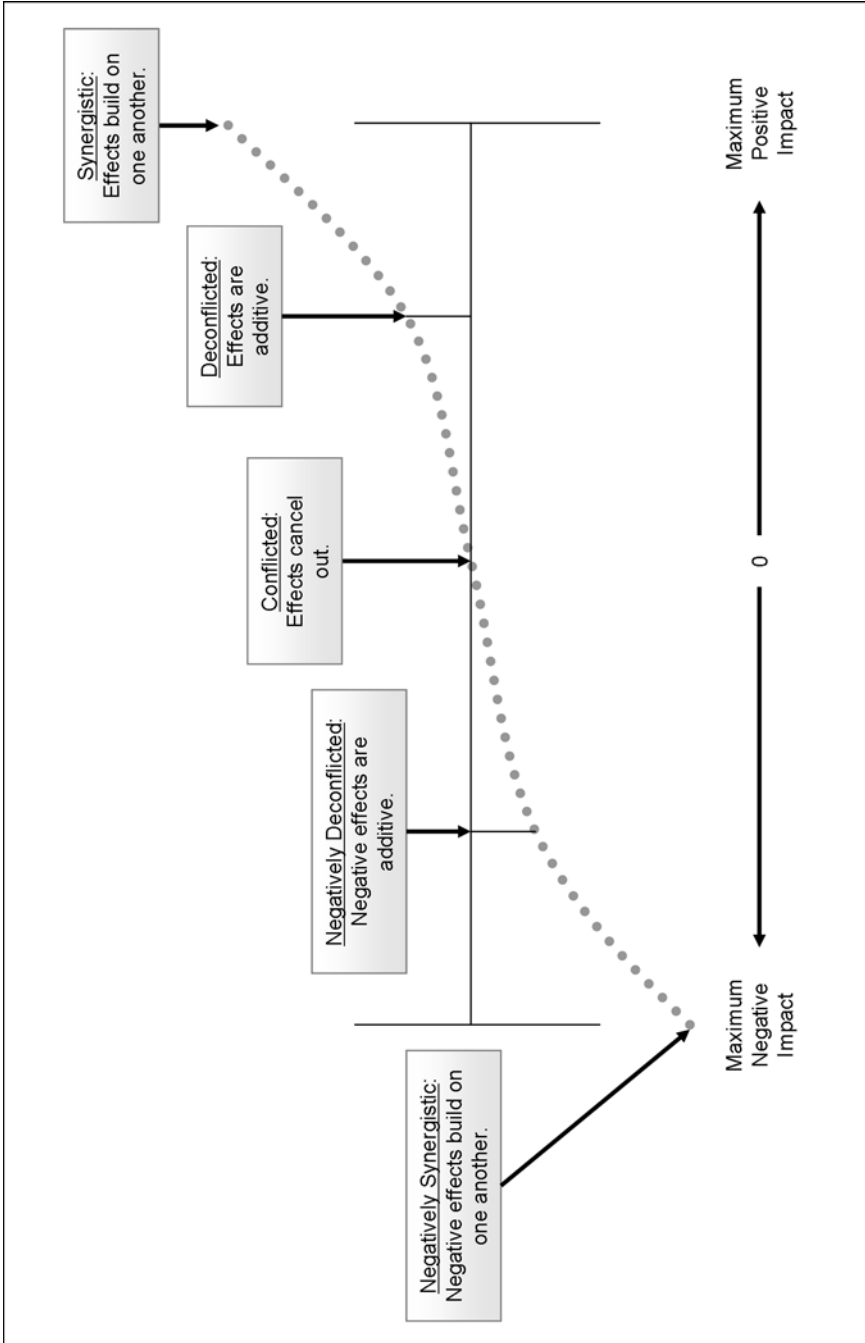


FIGURE 24. UNITY OF EFFECT:  
COORDINATION OF ACTIONS TO MASS EFFECTS

succeed and of how their foe's reactions might run awry and hamper the future efforts of "the cause."<sup>182</sup>

- Planning

The planning process for a course of action implies at least three subprocesses: one to task each of the capabilities to be used; another to coordinate the actors involved to deconflict actions and ideally to achieve a synergistic unity of effect; and a third to communicate an understanding of the plan to those who are to execute it. The first will vary depending on whether the assets involved are organic to the command, are non-organic but taskable, or cannot be controlled in any meaningful sense but must nonetheless at least be coordinated to achieve a desired end-state.

## **Execution**

The human-centric focus of effects-based operations requires an execution that can be every bit as precise in its accuracy and timing as the precision targeting of a key node in an electric power generation or communications system. However, given the fact that in interactions between complex adaptive systems, the exact circumstance under which a plan is to be executed will always be changing, precision of execution means adapting the actions even as that observer is changing. This entails adapting actions both to the observers targeted and to the immediate context in which they will be seen. This suggests that any plan must allow those executing

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<sup>182</sup> Rhodes, Edward. "Conventional Deterrence: A Review of the Empirical Literature." *Second RMA Round Table*. Tysons Corner: SAIC. 1997.

it the latitude to adapt to the circumstances existing at the moment of execution.

- Controlling observables

Because effects derive from the right observers seeing the right aspects of an action at the right time to create the desired effect and because these will be continually changing, those executing the JTF plan must fine tune their actions to take into account any changes in the observers' ability to see those actions. In practice, this means monitoring and adapting to the observers' surveillance system or other collection means to ensure that the right aspects of the right actions are detected and coordinating the units applying the stimulus to ensure that each creates the right impact. Thus, success in JTF execution involves an understanding of which facets or attributes of the action will be seen by observers and then adjusting actions undertaken accordingly.<sup>183</sup>

The process of adapting to observers involves translating an execution order into the terms of a local situation. An order to "take the town," for instance, might be translated in its execution into a series of house-to-house engagements. Similarly, an order to make contact with rival factions might be translated into a series of delicately orchestrated meetings with the people involved. Moreover, adapting a plan or order to fit the circumstances usually means adapting it to meet the demands of a very different operational pace and to a different and probably

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<sup>183</sup> Eight such observables appear obvious: what the action was; what kind of force, diplomacy, or other application of power was used to execute it; on what scale; where; over what operational scope; how fast; for how long; and with what demonstrated degree of coordination. These are explained in more detail in: Smith, *Effects-Based Operations*, pp. 234-250.

much more detailed tactical or operational level of knowledge of the situation.

In effects-based approaches, the challenge for tactical commanders is to ensure that the actions are seen by the targeted observers as the Joint Task Force plan intends. It would do little good, for instance, to have carefully crafted a response of a certain scale if that scale were not detected and reported.<sup>184</sup> Thus, successful Task Force execution rests heavily upon a knowledge of the observers' awareness creation process and, probably, of what can or cannot be detected or collected at a given time. This again is not a new principle. Strike operations have always sought to avoid enemy radars or to decoy or destroy sensors and command centers so as to permit aircraft to press home an attack. To do likewise in the all-embracing world of effects-based approaches, we similarly must know how the observer detects actions and creates his situational awareness both from the standpoint of what his sources of information are and their limitations, and from the standpoint of what he has likely seen in the past (his reference point for understanding the action).

Additionally, in an international system of complex adaptive systems, the actions executed play to diverse audiences composed of all those who may observe the action either directly or indirectly and especially those key players whose reactions and further response may be critical to the success of follow-on action-reaction cycles. Thus, those adapting and carrying out

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<sup>184</sup> This question of an opponent seeing and understanding the nature of an action was a cardinal feature of strategic nuclear deterrence theory during the Cold War and required some knowledge of the opponents' decisionmakers and decisionmaking process, but perhaps more importantly, a model of the surveillance system by which an action would be seen.

the action need to know what elements of the audience will see what and when they will do so, much as the Army Captain in Najaf understood that his actions would be seen by the evening news media audience.<sup>185</sup>

- Context

Observers will see Task Force actions in the context of all of the actions they can see at the time of execution and interpret those action on the basis of how they resemble or differ from other actions taking place at the same time. The greater the frame of reference of the observer, the wider will be the set of actions comprising the context. A coalition patrol in Iraq, for example, would be seen in different ways by Kurdish, Shi'i, and Sunni observers in the same village, reflecting differing contexts and histories. These contexts are critical at all levels of execution because they can increase the direct effect of an action, confuse or detract from that effect, nullify it, or cause exactly the opposite effect of that intended by the planner.

These contexts are built partly of actions that can be controlled and partly of those actions that cannot be controlled either because history cannot be rewritten or because the actions come from other parties whom the commander cannot control. The commander may, for example, have some control or influence over the actions of coalition partners, little influence over the actions of neutrals or non-governmental organizations, and still less over adversaries save to the degree that his own actions can shape their behavior. The task of the executing commander is to control most of the visible actions being undertaken and, perhaps, to build upon precedents and

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<sup>185</sup> Wilson, "Over 60 Days." p. A-17.

existing perceptions.<sup>186</sup> The task in executing the action is to operate within and, where possible, to exploit a given context by optimizing or, as need be, minimizing the *deltas* presented by the action so as best to control the perceived differences from a known context that are likely to drive observer behavior. Because this context cannot be fully predicted and will change constantly, creating the right direct effect will require constant adaptation by those executing it no matter how good the original plan may have been. In Iraq, for example, the tactical commander's or *strategic corporal's* knowledge of a neighborhood will likely be the key ingredient in adapting actions to a changing context for best effect.

- Feedback

Finally, the executing force will be the JTF commander's first source of feedback on the operation. In effects-based efforts, this reporting will include whether the action was observed or felt and the intended direct effect achieved. However, the feedback from executing forces might also include information on any immediately noticeable reactions (e.g., the lights going off in adjacent areas) or changes in behavior (e.g., an increased alert status). Together, these will provide the first inputs to awareness creation in the next cycle of interaction.

## **Social influences**

Social influences are not a process in the same sense as the other essential processes but are nonetheless a key consideration in the JTF planning process in several significant ways. First, the entire effects-based problem that the commander is

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<sup>186</sup> Manthorpe, "Perception Management Today." p. 9.



trying to deal with is defined in cognitive and social terms so that success in JTF sensemaking, decisionmaking, and execution are dependent on an understanding of the social influences involved. However, they are reflected in a very different way as well. They define the bounds of what is or is not acceptable to the public and leadership of the nation or coalition for which the JTF is acting. The greater the speed at which the JTF commander and subordinate tactical commanders are required to act and react, the more the commander will require some sense of the limits of the national and upper level consensus supporting him.<sup>187</sup> Even more, there will also be a need to define the limits of what other cooperating actors such as non-governmental or international organizations may deem acceptable in continuing support. As this infers, the command will be required to understand the social influences in play in a diverse array of other institutional, national, and coalition actors. Indeed, this understanding of the multi-faceted social influences in play is a critical factor in any contest of psychological attrition because it is exactly in the social domain that the real battles play out.

Of the three cases, the JTF commander would arguably have the most resources immediately at hand but, unlike the others, would also have access to the resources of a large state and potentially to the still larger resources of a coalition of states. However, he would also have to work within an extensive, formal, and—at least on the surface—doctrinaire hierarchical

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<sup>187</sup> This poses a dilemma. The pace of an interaction (especially at the tactical level) may be expected to far outstrip any ability to obtain a political consensus before each action, and any effort to incorporate such guidance would make the Task Force vulnerable to a more flexible foe, yet acting independently runs the risk of outrunning the national or coalition consensus and potentially undermining the military-strategic or geo-strategic end-state that the Task Force's actions are meant to achieve.

organization. Yet, this formal organization would be only part of the actual organization, which would also contain informal sets of interpersonal “team” relationships, the extent and activity of which would vary as a function of the commander’s leadership style.

As in the case of al Qaeda, the commander’s problem would be global or regional in scope although tending to be serially area-specific in its operations, that is, Joint Task Forces are usually part of a global national or coalition reaction capability and, as such, are expected to act in a succession of specific individual areas as directed. In this capacity, the Task Force commander would have the capability to bring sufficient operational and information resources to bear to support a conventional military dominance in any specified area but, without supplemental inputs, the Task Force would not have enough local information (and especially the deep local knowledge and expertise) to dominate all of the areas of interaction that might be tested by a deft asymmetric adversary.

## COMPARING CASES

A comparison of the three cases offers an insight into how each adapted the effects-based approach to deal with their specific problem set, resource constraints, and organization. In Figure 25, we can trace the broad outlines of how some of these differences affect the respective approaches to the conduct of effects-based operations by comparing how each handle the essential steps.

In the case of the village elder, a classic style of effects-based operations based on local social networking works well on a small scale but is almost entirely built of interpersonal relation-

Village Elder	Al Qaeda	Joint Task Force
<p><b>Awareness Creation</b></p> <ul style="list-style-type: none"> <li>• Ad hoc human tasking</li> <li>• Human and open sources</li> <li>• Decisionmaker fusion</li> </ul>	<p><b>Awareness Creation</b></p> <ul style="list-style-type: none"> <li>• Case-by-case tasking</li> <li>• Human and open sources</li> <li>• Decisionmaker collation/fusion</li> </ul>	<p><b>Awareness Creation</b></p> <ul style="list-style-type: none"> <li>• Formal tasking process</li> <li>• Organic, non-organic, accessible/sensor heavy</li> <li>• Multi-level fusion</li> </ul>
<p><b>Sensemaking</b></p> <ul style="list-style-type: none"> <li>• Local knowledge/history</li> <li>• Decisionmaker "sense" of situation/trends</li> </ul>	<p><b>Sensemaking</b></p> <ul style="list-style-type: none"> <li>• Knowledge base/ad hoc by type</li> <li>• Multi-level cascades/trends</li> <li>• Theological scaling/timing</li> </ul>	<p><b>Sensemaking</b></p> <ul style="list-style-type: none"> <li>• IPB and ONA and Blue/Red Team*</li> <li>• Local to national "sense" of situation, multi-level trends</li> </ul>
<p><b>Decisionmaking</b></p> <ul style="list-style-type: none"> <li>• Decisionmaker projection</li> <li>• Decisionmaker end-state, effects, actions estimate</li> </ul>	<p><b>Decisionmaking</b></p> <ul style="list-style-type: none"> <li>• Immediate vs. infinite projection</li> <li>• Franchised planning/execution</li> <li>• Local coordination</li> </ul>	<p><b>Decisionmaking</b></p> <ul style="list-style-type: none"> <li>• Staff projection with ROE/guidance</li> <li>• Formal staff PMESII planning process</li> <li>• Local military coordination</li> </ul>
<p><b>Execution</b></p> <ul style="list-style-type: none"> <li>• Decisionmaker observables/context assessment</li> <li>• Human feedback</li> </ul>	<p><b>Execution</b></p> <ul style="list-style-type: none"> <li>• Surveillance: Attach vs. campaign</li> <li>• Local context/coordination</li> <li>• Media feedback</li> </ul>	<p><b>Execution</b></p> <ul style="list-style-type: none"> <li>• Local surveillance/observables estimates</li> <li>• Local/Upper Level coordination</li> <li>• Tactical/Task Force feedback</li> </ul>
<p><b>Social Influences</b></p> <ul style="list-style-type: none"> <li>• Decisionmaker assesses limits of actions</li> </ul>	<p><b>Social Influences</b></p> <ul style="list-style-type: none"> <li>• Local and movement acceptance</li> <li>• Franchise interests/mores</li> </ul>	<p><b>Social Influences</b></p> <ul style="list-style-type: none"> <li>• Local: Teamwork/Leadership</li> <li>• Upper Level: ROE/guidance</li> </ul>

\* IPB – Intelligence Preparation of the Battlespace  
 \* ONA – Operational Net Assessment

FIGURE 25. COMPARING CASES

ships that would take decades to develop. In the case of al Qaeda, the effects-based approach takes two different forms: intricately planned major international terrorist operations and guerrilla-style tactical terrorist operations. Both depend on the networking of interpersonal relationships in a franchised form of fanatical Islamic fundamentalism coupled with cell-style regional franchise and internal organization, with both in turn relying on the Internet and on a global media for achieving “strategic” end-states. In the case of the JTF commander, the problem takes a different form—effects-based responses to a situation from outside the region—and relies heavily upon extensive communications networking to amass knowledge of an unfamiliar physical and social terrain—conceivably the most challenging of the three problems.

The cases underline several key points.

- First, the assessment, planning, and execution process in one form or another is basic to human interactions and as much a part of the reactions of the would-be neutral as it is of the two contending parties in a conflict and as applicable to the non-state actor as it is to state actors and their militaries.
- Second, the process is by no means limited to a large staff and formal military organizations, but exists as much at the tactical level of interaction as it does at other levels.
- Third, the operation described did not require a highly technological network so much as it did the efficient networking of the assets that were available.
- Fourth, the tools or “conceptual equipment” required likewise were not those of exotic mathematical models, but an amalgam of relatively linear analyses, models, and human expertise.

- Finally, many of the complex calculations involved would have been conducted in the heads of the decision-makers and their advisors using analogies of what they collectively knew from previous situations.

## CONCLUSIONS

In Chapter Four, we describe a set of essential processes that make any action-reaction cycle function and outline the basic problem set that was their *raison d'être*. As the term *essential processes* implies, these processes and problems are generic, that is, they apply to all systems attempting to pursue an effects-based approach to operations whether in a military context or in a broader whole-of-nation context. In this chapter, we apply this generic model to examine how the essential processes are reflected first in the basic planning, execution, and assessment process, and then to examine the requirements and problems faced by three very different “commanders” and how they might apply an effects-based approach. As the diversity of the problem sets and the resulting requirements that each commander faces indicate, the effects-based approach will vary across commanders, situations, levels of the complexity hierarchy, arenas of interaction, and time.

The examples reviewed present an image of a diverse array of situation-specific problems and requirements contained in the context of a set of generic essential processes and tasks. This image in turn brings us to the next question: what are the potentially decisive variables that might be exploited in conducting an effects-based approach to operations? One element of the answer is clearly the capabilities of the individual decisionmakers involved and hence their ability to recognize the options, to choose the right ones, and to exercise them effi-

ciently. Logically, the more able, far-sighted, innovative, experienced, and educated the decisionmaker is, the closer he or she might be expected to come to exploiting the full potential of the options that the decision space might offer.<sup>188</sup> Another element lies in the agility of the commander to act, react, adapt, and evolve; although in part a function of the leadership and team-building efforts of the commanders, it is also a function of organization and doctrine, particularly in the degree of the freedom of action accorded. Still another element, already evident in the examples, is the collection of capabilities a commander or decisionmaker can bring to bear to assess, plan, and/or execute and thereby deal with a particular problem and meet its specific requirements—essentially a decision space. This decision space, however, has two dimensions: a space described by all of the capabilities available to that decisionmaker at a given time and location and in a given arena, and a much larger space that reflects all of the possible combinations of these capabilities that can be networked together for application.

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<sup>188</sup> An analogy here is the situation of a fighter pilot. The pilot's capabilities-based decision space is a function of the performance envelope of the aircraft he or she is flying: how high, how fast, with what turn rate, etc. Within this performance envelope is a second more idiosyncratic decision space described by the capabilities of the pilot himself. With better airmanship, greater and more realistic experience, and more hours flying the aircraft, the pilot will be better able to "push the envelope" of the aircraft, that is, to use a greater proportion of the capability decision space. Much as in the case of Clausewitz's *zweikampf* wrestlers, in a clash between two aircraft there will be two sets of decision spaces in play. Each aircraft will have a decision space defined by the aircraft performance envelope, but it will also have a decision space defined by the relative capability of the pilots involved to use that decision space and to exploit any advantages that it might afford over the opponent or that their own capability and training might afford.

The next step is to focus more closely on how these elements might figure in the decision space of the JTF commander with a particular emphasis on how networking might either expand the decision space afforded by the collected capabilities of a whole-of-nation or whole-of-coalition approach or to expand the knowledgeability of decisionmakers by providing them with better networked support to bound more sharply the complex assessment, planning, and execution decisions they must make.





## CHAPTER 6

### SEIZING A DECISIVE ADVANTAGE: NETWORKING AND EFFECTS-BASED APPROACHES TO OPERATIONS

**T**his book begins with an assertion that what is new about effects-based approaches is not the concept that they represent but the prospect of applying Information Age thinking and network-centric (or network-enabled) operations to making the resulting operations better. One network-centric contribution seems obvious: faster and more precise targeting and better communications connectivity can demonstrably improve those aspects of effects-based approaches revolving about attrition-based major combat operations. Yet, as the preceding chapter underlines, the really hard challenges in effects-based operations lie in coping with the sheer complexity of what commanders are asked to do in assessing, planning, and executing operations that are at once human-centric, cross-spectrum, and whole-of-nation. These challenges are made still more pressing by the fact that it is exactly such complex interactions that are at the heart of our confrontations

with the asymmetric foes of the post-9/11 security environment and are at the core of the challenge faced by a Joint Task Force commander. How then might network-centric operations be combined with effects-based approaches to achieve a decisive advantage?

The issue at hand here is not whether we can conduct effects-based approaches to operations. We already do so in many and varied ways. It is rather how much better we might be able to conduct them with Information Age thinking and technology. And, it is not about using such tools to arrive at a precise quantifiable answer anymore than it was for the village elder to do so. The world and the problems faced remain complex. The real goal is to increase the probability of success of the decisions we make, the actions we take, and the effects we create. This increase is where the hope for a decisive advantage in operations that are both network-enabled and effects-based is really to be found.

## CLASSIC VS. INFORMATION AGE EFFECTS-BASED APPROACHES

In the three examples in the previous chapter, the village elder, al Qaeda, and the JTF commander all use some form of effects-based approach to deal with very different kinds of situations. There is a temptation to look at the apparently simpler operations conducted by the village elder or al Qaeda and perhaps to conclude that the asymmetric competitors have the advantage. In actuality, if we compare the Joint Task Force with the others in terms of networked support and the tools that might thereby be made available, the reverse may be true.

Complexity theory tells us that there are no definitive solutions to complex problems and that we must be content with bounding the nearly infinite possibilities to a set of most probable answers. In classic effects-based approaches, this bounding function is carried out in the heads of decisionmakers in various venues and may end up being proffered as intuition, guessing, or a “feel” for the situation. In actuality, this intuition is usually based less on some esoteric analysis of the problem than it is on analogies that are consciously or unconsciously drawn between the current situation and some similar preceding situation known to the decisionmaker. Although, as this implies, the probability of a correct “guess” might be expected to increase with the experience level of the decisionmaker, the reality is more that a richer experience base brings a richer library of potential analogies to the individual’s mental model and thus an increased probability that one of these previous situations will resemble the situation at hand.

If we look at how the village elder and al Qaeda chieftains handle the complexities of their effects-based operations, it is apparent that both take what might be described as a classic approach. They rely on the experience, intuition, and innovative skills of the human decisionmakers involved. The drawback is that the decisions and assessments made are only as good as the individuals making them—and the convenient presence of a military or political genius at a critical juncture is far from guaranteed. In this respect, the case of the Joint Task Force is only marginally better. Its decided advantage in connectivity allows it, at least theoretically, to access a web of other decisionmakers that are more expert in specific problem areas, e.g. in estimating the diplomatic fallout or cascades that might be occasioned by a particular action. That is, with networking, the quality of the decisions is no longer dictated by

the abilities of a single decisionmaker but by those of the aggregate of decisionmakers who might contribute to the decision. Logically, with more time and a wider network, the advice and the decisions are likely to be much improved.<sup>189</sup> Similarly, connectivity also allows the Joint Task Force to access and query a large national knowledge base and potentially to provide a kit of analytical tools and models that might also be applied to refining its estimates and decisions.<sup>190</sup>

The classic effects-based approach is that of the village elder and his counselors who depend on an established social network and the expertise of a limited number of contributors. Al Qaeda seems to represent a hybrid. There are local social and movement-wide social networks to contribute expertise, but the networks are facilitated by access to modern commercial communications. More importantly, the linked regional and international media become al Qaeda's battlespace in achieving its desired operational and strategic end-states. The JTF commander presents a different hybrid with capabilities designed primarily for symmetric attrition-based operations, with little local social networking in the area of operations, but with a professional team and the capacity for significant reach-back. The comparison also suggests three measures for assessing effects-based operations: the quality of the human decisionmakers, the quality of the networking, and the quality

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<sup>189</sup> These advantages must be balanced by some realities. The decision that is so well staffed as to be late does little to aid the commander, and assessments that represent so many analytical and bureaucratic compromises as to be meaningless are likewise going to be worthless.

<sup>190</sup> If in practice this reach-back falls short, it is more often from a lack of social networking to include organizational and bureaucratic hurdles and an insistence on hierarchical niceties rather than from a lack of physical connectivity.

of the support to the human decisionmakers that networking might provide.

In looking at the quality of the human decisionmakers, it seems obvious that greater experience, better education, and better training can improve the quality of the decisions. However, it should also be obvious that the potential for such improvements is not restricted to Joint Task Forces or large nation-states but is within the grasp of the asymmetric challenger who, it must be remembered, is also likely to have a greater familiarity and experience with the local situation.<sup>191</sup> This implies that any improvement in the quality of the human decisionmakers by itself—however much merited in its own right—is not likely to provide a decisive advantage for the Joint Task Force commander. This leaves two other variables in play: the quality of the networking and the quality of the support the networking provides, both of which can have a major impact on the quality of human decisionmaking.

## NETWORKING: COMMUNICATIONS AND SOCIAL

When we look at the quality of networking, it is immediately evident that we need to make a distinction between two different kinds of networking: communications networking and

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<sup>191</sup> The JTF commander responding to an emergent situation, by contrast, is likely to be heavily reliant on organic sensor reporting and lacking in organic human reporting. The latter can be provided by non-organic assets either from other agencies in his own state or from allied Services and from local militaries and police, but will have a varying validity with those from national intelligence agencies generally validated before release and those from local entities requiring further validation often with few means of doing so. The longer the Joint Task Force remains in an area and the more extensive the human reporting it creates, the better the reporting is likely to become and the easier the validation problem will become.

social networking. The communications networking can be defined in terms of the ability to link nodes—human or machine—with a means of transmitting data, information, and knowledge. The better able the network is to transmit these to the right node at the right time, the better the quality of the networking becomes. When the nodes in this network are machines and what is being transmitted is data, the communications networking challenge appears straightforward. We basically need to ensure that the various parts of the network are interoperable and able to handle the data being transmitted. If this handling includes some form of collation and validation, we can then speak of an “information” vice “data relay” system, and if we define “knowledge” simply as the aggregate of information, we can speak of the “knowledge management” capabilities of our networking in handling this aggregated information. If we define networking solely in linear terms, therefore, communications networking might be seen as the answer to our needs. The problem is that data and information are only a portion of what is needed for effects-based operations. Effects-based approaches insist that:

- the problems and solutions are not linear but complex;
- the reporting of complex subjects and situations will be required;
- the knowledge needed is not just aggregated information but an internalized understanding of complex entities and situations;
- this complex understanding must somehow be transmitted; and
- this knowledge must be understood by people: reporters, assessors, decisionmakers, and warfighters.

In brief, the communications networking is only part of the story. To deal with the complexities of an effects-based approach, people must relate to people, an interaction in which the communications networking is but a medium for the required networking: the human social networking that will deal with the complex dimensions of what is after all a human-centered approach to conflict. Effects-based approaches are not about connecting nodes so much as they are about networking people.

In the examples, the Joint Task Force commander enjoys a clear advantage in communications networking with a high capacity network architecture that is ubiquitous, relatively secure, and interoperable to varying degrees. The decisive impact of this advantage on the level of situational awareness and operations was seen most clearly as the pace of conventional tactical military operations increased during the major combat phase of Operation Iraqi Freedom.<sup>192</sup> Yet, this impact diminished sharply as the battle shifted to an asymmetric foe avoiding conventional combat operations and focusing on a damage infliction strategy in a war of psychological attrition. In the case of social networking, although too great a reliance on social networking might have limited al Qaeda's tactical responsiveness, this was balanced by an ability to transform social networking into an agent network for human reporting,<sup>193</sup> a disparity that was accentuated by the Joint Task

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<sup>192</sup> The Office of Force Transformation conducted a study interviewing ground force commanders that reflected this impact, an impact that was most apparent in the speed of the operations and the ability of tactical commanders to take risks that might otherwise have been unacceptable.

Garstka, "*Fighting the Networked Force*."

<sup>193</sup> That is, the asymmetric challenger could use the depth of its affiliates' networks in many areas to acquire and vet human reporting.

