Planning: Complex Endeavors

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Chapter 1. Introduction

There are two major drivers of the need for disruptive innovation, sometimes referred to as transformation, in the Information Age. The first and arguably the most compelling drivers are the changes to the environment in which an entity operates. For militaries, this is the changing nature of their adversaries, their strategies and tactics, as well as the "non-traditional" nature of the missions they are expected to undertake. For businesses, it is the changing nature of their competitive spaces.

There are, of course, profound differences between these arenas of competition and conflict. Thus, an approach that is successful in one may not be appropriate for another. However, there are significant similarities related to the nature of the "solution" or how to cope with the new environments in which these entities find themselves. For example, Information Age environments (whether military, government, or business) are all characterized by increasing complexity and uncertainty, as well as by the need for more rapid responses. As a result, individual entities and groups of entities with common goals need to be more agile to be successful in the Information Age.

For example, the 21st century military mission space encompasses a wide range of operations (including civil-military operations) in which success requires (1) an effects based approach to operations where the effects that need to be considered include not only military effects, but social, political, and economic effects, and (2) the ability to work effectively in coalition environments that include not only other militaries but also other government entities, international organizations, businesses, and a variety of non-governmental and private voluntary organizations (NGOs and PVOs). Similarly, Information Age businesses need to work more closely with suppliers, customers, and even competitors, sharing information that only a few years ago they would have vigorously protected.

The other major driver of disruptive innovation is the set of Information Age concepts and technologies that allow entities to operate differently and the resulting changes in the economics of information. Power to the Edge principles and network-centric concepts could have been more widely applied before existing communications and networking capabilities became commonplace. However, the costs (particularly the transaction costs) to achieve a given level of capability would have been far greater than they are today. Thus, adopting these innovations 'before their time' was not generally seen as cost-effective. Today the economics of communications and information technologies has created enormous opportunities to leverage the power of information and collaboration cost effectively by adopting Power to the Edge principles and network centric concepts.

These innovations require the coevolution of concepts of operation, approaches to accomplishing the functions associated with command and control, organization, doctrine, processes, systems, education and training as well as other components of mission capability packages to achieve robustly-networked enterprises capable of instantiating Power to the Edge principles to get to, and to leverage, shared awareness and understanding. Planning, a process that creates the necessary conditions for

synchronizing actions and effects, needs to be "reinvented" as well. Changing our approach to Command and Control without co-evolving our approach to planning and plans is akin to improving the quality and the distribution of information while not permitting individuals and organizations to use the improved information to which they have access.

Disruptive innovation or transformation is by definition more than incremental improvement or sustaining innovation. It requires venturing beyond comfort zones; to take voyages of discovery. As such, it would be unreasonable to expect the answers to be apparent or the data for analysis to be available before the endeavor is launched. The way ahead involves the formulation, design, and implementation of campaigns of experimentation and associated programs of research focused on the development and assessment of interactive and dynamic effects based planning in the context of 21st century mission challenges.

Purpose

The purpose of this book is to present and explain an approach to planning that is appropriate for complex endeavors at a level of detail sufficient to formulate and conduct a campaign of experimentation to test, refine and ultimately implement a new approach or set of approaches to planning. The term *complex endeavors* is used here to refer to undertakings that have one or more of the following characteristics:

1. The number and diversity of the participants is such that
    a. there are multiple interdependent "chains of command,"
    b. the objective functions of the participants conflict to some extent with one another or their components have significantly different weights, or
    c. the participants' perceptions of the situation differ in important ways; and
2. The effects space spans multiple domains and there is
    a. a lack of understanding of key cause and effect relationships and
    b. an inability to predict effects that are likely to arise from alternative courses of action.

Scope

Toward this end, this book explores the nature of the planning process, and its products - plans, that promise to be appropriate for complex endeavors; those typified by stabilization and reconstruction in both permissive and non-permissive environments. While *Understanding Command and Control* was not prescriptive with respect to advocating a particular approach to Command and Control (it sought to identify the

relevant space[1] to be considered and encourage a through exploration of that space), this work describes the nature of the planning approaches and the products of these planning approaches that appear to be well-suited for complex endeavors.

Having said this, it should not be inferred that we are suggesting blind acceptance and immediate implementation. Rather, we believe that the approach(es) to planning identified in this book deserves consideration as part of a campaign of research and experimentation.

Organization of the Book

Having concluded that a campaign of experimentation is necessary, this book also provides the intellectual foundation for such a campaign including (1) appropriate definitions for key concepts,[2] (2) a conceptual reference model that puts planning in the context of the functions associated with command and control and execution, (3) a set of research issues, and (4) the identification of key activities on the critical path to developing and assessing appropriate approaches to planning.