Force commander's need to engage in whole-of-nation operations that presented a far wider social networking requirement.<sup>194</sup> The bottom line for networking, therefore, is an advantage to the Joint Task Force in communications networking and to the challenger in social networking—with neither impact by itself decisive.

This leaves the third variable: the quality of the support that networking is able to provide to human decisionmakers. It is all too easy to reduce this variable to a dichotomy in which capabilities such as blue force tracking and sensor architectures confer one kind of advantage on the Joint Task Force commander while social networking for human reporting and local expertise confers another on the terrorist, and to conclude once again that neither side has a decisive advantage. However, if we look instead to what the combination of communications and social networking might provide, a different picture emerges. The JTF commander has the prospect of building on two strengths: a superior communications network and a potential reach-back both to the massive knowledge and information assets of a major state and to far wider base of Information Age technologies. Moreover, this advantage is multiplied with each additional coalition partner incorporated into the network. The ability to link all of these knowledge resources together even by conventional phone lines or secure Internet seems in little doubt. The bigger challenge is to organize and orchestrate the people, knowledge resources, and technologies, that is, to engage in social networking such as “team building” and “agile organization.” The incentive is the

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<sup>194</sup> In part, the absence of such networking appears to be a function of the Joint Task Force mission. Local social networking is a product of extended operations in a particular area—not the desired norm for reaction forces who return to home bases once stability is restored.



prospect that the combination of communications and social networking could enable joint and coalition forces to handle the complexities involved in such operations better than their would-be challengers.

This discussion, of course, only raises additional questions. If human intervention is a necessary part of an effects-based approach, then how do we know who will need the support? What will they need, and when? And, how might we apply Information Age technologies, analytical aids, models, etc. to provide the needed support?

## HUMAN INTERVENTION, NETWORKING, AND THE JTF PROBLEM

This is where the dissection and drill-down of the effects-based action-reaction cycle comes in. We can use the essential processes and drill-downs or some similar dissection of the action-reaction cycle and its essential elements as a frame of reference in examining the Joint Task Force assessment, planning, and execution processes to see where we are likely to encounter the ambiguities and uncertainties and where the complexity is most likely to arise. That is, we can identify the points at which human intervention will be required and so begin to define a road map of human “nodes” that might need decisionmaking support.<sup>195</sup> As we drill further into each of these nodes and the problems, subprocesses, and questions it embodies, we can begin to identify which elements might be aided by additional inputs of information (e.g., from data-mining or the use of

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<sup>195</sup> This is not to imply that each node equates to a different human being, but rather that some human in the loop will have to deal with the complex problem identified in whatever form it may take.

intelligent agents); various forms of linear analysis (e.g., pattern analysis); cognitive and social modeling and simulation; or inputs from human experts in the specific kinds of complex subject matter that might be brought to bear through networking.

However, we need to be careful not to overstate the case. While the idea behind the notion of “essential processes” is of generic processes common to all complex adaptive systems, complexity theory argues that the needs of each commander and the requirements of each situation will be unique in many ways. Logically, therefore, the specific decision aids required will vary from one command and one situation to the next.<sup>196</sup> What we have rather is a single basic road map that permits us to identify those generic parts of the problem that may be subject to various kinds of linear analysis, or modeling, or expert input. This is to say, by extension, that we can identify the general parameters of decision support aids (e.g., knowledge and information base search and retrieval, human expertise, linear analytical tools, and modeling and simulation) that might be brought to bear via the communications and social networking to aid the Joint Task Force in its attempts to deal with the specific problem sets and determine roughly where they might be applicable in the basic effects-based action-reaction cycle.

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<sup>196</sup> In this respect, the Libyan operations by the Battle Force of the U.S. Sixth fleet in 1986-1987 offer a unique glimpse into a Joint Task Force over the course of the first of three Attain Document Operations over one-month intervals from January to March 1986 and the adaptation of efforts as the interactions evolved, and then in a reprise of those operations a year later after some lessons learned adaptation of capabilities and organization yet with the same staff and much the same forces but under a different commander.

### *Awareness creation*

The Joint Task Force displayed three distinct awareness creation requirements: (1) maintaining an operational picture, (2) maintaining a multi-faceted regional or global awareness, and as needed, (3) refining this awareness sufficiently to support the sensemaking that will undergird planning for specific operations, for example, moving from simply detecting and tracking to attempting to assess intentions and future movements. Although it may be tempting to view the first as merely a problem of collating sensor inputs (and therefore relatively linear), in point of fact it presents a complex problem for two reasons.

First, even the basic location data may be drawn from multiple organic and non-organic sources including both sensors and human or open source reports that must somehow be integrated into a single coherent picture. This means that not only are there the expected and non-negligible problems of sensor data integration, but also the “contamination” of any linear result with the not-to-be-ignored complex human reports. Even more, although we tend to think of this picture in terms of detectable platforms—ships, planes, and tanks—in the ground environment and especially in operations against an asymmetric foe, we must also think in terms of individual warfighters who may not be in uniform and who may be melded with a civilian population or, in a naval context, of “fishing” boats transporting arms and warfighting personnel. Because these fighters and transports are not very susceptible to reliable definitive detection by regular sensor reporting, it is the complex human reporting that becomes the foundation of the Joint Task Force operational picture.

Second, in an effects-based approach, this operational picture is not sufficient. Joint Task Force planning must address the potential cascade of indirect effects into and from the diplomatic, political, and economic arenas. Given the multi-level interactions between complex adaptive systems that this implies and the likely pace of these interactions, the commander cannot simply assume that some higher level command intent will cover all possible eventualities. Therefore, he will likewise require a complex awareness that extends to other arenas to include the factors driving the behavior of international and non-governmental organizations.

### **Human intervention**

In Figure 26, we begin to break out and identify some of the junctures (indicated by the ovals) at which the creation of this two-edged awareness will involve complex judgments and assessments and thus human intervention. The overall judgment as to what will or will not be reflected in the overall Joint Task Force awareness will remain complex for the reasons described above, but we can also drill down to a series of subprocesses: tasking, collection, and fusion. Because these, too, involve uncertainties, unknowns, unknowables, and assessments of multiple interdependent variables, they will likewise require human intervention. But, these major subprocesses can be further decomposed into sub-subprocesses, some of which are subject to analysis—in this case collection system capacity—and some of which can be further decomposed to identify either additional areas subject to analysis and modeling or further junctures at which some complex judgments will need to be made.

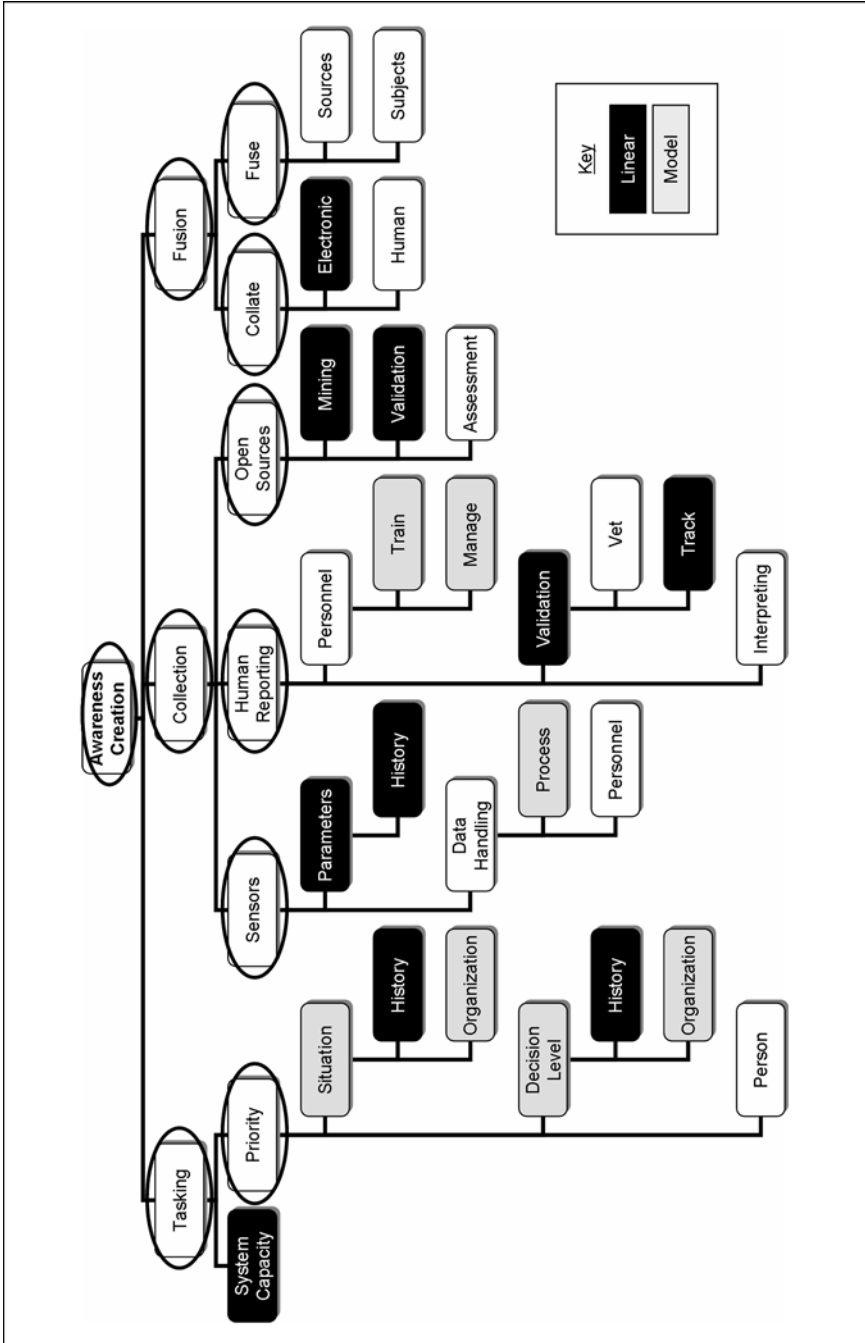


FIGURE 26. AWARENESS CREATION

In the tasking subprocess, for example, one complex judgment would be deciding how to apportion the collection assets available against the requirements imposed by the situations, missions, or particular commanders. Parts of that problem (gauging the idiosyncratic demands of a particular commander) might remain complex, but others (gauging system capacity, or the historic requirements for a particular type of situation or for a particular level and type of command) would be relatively linear. In collection, complex judgments would be required to balance the interdependent variables involved in orchestrating available sensors or determining which human reporting sources to task or which open sources to believe, and still other complex junctures would arise in further drill-downs to questions as to which human sources are reliable and worth accessing, and in vetting and validating these sources. Finally, in fusion, there are multiple complex decision points involved in choosing which of several conflicting reports to believe and how each might fit into a coherent picture. Each of these cases involve decisions on complex problems in which a precise cause-and-effect chain cannot be discerned, or in which there are multiple potential chains, or in which needed information is missing or ambiguous.

### **Networking support**

The glue that holds the awareness creation effort together is the ability to network the necessary information and analytical tools and people, decisionmakers, or experts. Any assessment of what sensors might be brought to bear on a problem assumes the ability to network those sensors together both to make them mutually supportive and to make their collection and reporting timely. Any assessment of the human and open source reporting that might be brought to bear likewise hinges

on the ability to access the sources or perhaps the analysis of those sources. Any ability to use information and analytical tools assumes a parallel ability to input data and information to a specific problem and to update the data in them. If we accept that these tools are all to be used by humans for dealing with the irreducibly complex aspects of the awareness creation problem, then the ultimate goal of networking is to support the human in the loop. Similarly, it would do little good for humans to make the hard analytical and tasking decisions if those decisions could not be communicated to become part of the shared understanding of command intent and situational awareness. Logically, dependence on this networking will become more important as the size of the Joint Task Force command element decreases and reach-back to external sources of information and knowledge becomes increasingly critical to the commander's ability to make informed complex decisions.

The role of the tool provided via the network is to provide ways for the human at each of the above critical junctures to make a better decision, not to substitute for that decision. Although some might contend that information technologies are advancing to the point that the tools can in fact make the decisions, it seems clear that we currently have no good way to model much less deal with the complexities involved in effects-based operations without in some manner resorting to the human in the loop. This focus on human intervention is driven by two major factors: the degree of complexity involved in the effects-based action-reaction cycle (something that varies enormously even in the difference between sensors and human reporting in the collection problem) and the subjective and qualitative nature of the social domain inputs to any model that might aspire to applying the technology. The potential

tools for awareness creation come in three forms: (1) those that permit us to obtain and handle information; (2) the analytical tools and models to let us vet, validate, and evaluate that information, support its analysis, or offer new insights as to where to look further; and (3) those that enable us to identify, access, and link to tacit knowledge and expertise, with the latter being as much a question of organizational tools as it is of communications networking hardware.

For the Joint Task Force awareness creation process, these tools would address three basic decisionmaking needs: (1) assessing the availability of collection capabilities and melding the data from a wide variety of individual platforms into a single sensor picture; (2) identifying potential sources of human and open source reporting and vetting and validating those sources; and (3) integrating and fusing sensor, human, and open source reporting both within those categories of collection and in the creation of a single coherent picture.<sup>197</sup> Because of the need for continual tasking and feedback iteration in creating a degree of awareness capable of supporting complex, interactive, and ongoing effects-based operations, these tools cannot be limited to a “one size fits all” set of specific tools, but will likely have to alternate and adapt to fit Task Force needs (e.g., a set of warfighting tools might be replaced by a different set as a Task Force operation transitions to post-conflict stabilization or vice versa as it moves from crisis response operations to major combat) and the tools themselves will need to be interactive to adapt to immediate Task Force needs.

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<sup>197</sup> In the 1987 operations off Libya, our Task Force was newly reconfigured to use the Joint Online Tactical System (JOTS) to integrate organic Task Force tactical data with non-organic theater or national data, whereas other functions were either done at higher levels or in my head.



- Electronic data

The integration of electronic data is the most linear and straightforward of the tool-friendly tasks associated with awareness creation and has been the thrust of many if not most of the discussions of network-centric operations to date. The application of electronic data integration tools in the collation of the diverse sensor data and its fusion into a meaningful sensor picture is not new and has been a focus of various efforts for the past 20 years or more. Likewise there have been steps toward the creation of a visualization tool that might integrate the technical parameters and location data on various sensors into a comprehensive picture of system collection capacity—organic, non-organic, or accessible—in any given place, time, or situation so as to enable planners to discern and optimize the use of available assets or to react to *ad hoc* changes in situation or resource availability.

- Data mining/intelligent agents<sup>198</sup>

The *raison d'être* of both data mining and intelligent agents is the identification and retrieval of data and information buried either in a large quantity of data or in categories and files of information that may appear to have nothing to do with the subject at hand. This tool has an obvious application in the case of the voluminous open source material, although with cautions that any search must be multi-lingual.<sup>199</sup> However, it

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<sup>198</sup> De Rosa, Mary. *Data Mining and Data Analysis for Counterterrorism*. CSIS. March 2004. pp. 20-23.

<sup>199</sup> Conducting data mining only in English would have two negative effects: it would miss a substantial part of the available data and information base to be mined, and in any attempt to assess the psychological aspects of observer reactions it would also skew the results and potentially mislead.

also provides a way for the Task Force to access multi-source and multi-agency human reporting and other resources, i.e. dealing with reporting from other agencies and organizations where the reports are accessible but not necessarily in forms that lend themselves to immediate identification. Indeed, reporting from other agencies and organizations is far more likely to be in the form of human reporting than in that of electronic data.

- Compare and contrast

Modeling and analytical tools such as pattern recognition capabilities offer ways to compare and contrast the results of reporting both for the reports of a given source and across all reporting sources. In the former, the tool serves to compare a report with others in a given subject area, timeframe, or location, or with reporting by the same source over time so as to vet and validate the reliability and knowledgeability of human sources, or in dealing with open sources in establishing the biases and reliability of a particular source. The same is true in fusing all-source reporting where the problem is sorting out conflicting reports from multiple unrelated sources, or fusing operational awareness with the larger social and cognitive awareness to provide a comprehensive overall awareness suitable for decisionmaking.

It should be evident in the above that these tools by themselves are insufficient to create the awareness needed. Although they come closest to creating a comprehensive picture when integrating sensor data, such a picture is only one form of awareness and does little to address issues such as intent, much less the cognitive and social domains that are at the heart of effects-based operations. In these areas, there will be a need

for a different kind of knowledge, the internalized and evolving mastery of a complex subject that resides in the mind of an expert. As the available expertise improves, so too will complex decisionmaking.

### *Sensemaking*

Sensemaking is more complex than awareness creation both because it involves a deep cognitive process and because it builds upon all of the complex analyses and judgments contained in the awareness creation. For the Joint Task Force, sensemaking serves two needs: expanding awareness into an internalized understanding of the operational environment and providing the foundation for planning either reactions to a particular stimulus or some future action. The first involves creating an evolving “sense” of the ongoing and ever-changing operational and regional picture using histories, an existing or created knowledge base, and libraries of analogies that permit the human decisionmaker to “fill in the blanks” or to derive a cause-and-effect relationship. The second applies in two ways: understanding the source and direction of a continuing spiral of interactions and supporting a planning process that must look out several cycles or more into the future. These distinctions underline a certain time dimension to sensemaking with the response to the immediate cycle demanding an up-to-date sense of the operational environment, and the planning process offering more latitude to seek and obtain outside support.

### **Human intervention**

As the above and the cognitive and social dimensions of the tasks involved imply—and as illustrated by the proliferation of circles designating complex decisionmaking junctures in Fig-

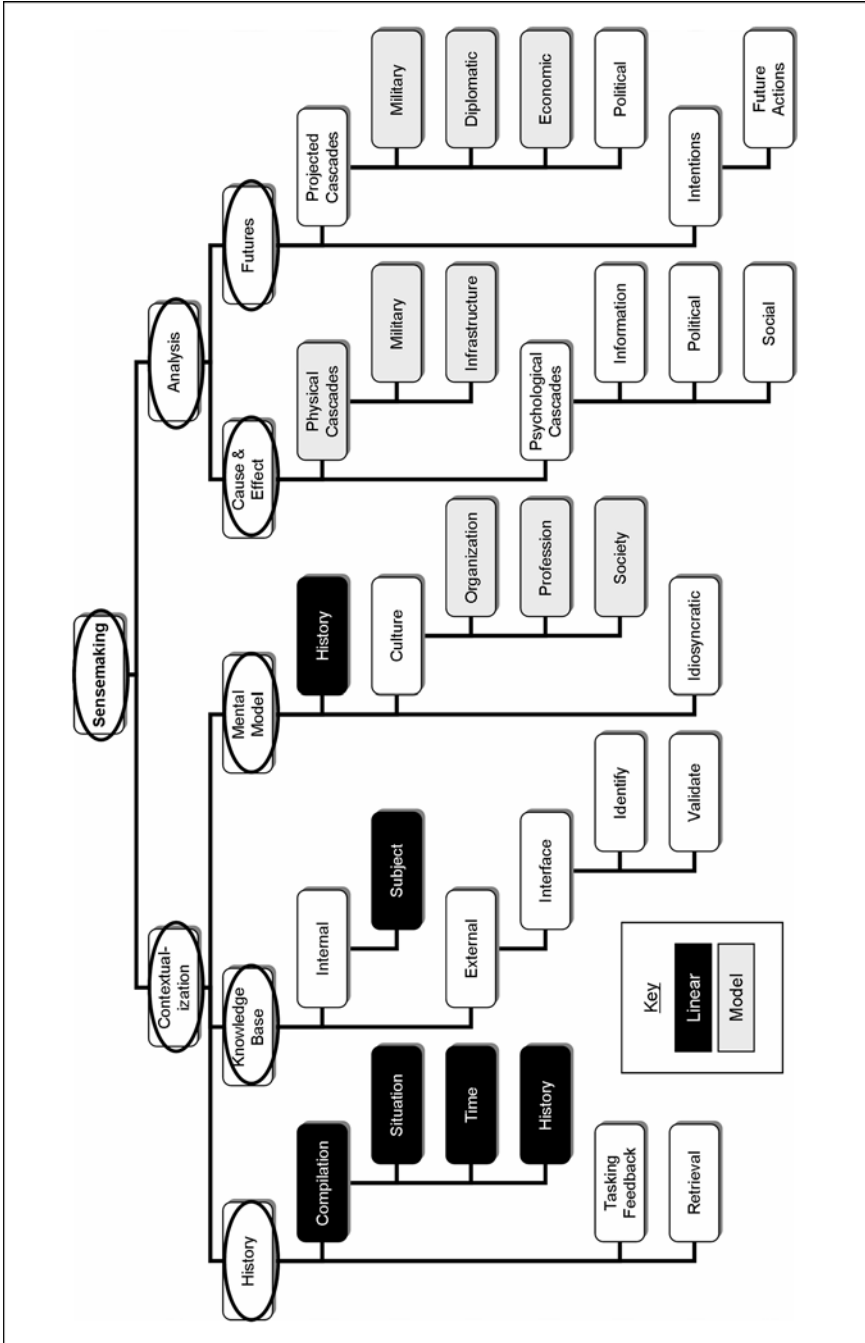


FIGURE 27. SENSEMAKING

ure 27—the sensemaking function is rife with complex questions and, hence, areas where human interventions will need to be made. Sensemaking by definition is a cognitive process and, hence, undeniably complex as are the two major subprocesses: contextualization and analysis. Contextualization is basically putting the awareness created into a framework that will confer meaning in the human mind, and analysis ultimately reflects a set of human understandings and conjectures. These intrinsically complex junctures are supported by a series of sub-subprocesses, which, although complex in their own right, get down to where various tools can be brought to bear to help Task Force decisionmakers bound the complexities involved, time permitting.

### **Networking support**

The scope of the tasks described under the rubric of sensemaking mean that it would rapidly exceed the manpower of a small forward Joint Task Force staff. Interactive networking back to larger elements can offer ways of enabling even the relatively small staff of an *ad hoc* on-scene Joint Task Force commander to undertake what otherwise might require the assets of a theater commander.

Although at least part of this problem might be solved by linking to a conventional database at higher headquarters, three additional problems arise. First, in a complex and unpredictable world, the situation that the commander confronts may not be covered by the standing knowledge and database. Second, even if the subject is covered, the information that the commander requires may not be in that knowledge base, indeed the foe is likely to make every effort to ensure by his choice of actions that the needed information is not available.

And third, the complex understanding needed may not be in a form that can be archived either because it is continually changing or because it represents an understanding that is not readily reducible to a needed format. Thus, the critical feature of support to the Joint Task Force commander will likely revolve about the need to insert new knowledge into a standing knowledge base and especially to mobilize the specific knowledge needed from relevant subject matter experts, wherever they may be. This again suggests a requirement for a combination of information and analytical tools, but it also indicates a need for organization and social networking to identify, vet, and tap knowledgeable experts whenever needed.

As this implies, the biggest single impact on Joint Task Force sensemaking is likely to be the availability of a detailed and comprehensive data and knowledge base. The better and more fine-grained the knowledge base, the more tightly bounded the judgments and assessments of the decisionmakers can be. The development and maintenance of such a base either in the Task Force itself or externally, e.g. in an Operational Net Assessment, offers multiple opportunities for information, analytical, and modeling tools as well as for the introduction of subject matter expertise.

- Information technologies

The crux of the problem is the Joint Task Force's ability to retrieve knowledge and information as needed to bound decisions in the face of a complex and often unpredicted situation. This poses four problems: (1) the information/knowledge base must be compiled even though it may not be possible to predict exactly what information and knowledge may one day be

needed;<sup>200</sup> (2) the correlation between the information that the Task Force requires and the information in the system may not always be evident (e.g., information to be found in a Department of Energy report); (3) the database must include not just data but social and historical knowledge that may not be in a readily retrievable form; and (4) the database must be updated continuously.<sup>201</sup> These challenges appear to provide grounds for the application of a wide array of different information technologies. For example, the use of intelligent agent technologies provides prospects of automated inputs to maintain currency and filing able to capture the data needed and retrieve it in various forms and configurations to meet the Task Force commander's needs.

- Analytical tools

The drill-down also points to a number of areas where various analytical tools might be of help in extracting meaning from the historical and knowledge base. For example, tools such as pattern recognition might assist in assessing the likely reaction times, detection limitations, and kinds of response to be anticipated from a surveillance system. They might also be of use in forecasting the cascades of physical and psychological effects that are likely to ensue from the current action-reaction cycle or their probable impact on diplomatic behavior.

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<sup>200</sup> The database required by the Joint Task Force is in many ways akin to the stereotypical analyst, someone who never throws away information that might someday be useful.

<sup>201</sup> If the update is not continuous then it will not be possible to determine whether the absence of activity at a given time was the result of a lack of action that may be significant or a lack of reporting and database entry.

- Modeling

Modeling, especially cognitive and social modeling, can also play a larger role in a number of areas. Although the greatest attention has been on modeling cascading Political, Military, Economic, Social, Information, and Infrastructure (PMESII) effects, the potential is far wider and extends to assessing the “why” of an action, to pursuing the cause-and-effect chains back to the observations and decisions that gave rise to them, or to projecting the nature of follow-on interactions. Similarly, the commander will need to know something of the other side’s decisionmaking process and the personalities in it, aspects of which can likewise be modeled.

The creation of mental models to assess how observers will perceive and react to our own actions or those of others poses yet another different challenge with three levels of modeling: one for individual decisionmakers to be identified and information derived from biographical information, personal contact, or writings to be stored; one for groups of decisionmakers (e.g., the Kremlin); and another for a general case in which the common link may be membership in an organization such as al Qaeda. Cognitive models are clearly applicable to this task but come with the caution that there are two distinct types of behavior to be modeled: the “nature” aspect of how human beings in general perceive, decide, and react; and the “nurture” aspect of how particular individuals and particular groups might react differently based on experience or acculturation. The latter models require a deep understanding of the specific culture involved, which is difficult to acquire much less translate into a model, and the more frequent solu-



tion is likely to involve a hybrid of models with expert intervention.<sup>202</sup>

Finally, in all of the above, there is a major additional consideration. In any interaction with a complex adaptive opponent, it will not be sufficient to develop a single, enduring model. The only thing that is certain of such encounters is that they will change from one interaction to the next and that the parts of the carefully modeled systems will in some way change as a result. Like the iterative evolution of awareness, therefore, any model used must be sufficiently dynamic and flexible to incorporate and reflect changes as the situation evolves.

### *Planning/decisionmaking*

The Joint Task Force's effects-based planning/decisionmaking process reflects both the accumulated complex judgments of the preceding steps and the additional complex judgments required of the planners reflected by the continued proliferation of ovals in Figure 28.

## **Human intervention**

In the planning process, Joint Task Force planners are asked to undertake three kinds of complex decisionmaking:

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<sup>202</sup> I experimented with such a hybrid in the Navy's 2000 and 2001 Global Wargames combining Caesar I and II models developed by Professors Alex Levis and Lee Wagenhals at George Mason University with experienced regional intelligence analysts. The result was a cross-pollination of ideas with the analysts' interventions refining the models' ability to forecast likely reactions to future moves, and the analysts using the interactions to inspire "Quick Look Assessments" that provided immediate analytical feedback to commanders on the budding reactions to interactions just completed.

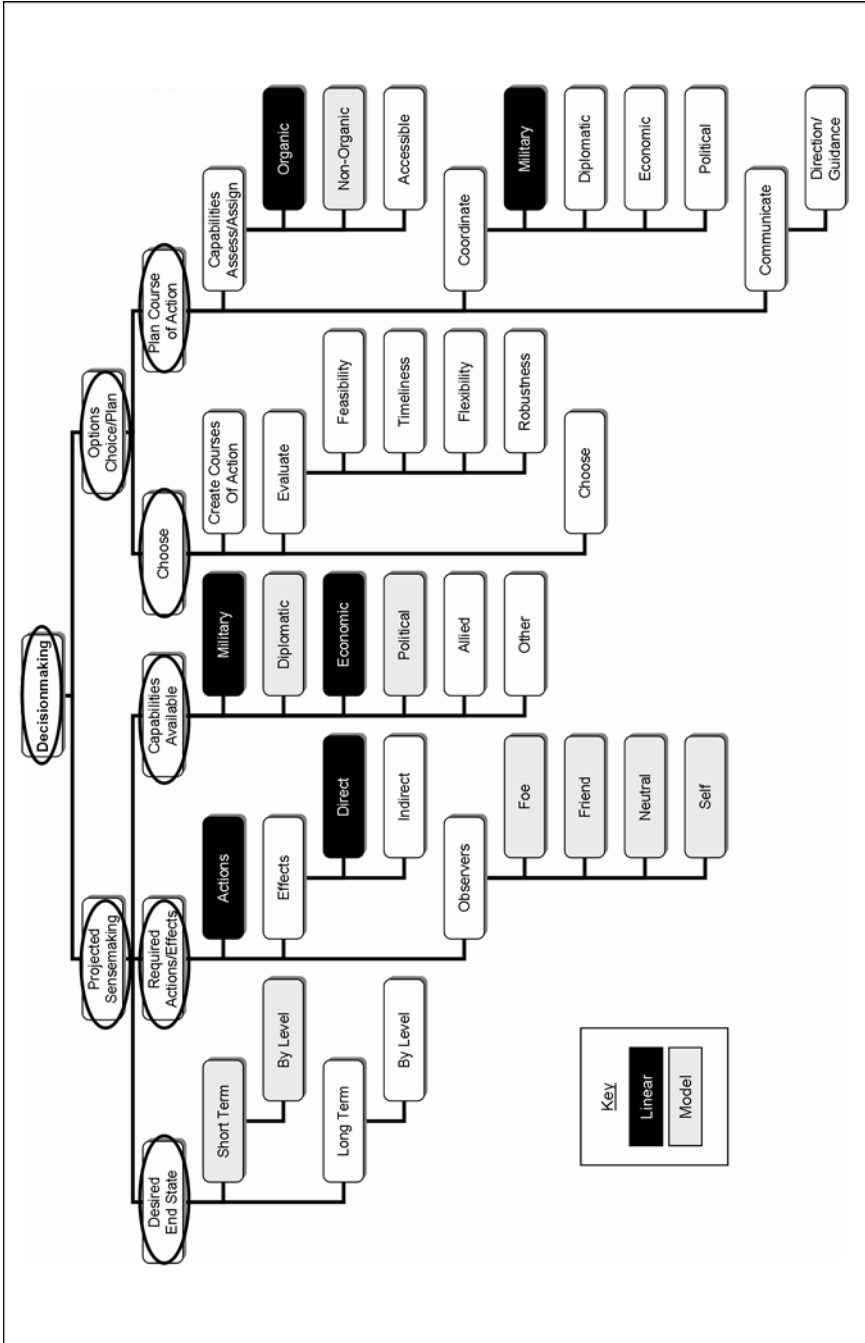


FIGURE 28. DECISIONMAKING

- To estimate how a direct physical effect at one level of one arena in the security environment's system of complex adaptive systems will translate into cascades of indirect effects at succeeding levels both in that arena and in other arenas throughout the entire complex structure (that is, forward sensemaking to test hypotheses containing multiple interdependent variables);<sup>203</sup>
- To assess how an individual effect will add or detract from other effects either in the same timeframe or in the context of previous actions;<sup>204</sup> and
- To estimate how all of this will occur not only for a single adversary or group of adversaries but across a spectrum of potential observers (friend, foe, and neutral).

## Networking support

It seems doubtful that all of the tools and expertise needed to undertake such assessments would reside in the Joint Task Force staff even if supplemented by a standing deployable headquarters staff. Moreover, given the nature of interactions

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<sup>203</sup> In this context, the higher the level of the complex adaptive systems interacting, the more complex that interaction is likely to be, with the effects created at higher levels often being some aggregate of those occurring at lower levels. The interactions at these lower levels involve a host of interdependent variables and flows and are all essentially nonlinear, even though those at the tactical level can at times seem almost linear, e.g. attrition. In Operation Iraqi Freedom, for example, one criticism was that the United States could attack any military facility it chose to and document that destruction, but could not trace or measure very well what impact that destruction had on Iraqi operations. That is, the United States was able to measure the linear, tangible effects but not the complex nonlinear effects.

Cordesman, Anthony. "Iraq and Asymmetric Warfare: The US vs. FRL/ Islamist Duel." CSIS Paper. 6 December 2003. pp. 11-19.

<sup>204</sup> At each or these levels, actors may be expected to self-organize so as to adapt to a changing set of stimuli with the result that the system both at each level and as a whole evolves even as we attempt to achieve a given effect.

between complex adaptive systems, these requirements would vary from one interaction to the next. Accordingly, the command would need access to varying sets of tools and expertise or to an off-board process that could somehow blend these with the on-scene expertise of the Task Force.

The tool and expertise requirements for *projected* sensemaking are in many ways similar to those of sensemaking but with one important difference: the requirement to hypothesize how observers will see and react to an action. This difference and all of its complexities suggest the need for a family of inter-related but dynamic and interactive tools: interrelated because of the multiple dimensions of the problem; dynamic because of its ever-changing nature; and interactive because the tools must provide a basis for testing the “what if” propositions at the root of effects-based planning. At least three kinds of such tools seem warranted: those to model physical systems and capabilities, those to model observer reactions, and those to integrate the outputs of the tools and translate them into a picture that is meaningful to the commander and his planners.

- Modeling physical systems

The need for modeling physical systems and capabilities can be seen in a number of areas. If the effect of an action is in some substantial part to stem from how observers “see” that action, and if the actions to be seen are in essence collections of visible attributes, then it follows that we must be able somehow to model exactly what aspects of a given action the observers will see in order to fathom how they might react. This means that we will have to be able to model the surveillance or collection system by which the actions are seen by observers both to determine what they will or will not see and to estimate how

information on a particular action might be filtered.<sup>205</sup> What is different here is that the task is less to avoid detection than it is to have observers see specific aspects of a given action so as to shape perceptions in a desired direction. Doing that implies a wider model than we have normally considered, one that incorporates not just a pattern analysis of where sensors are and what they have seen in the past, but that also integrates human and open sources and that spans more than the military arena.

- Systems dynamics

In an effects-based approach, the distinction between physical and psychological effects is important because it differentiates between two very different kinds of interaction and propagation in the cascades of indirect effects growing from a direct effect and, accordingly, connotes two very different approaches to estimating the intended and unintended consequences to be considered in the planning process. The links between actions and physical effects, particularly destruction, are usually fairly linear and the links between the direct physical effect and a cascade of resulting physical effects, similarly, tends to be relatively linear. Even though we may not be able to predict all of the potential effects of such a cascade (for example, all of the consequences of destroying an electrical grid), we can readily understand the relationship between one effect and the next anywhere in the chain and, theoretically, could track indirect physical effects from one to the next in a cascade stretching back to a direct effect and the action that set

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<sup>205</sup> This is not new. During the Cold War, for example, we modeled Soviet surveillance systems and, for strike planning, we routinely plotted enemy radar and other surveillance envelopes so as to avoid them.

the cascade in motion.<sup>206</sup> Indeed, the U.S. Air Force's effects-based targeting efforts have perfected this kind of assessment both in identifying the direct and indirect effects and in streamlining the processes involved to fit in the context of an accelerated Air Tasking Order.<sup>207</sup> The use of systems dynamics opens the prospect of further defining the physical cascade, but perhaps more significantly, could do so from a psychological perspective as well given adequate input both from area experts and specific culture sociological models.

- Cognitive modeling

The links between actions and psychological or social and cognitive effects and their follow-on cascades are far more problematic specifically because they are complex in all of the senses we have discussed. Still, the problem is not new. The Air Force has studied the relationships between physical destruction and psychological effects for decades. The shock and awe of precision strike and, more recently, of parallel vice sequential strike operations,<sup>208</sup> and John Warden's rings of

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<sup>206</sup> Although all of the potential effects of a physical cascade may not be predictable, where there is an overriding consideration such as in the Allied bombings of the rail lines into the Normandy beachhead, the chains can be "pruned" to the known relationships of a particular section. For a more extended discussion, see:

Smith, *Effects-Based Operations*. pp. 322-326.

<sup>207</sup> This process is hardly new but has been the basis for U.S. Air Force work in effects-based operations for more than a decade, much of which has focused on the trade-offs between desired and undesired effects. See:

McCrabb, Maris. *Uncertainty, Expeditionary Air Force, and Effects-Based Operations*. AFRL Paper. Rome. June 2000. pp. 34.

McCrabb, Maris. *Concept of Operations for Effects-Based Operations*. AFRL Paper. February 2001. p. 10.

<sup>208</sup> Deptula, "Firing for Effects." pp. 48-50.

relationships between targets and leadership will<sup>209</sup> are all examples of such linkages. The issue for the Joint Task Force commander, however, is not to model these at a strategic level but to understand how the effects will play out at the tactical and operational levels of interaction and then how these might carry over to the strategic level, for better or worse.

- Social modeling

Modeling observer cognitive processes will be necessary here as in sensemaking, but such modeling is not enough. To gauge and anticipate reactions, the planners will need to take into account the ways in which the cognitive processes of observers may differ from a standard model and how the perceptions of observers will change as a result of any actions undertaken. This is to say that the cognitive models will need to be mated either with (culture by culture, faction by faction, organization by organization) models of how specific groups of observers will see and understand or that some input from human experts on the areas in question will be needed. Because the former depends heavily on the expertise of those creating and maintaining these social models and because such expertise is rarely reflected in the models, the more likely course is a hybrid approach that continually injects human expertise into a more general model.

While it is possible that models will become available that integrate all of these, the nature of the projected sensemaking task indicates that the real need is for a *federated family* of different models, each of which can address one or another aspect of the problem (e.g., one for decisionmaking processes, one for

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<sup>209</sup> Warden, “The Enemy as a System.”

the economic consequences of an action, another for the political and diplomatic, and another for the military). The difficulty in this is that all of the models must be dynamic and involve a continuing interaction.

### *Execution*

Execution is the response phase of the action-reaction cycle and, as such, the beginning of a new cycle with the provision of initial feedback to commanders on the mission just completed. For the commander, this feedback is comprised of three inputs needed to both assess the results achieved and prepare for the next round. The tactical unit can report that the action has been completed and did or did not have the direct impact contemplated. It may also report any local variations from an established norm that it observes during and immediately after the mission to be combined with any other observations of deviations from an observed norm from other sources that will enable him to discern initial reactions by various observers. Finally, the commander will also need any indication of a larger cognitive shift or behavior change to assess the larger dimensions of observer reactions.

### **Human intervention**

For the Joint Task Force commander, the execution process involves complex decisionmaking at two levels and in three areas. The planned course of action will generally be carried out at the tactical level by tactical commanders who must adapt their actions even as they unfold to ensure that observers will see the aspects or attributes planned. They must also conduct running observations for feedback both of whether the direct effect occurred as planned and of any immediately obvi-



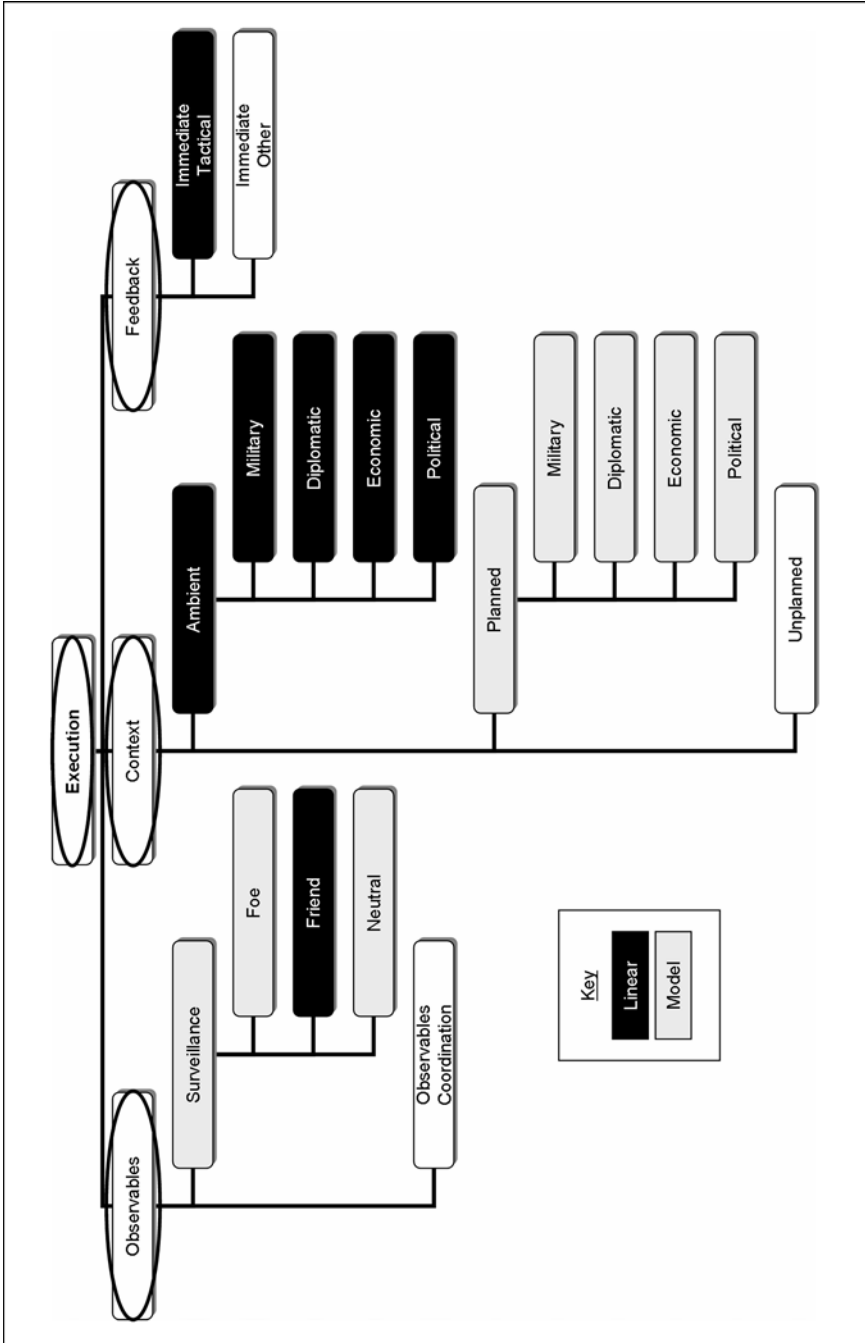


FIGURE 29. EXECUTION

ous reactions to their actions. At the operational level, the Joint Task Force commander must also monitor the action as it takes place to ensure that it continues to be in the context planned and that it continues to conform to a higher level command or national intent, even as the latter evolves.<sup>210</sup>

### **Networking support**

It should be apparent that all of the capabilities to support such an adaptive decisionmaking process will not be available at the level of the tactical commanders executing the course of action. Indeed, depending on the amount of forewarning, the models and knowledge required may not necessarily exist at Joint Task Force or theater command. In brief, the ability to bring the right tools and expertise to bear will again rest on the ability to network.

From the standpoint of the tactical commander trying to ensure that the correct aspects of the planned action are seen by the right observers, a continuously updated report of observer surveillance and collection efforts seems fundamental. Providing such support “at the speed of battle,” however, would likely mean adapting the physical system modeling of the surveillance system to continuous and highly detailed

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<sup>210</sup> During the final Attain Document Operation in which Joint Task Force aircraft and ships were sent south of the Libyan “line of death,” the Commander of the Sixth Fleet, then VADM Frank Kelso, was given the authority to apply the rule of engagement (ROE) granted by the White House that would set a U.S. reaction in motion. To ensure that this process went smoothly, he came aboard the Battle Force flagship, *USS Saratoga*, and sat in its flag command center where the entire operation was to be coordinated by the Joint Task Force commander, then Rear Admiral Dave Jeremiah. When the time came for a reaction to Libyan anti-aircraft missiles being fired at U.S. aircraft, therefore, the granting of the ROE consisted of Jeremiah looking at Kelso and the latter’s nod of assent.

reporting and coupling this reporting to a visualization tool that would permit ready understanding of both the collection and any deviations from the norm.<sup>211</sup> This would also be the first step in feedback. The tool might also be reversed to let commanders know what aspects of their actions would be seen by whom at any given time as the operation unfolds.

From the standpoint of the Joint Task Force commander at the operational level, the problem is not only to ensure that the evolving action being executed is seen as intended, but also to monitor how the action in progress—and any unforeseen aspects of the interaction—fit into an evolving context encompassing the local observers, regional observers, a global media, and his own public. To do this, the commander will need to have some idea of the multi-level, multi-arena norms or ambient contexts into which actions will be inserted. This process now currently revolves about an *ex post facto* monitoring of global news reporting such as CNN, whereas the key context in Afghanistan, for example, revolved about tribal, ethnic, and regional contexts that would not have been reflected on CNN or, for that matter, al Jazeera. This suggests the need for additional information tools coupled with cognitive and social modeling, an indications matrix based on algorithms derived from the modeling, and perhaps a ready visualization to make this available to the commander rapidly and intelligibly, or for access to a subject matter expert in the area who can provide such support. These same tools would then provide the initial

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<sup>211</sup> To some degree, this is already done in air strike operations with visualizations of the detection ranges of the enemy electronic sensors to be avoided. Effects-based operations introduce two different aspects to this. First, the avoidance might well be reversed with the objective becoming that of ensuring that the action or particular parts of it are seen. And second, support would be required not only for high performance platforms but also for a broad spectrum of forces, e.g. Stryker units.

feedback to the commander regarding reactions to the Task Force's actions.

### *Social influences*

The ways in which the social domain influences the Joint Task Force problem are highly complex. They are not however a step in its planning process in the same sense as the preceding steps, but are rather key considerations to be taken into account in all of them, especially the sensemaking and planning phases.

### **Human intervention**

The impact of social questions on Joint Task Force decision-making will be felt in two ways. The first is in assessing the adversary and other observers and their reactions to any actions being considered in the planning process and to how the actions as executed might be perceived. The second is essentially in understanding and carrying out the command intent, an intent that will of necessity reflect all of the social domain considerations involved in creating and maintaining a public consensus in support of the actions that the Joint Task Force takes. The diagram in Figure 30 shows four cross-over points into areas of the cognitive process, each of which involves complex decisionmaking in both of these dimensions. That is, planning will need to take into account: the mental models with which the observers whose behavior they wish to shape will see what is done and the basket of analogies from which they are likely to draw, the understanding they are likely to draw from the action and these models, the sense that they will make of it, and their perceived options for responding. Similarly, the Joint Task Force's understanding of their own

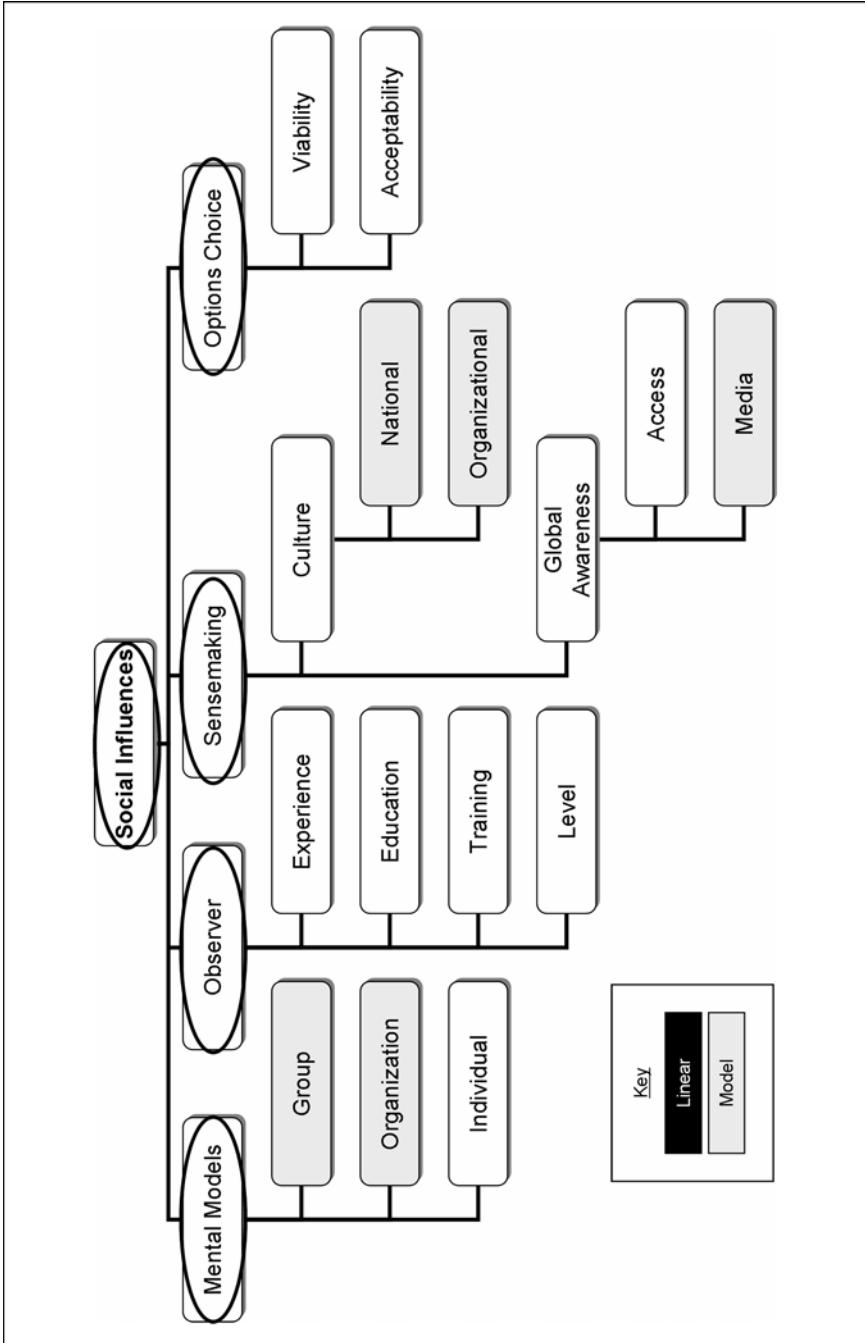


FIGURE 30. SOCIAL INFLUENCES

command intent will hinge on how well they understand the same four influences and any constraints they may impose on their own actions.

### **Networked support**

As the above once again makes plain, the ability to update knowledge bases, to access and adapt tools, or most importantly, to communicate with an expert on an interactive basis so as to gauge the social influence involved hinge on the networking. And, that networking is both the communications connectivity and the social networking that permits the commander and the supporting “system” both to locate a reliable expert on a particular area or group and to understand his or her input.

Because the social processes by which social influences are generated involve many interdependent variables, the full span of which will never be known, their impact upon the Joint Task Force assessment and planning processes will be complex. Dealing with this complexity to bound decisions, either in ensuring that plans and execution will support a political consensus or in assessing the likely reactions of observers, will entail reliance on two forms of tools: one for gathering information and knowledge to update the knowledge base and another for modeling the behavior of the societies involved—likely group and organization mental models, frameworks for understanding, factors in sensemaking and *weltanschauung*, and perceptions as to the viability and acceptability of particular courses of action. However, these modeling tools very often pose a “garbage in, garbage out” problem in that, especially in trying to model non-Western behavior, they are very much dependent on subjective/qualitative inputs and, hence, on the

expertise of those acquiring and inputting the data and information. This suggests the need for continual involvement of a subject matter expert either to guide the use of the model or, where time is of the essence, of direct inputs to or answering the questions of the Joint Task Force commander.<sup>212</sup>

*...and the other guy?*

Finally, although it may appear that we have looked at the steps of the action-reaction process from the standpoint of the Joint Task Force reacting to some situation and planning a response and have somehow overlooked the other half of what is emphatically an *interaction*, the reverse is actually true. The cycle and “essential process” steps described are, as living systems theory would suggest, common to both sides of any interaction. This means that the decisionmaking process of observers should in its most basic aspects parallel our own and, thus, that the complexity associated with understanding the adversary or partner is not infinite but bounded by similar requirements and limitations, albeit shaped by the idiosyncrasies of the individual observers and the social influences affecting their perceptions and behaviors. The above implies that the dissections, drill-downs, identifications of complex decisions to be made, and knowledge and information requirements involved in the action-reaction cycle are as much a road map to analyzing the perceptions and decisions of the other

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<sup>212</sup> Admiral Mike Boorda upon his return from duties as NATO’s Commander in Chief, South during the NATO operations in Bosnia complained to me, his former Battle Force intelligence officer, that the intelligence he had received had not responded to his needs as a commander because it had been focused on an outdated and “largely useless” order of battle (OOB) when what he really wanted was an insight into how the contending factions thought. “All I got was OOB and vague studies when I just needed to be able to talk to *someone* who knew the area and the people.”

side as they are to figuring out how to handle the complexities of effects-based operations on our own side. Indeed, viewing the other actors from this perspective is the key to doing effects-based operations. We cannot execute operations that use sets of observables to shape perceptions until we can model or estimate how the observers will sense or otherwise pick out those observables. We cannot plan actions and effects and, thus, what those observables ought to be until we have some idea of the context in which they will be seen and evaluated, or of the sense that might be made of them, or of how this sense might translate into a reaction or an inaction. This suggests that the Joint Task Force planning cycle and its requirements for information, tools, and expertise really represent two cycles, one within the other; a force planning process that is, step by step, mirroring and reacting to similar processes in other actors.

## PUTTING THE PARTS TOGETHER

By themselves, the decisionmaking aids, information, analysis, modeling, and expertise are not new. We know how to do linear assessments and pattern analysis, indeed, there is a rich history of military operations research and a budding field of computer-assisted pattern analysis to support efforts. We also know how to model human cognitive and social decisionmaking processes with this knowledge increasingly supplemented by a growing body of research on the human mind and how it is “hard wired.” And, we have long recognized the role of subject matter experts, from the foxhole expert on a particular firefight to the academic expert with a tacit mastery of a region and its culture. The challenges in applying them to effects-based approaches arise from three things: (1) putting all three together in an interacting hybrid; (2) applying the hybrid to



both military operations and the multiple dimensions of a whole-of-nation response; and (3) doing all of this at the speed of battle rather than at the speed of academe.

### *A triple hybrid*

The three elements to be brought together are the tacit, internalized, and not entirely expressible knowledge of the expert, the “soft” science knowledge of the social sciences, and the “hard” science knowledge of mathematics, engineering, and operational analysis. Each has methodologies and metrics, but each proceeds from a different concept of reality and a different way of approaching the problem. A big part of this problem revolves about the apple-and-orange comparison difficulties inherent in any interdisciplinary approach—and the attendant tendency for experts to look at the inputs as separate and ostensibly incompatible. As a result, there is a tendency to think of integration, at best, simply in terms of the serial application of first one and then the next form of analysis. Yet, as the idea of an aggregation rheostat suggests, understanding complex adaptive systems and their interactions demands an interconnected, interdisciplinary hybrid of linear, social/cognitive, and expert analysis. Linear analyses of historical precedents and formal organizational structures, for example, can provide the *internal models* and *building blocks* that might support further modeling and simulation, while that modeling in turn might provide ways of *tagging* certain individuals and organizations whose conduct might prompt different directions in the historical and organizational analyses that would provide more support to modeling efforts, and so on. That is, the continued interchange between sometimes starkly different approaches can produce a more detailed and refined result even though the diverse analyses may never “add up” in a

quantitative sense. Moreover, the same is likely to be true of a continued, iterative input by experts in a specific area of study both from the standpoint of applying socio-cognitive models to specific social groups and from that of refining the model itself.

In effects-based operations, the requirement for such an iterative give-and-take among the disciplines is not restricted to the interactions at one level, one subprocess, or one arena of interaction, for all are interdependent complex systems whose interactions cannot be separated. Thus, any geo-strategic diplomatic assessment of a situation and possible actions would have to consider the impact on and opportunities presented by a local military commander—and vice versa.<sup>213</sup> This implies a need for complex judgments both as to the most likely outcomes at different levels and arenas with these judgments and any further analyses combined to refine the bounding applied in successively more complex interactions. Conventional and pattern analysis might be used on an iterative basis in conjunction with social and cognitive models of the decisionmaking process with each round of analysis and modeling further refining the other. The potential for this kind of iterative synergy can be seen in the use of what is known of a formal organization and its functioning to first identify or *tag* likely participants in the informal process that will actually make the

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<sup>213</sup> Admiral Elmo Zumwalt, the U.S. Chief of Naval Operations during the October 1973 Middle East War Crisis, cites the surprise of Henry Kissinger, the Secretary of State during the Crisis, upon learning that the Soviet Navy in the Mediterranean had been conducting very aggressive anti-carrier “exercises” directed at U.S. forces that could have been a prelude to an attack at the height of the Crisis. Although the information was duly reported, it had never reached White House decisionmakers nor had news of all of the exchanges between the White House and the Kremlin reached the local commander. Yet, clearly the actions of both decisionmakers stood to have been deeply impacted by what was going on in the other’s arena. Zumwalt, ADM Elmo, USN. *On Watch*. Washington, DC. 1980. pp. 442.

decisions and then to model the likely informal structure. The tagging and modeling might in turn provide indications as to missing elements in both the formal and informal structures and lead to the identification of additional personalities and influence networks, and so on.<sup>214</sup>

## CONCLUSION

While the essential processes and drill-downs outlined in Chapter Four are generic as the entire idea of an essential process implies (that is, applicable to all of the actors involved in an effects-based operation and all of the levels of the system of complex adaptive systems from the individual to the society), in this chapter we have focused upon what these processes and drill-downs mean for the conduct of effects-based operations at the tactical and operational levels of the Joint Task Force problem and upon the potential contributions that networking and a variety of Information Age tools might play. As in Chapter Four, we have based much on the observation of a set of gifted commanders coping with the complexities of an effects-based approach. Although care has been given to focus on the questions and issues that the commanders needed addressed and the general kinds of solutions that might be available, all of the actual solutions were in fact worked out within the context of the existing force and organizational structures. This real-world basis carries two messages. It reminds us that effects-based approaches are not dependent on future technologies and the application of increasing computer power to exotic modeling techniques, but can be and are being con-

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<sup>214</sup> In the Cuban Missile Crisis, for example, Kennedy's EXCOM guessed at Khrushchev's decisionmaking circle based on the membership, longevity, and power bases of the members of the formal Presidium structure.

ducted right now. However, it also provides a tantalizing additional thought: what might we be able to do with a structure and organization conceived with effects-based approaches to operations in mind and with better networking specifically configured to aid the human in the loop?

This portent of what might be also points to the larger dimension of building the kind of flexible, adaptive force needed to optimize effects-based approaches, and to a succession of other questions:

How do we provide for the right people to provide the insights needed? How do we organize? How do we create the right networks to deal with problems that we can never entirely predict? How do we know what tools and models to create or how to acquire a set of models and tools that not only can be readily and comprehensively updated, but can also change flexibly to adapt to the exigencies of a particular situation? What capabilities do we need not just to conduct the process of planning, executing, and assessing effects-based operations, but also to carry them out; that is, how do we construct power, both national and military, that will yield the options we need? How do we create the complex awareness that will be needed to plan, execute, and assess effects-based operations? And, how do we organize for and inculcate into our operations the agility of thought and capability that is required for rapidly adapting effects-based operations to the actions and reactions of a quick, flexible, resourceful, complex foe?

## CHAPTER 7

### OPTIONS, AWARENESS, AND AGILITY

The examples of the Joint Task Force commander dealing innovatively with a complex foe in a tactical or operational level interaction provide an insight into what might be necessary for future operations applying effects-based approaches and how we think about the people, capabilities and organization that might be needed. What organization, training, and education would produce decisionmakers and subject matter experts able to deal with the complexities? How are the right capabilities and analytical aids to be chosen and made available? How do we design and acquire the networks that tie them together? This is a different aspect of the “how to” and revolves about creating the organizational, institutional, and force capability underpinnings that enable the kind of agile adaptable effects-based operations that commanders and a political leadership need to succeed. As such, it is the root of a larger “how to,” that of adapting and counter-adapting and of evolving and counter-evolving to deal with the threats of the post-9/11 security environment. This adaptability hinges on three factors: (1) the ability to generate *options* from which to choose a response, (2) the *awareness* needed to

choose the best option, and (3) the *agility* to generate and apply new options from one cycle to the next.

## OPTIONS, COMPLEXITY, AND DISRUPTIVE CHANGE

The wry maxim of the great Prussian planner and strategist, General Helmuth von Moltke, was that no plan survives first contact with the enemy. Although the maxim has clearly been borne out in military history, complexity theory adds a new wrinkle to von Moltke's perception. It infers that, because our adversaries are complex and are continually adapting and evolving, we can never be entirely certain either exactly what the specific threat will be or how the adversary will respond to our actions. Thus, any plan formulated on the basis of one set of premises is likely to be confronted by a different set of circumstances by the time it is implemented. Not only will a plan not survive first contact with the enemy, but it will be outdated by the time it is used. Whether in battle or in a long-range planning effort, therefore, we can never generate a perfect plan nor create a library of plans to cover all contingencies.

The uncertainty of the post-9/11 security environment poses a still more challenging problem in this regard. Symmetric, attrition-based, state-on-state threats could be bounded because the sheer scale of state-on-state attrition warfare demanded numbers and types of forces that could only be generated by long and large-scale efforts that were not easily hidden.<sup>215</sup> This fact limited the potential for the unexpected and truly disruptive war-winning change, and had the effect of bounding the infinite variety of possible threats to a relatively narrow range of probable military operations.<sup>216</sup> The result was a fairly constrained set of viable military options and capabilities

that could be built to that relatively narrow set of tasks. In asymmetric and state versus non-state conflicts, the focus is on surprise, maneuver, and psychological attrition and demands a different collection of tools and metrics for success. To this old problem has been added a new twist: the growing probability of attacks by “super-empowered individuals” (e.g., terrorists armed with nuclear, radiological, and biological weapons of mass destruction) who are not vulnerable to conventional modes of retaliation and thus to effective deterrence.

Against this backdrop, complexity theory warns that, unlike the gradual evolution of life painted by Darwinian theory, complex adaptive systems often change in a manner that is rather spasmodic.<sup>217</sup> Although complex adaptive systems are

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<sup>215</sup> During the Cold War, for example, one threat of technological surprise for both sides was that of a sensor that might make the oceans somehow “transparent” and thereby make the ballistic missile submarines that both depended on for secure second strike capability vulnerable to detection and destruction. In the period before World War II, a parallel threat was the Japanese development of a class of super-battleships. However, given the scale of the military forces involved on both sides, neither of these developments was likely to be decisive by itself—and in the case of the two Yamato class battleships, patently were not. The ability to keep the latter secret stands in stark contrast to the introduction of the HMS Dreadnought class battleship at the beginning of the century. Since one ship or even a small number of such ships was insufficient to win, the move set off a highly visible building race as both Germany and Britain attempted to build a large enough fleet to win a large-scale naval battle.

Massy, Robert K. *Dreadnought*. New York, NY: Ballantine. 1991. pp. xxiv-xxv.

<sup>216</sup> For all of the discussion of the *blitzkrieg* as a revolution in military affairs, it did not involve technologies that were unknown to the Allies and for all of their initial success, the Germans lost the war due to an inability to generate the scale of forces needed to win, to the point that by September 1944 the skies of the Western front were so dominated by Allied air that the Germans were no longer able to achieve the synergies that made *blitzkrieg* work.

Hastings, *Armageddon: The Battle for Germany*. pp. 86-87.

<sup>217</sup> Holland, *Hidden Order*. p. 11

sometimes characterized by lengthy periods of equilibrium marked by only gradual change, they may also experience an event—even a relatively minor stimulus—that throws the whole system into disequilibrium and sets off a period of rapid change as the system’s state and non-state actors attempt to adapt in order to survive, or fall in the attempt.<sup>218</sup> This feature of complex adaptive systems and the accelerated interconnectivity of Information Age systems in particular warn that the asymmetric adversaries of the post-9/11 world could become the agents of an unexpected catastrophically disruptive change that could push the self-organized criticality of the current international “system” into chaos. By extension, as in von Moltke’s warning, a lack of agility, understanding, or imagination and an attendant inability to adapt or to change existing plans and thinking quickly and decisively could prove disastrous for any actor who believes that he or she has the perfect plan with “all the answers.”

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<sup>218</sup> Miller’s living systems theory carries this one additional step and defines the competition and conflict in our security environment in terms of interactions between human beings and human organizations in a multi-level system of complex adaptive systems. In this model, a stimulus at any level of interaction has the potential to disequilibrate the whole system, e.g. the assassination of the Archduke Franz Ferdinand in 1914. And, because the disruptive change can affect the entire interconnected system, it follows that the process of adaptation will occur on many different levels, in different ways and at different speeds with each of these adaptations affecting the system as a whole. Both the change of military technology and tactics between mid 1914 and the end of 1918 and the impact of World War I upon European life and politics are examples of such complex interconnecting impacts and adaptations, as are the collapses of the European empires that failed to adapt to the change. Miller, *Living Systems*. p. 661.

Keegan, John. *The First World War*. New York, NY: Knopf. 1999. p. 3.



## *Options*

As the outline of the potentially decisive advantages available to the Joint Task Force underscores, the nation-state and the international system have an impressive range and scale of capabilities to marshal. Because of their size and organization, the nation-states possess a range and diversity of *potential* responses that the asymmetric challengers lack and have their own potential for creating unexpected disruptive change in the asymmetric challenger if only the right effect on the enemy can somehow be generated from the vast resources at their disposal. Indeed, perhaps the most significant contribution of a broad effects-based approach to operations is the ability to think in terms of whole-of-nation or whole-of-coalition political,<sup>219</sup> diplomatic, economic, cultural, and military capabilities. And, the most significant contribution of network-centric operations may be the possibility of linking these capabilities together in ways that have never before been feasible. Indeed, if we apply Ashby's Law of requisite variety<sup>220</sup> that, in a confrontation between complex adaptive systems, the side with the greatest variety of potential responses will likely survive, then the picture for the nation-state and international system becomes much more positive. The variety of capabilities plus the communications and social networking to link any combination of these capabilities together into a coherent response provides a diverse set of potential options and at least the potential to adapt.<sup>221</sup>

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<sup>219</sup> That is, the ability to create and sustain a political consensus in the context of a grand societal vision that provides a demonstrable will to succeed.

<sup>220</sup> Ashby, W.R. *An Introduction to Cybernetics*. London: Chapman and Hall. 1957.

<sup>221</sup> This indeed is the focus of the agile organization.  
Atkinson and Moffat, *The Agile Organization*, pp. 126-127.

This latter flexibility enables us to think in terms of attributes such as scale, scope, and timing to assess the apples and oranges of widely varied political, diplomatic, information, military, and economic capabilities and in terms of multi-dimensional, multi-level, multi-arena options and of the varied courses of action that might be applicable and effective in meeting a particular challenge or exploiting an emerging opportunity. How then do we translate these concepts into a workable effects-based approach or, better yet, construct capabilities with this flexibility in mind?

A major part of planning, executing, and assessing effects-based operations is the evaluation of options to choose a course of action, that is, deciding which potential military, diplomatic, political, and economic capabilities—configured in which way, in which numbers, in which context, and when—offer the best chance of achieving the desired effects. The other part is a longer term question: how do we create the capabilities that will provide the basis for these options when and where they are needed?

### *Apollo XIII*

The problem is analogous to that of the ill-fated Apollo XIII lunar mission. The ship was damaged and unreachable in space so that when the astronauts announced, “Houston, we have a problem,” any solution could only come from the capabilities already aboard the capsule. Nothing could be added. The major challenge was a damaged filter for the air supply and the consequent need to find some combination of capabilities, including those that may never have been intended to work together, that might offer a way of replacing the filter. To make the challenge still more pressing, there was an unalter-

able time limit for finding a solution that was imposed by the physics of the capsule's flight trajectory and by the limited air and other supplies aboard the capsule. In approaching the problem, therefore, the NASA engineers inventoried every possible capability aboard the capsule to determine which combinations of these odd implements might deal with the astronauts' predicament. They then evaluated the difficulties, risks, and advantages of each potential solution, all while working against an absolute and deadly timeline. In the end, they managed to create a solution to one key problem from an unlikely combination of toilet paper, socks, and duct tape.<sup>222</sup>

As in the Apollo XIII example, the *ad hoc* challenges of asymmetric competitors and the *ad hoc* opportunities of a complex interaction leave us in the position of trying to fashion viable options for unexpected threats and opportunities using only the capabilities at hand. The broad concept of effects-based operations expands this national and coalition "tool kit" of options to include all those that might be generated by the resources of a whole nation or whole coalition within the timeframe allowed by the situation, thus multiplying the number of possible options available and greatly increasing the probability of success. The keys to such successful responses will be the collection of the capabilities that are in the tool kit, how well we can access them, and how well we can put them together iteration after iteration to deal with an evolving situation. If we assume for the moment that we already have the organizational structure and networking needed to link these capabilities together, this leaves us with the problem of deciding just what equivalents of the NASA engineers' duct tape,

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<sup>222</sup> Notice that this involved a human intervention in the application of educated minds to seeing relationships between diverse materials that would never have otherwise been seen as related.

socks, and toilet paper might belong in the tool kit to optimize the options we will have available, as well as the necessary skills to put them together as the NASA engineers were able to do.

## BUILDING AN OPTIONS DECISION SPACE

Like the Apollo XIII, the capabilities in a national or coalition tool kit—political, diplomatic, economic, and military as well as social and cultural—delimit all of the potential combinations of actions from which decisionmakers might fashion options applicable to a given situation at a given time and hence, bound the realm of possible responses or courses of action. This bounded area of all feasible options would then constitute their decision space. The challenge for a commander is to recognize the capabilities in the tool kit and how they might be assembled in new and innovative ways. The challenge for acquisition is to build a tool kit and decision space that will afford the greatest likelihood of having the right capabilities and networking to meet any challenge that presents itself.

Understanding the dimensions and limits of this decision space entails reducing the capabilities in question to their component attributes: *how much*, *where*, *what*, *how fast*, and *how long*. Given the ability to network and to integrate various capabilities in the manner of an *à la carte* menu, we can then begin to think of the decision space as defined by three axes. One would be the scale of the action that could be mounted, that is, the *how much*. Another would be the scope or diversity of the actions that would be available, that is, the *how*, the *where*, and the *with what*. And the third axis would be the timing, that is, the *how fast*, *how long*, and the *how agile*<sup>223</sup> (see Figure 31).

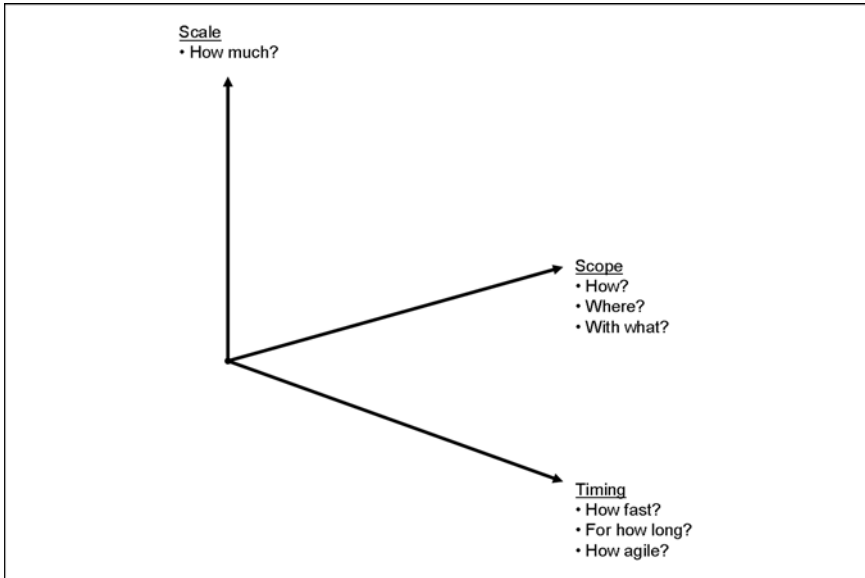


FIGURE 31. OPTIONS-BASED DECISION SPACE

Given the right structures and networking, the individual elements of a national response can then 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 observers in friends, foes, and neutrals. Similarly, the maximum scope of the national action would include the full global range of

<sup>223</sup> Note that what we have done here is limited to defining the broad outlines of a very general decision space. If we were to think of all the potential synergies that might occur as seemingly unrelated capabilities interact with each other—either positively or negatively—in a particular situation, the diagram could assume a more complex utility. Simon Atkinson has suggested that in a more tightly defined decision space, the mathematics of fractals might even be applied to identify likely combinations of capabilities that would lie along butterfly wing-shaped trajectories within the decision space.

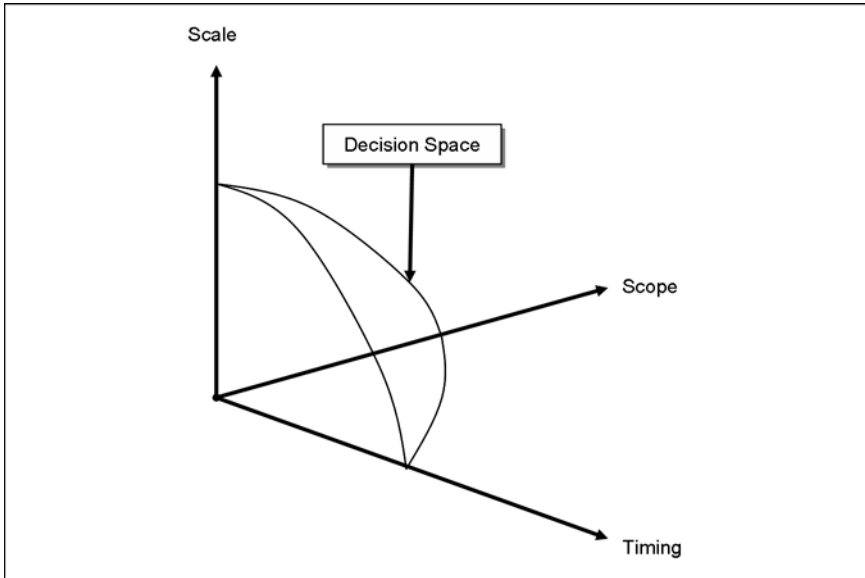


FIGURE 32. OPTIONS-BASED DECISION SPACE

national efforts, whatever and wherever those might be: everything from the FBI tracking down financial support to domestic terror cells to diplomatic efforts in the United Nations, or an unmanned aircraft surveillance of a particular insurgent group in Iraq or Afghanistan. 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 various elements can be combined, the resulting decision space of all possible combinations might resemble Figure 32; a decision space generated by the capabilities and the ability to network them would then encompass all of the options available to a nation or organization.

The axes are denominated in terms of the attributes of actions grouped into questions of timing, scope or diversity, and scale,

but we might take a further step and distribute the capabilities in some order along these axes, for example, grouping the rapid reaction capabilities (whether military, diplomatic, political, or economic) at one end of the time axis. With such grouping and distribution, we might then begin to think of the capabilities in terms of groups of options that could provide answers to the different questions posed.

For example, a challenge that demanded a response within 24 hours, and that might need to be sustained for several weeks, and that might need to include a variety of different actions to be exercised in succession but that did not require very large scale military forces would set criteria that would outline a particular bubble or vector in the decision space that would subsume all of the political, diplomatic, military, and economic capabilities that might be brought to bear. One obvious advantage with such an approach would be the ability to spot potential synergies between otherwise unrelated capabilities or contrarily to spot where the elements of such synergy are missing and, thus, where new or modified capabilities might be required.

In a multi-layer complex system of systems, this decision space would also vary from one level to the next. Thus, we would expect that the capabilities and options and decision space available to the strategic corporal on the roadblock in Iraq would be smaller and the available options both fewer and of a different character from those open to the operational commander, and that the operational commander's decision space would be different from those of the military staff or the national-level decisionmakers (see Figure 33).

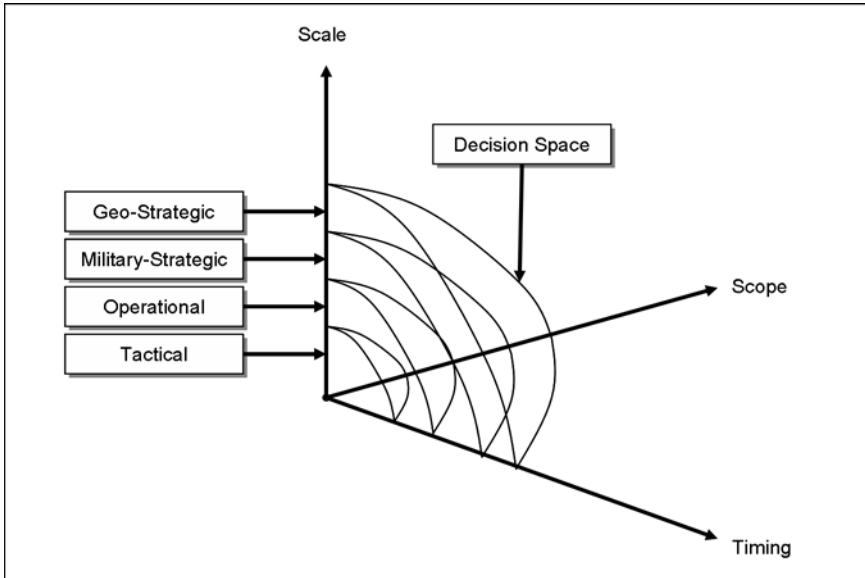


FIGURE 33. DECISION SPACES BY LEVEL

The key issue is building decision spaces at each level that can deal with the range of threats and to exploit the range of the opportunities likely to be faced at that level, while at the same time recognizing that the size of the decision space, even at the tactical level, will never be limited to simply military capabilities. The adequacy of a decision space at each level needs to be judged with reference to some threat or set of threats or to some set of requirements. As illustrated in Figure 34, where a challenge (Threat #1) can be handled within the scale, scope, and timing of available options in the decision space (e.g., within the timeframe required for a military force of a given scale and capability to be moved to an area and then sustained, within that for a political consensus or a coalition to be put together and then sustained, or in an arena where economic resources could be brought to bear), then the tool kit might be judged adequate. But if the challenge (Threat #2) demands a response that is too fast, too big, too long, or too



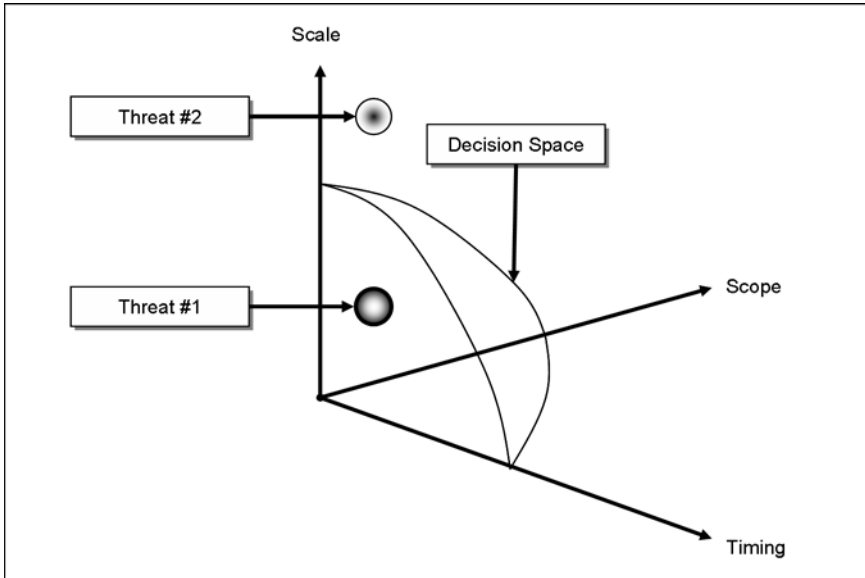


FIGURE 34. OPTIONS-BASED DECISION SPACE

different for the options tool kit available, then few if any options would be available and some reassessment and rebalancing of the tool kit would be in order.

The above implies a threat that is somehow relatively precise in time and nature. Yet, in dealing with asymmetric adversaries, it is not possible to define a specific enduring threat and an appropriate list of specific scenarios for which the decision space can be defined. Instead, we face the problem of *ad hoc* threats from complex adaptive foes, threats whose timing and nature almost by definition cannot be entirely predicted. In this complex world, the real problem is that of assessing whether a nation's or organization's decision space is sufficient to deal with the broad range of would-be surprises that might arise over the course of a long interaction either to meet immediate challenges of complex adaptive foes or to create a broad-based deterrence.

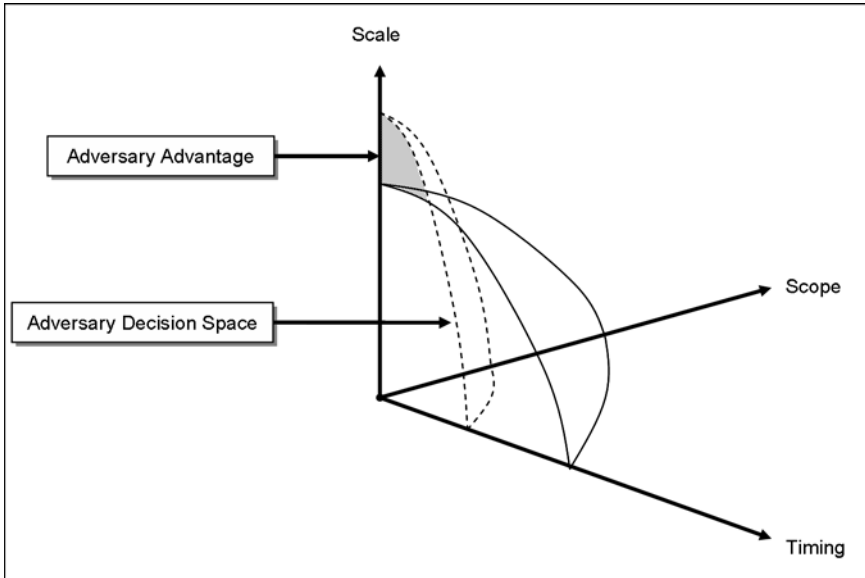


FIGURE 35. ADVERSARY DECISION SPACE

Again the process of bounding a range of the probable and possible adversary actions is the key. To do this, we can turn the same decision space construct around and apply it equally well to foes. They (as well as allies and neutrals), whether state or non-state, will also have decision spaces that are defined by those political, diplomatic, economic, and military capabilities that they can access, network, and bring to bear. By identifying what that decision space might be for each actor and overlaying the two decision spaces, 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 can guide any revision of tool kit networking and capabilities. In this case, while the adversary has a limited scope of actions that it might pursue and limited flexibility with regard to timing, it does possess the capacity for generating actions of sufficient scale to exceed our capabilities (see Figure 35).

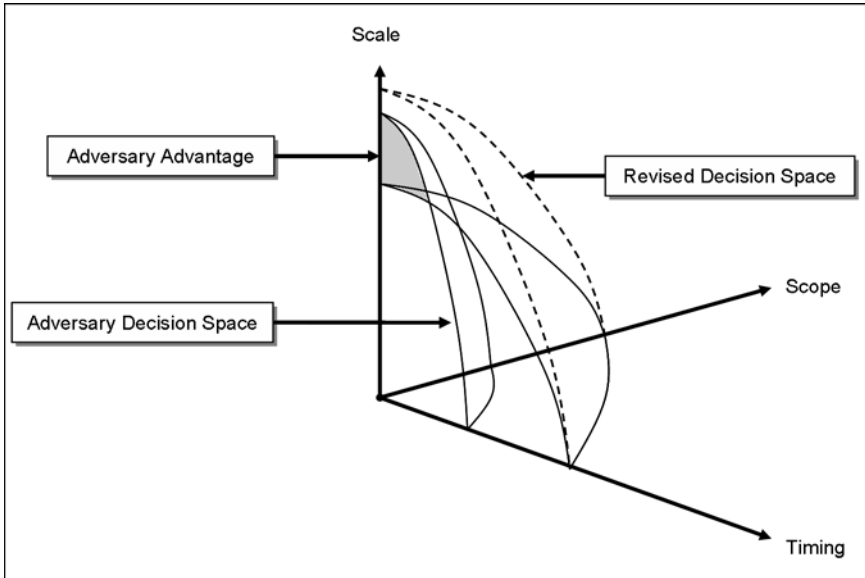


FIGURE 36. ADVERSARY DECISION SPACE

Although we might ordinarily tend to think of dealing with this disparity in terms of the revision to the tool kit needed comprising some form of increased capabilities for the military component of national power, in a multi-arena effects-based context, it could equally point to a need to build alliances or other relationships with other countries or actors so as to redress the imbalance (see Figure 36).

However, we might also think of the diagram from the perspective of General Krulak's three-block war in which troops must be prepared to shift back and forth from humanitarian operations to peacekeeping to lethal combat operations, or to conduct all three simultaneously. In this case, the decision space would need to include all of the "soft" capabilities for aid or public administration as well as those for combat, because if it were only equipped for combat, two of the three blocks would lie outside of its decision space, or the unit would need

to be so well networked that it could bring such “soft” capabilities from other sources (national and non-governmental) to bear at will.

Although it is fairly easy to understand the concept of the decision space with respect to another state, the approach applies equally to asymmetric non-state foes such as al Qaeda. 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. 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 the terrorists could control the timing of an attack so as to create surprise, they would require some considerable time to plan and execute the attack. By contrast, their decision space 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 that define success in terms of psychological attrition, and that are not bounded by rules of war (see Figure 37).

We could then compare the two decision spaces to see where al Qaeda was most likely to see an exploitable vulnerability or advantage and where we were least prepared to respond, or conversely, to assess where our own advantages and their vulnerabilities might lie. For example, the situation depicted in Figure 37 might then lead to efforts to extend the scope of our own decision space by focusing on capabilities to generate more diverse and flexible options and/or on capabilities to

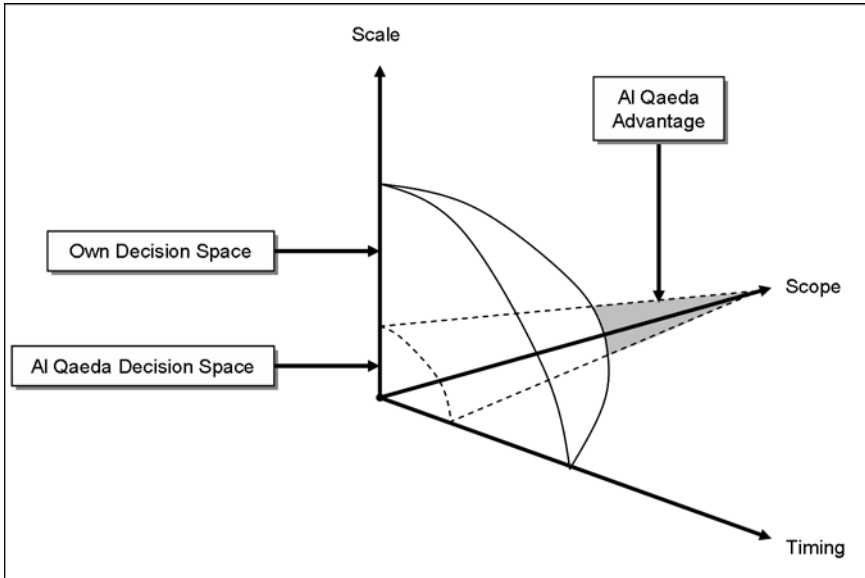


FIGURE 37. OPTIONS-BASED DECISION SPACE

exploit our perceived advantages in speed and scale—the advantages of networking being a case in point. Similarly, in response to a perceived al Qaeda (or other asymmetric attacker) advantage in exploiting perceived vulnerabilities created by the gaps between organizational competencies (e.g., between external and internal security organizations), the enlargement of the scope of our decision space might take forms that are distinctly non-military, such as increasing the coordination between law enforcement and military forces so as to cover potential exploitable gaps (see Figure 38).

Such decision spaces describe static balances such as might be incorporated into a national security strategy or an acquisition strategy. However, the decision space is actually far from static. It will vary with the capabilities we put into the tool kit, with how we organize, and with how well we network the capabilities across the scope of national power. That is, it will

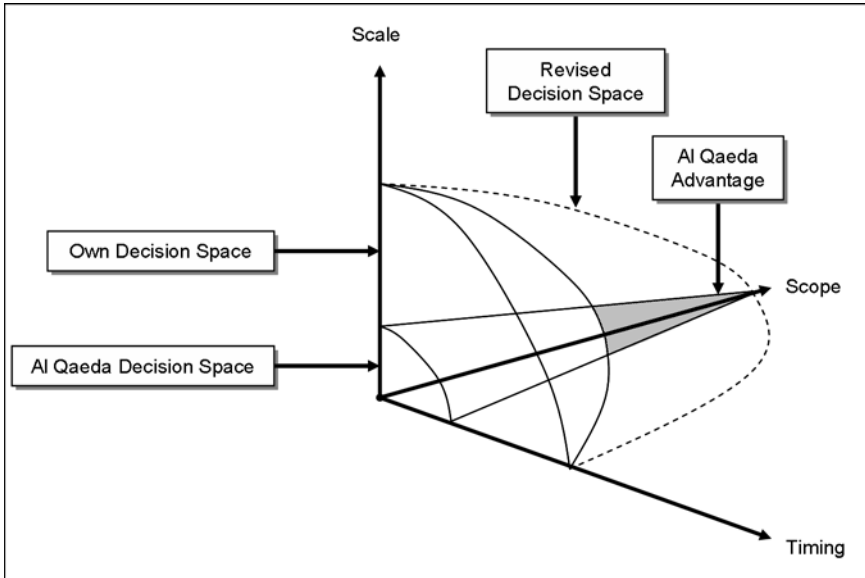


FIGURE 38. DECISION SPACE

vary over time in response to the changing challenges of the security environment.

For instance, if we were to plot the American decision space during World War II (see Figure 39), we might see a rather limited decision space in 1939 with capabilities for response sharply constrained by small standing forces and networking that was (as Roberta Wohlstetter so well underlined in her assessment of the successful Japanese attack on Pearl Harbor) poor and untried. By 1942 and the first major American effort in North Africa, this decision space might have expanded somewhat, but was still limited by war production that was still gearing up and a military force that was still largely untried.<sup>224</sup>

<sup>224</sup> Atkinson recounts the process of winnowing out equipment, commanders, command arrangements, and personnel.

Atkinson, Rick. *An Army at Dawn: The War in North Africa, 1942-1943*. New York: Henry Holt. 2002.

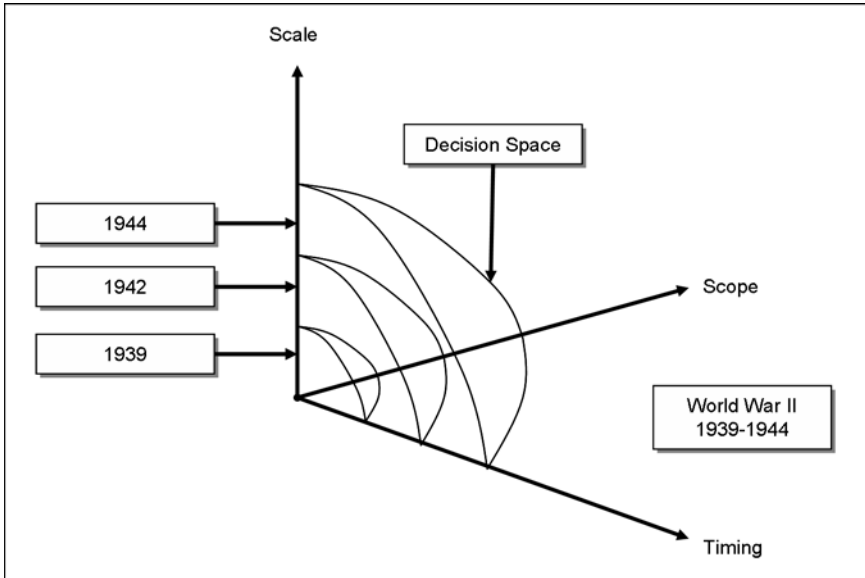


FIGURE 39. DECISION SPACE EVOLUTION OVER TIME

However, by late 1944 with war production at its peak and a combat hardened force, the decision space expanded enormously as a plethora of new capabilities and a new ability to network born of trial and error brought a substantial increase in the options available to American decisionmakers, who could then consider actions such as the two-pronged invasion of France and the island hopping campaign in the Pacific, which might have been impossible beforehand.

Similarly, the decision space can be plotted over a far shorter timeframe during the course of a crisis as military movements and mobilization or diplomatic and domestic coalition building open new options. During the Cuban Missile Crisis of 1962, for instance, President Kennedy's decision space on the first day of the crisis might be described as being limited (see Figure 40). American strategic nuclear forces could have provided an immediate and large-scale response (in one

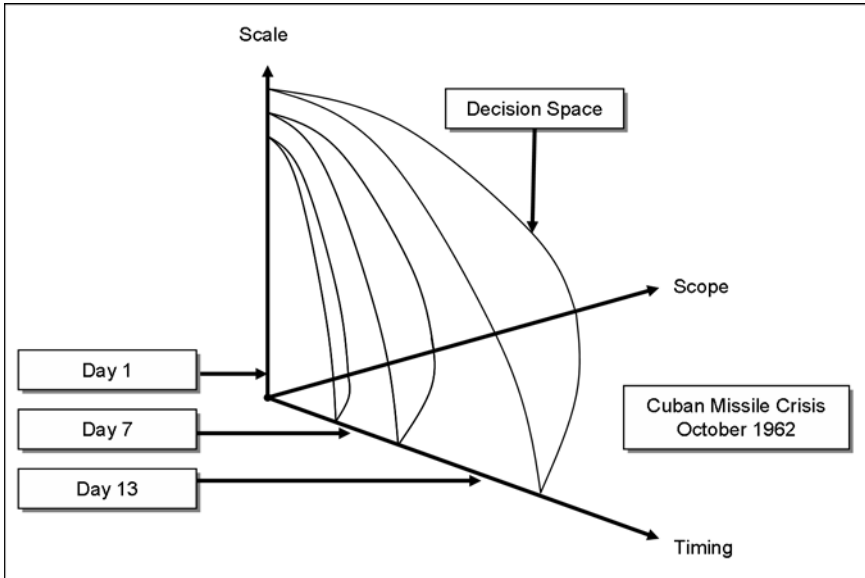


FIGURE 40. DECISION SPACE OVER TIME

disastrous paroxysm) but the scope and timing of other possible actions and thus the size of the decision space was limited. Accordingly, the Executive Committee (EXCOM) that comprised the informal decisionmaking organization for the crisis elected to maintain an outward stance of inaction while attempting to expand the options (and thus the decision space) by increasing surveillance, beginning to mobilize forces under the guise of exercises, and pursuing diplomatic action. By Day 7, these efforts especially in the United Nations and the Organization of American States had expanded the scope of options available to the point that open confrontation was possible. And, by Day 13, with quarantine in place and a mobilization of military forces continuing, the decision space had increased to the point that a successful confrontation with Khrushchev was possible.



One might equally apply this construct to an assessment of the Soviet decision space, with an initial advantage deriving from the presence of Soviet forces and some missiles in Cuba on Day 1, but with a decline relative to the United States as American diplomatic and military efforts began to take effect. Because the initial American efforts would have been without Soviet knowledge, Soviet decisionmakers might have perceived a continuing decision space advantage even as that advantage evaporated. When American actions became known, the Soviets then accelerated the deployment of missiles already within Cuba in an effort to restore their decision space advantage, but it proved to be too late to offset the American momentum.

Notice that in both cases there were sharp time constraints. The American advantage in decision space would only last until nuclear armed missiles became operational in Cuba, at which time the Soviet space would have opened considerably. Notice too that the problem in both cases was not with the lack of options but with the lack of what each side judged to be *viable* options. Thus, the American efforts to conceal their knowledge of what was happening in Cuba and any mobilization sprang not from an inability to strike at the Soviet Union but from a judgment that a nuclear option was not viable.

### *...and networking*

At the heart of the decision space is the requirement for networking. It is the networking that permits us to combine military power in a *joint* action and all forms of power in a whole-of-nation or whole-of-coalition action. If we assume, for instance, that a whole-of-nation capability contains  $m$  possible individual military actions,  $p$  possible individual political

actions,  $d$  possible individual diplomatic actions, and  $e$  possible individual economic actions, then the number of different combinations of all of these actions that might be assembled into options would be, as indicated below, 2 to the  $m$  plus  $p$  plus  $d$  plus  $e$ . Accordingly, to “go joint” or to “go whole-of-nation” can mean geometrically increasing the total number of possible combinations and options.

$$\text{Number of Options} = 2^{m+p+d+e}$$

However, the ability to combine capabilities into an option is a function of networking: the communications links or connectivity that permits coordination and exchanges of knowledge and information to occur and the social networking that permits the humans involved to interact intelligently with each other. Thus, the equation is really along the lines of

$$\text{Number of Options} = 2^{m+p+d+e} * N_c * N_s$$

in which the number of actual options is a function of two networking functions, each on a 0-to-1 scale:  $N_c$  for the degree of communications networking (e.g., the percentage of all of the potential actors in a potential action who have some physical means of communicating with one another) and  $N_s$  for the degree of social networking (e.g., the percentage of potential correspondents that can understand each other’s proposed actions sufficiently to coordinate efforts). Thus, if either the social or the communications networking quotients were to fall to zero, no matter how good the range of capabilities available, they could not be combined into a viable option.

## AWARENESS

It is one thing to have options and quite another to pick the right ones. In effects-based approaches to operations as in any military operation, intelligent choice clearly hinges on awareness of the situation and the opponent. But, just what is meant by “awareness” or “shared situational awareness” in the context of an effects-based approach? The earlier discussions of the human dimension of conflict and of the multiple interdependent levels and arenas in which options must be assessed and executed point to an effects-based awareness that demands far more than target locating information. Rather, all of these elements point to a need for complex knowledge and understanding whether by the strategic corporal or national-level decisionmakers.

### *Knowledge and understanding versus data and information*

The preceding chapters make clear that effects-based awareness differs in many ways from the sensor-derived detection, identification, location, and tracking inputs that constitute so much of the support for tactical level combat operations. For one thing, “shaping the behavior of friends, foes, and neutrals” and tracking cascades of psychological as well as physical effects demand knowledge and understanding that cannot be derived from sensors. For another, the range of effects-based approaches extends well beyond major combat into the gray areas of peacetime deterrence, humanitarian support, peacekeeping, peacemaking, crisis response, and post-conflict stabilization—areas that require knowledge both of complex cognitive processes and societies. As military operations diverge from the relatively straightforward linearity of major combat, awareness will be based less on sensor-derived

information that is machineable and quantifiable and centered more on complex knowledge that is not readily reducible to quantification.

This knowledge is not simply an aggregate of data and information. Rather, it represents an internalized and perhaps not easily articulated understanding of a complex subject, whether a local commander's understanding of a particular firefight such as the Army Captain in Najaf or a noted academic's understanding of the local history and politics. Indeed, post-major combat operations in both Iraq and Afghanistan emphasize how dependent effects-based operations are on just such knowledge-based awareness. The real question is how this knowledge and understanding can be captured and used by those planning, executing, and assessing effects-based operations.

### *Fusion*

In the dissected action-reaction cycle, the companion to awareness creation was contextualization. The fusion process fills a similar function in melding reporting from various sources—sensors, human reporting, and expertise—into a single coherent Common Operating Picture (COP). However, the diversity of data and information and the complex nature of the knowledge required for an effects-based COP pose special problems. Whereas the sensor-derived data that figure in a traditional COP are relatively clear cut and amenable to machine collation, the human-derived information and expertise so necessary to operations in Iraq and elsewhere have a distinctly different character. Human-derived information is at once subjective, ambiguous, and uncertain, and must be put into some context to be validated. Knowledge derived from

expertise has yet another character because it stems from an individual's mastery of some complex subject based on an internalization of complex sets of interdependent variables.<sup>225</sup> As this suggests, effects-based fusion requires a knowledge base on which to build, such as the Operational Net Assessment (ONA) being refined by the U.S. Joint Forces Command.<sup>226</sup> However, the ever-changing nature of complex adaptive opponents and the *ad hoc* nature of likely challenges—as well as the experience of operations from Grenada to Iraq—signal that any ONA effort must be tempered by two additional realities. In dealing with a complex adaptive system, no knowledge base however extensive will ever be complete, and any knowledge base will be time-late. This is to say that the fusion process must be as complex and adaptive as the foe.

### *Networking*

The problem presented by the need to fuse dissimilar information sources is equally about the interfaces that enable the fusion to occur. Successful fusion of sensor-derived and human-derived information and human expertise involves three interfaces:

- machine-machine (e.g., sensor-to-shooter connectivity),
- man-machine (e.g., command center displays), and
- man-man, including issues such as team building, trust and confidence, and expert-to-operator interaction.

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<sup>225</sup> Understanding the social domain for a particular actor, for example, would likely require expertise.

<sup>226</sup> The U.S. Joint Forces Command has been at pains to create such a net assessment combining a wide array of hard and soft information on likely areas of unrest to support effects-based operations.

The machine-machine interface, despite the challenges involved, is the easiest of the three and already the focus of most network-centric efforts. The man-machine interface is a greater challenge but has been the focus of efforts and experimentation both military (notably at the U.S. 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 different field (e.g., a regional expert or a worker in a non-governmental agency) when there is no common shorthand.<sup>227</sup> 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.

While the connection between awareness and networking may appear self-evident, there are two important issues to be considered: the requirement for internalized complex knowledge and the need to cope with unpredictable observers and changing situations. While it is certainly true that communications networks can be created to link two commands or two human beings, their ability to communicate complex knowledge is very much a question of social networking in many different guises. It requires education and some form of social network-

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<sup>227</sup> Notice that this does not assume that the forward commander needs to be a regional specialist, especially because 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 to appreciate and take action upon the expert’s input.

ing for a Middle East expert to convey meaningful knowledge to the strategic corporal on a sensitive road block in Iraq, who is himself the expert on his specific local situation. In brief, the same networking quotients pertain to effects-based awareness as to options generation.

## AGILITY

In *Power to the Edge*, Alberts and Hayes define six dimensions of agility:

- robustness, the ability to maintain effectiveness across a 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.<sup>228</sup>

In effects-based approaches, this concept of agility takes on added meaning. Robustness, resilience, responsiveness, flexibility, innovation, and adaptation become aspects of the ability of a player to create the options needed to deal with the unexpected and then to adapt these options or generate new options time and again as an interaction and all of its ramifications unfold. Just as it is not sufficient simply to have options and a decision space, it is not sufficient to be able to choose the

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<sup>228</sup> Alberts and Hayes, *Power to the Edge*, p. 128.

right one *once*. The whole nature of the interactions between complex adaptive systems is that they are never quite done. The right choices in one cycle are not necessarily the right ones in the next cycle. Indeed, the whole focus of an adaptive foe is on ensuring that any success we may enjoy in one cycle will *not* be repeated in the next.<sup>229</sup> In such a face-off, having a wide range of options from which to fashion actions and being able to mobilize and fuse the knowledge needed to make the best choices must be accompanied by a third element: agility. We must be agile enough in the entire process of planning, executing, and assessing effects-based operations to maintain a “speed of command” or “speed of decision” sufficient to drive the interaction and thereby keep the foe on the defensive.<sup>230</sup>

### **Scalability and timeliness**

Effects-based approaches to operations clearly need to be both dynamic and scalable down to the tactical level. Yet, given the requirement to orchestrate complex actions on many levels of many arenas, one might easily conclude that effects-based approaches can only be planned and assessed at the operational level of war or higher, that is, where timelines are longer and where the assets exist to undertake such a detailed process.

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<sup>229</sup> This recalls Clausewitz’s example of the two wrestlers who must continually adapt to one another’s actions and reactions.

Beyerchen, “Clausewitz, Nonlinearity, and the Unpredictability of War.”

<sup>230</sup> Atkinson and Moffat note that “the challenge to the military is not so much to make its fighting structures more networkable...but to ensure that the way forces are commanded and controlled and policies formed are coherent and similarly adaptive and agile to the forces they command...complex systems cannot be controlled and to attempt to do so would be to deny the network its fidelity, agility, and trusts to do the right thing. They can, however, be influenced, bounded, and placed within an appropriate context.”

Atkinson and Moffat, *The Agile Organization*, p.17.



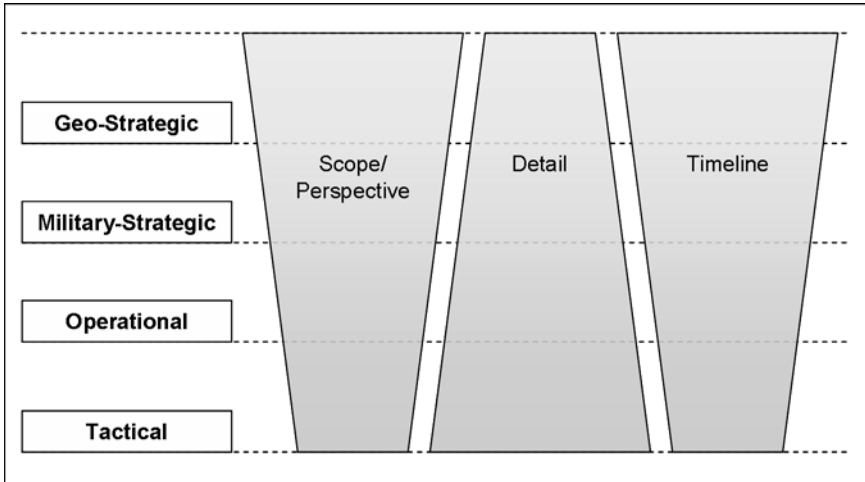


FIGURE 41. VARYING CONTEXT

One might also conclude that effects-based approaches are not scalable down to the tactical level, nor can they be conducted on a dynamic basis. Indeed, there seems to be a stark contradiction between the rather ponderous and time-consuming process of dissecting action-reaction cycles and analyzing their linear, cognitive-social, and complex elements on the one hand and the requirement for executing precise actions against an adaptive foe in an ever-changing situation on the other. Yet, if we recall the example of the Army Captain and the firefight over the burnt out Humvee, it is clear that both we and our foes are conducting and continue to conduct tactical level effects-based operations despite these challenges. How do the tactical commanders do this?

At the root of the scalability and timeliness problem are three factors: the difference in scope, the difference in level of detail, and the differences in the length of the action-reaction cycle from one level to the next and one arena to the next (see Figure 41). Whereas the timeline for the cycle may stretch to

months at the military-strategic or geo-strategic level, it probably will be denominated in days or hours at the operational level and in minutes or seconds at the tactical level. Similarly, although the scope or perspective will be greatest at the geo-strategic level and least at the tactical level, the degree of detail will be greatest at the tactical level. In general, the actions to which we must adapt will be the most rapid, the most detailed, and the most immediately lethal at the tactical “edge.” It should be obvious that any system of command and control in which the higher level of command enforces its own action-reaction cycle and pace on lower levels will tend to remove the tactical commander’s critical ability to adapt. It should also be obvious that, network-centric capabilities notwithstanding, a higher level command that tries to master all of the details available to its tactical commanders will soon find itself bogged down in detail and become dysfunctional.<sup>231</sup> If a linear centralized command system will not work, how are we to combine a mastery of the diverse elements of a whole-of-nation option with the tactical adaptability needed to deal with a complex foe?

The problem, in fact, reinforces some of the central tenets of network-centric operations concerning the decentralization of power leading to better speed of command. Alberts and Hayes note several such modes of command in *Power to the Edge*. One of these is a mission-specific mode dating back to the German *Aufstragtaktik* of 1918, which relies on a commonly understood appreciation of the general situation and objectives to accord local commanders the freedom to act independently so as both to adapt and exploit a rapidly changing battle. An objective-

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<sup>231</sup> While this has always been the case, it is particularly true in effects-based operations because the extent and variety of the information and knowledge to be disseminated is greater.

specific mode, which has been employed by the British, dictates the objective but allows local commanders the freedom to figure out how best to create that desired effect.<sup>232</sup> However, any blanket recommendation also runs afoul of the reality of crisis operations in which the need to tightly control complex actions and effects at the national level becomes paramount. This implies an ability of decisionmakers at all levels to abbreviate and adapt any effects-based planning process to the time available and the needs at hand—and this in turn implies the need for a different, simpler, less linear, continuous cycle approach to planning.

In stratified, hierarchical modes of planning and decisionmaking, the process of defining such behavioral end-states and even the specific effects to be achieved would be accomplished at the level of the theater commander or higher. In part, this approach reflects assumptions that the information and knowledge needed will only be available at this level, and that the actions to be taken can only be coordinated from that level. In many ways, this approach also reflects traditional effects-based approaches in which the success of efforts to deal with complexity hinge on the genius of a commander.<sup>233</sup> The introduction of network-centric capabilities, especially a shared situational awareness and the ability to draw knowledge from anywhere in the network, invalidate much of the first assumption and make the second far less reliant on a

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<sup>232</sup> These are respectively labeled “Control Free” and “Problem Bounding.” Alberts and Hayes, *Power to the Edge*. pp. 23-26.

<sup>233</sup> If we look closely at the most common instances in which “command intent” succeeds in prescribing exact effects and actions, they are heavily focused on physical attrition at the tactical level of major combat operations, that is, they deal with an end-state that is immediate and physical and with actions that are largely limited to observable and quantifiable destruction.

unique genius. Moreover, if we accept that the operations for which we are planning are part of a continuing complex spiral of interactions between multi-level systems of complex adaptive systems rather than a single exchange in an essentially linear evolution, then complexity theory would also argue that the best chance of adapting to the exigencies of the interaction would lie in enabling the commanders at each level to deal with the interaction at their own level.

This is in fact one of the core arguments for bringing power to the *edge*. The Libyan example underlines that this is not new. The planning in that case was not done on the staff of the three-star Vice Admiral commanding the U.S. Sixth Fleet or on the staff of the four-star Commander-in-chief Europe, though both were regularly briefed and consulted. It was mainly conducted by the 20-man staff of the one-star commander of the Sixth Fleet's Battle Force, who in turn sought the inputs of the tactical commanders who would be executing any plan.<sup>234</sup> This planning process and mode of operation was repeated a year later under another Battle Force commander.

### **Centralized/top-down command versus decentralized/iterative guidance**

The core planning challenge posed by the multi-layered complex adaptive systems was to create effects, conditions, or behavioral end-states at one or more levels of the system of sys-

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<sup>234</sup> It is perhaps significant to note that, even though the rules of engagement for the conduct of operations south of the line of death were granted to the Sixth Fleet commander rather than to the battle force commander, when those operations commenced, the Commander Sixth Fleet (then VADM Kelso) moved to the carrier to be part of the tactical and operational interactions.

tems that might cross over into other levels. Given the complex context of the problems and tasks and especially the ability of effects to cross over into other levels and arenas, the problem is not only to plan but to coordinate and deconflict actions and effects.<sup>235</sup>

At first glance, this requirement for coordination and deconfliction would appear to fly in the face both of complexity theory and the tenets of network-centric operations. After all, complexity-driven uncertainties point to the need for flexible adaptation rather than fixed processes and network-centric operations derive their strength from decentralization empowered by shared situational awareness. Yet, coordination and deconfliction suggest both that planning must of necessity be centralized at the highest levels with specific “desired effects” handed down to lower levels for controlled implementation, and that the lower level planning processes be restricted to relatively linear tasks such as the actual targeting.

In actuality, the model of a system of complex adaptive systems that we have explored argues against such an arrangement in two ways. First, the innate complexity of the interactions means that we cannot simply think of desired effects as a given or as a monolithic national strategy that pre-

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<sup>235</sup> The tactical behavioral end-state of an action-reaction cycle may be straightforward: killing an opponent before he attacks. But, this exchange will only be one such interaction of a larger number occurring in a particular timeframe, each of which might appear to be a closed loop that is complete until the next problem or target presents itself. However, in effects-based approaches, each interaction, e.g. killing or capturing Osama bin Laden, could have an impact (positive or negative) on the next level or potentially upon the entire structure that would in some way contribute to or detract from the conditions and behavior we are trying to create overall.

cisely lists required behavioral end-states.<sup>236</sup> Given that the interactions of complex adaptive systems are not static but continually evolving in different ways and at different speeds on different levels, such givens and strategies would inevitably be time-late and out of sync with reality to the point of ceding the initiative to opponents. Second, in interactions with complex systems, the scope or perspective, the appreciation of the details of a developing situation, and the timelines for executing actions will vary so wildly from one level to the next that no one level is ever likely to have a complete mastery of the knowledge upon which the planning must be based or the ability to comprehend the entire complex interactions at another level. A common situational awareness is helpful in lessening this disparity, but the key is man himself both from the perspective of providing a mastery of the complexities that lie outside of conventional awareness and from that of human limitations on the span of control. The latter, although certainly evident in the history of crisis operations, is especially significant. As a general rule, the tactical level context is likely to have an extremely limited timeline and be limited in scope or perspective to the immediate engagement or at most to a scaled down operational perspective, but will have a degree of detailed appreciation of that immediate situation that other levels lack. At the opposite end, the geo-strategic level will usually have the longest timeline and a broad perspective that may extend to the international system of systems as a whole, but will usually lack the fine-grained detail of the tactical commander. Given that perspective becomes wider at higher

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<sup>236</sup> Any national strategy faces two dilemmas. First, if it is to have sufficient detail to be useful in a continually changing world, it is likely to be overtaken by events before it is even published or circulated. And second, in an application of the Heisenburg uncertainty principle, by stating specific desired end-states, it may make them either impossible or more difficult to attain.

levels, detail diminishes, and timelines grow longer, detailed tactical orders are not necessarily what we would want.<sup>237</sup>

## **Direction versus guidance**

The demands of complexity and the consequent advantages of decentralized planning at the level closest to the operation must be balanced against the demands of deconfliction, coordination, and prioritization. A tactical action that makes perfectly good sense at that level may convey a stimulus that is just the opposite of what is sought at higher levels of the system of systems. Conversely, it may be necessary to make sacrifices of tactical advantage or even tactical forces to achieve the larger behavioral end. The combination of short timelines and complexity hint that the relationship of planning from one level to the next is less that of control than of flexible coordination with the ability to adjust the degree of coordination as a situation evolves. The “fedora curve” illustrated in Figure 42 points to the difference in the requirement for coordination over the spectrum of interactions. The points in the interaction at which small tactical interactions might create the greatest disturbances would logically occur in the crisis or post-conflict stabilization and especially at the transition points to and from major combat operations. It is in these periods and at these points that the system is teetering on the brink of either losing its equilibrium or of regaining it and at which even a small additional disturbance can prove to be the single snowflake that causes an avalanche. It is also in these sections of the spectrum that actions are the most mixed—diplomatic, political,

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<sup>237</sup> An exception to this general rule occurs in crisis operations when the national-level decisionmakers attempting to coordinate multi-faceted whole-of-nation actions to achieve a precise effect may have to manage the local actions as best they can to ensure that the “message” gets across.

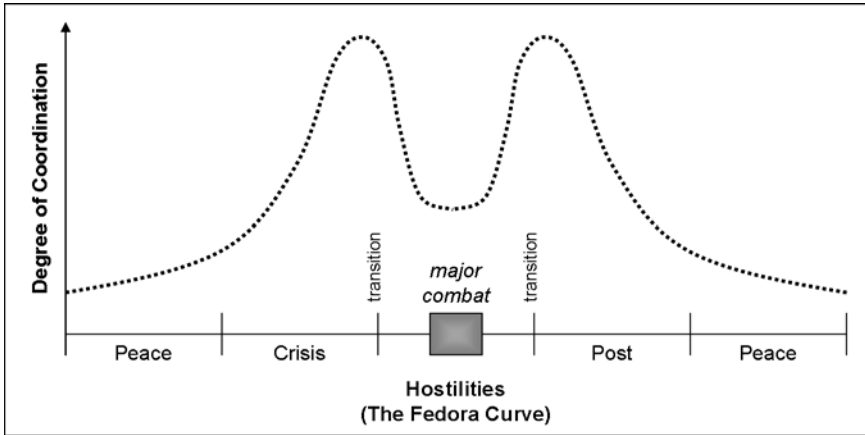


FIGURE 42. DIRECTION VERSUS GUIDANCE

military, and economic—and the most difficult to coordinate; as a result, these sections contain the highest probability of a misstep. By contrast, military operations in major combat are usually of such a scale and intensity that any single interaction will tend to get lost in the overall context unless it has achieved some particular significance.<sup>238</sup>

<sup>238</sup> We see this phenomenon in Operation Iraqi Freedom. There was a need for a tight coordination of all actions in the days leading up to the assault, all under close scrutiny not only by the Iraqi opponent, but also by coalition partners, potential future partners, regional players, United Nations Security Council members opposed to such action, world stock and oil markets that feared a cut off of oil supplies, and the media. That coordination requirement increased as the date for the invasion drew closer. Once major combat began, the military operations had a relatively free rein, a latitude that enabled them to operate at a pace that retained the initiative and permitted them to continually surprise their opponents. But as the major combat operations came to a close, the situation reverted to an increased level of control. That higher level of coordination not only up the chain but also with other elements of what then needed to become a whole-of-nation vice a military operation remains in evidence throughout the entire post-conflict period, a need manifest as well in the sheer size of the United States Embassy in Baghdad that was installed as the Coalition Provisional Authority returned sovereignty back to an Iraqi government.



The above suggests a process in which each level frames “guidance” in the manner of the *Aufstragtaktik* that provides the basic parameters of a desired effect for the next level down while leaving that level the freedom to apply that direction using its more focused perspective and more detailed knowledge to improvise and adapt its actions to the faster pace of its local action-reaction cycles. This guidance will be more general or aggregated at higher levels of decisionmakers, most likely reflecting both a longer timeline and a broader perspective or greater scope of variables. This suggests that any process must in fact be iterative with general guidance as to outcomes and behavior flowing downward and options for achieving those outcomes and producing that behavior flowing upwards. Moreover, this would be repeated at successive levels with, for example, the joint staff or regional combatant commander putting national-level guidance in military terms, the operational commander putting that guidance into terms of the forces that he is commanding, and individual tactical commanders putting it into the context of their own particular challenges.

Conversely, there should be an upward flow of ideas and options for realizing this guidance together with an assessment of the possible pitfalls at each level. In each case there will need to be some appreciation of the problem at least one level up and down. That is, the tactical commander will need to understand the context of the operational commander; the operational commander will need to understand both the tactical context and the regional commander’s context; and the regional commander and joint staff will need to understand both the situation of the regional combatant commander and that of the national-level decisionmakers.

However, this vertical communication and feedback is not all that is needed. In a whole-of-nation response there will also be a need for each level of command to communicate and understand laterally across the boundaries with different agencies of government, that is, actors on the same level and, therefore, similar perspectives, grasps of local detail, and timelines. Moreover, the same will be true of coalitions and other local players. Given the creation of some form of shared local situational awareness, the guidance can provide a framework for flexible interaction to a degree that detailed orders and centralized command cannot. Although this may sound complex and next to impossible to do, it is again the image of reality in today's operations. Operations in Bosnia and Kosovo, for example, could not be isolated from their political and diplomatic dimensions and involved interactions with coalition partners, United Nations, and non-governmental relief agencies at all levels and the options that could be presented to decisionmakers up the line were highly colored by these interchanges. In each case, one can observe personal interrelationships—sometimes in violation of orders or established procedure—that attempt to do just this.<sup>239</sup>

All three of the network-centric contributions come together in this process of adaptation and survival. The tool kit of options knitted together and enabled by networking provides 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 informed choices that increase the probability of success. Agility provides the speed,

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<sup>239</sup> Wentz, Larry. *Lessons from Kosovo*. Washington, DC: CCRP. 2002. pp. xiv.

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.

### **...and the strategic corporal?**

There is a tendency to think of decision spaces and the capabilities and networking that define them, of awareness and knowledge mobilization, and of the requirement for agility in terms of a planning process at the operational level of competition and conflict or higher. Yet, the most pressing need for adaptability is probably at the level of the strategic corporal or tactical commander who must execute effects-based plans on a day-to-day basis in the face of challenges that change on a minute-to-minute basis using only the knowledge and resources that can be brought to bear within that tightly constrained timeline. The reality is that the tri-fold adaptability construct applies even more pointedly at the tactical level whether the tactical commander is the corporal on the roadblock deciding whether an approaching truck is a mobile bomb or the Army Captain in Najaf engaged in a firefight over a burnt out Humvee.

The decision space at the tactical level of hostilities may be largely a function of military capabilities, but it is as dependent on social and communications networking as any other level of operations. In fact, the really dramatic “military revolution” evident in both Afghanistan and the major combat phase of Operation Iraqi Freedom was the ability of forward tactical commanders down to the strategic corporal to call upon a wide range of joint capabilities, such as precision air strikes. As at higher levels, the size of this tactical decision space was a function not only of new weapons but also of networking, the

interoperable communications that permitted the joint capabilities to be brought to bear, and the social networking evident in the training, flexible organization, and sheer innovation of tactical commanders in getting the job done. The challenge now is to expand this decision space as dramatically in operations other than major combat, operations that require more than “joint” communications and more than social networking and cross-training within a military community.

At this tactical level, as at higher levels, awareness is composed of both information and knowledge and dependent upon an understanding of command intent. The difference is in focus and detail. The Captain in Najaf did not have to know the history and tenets of Shi’i Islam to carry out his mission, but he did need to know that the city’s shrines were some of the holiest places in Islam and that his opponents were trying to provoke any action that might be portrayed in the media as an attack upon them. In the effects-based context of the operation, this would arouse the anger of the Muslim world and let the insurgents fomenting the unrest “win” the engagement. The captain also needed to know enough of the command intent to understand what his mission was, how it fit into at least the next level of the effects-based plan, and what freedom of action he had in carrying out his mission.

As this latter freedom of action implies, agility was the key to success in the firefight. Within the constraints of his mission, the Captain could literally call the shots so as to adapt his actions to the changing situation wrought by an exchange with an intelligent foe, that is, he was called upon to exercise all of the attributes of agility outlined in *Power to the Edge*: adaptation, responsiveness, flexibility, innovation, resilience, and robustness. His ability to adapt rapidly and agilely rested on

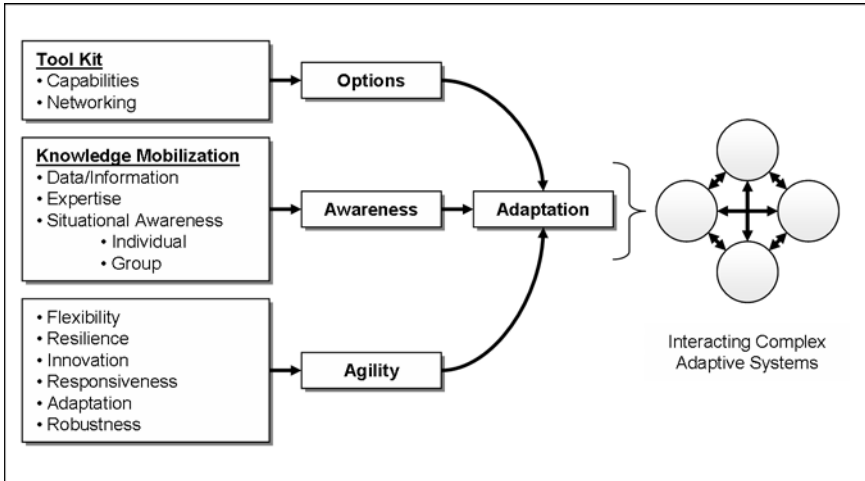


FIGURE 43. ADAPTATION

knowledge-based awareness: an understanding of command intent that could be applied to the changing situation and an understanding of the situation, something that was far more than simply knowing where the enemy was. The robustness and resilience of his effort depended not only upon the capabilities organic to his own small force, but also on those that could be introduced either to deal more efficiently with emerging threats or if the fight became too much for his organic resources. These capabilities in turn enlarged his decision space to the point that he could take risks and be more aggressive in carrying out his mission than if he were limited to his own resources. Above all, the actions and reactions and the planning processes and risk calculations had to be timely and responsive. In practice, this meant that the process had to be conducted in great measure inside the Captain's head using whatever knowledge and information were available at that given moment.

## PUTTING IT TOGETHER

In the above discussions, we see the intersection of three factors: (1) a tool kit of options for responding to an action; (2) the availability of sufficient awareness to choose the best of these options; and (3) the agility to create and execute the options and to adapt them to the particular challenges posed by each turn of the action-reaction cycle. Within this tri-fold framework, we can begin to identify the intellectual, informational, and technological tools from organizational change to decision aids that might better enable us to address the complexities of effects-based operations in a way that, if not perfect, is at least better than our opponents' ability to do the same.

Given sufficient time, any of the above networking could be accomplished. The key is creating a networking and knowledge flow that is sufficiently quick and dependable to enable commanders to adapt actions, generate new options, and implement new networking as the situation evolves. But the communications networking is the easy part of the problem. The social networking (military, interagency, academia, industry, culture, education and training, and doctrine) is both the most challenging and the most necessary for agility in effects-based operations.

## CONCLUSION

Chapter Four points to three potentially decisive variables in any effects-based approach to operations, loosely stated: the quality of the decisionmakers, the quality and diversity of the capabilities available, and the quality of the organization—specifically its agility and the degree of freedom of action it affords in carrying out effects-based operations. What we con-

sidered in Chapters Five and Six was primarily the use of networking in supporting the first two of these elements. We looked at the role of networking in enabling the Joint Task Force commander or, indeed, a nation or coalition to knit together diverse and apparently unrelated capabilities to deal with emerging situations. We also outlined a roadmap for exploiting the networking advantages of a modern Joint Task Force to support decisionmakers by identifying where and to what end human intervention would be necessary and what kinds of information and modeling tools and what kinds of reach-back to a national or coalition-wide reservoir of knowledge might aid the human in the loop to bound the complexities and ambiguities involved and thus increase the probability of making the right choices. This is to say, we focused on increasing the quality of the *decisionmaking* rather than the quality of the decisionmakers.

Clearly this effort is too narrow and requires some caveats. First, for purposes of comparison, we treated the quality of the decisionmakers themselves as a wash assuming that the quality on both sides would be roughly equal. But, this is not really true. Although we are tempted to extol the expertise of our asymmetric adversaries, the fact is that a state or coalition potentially has a far larger pool of experts and prospective decisionmakers to draw upon and a potentially greater ability to educate and train such prospects as well. The challenge confronting the state is to create the organizations and mindset to do this. Second, in a somewhat different vein, we used the model of the successful effects-based operations by two innovative commanders to glean the tasks and requirements portrayed in the roadmap. Yet, we only lightly touched upon the commanders' equally important efforts to build a team capable of dealing with these tasks and requirements and their

efforts to organize their staff and forces to that end. Similarly, we need to recognize again that these commanders' efforts took place within the confines of existing hierarchical organizational structures and, indeed, their successes often derived from creating ways of working around the organizational blockages posed by their existing systems.

What is apparent in all of this is the importance of the human role in the adaptive flexible effects-based solutions that we seek. This human role is the focus of the concluding chapter.



## CHAPTER 8

### CONCLUSION:

#### A NETWORK-ENABLED

#### BUT EFFECTS-BASED APPROACH

#### TO OPERATIONS

The effects-based approach to operations outlined in this book is characterized by a focus: (1) on the human dimension of conflict and competition; (2) on a full spectrum of actions in peace, crisis, and hostilities; (3) on the use of multi-faceted whole-of-nation or whole-of-coalition power; and (4) on the complex interconnected nature of any effects-based operation. The human dimension derives both from the fact that, no matter what form they may take, effects-based approaches are ultimately about shaping human perceptions and behavior, and from the fact that they depend heavily on human beings to make the complex estimates and decisions involved. In the effects-based approach, the focus on actions rather than targets means considering applications holistically across the full operational spectrum and in peace, crisis, and

hostilities. Similarly, because the focus is on what observers perceive rather than on what we do and because any action is therefore but one part of an observed whole, all operations are necessarily whole-of-nation or whole-of-coalition. Finally, an effects-based approach proceeds from the recognition that all actions are inextricably linked in a system of systems of human beings and human organizations whose complexity shapes both the nature of the problem and the assessment, planning, and execution of any operation.

The human dimension at the heart of all of the above makes any real-world operation inherently complex and makes the ability to deal with and exploit this complexity the primary determinant of success in any effects-based approach to operations. The unstated problem in all of the above, however, is that of time. Simply stated, no effects-based plan or process we can devise and no array of information and knowledge resources we can conjure up will be of any value unless it is timely. This timeliness may be with respect to an acquisition process providing capabilities to deal with new challenges and may be enumerated in years or—more appropriately for an ongoing confrontation with an innovative adaptive foe—in weeks.<sup>240</sup> It may be in the context of an operational planning timeline enumerated in days or hours. Or, it may be that of the strategic corporal faced with an all too literal “drop dead” timeline of seconds. The above breakdown certainly suggests that, to be workable, any effects-based approach must be timely, but the variations in timelines also imply something else: that any workable approach must also be scalable.

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<sup>240</sup> The rapid cycles of interactions with Iraqi insurgents using improvised explosive devices (IEDs) offer an obvious example of the speed with which counteractions need to be fielded.

What is noteworthy in the above is that none of it is new. The four foci describe how insightful leaders over the last two millennia and more have always approached competition and conflict, and the tyranny of time and need for scalability have always been immutable facts of war. If an effects-based approach to operations is not new, then what is?

The answer to this question and the basis for discerning what the Information Age can bring to effects-based operations that *is* new can perhaps be found in a clear distinction between what we have termed a *classic effects-based approach* and a new vision of a *network-enabled but effects-based approach to operations*.

## CLASSIC EFFECTS-BASED APPROACH

The classic approach recognizes the eternal interconnected complexities of competition and conflict and the demands of time and scalability, but has depended on human decisionmakers to deal with the uncertainties and complexities involved and to choose a course of action. This is to say that the classic approaches to effects-based operations have relied heavily on the intuition, education, experience, and occasionally, the sheer genius of the commanders and political leaders involved. The main problem with this dependence on the human in the loop lies in its limitations. First, there is an argument to be made that the quality of human decisionmaking varies greatly from one person to the next, is often slow, and is usually not very accurate. Second, given a dependence on human decisionmakers, there is the perennial challenge of choosing the right people to be decisionmakers. Finally, there is the problem of creating an organizational structure that enables all of the decisionmakers chosen to function effec-

tively. Through the centuries, classic effects-based approaches have attempted to address each of these in a variety of ways.

### *Human limitations*

It has been argued that the quality of human decisionmaking is at best uneven and idiosyncratic and that any human decision is likely to be imperfect at best. But we need to be careful to distinguish between two types of operational decisions. For example, a fire control problem in a military operation might present two challenges, one a problem of ballistics that is an application of physical laws and therefore linear and machineable, and the other a complex problem of whether or not to fire. There is little debate about the utility of even simple mechanical computers in the case of the former, but the central challenge of effects-based operations lies in the latter, a complex question with a never entirely predictable web of consequences.

Complexity theory insists that there are no perfect answers to the complex, multiple interdependent variable problems that characterize effects-based operations.<sup>241</sup> In fact, the real requirement in an effects-based approach to operations is to come up with a solution that is simply good enough to work and timely enough to deal with the situation at hand. This good enough/timely enough standard is hardly new in military decisionmaking, but it sets a different, more realistic standard for human decisionmaking in effects-based operations. It implies that the task is to decipher complex problems

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<sup>241</sup> Military theory reflects this innate complexity in its references to the operational *art*.

sufficiently to identify the one or more “80 percent” approximate solutions that have the greatest likelihood of being right.

The focus on probability of correctness in complex decision-making suggests both that quality of decisionmaking is relative and that it revolves about the likelihood of a given decision-maker obtaining a better and more accurate 80 percent solution than an opponent in a given amount of time. This level of human decisionmaking has clearly been attainable and history offers numerous examples of decisionmakers who have routinely achieved it from Napoleon to Patton and from Lincoln to Churchill. However, the ability to make such decisions is by no means restricted to the occasional genius. Cognitive scientists tell us that dealing with such complex problems is the kind of task for which humans have been “hard wired” by hundreds of millennia of evolution to accomplish fairly well, to the point that the more complex the problem is, the better the human is likely to perform relative to the machine. Indeed, the central contention of naturalistic decisionmaking is that the human is better able to deal with the complexities and uncertainties of military operations than the machine and that this is especially true when operating against a short timeline.<sup>242</sup>

Classic effects-based approaches accept that human decision-makers are a necessary element in dealing with ambiguities, complexities, and short decision times, and the emergence of complexity theory underlines that these problems will always be with us. If this is so and if the ability to handle complex problems varies from one individual to the next, then how do we figure out which people have the needed grasp of the com-

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<sup>242</sup> Stor, Jim. “The Commander as Expert.” *The Big Issue: Command and Combat in the Information Age*. David Potts, ed. Washington, DC: CCRP. 2002. p. 97.

plex problems involved so as to choose those best able to undertake an effects-based approach?

### *Choosing the right decisionmakers*

In classic effects-based approaches, the right person obviously needs to be in the right position at the right time to make the decisions needed. This requirement makes the selection process the key to success, something that has repeatedly been demonstrated throughout history. President Abraham Lincoln grappled with this selection problem for the first two years and more of the U.S. Civil War as he searched for a Union general with the insight needed to win that conflict. Lincoln required not only a brilliant operational commander, as General Grant had shown himself to be in the Mississippi campaigns of 1862-1863, but also a strategist who could command the campaigns of the far flung Union armies as a whole so as to bring the war to a successful conclusion. The quality of decisionmaking that Lincoln sought depended on a human ability not just to master all of the arcane details of a tactical and operational problem, but also to grasp the bigger and more complex picture that confronted Lincoln as President and to select talented military subordinates to implement it. Lincoln's and Grant's problem was not new. Even commanders of great genius are compelled to depend heavily on gifted subordinates to implement their insights.<sup>243</sup> Indeed, a strong case can be made that the recognition of this need was one aspect of their genius—in this case, of both Lincoln and Grant.

Yet, history also points out that the breadth of talent that an individual commander might tap could be rather limited. He might meticulously and laboriously build a staff or inner cir-

cle<sup>244</sup> as in the case of Nelson's "band of brothers" and these officers might in turn be dispatched to independent commands and build their own staffs and circles. But, such efforts were usually circumscribed by the vagaries of chance social networking within a relatively small milieu. In Nelson's band of brothers, the base of potential decisionmakers was expanded by the sheer length of the Napoleonic Wars, by the fact that they followed hard on the heels of another Anglo-French War (the War of American Independence), as well as by the fact that most of the major ship captains in the band had been at sea since they were little more than boys. This gave both the Royal Navy and Nelson the advantage of a protracted winnowing process in the face of a threat that remained remarkably consistent over the entire period. Similarly, when Grant took command of the Union armies, he left a well-formed band of brothers under General Sherman in the Army of the Tennessee and encountered an Army of the Potomac whose leadership had also been winnowed by three years of war and that already had a competent operational commander in General Meade. Accordingly, Grant was able to trust Sherman and his network of subordinate decisionmakers

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<sup>243</sup> Napoleon for example combined the roles of commander in chief and head of government, but despite his genius and workaholic energy, he still had to depend on a staff of key personnel to carry out his decisions. The social network he had to draw upon was most extensive in the army where he had spent most of his life and far less extensive in the navy and in the civilian world, something that tended to be reflected in his choices of the personnel upon whom he had to rely, for example, his foreign minister Talleyrand, whom he distrusted (with apparent good reason) and who defected to the Bourbons as Napoleon's power began to collapse. Indeed, it is instructive that, initially for domestic civil administration and later for ruling conquered kingdoms, he relied on his brothers, another known social milieu.

<sup>244</sup> This effort to build a close knit staff was strikingly evident in commanders Crowe, Jeremiah, and Boorda, whom I studied firsthand and used to develop and elaborate the concepts contained in this book.

to carry out a complex western campaign with only a general articulation of commander's intent and to trust Meade to do the same under his own watchful eye in the east.<sup>245</sup>

The problem in each of the above cases is that the choice of the right decisionmakers, which hinged on winnowing out those who lacked the ability and intuitive grasp to deal with the uncertainty and complexity, occurred by trial and error over the course of a lengthy war. The American experience in North Africa in 1942-1943 underlined in painful detail that America's peacetime selection processes did not indicate how well a commander would function amid the complexities and short timelines of a real-world battlefield, nor would those processes spot the innovative genius of a Patton.<sup>246</sup> But, such battlefield sorting and winnowing is expensive in lives and very risky for a nation at war. History is rife with examples of disasters that resulted from choosing the wrong man to be in the loop at a decision point, as well as examples of states and organizations that persistently took the wrong approach to generating and assigning decisionmakers.<sup>247</sup> The 18th and early 19th century penchant for selling Army commissions to the highest bidder is one obvious case in point, as is the still

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<sup>245</sup> Grant notes that upon assuming command he met with Sherman to work out the thrust of the western campaign and then gave him the freedom to implement it. He also notes that upon meeting and talking to Meade he had found someone he could trust, and he not only left him in command but gave him a considerable measure by promising to work with him on a "command by negotiation basis" in which Grant would only intervene where necessary. Grant, U.S. *Personal Memoirs of U.S. Grant*. Norwalk: Easton. 1989. pp. 359, 366.

<sup>246</sup> See: Atkinson, *An Army at Dawn*. 2002.

<sup>247</sup> Barbara Tuchman's *The March of Folly*, particularly the chapter "The British Lose America," offers a series of detailed examples that, especially in the case of the American Revolution, combine the political and military dimensions. Tuchman, *The March of Folly*. 1984.



older practice of restricting leadership or even military commissions to members of the nobility.<sup>248</sup>

The challenge has therefore always been to create a system by which those decisionmakers who are able to deal with the complex challenges to be faced can be identified, nurtured, and where necessary, winnowed to ensure that the right person is in the right spot to deal with uncertainties and complexities and make the timely decisions needed. This was in fact the core strength of the Prussian and later German General Staff system.<sup>249</sup> But, whereas the German General Staff system was configured to produce decisionmakers able to deal with the problems of a 19th and 20th century paradigm of symmetric, state-on-state, physical attrition-based warfare, the challenge for today is the creation of a system that can identify and nurture the decisionmakers for the complex multi-dimensional problems of a post-9/11 security environment that is characterized more by asymmetric conflict with state *and* non-state actors, and by contests of psychological attrition where conventional attrition models do not readily apply.

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<sup>248</sup> In fact, much of Napoleon's success in the early years of the French Revolution stemmed from his ability to tap the reservoir of talent that lay outside of the traditional military caste, a reservoir that provided the most innovative leadership of the French Army.

<sup>249</sup> John Keegan provides a good example in his description of the actions taken by a middle ranking General Staff officer assigned to visit the front to determine the answer to the complex and critical question of whether the German advance into France in 1914 should halt .  
Keegan, *The First World War*. p. 120.

## *Organization*

In the past, optimizing the decisionmaking potential of a good leader and his subordinate decisionmakers also depended on how both decisionmakers and decisionmaking were organized. This need has certainly been reflected in the attention that good commanders have always paid to team building and the creation of a close knit staff, that is, to organizing the informal social networks supporting their decisionmaking. While such efforts have become emblematic of good leadership extending across an entire force, they are by their nature most effective in an immediate inner circle where close bonds of trust and confidence can be built through propinquity and constant interaction and vary idiosyncratically from one staff to the next according to the personalities involved.

The bigger organizational challenge is that of creating and working with the more formal structures governing the relations between the major players in the system of systems. One such structure would be that for identifying and nurturing decisionmakers and for recruiting and training personnel. Another might be that by which the capabilities to be employed are generated and made available at the right time and place—the structures that shape a decisionmaker's range of options. But, perhaps the most pertinent to effects-based approaches is the set of formal organizations that have historically been lumped under command and control, including two general types: those to provide direction and guidance and those to amass the information and knowledge required to assess, plan, and execute operations.

Historically, these command and control structures have betrayed a tension between a need for direction and hence

integration and hierarchy on the one hand and operational flexibility and autonomy on the other. This tension in turn reflected two enduring problems: the limited span of control that a single individual might feasibly exercise and the breadth of the situation or knowledge he could perceive and internalize.<sup>250</sup> As the *levée en masse* drastically increased the size of Napoleonic era armies, it became increasingly necessary to move to a more hierarchical organization.<sup>251</sup> After all, as Clausewitz pointed out, while it might not be possible to control 500,000 men individually, it is possible to control three army corps and for the corps commanders each to control several divisions, and so on.<sup>252</sup> Such hierarchical organization, however, tends to be at the expense of the operational flexibility needed to adapt to the actions of an enemy. Yet, this press toward hierarchy was to some degree balanced by the limits of the situational awareness available to Napoleonic era commanders. Because a general could see only the battle in front of him, he needed to grant some measure of autonomy to commanders beyond his view to act on their own.

The same dichotomy was true of Napoleonic era diplomats operating abroad. For them, a query to and response from a foreign minister might take months; thus, diplomats had to be accorded some considerable degree of autonomy in day-to-day operations. In both the military and diplomatic cases, the pragmatic result was a balance between an organizational structure that might be hierarchical in some areas but still depended on autonomous action in others. However, it also

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<sup>250</sup> Crevald, Martin Van. *Command in War*. Cambridge, MA: Harvard. 1985. p. 261.

<sup>251</sup> Keegan, John. *A History of War*. New York, NY: Knopf. 1994. pp. 348-353.

<sup>252</sup> Clausewitz, Carl Von. *On War*. Book V. Michael Howard and Peter Paret eds. and translators. Princeton, NJ: Princeton. 1976. p. 294.

produced a situation in which a whole-of-nation approach could not reasonably be exercised in the field.<sup>253</sup>

This balance began to change by the time of the U.S. Civil War with the introduction of a ubiquitous field telegraph system and an Army Telegraph Office adjacent to the White House that was frequently visited by President Lincoln—a predecessor to the current “Situation Room.” With the telegraph, Lincoln as national commander in chief could and did exercise a larger strategic judgment and frequently did intervene in military decisions to that end. Although such interventions diminished after the selection of Grant, a military strategist who Lincoln felt he could trust, the President continued to exert a whole-of-nation influence on Union efforts that likely included laying out a commander’s intent as to a desired political end-state as the war wound to a close.<sup>254</sup>

With the rise of better communications over the past century and a half, the balance between integration of efforts and operational flexibility has been continually tested and the approaches to dealing with the questions of span of control

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<sup>253</sup> Napoleon as both commander in chief of the army and head of government could theoretically combine all elements of a whole-of-nation response, but the actuality—as his correspondence with Talleyrand, his foreign minister, and Fouché, his interior minister testify—was that the delays in communicating with Paris forced the autonomy in any event.

Talleyrand, Charles-Maurice de. *Lettres de Talleyrand à Napoléon*. Paris: Bonnot. 1967.  
Fouché, Joseph. *Mémoires de Joseph Fouché*. Paris: Bonnot. 1967.

<sup>254</sup> One good example of this commander in chief’s intent was Lincoln’s closed conference with Generals Grant and Sherman and Commodore Porter in the closing days of the Civil War in which he laid out his ideas for how the war was to be concluded and his plans for its aftermath—an intent later reflected in the generous terms that Grant and Sherman accorded the surrendering armies of their Confederate counterparts, Generals Lee and Johnson.  
Foote, Shelby. *The Civil War: A Narrative*. Alexandria: Time-Life. 1998. p. 32.

and the degree of situational awareness have proliferated accordingly.<sup>255</sup> The tension between the need for integration and operational flexibility has persisted. Additionally, the era of rapid global communications has presented a new challenge. Small military actions that might have heretofore escaped attention can be used to signal critical shifts in national intent.<sup>256</sup>

Similarly, with an instantaneous global media, the actions of the strategic corporal can have an international impact. As might be expected, this instantaneity has created a strong temptation to organize decisionmaking to be able to control down to the tactical level, even as the need to deal with a rapidly adapting adversary is growing. This problem is compounded by the need for whole-of-nation operations involving many elements of national power, despite the fact that the decisionmaking structures of each of these elements tend to differ and often to remain jealously compartmentalized along departmental or ministerial lines and only come together at the level of the national decisionmakers.

In one way, the above discussions should be reassuring. Their implication is that, if we accept the classic approach of relying on the human in the loop to deal with ambiguities and complexities, we can carry out an effects-based approach to operations. This is not to say that we cannot do better and, in

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<sup>255</sup> Alberts et al. point to six such command and control philosophies. Alberts, David S., John J. Garstka, Richard E. Hayes, and David T. Signori. *Understanding Information Age Warfare*. Washington, DC: CCRP. 2001. p. 170.

<sup>256</sup> A succession of Middle East crises between 1967 and 1973 are good examples of this signaling and counter-signaling between the U.S. and the Soviet Union using naval forces. Smith, *Effects-Based Operations*. pp. 193-204.

fact, there have been continued efforts over the past two centuries to improve the selection and organization needed as we are now attempting to do in adapting Cold War processes and thinking to a post-9/11 environment. But the discussions hint at something more. Just as the improvements in communications over the past 150 years tended to alter the balance between hierarchy and autonomy, the thinking and technology of the Information Age raise the tantalizing prospect of moving beyond the bounds of a commander's experience and education, or that of his staff.

*Timing, scalability,  
and first generation network-centric operations*

In the first flush of network-centric operations, efforts to exploit the promise of the Information Age tended to focus on taking the human out of the loop to decrease human error and increase both awareness and the speed of decisions, areas in which the pay-off for investment in information technologies was most evident and most quantifiable. Networked communications also offered a way to centralize decisionmaking at higher levels of command where the manpower and information resources existed to "solve" the complex problems of the battlefield. The centralization also promised to control more closely the "signals" generated by actions and, at least theoretically, to diminish the chances of untoward actions, as exemplified by movements to insert Judge Advocate General lawyers into the cycle to rule on the legality of actions. Similarly, centralization brought an increased tendency to look at the effects-based approach as something that was not scalable, least of all to a tactical level.

Application of this “first generation” of network-centric operations to the effects-based approach quickly ran afoul of the complexities involved. Removing the human from the loop to create a pure “sensor to shooter” architecture demonstrably worked, but it applied to a relatively narrow part of the operational spectrum where pesky complex variables could be eliminated to reduce the problem to what is little more than a firing solution.<sup>257</sup> Similarly, while centralizing direction at higher levels was and remains a necessary capability particularly in trying to achieve a unity of effect, it also has a trade-off in that it reduces the ability of “edge” actors to adapt and survive in what are usually faster paced interactions at their level. Centralization also tends to leave the internalized effects-based approach to operations of human decisionmakers at lower levels, e.g. the Army Captain in Najaf, as something that could not be really considered an effects-based approach to operations at all. Indeed, the new tools seemed to tempt us to believe that we could use increasing computer power to apply linear processes to the nonlinear problems of the effects-based

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<sup>257</sup> Some advocates of network-centric operations have proposed that, with better sensors and connectivity, they could disperse the fog of war and create a perfect situational awareness in a 200-mile cube around a military force. In some limited settings, notably the area around a carrier battle force in mid-ocean where there are a finite number of ships, aircraft, and submarines to detect and monitor, some such approximation might be achieved although with a string of caveats. For example, the capability to detect is not static but tends to be a cat-and-mouse game with foes who seek to avoid detection and identification, whether by using geography to mask sensor detection as NATO naval forces did in their operations in the fjords of Norway during the Cold War, or by disappearing into a plethora of merchant and fishing traffic as al Qaeda personnel attempting to exfiltrate Afghanistan and Pakistan appear to have done after Operation Enduring Freedom. Yet, even with these efforts to avoid detection, this naval situational awareness problem and its air counterpart are probably the most certain and least ambiguous aspects of the awareness problem. When the scene is shifted to ground force operations, the uncertainties and ambiguities increase dramatically.

approach without bogging down decisionmaking to the point that solutions were no longer timely or, even more, to develop some form of model or algorithm to “solve” the complexities involved.

The truth as usual probably lies somewhere between the human decisionmaking of the classic effects-based approach to operations and the network-centric solution: an approach that is network-enabled yet human-centric.

## NETWORK-ENABLED EFFECTS-BASED APPROACHES TO OPERATIONS

Whereas in classic effects-based approaches any improvements in performance derive from choosing more capable and perceptive humans with more experience and perhaps a broader education to be the human in the loop, in network-enabled effects-based approaches to operations the objective is to supplement the capabilities of individual decisionmakers with all of the knowledge, information, data, analytical tools, and cognitive, social, or cultural anthropological models that networking might bring to bear. Some aspects of this potential network contribution are fairly evident. In dealing with the ambiguities and uncertainties of real-world operations, it stands to reason that the poorer the quality of the awareness, the more poorly the problem will be defined and the more an assessor or decisionmaker will be forced to hazard a guess as to the ground truth. Likewise, the more limited the available knowledge of a complex problem is, the more the human decisionmaker will be forced to rely on his or her own instincts. To be sure, such naturalistic decisionmaking is not a coin toss but a conscious or subconscious effort to draw upon a mental model library of analogies that might potentially be applicable



to the situation. As the decisionmaker's experience and education increase, their library of mental models will grow and their analogies to be applied will become more detailed and pertinent—and their decisions will more likely prove correct or effective.

The quality of the support that networking can bring to bear affects this human intervention in two ways. The better awareness it provides, the better defined the problem will be and the less human “guesswork” intervention will be needed. Likewise, the more extensive the knowledge and analogy base that decisionmakers can tap through networking, the less they will be restricted to their own experience and education, and the more likely they will be to make correct assessments or decisions. In other words, the better the networking lets us deal with whatever elements of a complex problem we can address, the better the decisionmaking is likely to be. In fact, these are the same metrics we pointed to as being potentially decisive in conflict with the asymmetric challengers of the post-9/11 security environment.

In this book, I have attempted to lay out a pragmatic middle course that neither condemns us to a classic approach dependent solely on the human decisionmaker nor excises the man from the process. Rather, it treats human decisionmaking as a necessary and valuable part of any effects-based approach and treats networking as an essential tool, one that offers the possibility of a new network-enabled form of effects-based operations and with it the potential for creating a decisive advantage in the complex post-9/11 strategic environment. It also recognizes that this new “second generation” of network-centric operations is not static but will continue to evolve and proposes that this evolution should be shaped by the require-

ment to support a human-centered approach to effects-based operations. The vision that emerges from this confluence of network-centric and effects-based operations is that of a series of sliding scales, one set describing the trade-offs between classical human centered effects-based approaches and new network-enabled approaches and another describing a continuing evolution of Information Age capabilities and, thus, the increasing levels of network support that might be made available to the human decisionmakers in the loop.

The idea of trade-offs implies that this is not an automatic inexorable process driven by new technology but rather something that can be managed both to encourage the development of technologies specifically directed at dealing with the problems of effects-based operations and to balance the needs with the resources available. This suggests a continuum between classic human-centered effects-based approaches at one end and a fully network-enabled effects-based approach at the other end, with the latter gradually moving further out as technologies and capabilities mature. With less quality network-enabling, the closer we will be to the classic, human decisionmaker-dependent approaches, while still pursuing effects-based approaches. Similarly at the other end of this spectrum, efforts to improve networking support will not eliminate the need for the human in the loop or, by extension, the need to improve the selection, education, and nurturing of potential decisionmakers, or the need to explore new and potentially more agile and responsive ways of organizing. Instead, the trade-offs point to a symbiotic development process in which improvements in networking capabilities, human decisionmaker selection and education, and new approaches to organization build on each other.

The rough outlines of the trade-offs between human intervention and the support provided by networking have already been visible in the discussions in previous chapters:

- as the uncertainties, ambiguities, and unknowables increase, more human intervention will be required;
- as the complexity becomes greater, the human role will become greater;
- as the available time for decisionmaking decreases, the likelihood of an unaided human decision will increase; and
- as the available support decreases, the human will be called upon to fill the gaps more often.

*1. As the uncertainties, ambiguities, and unknowables increase, more human intervention will be required.*

Complexity theory argues that, in interactions between complex adaptive systems, there will always be uncertainties, unknowns, and unknowables, the extent of which will vary with the numbers and intricacy of the interdependent variables at work. Like Clausewitz's "fog of war," all are different aspects of a complex real world. Moreover the uncertainties will tend to increase dramatically as those to be detected attempt to create uncertainties and unknowns in all sorts of innovative ways. Thus, awareness can be expected to include some elements of a process of adaptation and counter-adaptation in a coevolution between those seeking to create the awareness and those seeking to evade or mislead it.<sup>258</sup> The

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<sup>258</sup> The continued cycle of innovation and detection efforts with respect to improvised explosive devices in post-major combat operations in Iraq are a clear example of this process at work.

uncertainties and unknowns are perhaps most pronounced in operations where the human dimension is most starkly dominant such as counterinsurgencies, peacekeeping, peacemaking, post-conflict stabilization, or deterrence. In these operations, the information required for awareness revolves about human reporting that is in its own right ambiguous, subjective, and uncertain with the added possibility of deliberate deception and disinformation. Furthermore, the uncertainties and unknowables are multiplied by an order of magnitude when awareness must somehow be translated in making sense of the situation at hand.

As the multi-tiered living systems model underlined, the uncertainties, ambiguities, and unknowables in question are to be found at every level and in every arena of interaction. In each case, awareness and understanding (however imperfect) are absolute necessities, and yet holding out for more and better information or reporting is seldom an option and more often an invitation to inaction and the loss of initiative. This signals two dimensions to the awareness and sensemaking problems, one in which the information and knowledge are simply unknowable and another in which what is needed may be knowable but will not or cannot be known in time to aid a decision. Because the uncertainties and ambiguities must be resolved in one way or another within the time available for a decision, the usual resort is to the human in the loop, whether that person is a diplomat, an intelligence analyst at a national agency, a local commander, or the strategic corporal facing a potential suicide bomber.

*2. As the complexity becomes greater, the human role will become greater.*

In effects-based approaches to operations, decisionmakers must cope with multi-layered, interconnected systems of complex adaptive human and social systems in which not only are there multiple systems with each system containing a plethora of interdependent variables but each of these systems is also continually evolving, changing, and adapting both to the changes of the systems around it and to changes in the environment that contains the system of systems. This complexity means: (1) that the actions and reactions of other systems—friend, foe, or neutral—can never be entirely predicted; (2) that surprise, ambiguity, and uncertainty are permanent factors in any calculation; and (3) that competition and conflict in a legion of forms are the norm. Further, because all of these systems are interconnected and reflect the cumulative result of a continuing coevolution, each action undertaken and each effect created is bound to be influenced by every action that has gone before it and will influence every action that follows it in some way. Likewise, any action taken will shape not just the behavior of the intended observer but also that of any actor who can observe it and will likewise affect the behavior of the system of systems as a whole in a never-ending spiral of interactions. Finally, because all of these systems are inextricably intertwined, any action at any level has the potential to affect other interactions at other levels and arenas from the tactical to the geo-strategic and from the political to the economic and social, and in ways that can never be fully anticipated.

Given such a multi-faceted complexity, the ubiquity of humans in the loop should not be surprising. The purpose of these human interventions is not to “solve” the complex problems at

hand but rather to “bound” them, that is, to determine which assessments might be closest to being correct or which prospective solutions have the greatest probability of working. Historically, there has always been a need for human intervention to deal with the complex questions and decisions imposed by what are after all human-centric effects-based operations. The solution has been, in essence, to use one complex adaptive system to deal with another. Current operations are no different. Dealing with the complexities either of major combat operations or of stabilization operations demands some form of human intervention. In the context of complexity theory, this bounding is relative and can never be perfect. There is no guarantee that the bounded assessments and solutions will be correct, only an increased likelihood of being correct as the bounding improves. The relative nature of this bounding applies to the adversary as well. The better the foe bounds the problem, the more likely he is to be right. As this suggests, in order to win, it is not necessary to be right all of the time. Neither side will be. Rather, it is simply necessary to be right more often and more consistently than the opponent.

In the examples surveyed in this book and its predecessor, human interventions were evident at every point that a complex problem presented itself.<sup>259</sup> The greater the number and extent of the complexities involved, the greater the scope and importance of the human intervention that was required.

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<sup>259</sup> This is indeed the thrust both of Beyerchen’s insistence on the roles of metaphor, Rosenau’s emphasis on the need for “conceptual equipment,” and Czerwinski’s discussion of command and control.

Rosenau, “Many Damn Things.” p. 83.

Beyerchen, “Importance of Imagery.” p. 161.

Czerwinski, *Coping with the Bounds*. p. 213.

*3. As the available time for decisionmaking decreases, the likelihood of an unaided human decision will increase.*

As the two preceding trade-offs have indicated, there is also a time factor to be considered. As any combat veteran will attest, the speed at which a decision or assessment will need to be made is a function of the urgency of the requirement and not of the speed at which the analysis can be conducted or at which information or support become available. Decisions have to be made when they need to be made and not necessarily when all of the ingredients for a correct decision are at hand. In the context of the multi-layered system of complex living systems, the pace of action-reaction cycles is dictated by the individual interaction, much as the pace of Clausewitz's *zweikampf* is dictated by the interaction between the wrestlers in his example. To the degree that the resolution of ambiguities and uncertainties cannot be accomplished within the decision time available, or to the degree that the complexity of a problem cannot be bounded in time, or to the degree that the networking cannot produce the needed awareness or knowledge in time, the human in the loop becomes the last resort, a decisionmaker who has no choice but to exercise his or her best judgment to fill in the blanks and deal with the situation.

However, there is a deeper systemic problem here as well. Because the interactions between and among systems of complex adaptive systems take place at many levels and because these action-reaction cycles proceed at their own paces, attempts to control their paces risks keeping these "edge" elements from adapting to a changing situation fast enough to deal with enemy actions, much less to get inside and stay inside the opponent's OODA loop. That is, interactions must not

only be timely, but they also must be scalable so as to allow different levels and different components to function at their best pace of operations.

*4. As the available support decreases, the human will be called upon to fill the gaps more often.*

If we were to put each of the above three trade-offs in the converse, we would describe a fourth trade-off between the quantity and quality of networking support and the extent of the human intervention required. Thus, the more the networking can reduce the uncertainties, ambiguities, and unknowns in a problem, the more it can limit the scope of the human intervention required; the more networking can help to bound the complexities inherent in any effects-based approach, the more limited the demands on the human decisionmaker will be; and the longer the decision times that networking can help to bring about, the less the human decisionmaker will have to fill in the time-driven unknowns. This trade-off has at least two additional dimensions, however:

- First, if we view networking not as a static given but as a dynamic variable that can be improved by better technology or more effective models and simulations or more agile organization, then the trade-offs in each case and overall should be expected to lessen the extent of human involvement required. This is not to say that the entire complex problem will suddenly become machineable. Complexity argues against that being the case if only because we will never be able to be sure that we have identified and correctly assessed all of the interdependent variables or that the inputs to our socio-anthropological models are in fact correct.



- Second, because the functional roadmap outlined in this book is broken down into specific problems requiring human intervention within the action-reaction cycle and because these action-reaction cycles will be occurring at many different levels and arenas, improvements in networked support will not be monolithic, but will vary from one problem area to the next. This means we will need to think not in terms of a single continuum, but of multiple continua reflecting the impacts of improvements on specific kinds of decisionmaking in different problem areas at different levels and even in different arenas.

### ...AND SCALABILITY

The continua outlined above raise another question: can effects-based approaches to operations be scalable to the point that they can be made to work at the tactical “edge”? This question is central both to efforts to drive “power to the edge” and to create an “agile organization,” as well as more immediately, to succeed in the kinds of asymmetric conflict that have characterized the post-9/11 world. Yet, the requirement for scalability would seem to stand in stark contrast to an effects-based planning process that can appear ponderous, time-late, and barely implementable at the major command level.

The real-world picture we have drawn is that of a multi-level system of complex adaptive living systems in which there are multiple edges, each of which engages in its own unique interactions with friends and foes. This image should convey the message that we have no choice but to make any effects-based approach to operations scalable and that to do otherwise risks rendering the edge units incapable of dealing with the rapid local interactions. But, the continua suggest something more.

They indicate that a formal well-staffed effects-based planning process may not be a prerequisite for all effects-based interactions. They suggest that the same kinds of trade-offs as those between uncertainty, complexity, and networked support on the one hand and human intervention on the other may also apply to scalability, especially at the tactical level. At the tactical edge, we expect that the timelines will be short, that the support available to resolve ambiguities and uncertainties or to bound the complexities will probably be minimal, and that the reliance on human intervention will be correspondingly greater. This is to say, we expect that tactical level interactions will largely be assessed, planned, and executed in the head of the immediate tactical commander involved. This is not to say, however, that such interactions do not meet the criteria for effects-based approaches to operations outlined at the beginning of this chapter. Clearly, they still focus on the human dimension of competition and conflict. They are still conducted across the operational spectrum and in peace, crisis, and hostilities. They can still involve non-military elements of national power or of coalition power. And they are still complex. The image of the Army Captain in Najaf comes to mind, a tactical commander executing an effects-based action and adapting it on the fly to a rapidly changing series of action-reaction cycles with an innovative foe.

What is apparent here is a different problem, not the ability of the tactical commander to accomplish effects-based processes in his head, but the challenge it implies for the operational commander. In effects-based approaches, the operational commander must somehow find ways to give his subordinates the freedom to act and adapt, i.e. to re-plan the operations on the fly while at the same time ensuring that any such efforts are sufficiently coordinated to achieve the unified overall effect

needed to get to the desired end-state. Moreover, because the requirements for unity of effect may be expected to vary over time with the situation and over the peace-crisis-hostilities spectrum, this balance between freedom of action and unity of effect will likewise vary and with it the requirement for commander direction.

In principle, neither the above problem nor the ability of tactical commanders to adapt is new. In fact, we already have explored two scalable, rapid, cyclical processes in this book and its predecessor: the OODA loop and the action-reaction cycle. Even though neither of these is specifically thought of as a planning process, both do represent continuous cycle approaches to problem solving. In fact, the OODA loop was conceived for tactical fighter engagements in which the elements of the process were carried out on a real-time basis in pilots' heads during a series of aerial maneuvers.<sup>260</sup> And, both can be defined in terms of a planning, execution, and assessment process to support an effects-based approach. In the OODA loop, the Orient and Decide segments can be equated to the *planning* phase of an effects-based operation,<sup>261</sup> the Act segment to the *execution* phase, and the Observe segment to the *assessment* phase—all jammed into a cycle that may last less than 90 seconds (see Figure 44). Even more, the OODA loop also presumes a continued interaction between two or more interacting OODA loops with changes in the actions of one driving the changes in the actions of the other. That is, it represents an interaction between complex adaptive systems.

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<sup>260</sup> Hammond, Grant T. "The Essential Boyd." *Belisarius*. April 2000. pp. 9-10.

<sup>261</sup> Given the addition of an "adapting" task to the planning, executing, and assessing tasks of effects-based planning as proposed by the U.S. Joint Forces Command, the Orient phase might then be equated to the *adapting* and the Decide phase to the *planning*.

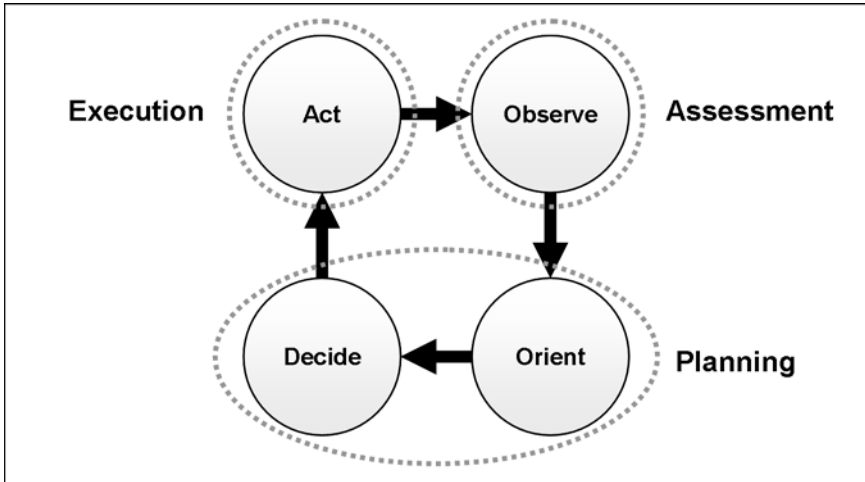


FIGURE 44. OODA CYCLE

From an effects-based perspective, the OODA loop is about providing the right actions at the right time to drive observers' OODA loops in the right direction while being able to react quickly and resourcefully enough to deal with anything.

In fact, the OODA loop model reflects underlying tactical realities: there will not always be time for an involved planning process or for obtaining all of the relevant information and the shorter the timeline, the more success will depend on the human decisionmaker. For the JTF commander or the strategic corporal on a road block, this means that the process has to be internalized by training and experience to the point that it can be almost intuitive. Indeed, this was the point of Colonel John Boyd's initial teaching of the OODA loop—a reaction to American fighter losses during the Korean War.

The action-reaction cycle we have used to characterize the interactions occurring throughout the system of systems is basically an elaborate OODA loop (see Figure 45). Its *awareness*

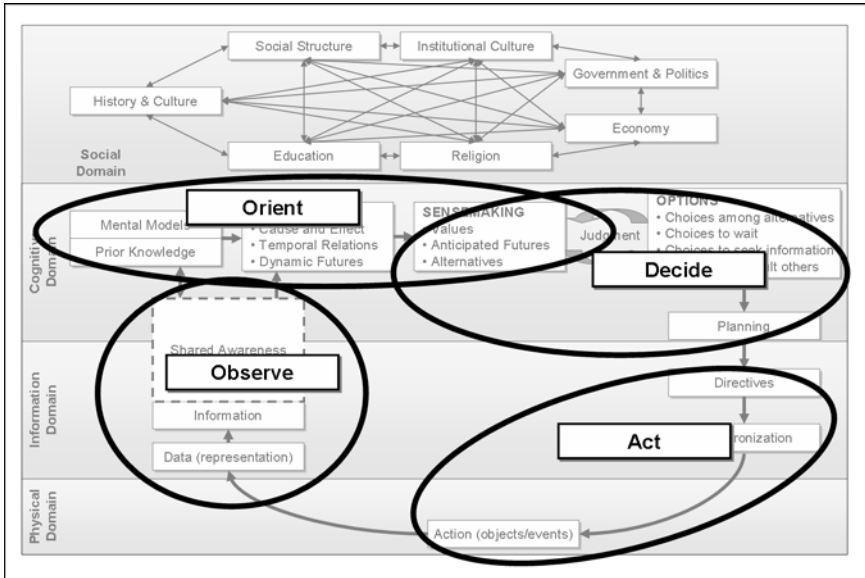


FIGURE 45. OODA VERSUS ACTION-REACTION CYCLE

*creation* step corresponds to the Observe phase of the OODA loop: a stimulus at one or another level of the system of systems is detected and reported through a surveillance “filter,” with that report collated to other reporting and any pattern of previous actions. *Sensemaking* corresponds to the Orient phase, while *decisionmaking* becomes the Decide phase and *execution* the Act phase of the OODA loop. Like the OODA loop, it has no real beginning or end but is a continuous interaction. As with the OODA loop, success or failure in one cycle sets the stage for another cycle until the engagement is completed.

The implication here is clear. Just as a tactical fighter engagement for all of its complexity in the manner of Clausewitz’s *zweikampf* of wrestlers remains something that can be mastered in the context of an OODA loop, so too can the action-reaction cycle and its reflection in the planning process be mastered as an internalized process. While the resulting com-

plex decisions may not be as well-bounded as those proceeding from a more formal process, they can be rapid enough to deal with a real-world battlefield, and given the right kinds of networking, they can be as well-informed as time permits.

What does all of this portend for our approaches to network-centric operations?

## SECOND GENERATION NETWORK-CENTRIC OPERATIONS

The persistent theme of this book and its predecessor is that effects-based operations are not new but that the support to their assessment, planning, and execution that might be rendered by Information Age networking is a new and potentially decisive ingredient in the equation. It seems clear that network-centric operations involve considerably more than linking sensors and shooters and more than the network architectures proposed for attrition-based and often largely tactical military problems. The effects-based problem that networking is to address is centered on a human dimension, covers actions in peace and crisis as well as hostilities, involves a diversity of non-military actors, and revolves about a mastery of problems that are innately complex. Instead of excising the human from the loop to increase the speed of decisions, it demands human intervention to address the ambiguities and uncertainties involved and to fill in the blanks posed by the unknown and unknowables of a situation or to bound complexities, and it relies on human intervention to make timely decisions even where supporting information and analysis are lacking. As this suggests, this human decisionmaking is not restricted to the commander but occurs wherever the ambiguities and complexities occur in the action-reaction cycle. Even more, the

nature of the multi-level, multi-arena system of complex systems within which operations are to be executed insists that action-reaction cycles will be occurring simultaneously at many different levels in many different arenas and may involve many different kinds of actors—military, diplomatic, other agency, international organization, and non-governmental—at every level. Finally, the action-reaction interactions are not just with a foe, but equally with allies and partners, with neutrals, and indirectly, with the local, regional, international, and domestic public within whose minds a war of psychological attrition must ultimately be won.

These requirements suggest a different kind of network-centric operation from that which we have labeled *first generation*. At the core of this difference lie the primacy of the human in the loop and the diversity of the support that the network must provide to that human being. One aspect of this difference has already been apparent in the distinction between communications and social networking. In an essentially linear problem centering around moving data from one machine to another, it is easy to focus on the communications architecture, but when the requirement shifts to complex problems whose resolution centers on knowledge and understanding, the core focus shifts to interactions between human beings and the purpose of the communications network becomes that of facilitating those interactions and providing the diverse forms of support that effective human intervention may require. In this book, we have only scanned the forms of support in very general terms, but it is already possible to see in the types of support required everything from the use of data mining and intelligent agents to sort through a plethora of human reporting in open and closed source material; intelligent agents and gaming techniques to assess the consequences of a prospective action;

cognitive, social, and cultural anthropological models; and the role of subject matter experts either in direct support or in putting a “reality check” on modeling and gaming efforts. Moreover, these requirements will not remain static but will continually change as the environment changes and as a particular situation changes. This suggests a second generation network that is a continually changing mesh of relationships and that is unbounded in scope.

*...and agile organization*

In fact, the above sketch demands much more than a network, however good and comprehensive that network may be. It implies an organizational approach to underpin the informal social and communications networking. This book and its predecessor draw upon examples from military history and from real-world operations to develop a basic concept of cross-spectrum effects-based approaches to operations and to address the “how to” of implementing them. Such a concept has the advantage of demonstrating the real feasibility of conducting effects-based operations and of incorporating all of the complexities involved in a way that experimentation attempting to define a dependent variable to examine cannot. But, it also has a drawback because it outlines the “how to” of *current* capabilities, doctrine, and organization, rather than what might be. A distinction, therefore, must be made between the roadmap of the generic essential processes in the action-reaction cycle and the drill-downs to equally generic effects-based questions and problems, and the separate and very different challenge of how we might better organize to conduct those processes and to solve those problems, and by extension, what doctrine is needed and what capabilities (networks, analytical and information tools) and webs of expertise might be needed. This



latter challenge extends to revisiting the perennial problems of classic effects-based approaches: choosing, nurturing, and networking the decisionmakers and experts we will need. It also implies a need to examine these issues from the different perspective provided by the image of an interacting and coevolving system of complex adaptive systems and how they and the decisionmakers in them learn and adapt, a process that applies as much to our would-be opponents as it does to our own efforts.

## THE PARADOX: COMPLEXITY SIMPLIFIES

The above descriptions of what will be needed—the whole idea of human-centered, cross-spectrum, whole-of-nation effects-based approaches to operations—can surely seem daunting in their scope and complexity. However, there is a paradox here. Complexity actually simplifies the problem we must tackle. If we accept the innate complexity of the problem, then we accept that there cannot be perfect awareness, that we will never have all of the answers, that we will never entirely understand our adversaries (or for that matter the friends and neutrals with whom we work), that we cannot “solve” the problem but must be content with bounding it, and that we will never be able to plot all of the possible consequences of our actions. It is sufficient that we do all of these things well enough to succeed, and better than our opponents. Complexity forces us to accept a reasonable standard for decisionmaking, one that can always be improved upon to be sure, but one that history shows is not overly daunting.

If we likewise accept the idea of complexity by contamination, that just because a particular aspect of a problem may make

the result complex does not mean that all other aspects are complex, and that what we know of those other aspects can help us to bound the complex parts of the problem, then we have also opened the door to a dissection of the effects-based problem that can reduce it to sets of specific tasks. The complexity does not go away, but given the reasonable standard of decisionmaking described above, we have the means of pulling the effects-based problem apart to identify individual solutions that together can contribute to increasing the probability of correct decisions.

Finally, if we accept the idea that the best capability we have to deal with the complexities and ambiguities is the human being, then we can begin to look not simply for points at which the effects-based problem becomes complex and, thus, no longer susceptible to linear solutions but rather points at which the intervention of another complex adaptive system—a human—will be required. This human in the loop will then focus our efforts on enabling the human decisionmaker to make better decisions. In so doing, we can also focus on the many different kinds of humans in the loop and their functions: the decision-makers who will shape the outcomes of an immediate situation from strategic corporals to tactical and operational commanders; those who will shape longer term outcomes from planners and staffs to national-level leaderships; and those who will shape perceptions and behavior—our own and that of other actors—by how they perceive and analyze the actions that they observe.

In brief, accepting the complexity in all of the above simplifies what we must do by allowing us to deal with the challenges not as a single overwhelming problem but as a series of specific

tasks to be undertaken. In this context, the roadmap we have outlined allows us to identify the knowledge, information, or other support the human in the loop will need. We can identify the processes such as the contextualization and analysis in support of sensemaking or the projected sensemaking and planning in support of decisionmaking, and break each down into still more specific problem areas whose ambiguities and complexities might be bounded with further inputs of information and knowledge (e.g., the use of data mining and intelligent agents), or with flexible expandable libraries of analytical and social and cognitive modeling tools, or with inputs from subject matter experts from the foxhole to academia. Finally, with these more precisely defined, we can begin to sketch general information and knowledge base requirements, the outlines of a family of tools, or even better, a tool-making tool kit,<sup>262</sup> and a social and communications networking architecture capable of supporting the decisionmaker's needs.

This should not be taken to mean that we must await the research and technology or modeling tools before attempting to implement effects-based approaches to operations. The time for the application of effects-based concepts and the need for adapting the networking to support that application are now and their absence is measured in lives lost. This prospect forces us to think in terms of a somewhat different sliding scale. As better information tools become available, as new research on human cognitive processes is completed and new modeling tools arise, and as new ways of tapping the knowledge and expertise of a large well-educated population come online and are brought into the family of effects-based capabilities at our

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<sup>262</sup> That is, a three-way hybrid of knowledge mobilization and the interactive application of conventional linear analyses coupled with cognitive and social modeling and human expertise.

disposal, the requirement for unaided human intervention and for human intervention as a whole should diminish. As I and most other combat veterans would insist, that human role will never disappear just as the complexity of military operations will never go away. The objective of an effects-based approach and of the second generation of network-centric operations is rather to make the human in the loop more right, more often.

## ABOUT THE AUTHOR

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Dr. Smith is the author of *Effects-Based Operations: Applying Network Centric Warfare in Peace, Crisis, and War*, published in 2003 by the Office of the Secretary of Defense under the Command and Control Research Program (CCRP).

During a 30-year Navy career, he saw combat in Viet Nam as the Intelligence Officer on the staff of Commander Delta Naval Forces, completing almost 200 combat missions in helicopters and OV-10 Broncos, to include being shot down and wounded in action. Later assignments included duty in the Navy Field Operational Intelligence Office, as Executive Assistant to the Political Advisor to CINCLANT/SACLANT, and as Assistant Naval Attaché to Paris. His last sea duty was as the Assistant Chief of Staff for Intelligence for Cruiser Destroyer Group Eight and the Battle Force Sixth Fleet, a tour that included participation in the intercept of the *Achille Lauro* hijackers and in the 1986 and 1987 operations off Libya. He then served on the staff of the Director of Naval Intelligence

and was a primary player in creating the Navy white paper “...*From the Sea*.” Subsequently, he set up the Intelligence Directorate in the new Office of Naval Intelligence and served as Deputy Director for Intelligence. His final Navy tour was on the personal staff of the Chief of Naval Operations in the CNO Executive Panel where he directed the Navy’s RMA wargames and was the author of the Navy’s *Anytime, Anywhere* vision. Upon his retirement from the Navy in 1998, Dr. Smith joined Boeing’s Washington Studies and Analysis think tank where he works closely with the Office of the Secretary of Defense, the Office of Force Transformation, and others on network-centric and effects-based operations.

Dr. Smith’s military decorations include the Defense Superior Service Medal, the Legion of Merit, two awards of the Bronze Star with combat “V,” the Purple Heart, the Air Medal, two awards each of the Defense Meritorious Service and Meritorious Service Medals, a Combat Action Ribbon, Presidential and Navy Unit Citations, a Vietnamese Cross of Gallantry, and the French Order of National Merit – Officer.

Dr. Smith has spoken and written widely on network-centric and effects-based operations. His well received “Network Centric Warfare: What’s the point?” appeared in the winter 2001 *Naval War College Review*. Other publications include:

- “They Can Buy It, BUT..,” *Proceedings*, (Feb 94),
- “What ‘..From the Sea’ Didn’t Say,” *Naval War College Review* (Winter 94-5),
- “Putting it through the right window,” *Proceedings* (June 95),
- “The Navy RMA Wargames,” *Naval War College Review* (Autumn 97),

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- “The operational implications of network centric warfare,” *Defence Digitisation Bulletin* (January 2001),
- “Effects-Based Operations and Perception Management,” *Defense Intelligence Journal*, No. 1 2003-4,
- “Effects-Based Operations: The Way Ahead,” Paper for the 9<sup>th</sup> ICCRTS, September 2004, and
- “Approaching the ‘how to’ of EBO,” Paper for the 10<sup>th</sup> ICCRTS, June 2005.

He has also written chapters in three books:

- “The Process of Defining a New Role for Naval Forces in the post-Cold War World.” *Strategic Adjustment*. Turbowitz et al. ed. Columbia University Press. 1999.
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# INDEX

## A

action x  
action-reaction cycle xii, 97, 106  
adaptation 41, 265  
aggregation 69, 78  
agile organization 314  
agility 265  
analogies 86  
analysis 129, 171, 215  
Aristotle 68  
Ashby's Law 152, 243  
assessment 154, 158, 165  
asymmetric conflict 6  
attrition 6  
awareness 205, 261  
awareness creation 113, 154,  
158, 165

## B

behavior x  
bomb damage assessment 23  
bounding 75, 197  
building blocks 71, 75, 88

## C

capabilities 174  
Clausewitz, Carl von xvii, 57, 59  
coevolution 41  
collation 121  
collection 117  
collection capacity 116  
communications networking 200  
compilation 125

complex 38  
complex adaptive system 5, 41,  
44  
complexity 17, 33, 34, 36, 65  
complexity paradox 93  
complexity theory 60, 68, 74,  
197, 204  
complicated 37  
conflict 56  
contamination 82  
context 143  
contextualization 122, 169, 215

## D

data 211  
data mining 211  
decision space 246, 277  
decisionmaking 132, 156, 160,  
219  
deconfliction 180  
diversity 70  
Douhet, Giulio xviii

## E

effects-based approach v, vi, ix,  
xviii, 5, 96  
effects-based operations xviii, 28  
effects-based targeting xix  
emergence 41  
end-state 134  
essential processes xii, 107  
execution 140, 156, 162, 182,  
226

**F**

feedback 144, 186  
flexibility 265  
flows 70  
fog 57  
friction 57  
fusion 120, 121, 262  
futures 131

**G**

genius factor 107

**H**

history 124  
Holland, John 69  
human in the loop xii  
human reporting 118

**I**

imagination 89  
innovation 265  
intelligent agents 211  
internal models 71, 76, 88

**J**

just war 11

**K**

knowledge base 126

**L**

liberal arts 90  
Liddell-Hart, B.H. xvii  
linear 4, 38

linear reduction 82  
living systems model 45, 56, 71  
living systems theory xi

**M**

maneuver warfare xix  
means 6  
media damage assessment 120  
mental models 103, 128, 218  
metaphors 86  
meta-systems 106  
modeling, cognitive 224  
modeling, social 225

**N**

nation building vi  
naturalistic decisionmaking 86, 90,  
170  
network-centric approach vi  
network-centric operations xiv  
networking 259, 263  
nonlinear 33  
nonlinearity 70

**O**

observables 142  
OODA loop 309  
open sources 119  
operations other than war 9  
options 138, 177, 243

**P**

perceptions 105  
planning 139, 156, 160, 172, 219  
post-conflict stabilization opera-  
tions 14, 29, 67  
prioritization 116

projected sensemaking 172, 222

will 6  
World War II 256

## R

resilience 265  
responsiveness 265  
robustness 265

## Z

zweikampf 59

## S

scalability 266  
self-organization 41  
sensemaking 122, 154, 158, 165,  
213  
sensemaking, projected 132  
sensors 118  
social influences 145, 157, 164,  
186, 230  
social networking 202  
span of control 272  
state of hostilities 14  
state of war 14  
strategic corporal 20, 186, 277  
Sun Tzu xvii  
synergy 180  
systems dynamics 223  
systems of systems 42

## T

tacit models 87  
tagging 70, 76, 87  
tasking 115  
timeliness 266  
transformation 3, 5

## W

weapons of mass effect 8  
whole-of-coalition 16  
whole-of-nation 16



# Catalog of CCRP Publications

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(\* denotes a title no longer available in print)

## Coalition Command and Control\* (Maurer, 1994)

Peace operations differ in significant ways from traditional combat missions. As a result of these unique characteristics, command arrangements become far more complex. The stress on command and control arrangements and systems is further exacerbated by the mission's increased political sensitivity.



## The Mesh and the Net (Libicki, 1994)

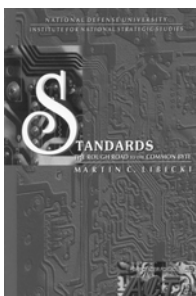
Considers the continuous revolution in information technology as it can be applied to warfare in terms of capturing more information (mesh) and how people and their machines can be connected (net).



## Command Arrangements for Peace Operations (Alberts & Hayes, 1995)

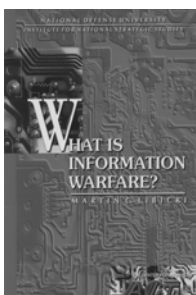
By almost any measure, the U.S. experience shows that traditional C2 concepts, approaches, and doctrine are not particularly well suited for peace operations. This book (1) explores the reasons for this, (2) examines alternative command arrangement approaches, and (3) describes the attributes of effective command arrangements.





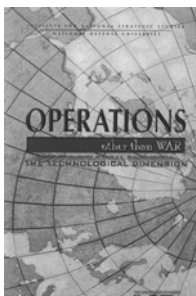
### **Standards: The Rough Road to the Common Byte** (Libicki, 1995)

The inability of computers to “talk” to one another is a major problem, especially for today’s high technology military forces. This study by the Center for Advanced Command Concepts and Technology looks at the growing but confusing body of information technology standards.



### **What Is Information Warfare?\*** (Libicki, 1995)

Is Information Warfare a nascent, perhaps embryonic art, or simply the newest version of a time-honored feature of warfare? Is it a new form of conflict that owes its existence to the burgeoning global information infrastructure, or an old one whose origin lies in the wetware of the human brain but has been given new life by the Information Age?

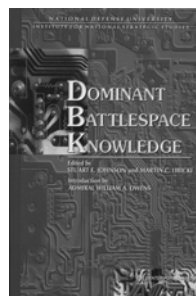


### **Operations Other Than War\*** (Alberts & Hayes, 1995)

This report documents the fourth in a series of workshops and roundtables organized by the INSS Center for Advanced Concepts and Technology (ACT). The workshop sought insights into the process of determining what technologies are required for OOTW. The group also examined the complexities of introducing relevant technologies and devices.

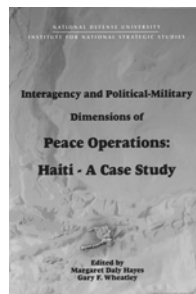
### **Dominant Battlespace Knowledge\*** (Johnson & Libicki, 1996)

The papers collected here address the most critical aspects of that problem—to wit: If the United States develops the means to acquire dominant battlespace knowledge, how might that affect the way it goes to war, the circumstances under which force can and will be used, the purposes for its employment, and the resulting alterations of the global geomilitary environment?



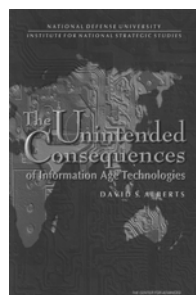
### **Interagency and Political-Military Dimensions of Peace Operations: Haiti - A Case Study** (Hayes & Wheatley, 1996)

This report documents the fifth in a series of workshops and roundtables organized by the INSS Center for Advanced Concepts and Technology (ACT). Widely regarded as an operation that “went right,” Haiti offered an opportunity to explore interagency relations in an operation close to home that had high visibility and a greater degree of interagency civilian-military coordination and planning than the other operations examined to date.



### **The Unintended Consequences of the Information Age\*** (Alberts, 1996)

The purpose of this analysis is to identify a strategy for introducing and using Information Age technologies that accomplishes two things: first, the identification and avoidance of adverse unintended consequences associated with the introduction and utilization of information technologies; and second, the ability to recognize and capitalize on unexpected opportunities.

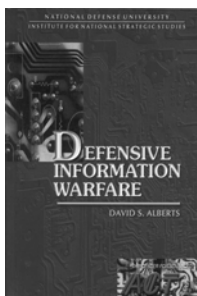




### **Joint Training for Information Managers\***

(Maxwell, 1996)

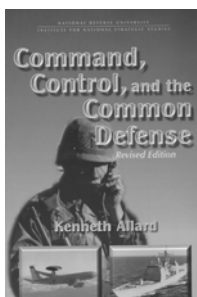
This book proposes new ideas about joint training for information managers over Command, Control, Communications, Computers, and Intelligence (C4I) tactical and strategic levels. It suggests a new way to approach the training of future communicators.



### **Defensive Information Warfare\***

(Alberts, 1996)

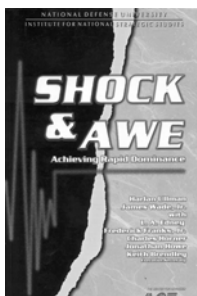
This overview of defensive information warfare is the result of an effort, undertaken at the request of the Deputy Secretary of Defense, to provide background material to participants in a series of interagency meetings to explore the nature of the problem and to identify areas of potential collaboration.



### **Command, Control, and the Common Defense**

(Allard, 1996)

The author provides an unparalleled basis for assessing where we are and where we must go if we are to solve the joint and combined command and control challenges facing the U.S. military as it transitions into the 21st century.



### **Shock & Awe: Achieving Rapid Dominance\***

(Ullman & Wade, 1996)

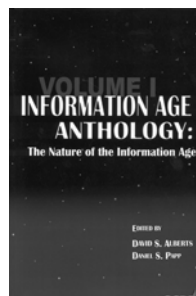
The purpose of this book is to explore alternative concepts for structuring mission capability packages around which future U. S. military forces might be configured.



### **Information Age Anthology: Volume I\***

(Alberts & Papp, 1997)

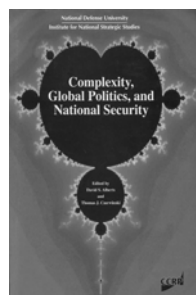
In this volume, we examine some of the broader issues of the Information Age: what it is; how it affects commerce, business, and service; what it means for the government and the military; and how it affects international actors and the international system.



### **Complexity, Global Politics, and National Security\***

(Alberts & Czerwinski, 1997)

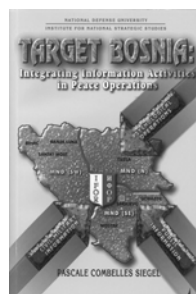
The charge given by the President of the NDU and RAND leadership was threefold: (1) push the envelope; (2) emphasize the policy and strategic dimensions of national defense with the implications for complexity theory; and (3) get the best talent available in academe.



### **Target Bosnia: Integrating Information Activities in Peace Operations\***

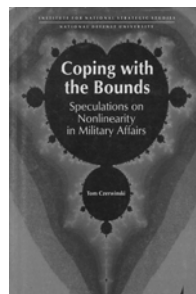
(Siegel, 1998)

This book examines the place of PI and PSYOP in peace operations through the prism of NATO operations in Bosnia-Herzegovina.



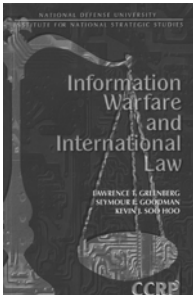
### **Coping with the Bounds (Czerwinski, 1998)**

The theme of this work is that conventional, or linear, analysis alone is not sufficient to cope with today's and tomorrow's problems, just as it was not capable of solving yesterday's. Its aim is to convince us to augment our efforts with nonlinear insights, and its hope is to provide a basic understanding of what that involves.



## CCRP Publications

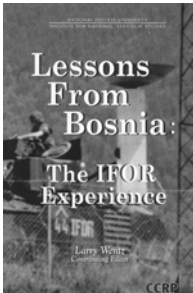
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### **Information Warfare and International Law\***

**(Greenberg, Goodman, & Soo Hoo, 1998)**

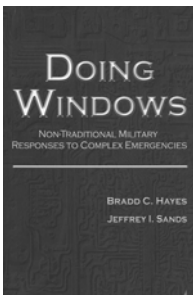
The authors have surfaced and explored some profound issues that will shape the legal context within which information warfare may be waged and national information power exerted in the coming years.



### **Lessons From Bosnia: The IFOR Experience\***

**(Wentz, 1998)**

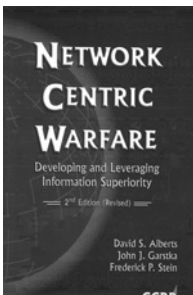
This book tells the story of the challenges faced and innovative actions taken by NATO and U.S. personnel to ensure that IFOR and Operation Joint Endeavor were military successes.



### **Doing Windows: Non-Traditional Military Responses to Complex Emergencies**

**(Hayes & Sands, 1999)**

This book examines how military operations can support the long-term objective of achieving civil stability and durable peace in states embroiled in complex emergencies.



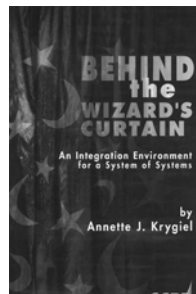
### **Network Centric Warfare**

**(Alberts, Garstka, & Stein, 1999)**

It is hoped that this book will contribute to the preparations for NCW in two ways. First, by articulating the nature of the characteristics of Network Centric Warfare. Second, by suggesting a process for developing mission capability packages designed to transform NCW concepts into operational capabilities.

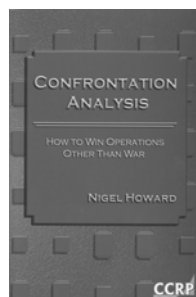
### **Behind the Wizard's Curtain (Krygiel, 1999)**

There is still much to do and more to learn and understand about developing and fielding an effective and durable infostructure as a foundation for the 21st century. Without successfully fielding systems of systems, we will not be able to implement emerging concepts in adaptive and agile C2, nor reap the benefits of NCW.



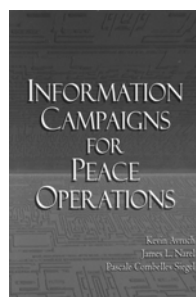
### **Confrontation Analysis: How to Win Operations Other Than War (Howard, 1999)**

A peace operations campaign should be seen as a linked sequence of confrontations. The objective in each confrontation is to bring about certain “compliant” behavior on the part of other parties, until the campaign objective is reached.



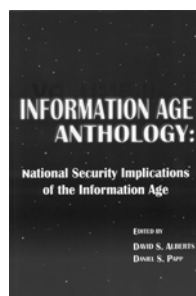
### **Information Campaigns for Peace Operations (Avruch, Narel, & Siegel, 2000)**

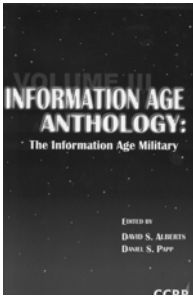
In its broadest sense, this report asks whether the notion of struggles for control over information identifiable in situations of conflict also has relevance for situations of third-party conflict management for peace operations.



### **Information Age Anthology: Volume II\* (Alberts & Papp, 2000)**

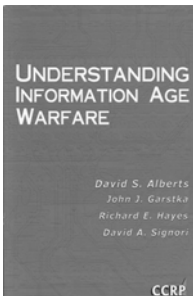
Is the Information Age bringing with it new challenges and threats, and if so, what are they? What dangers will these challenges and threats present? From where will they come? Is information warfare a reality?





### **Information Age Anthology: Volume III\* (Alberts & Papp, 2001)**

In what ways will wars and the military that fight them be different in the Information Age than in earlier ages? What will this mean for the U.S. military? In this third volume of the Information Age Anthology, we turn finally to the task of exploring answers to these simply stated, but vexing questions that provided the impetus for the first two volumes of the Information Age Anthology.



### **Understanding Information Age Warfare (Alberts, Garstka, Hayes, & Signori, 2001)**

This book presents an alternative to the deterministic and linear strategies of the planning modernization that are now an artifact of the Industrial Age. The approach being advocated here begins with the premise that adaptation to the Information Age centers around the ability of an organization or an individual to utilize information.

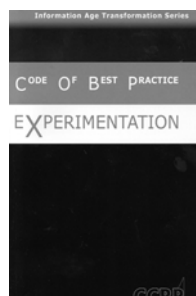


### **Information Age Transformation (Alberts, 2002)**

This book is the first in a new series of CCRP books that will focus on the Information Age transformation of the Department of Defense. Accordingly, it deals with the issues associated with a very large governmental institution, a set of formidable impediments, both internal and external, and the nature of the changes being brought about by Information Age concepts and technologies.

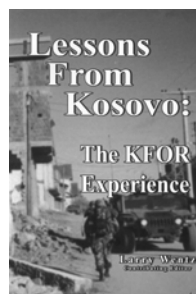
### Code of Best Practice for Experimentation (CCRP, 2002)

Experimentation is the lynch pin in the DoD's strategy for transformation. Without a properly focused, well-balanced, rigorously designed, and expertly conducted program of experimentation, the DoD will not be able to take full advantage of the opportunities that Information Age concepts and technologies offer.



### Lessons From Kosovo: The KFOR Experience (Wentz, 2002)

Kosovo offered another unique opportunity for CCRP to conduct additional coalition C4ISR-focused research in the areas of coalition command and control, civil-military cooperation, information assurance, C4ISR interoperability, and information operations.



### NATO Code of Best Practice for C2 Assessment (2002)

To the extent that they can be achieved, significantly reduced levels of fog and friction offer an opportunity for the military to develop new concepts of operations, new organisational forms, and new approaches to command and control, as well as to the processes that support it. Analysts will be increasingly called upon to work in this new conceptual dimension in order to examine the impact of new information-related capabilities coupled with new ways of organising and operating.





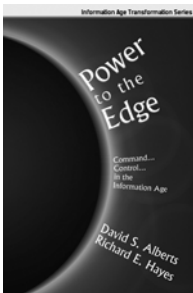
## Effects Based Operations (Smith, 2003)

This third book of the Information Age Transformation Series speaks directly to what we are trying to accomplish on the “fields of battle” and argues for changes in the way we decide what effects we want to achieve and what means we will use to achieve them.



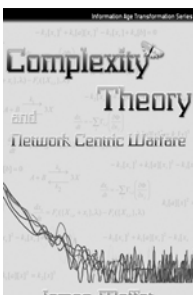
## The Big Issue (Potts, 2003)

This Occasional considers command and combat in the Information Age. It is an issue that takes us into the realms of the unknown. Defence thinkers everywhere are searching forward for the science and alchemy that will deliver operational success.



## Power to the Edge: Command...Control... in the Information Age (Alberts & Hayes, 2003)

*Power to the Edge* articulates the principles being used to provide the ubiquitous network that people will trust and use, populate with information, and use to develop shared awareness, collaborate, and synchronize actions.



## Complexity Theory and Network Centric Warfare (Moffat, 2003)

Professor Moffat articulates the mathematical models that demonstrate the relationship between warfare and the emergent behaviour of complex natural systems, and calculate and assess the likely outcomes.

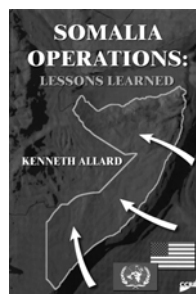
## Campaigns of Experimentation: Pathways to Innovation and Transformation (Alberts & Hayes, 2005)

In this follow-on to the Code of Best Practice for Experimentation, the concept of a campaign of experimentation is explored in detail. Key issues of discussion include planning, execution, achieving synergy, and avoiding common errors and pitfalls.



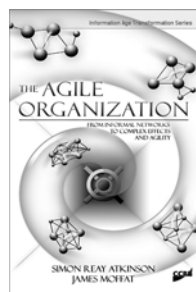
## Somalia Operations: Lessons Learned (Allard, 2005)

Originally published by NDU in 1995, this book is Colonel Allard's examination of the challenges and the successes of the U.S. peacekeeping mission to Somalia in 1992-1994. Key topics include planning, deployment, conduct of operations, and support.



## The Agile Organization (Atkinson & Moffat, 2005)

This book contains observations, anecdotes, and historical vignettes illustrating how organizations and networks function and how the connections in nature, society, the sciences, and the military can be understood in order to create an agile organization.



## Understanding Command and Control (Alberts & Hayes, 2006)

This is the first in a new series of books that will explore the future of Command and Control, including the definition of the words themselves. This book begins at the beginning: focusing on the problem(s) that Command and Control was designed (and has evolved) to solve.









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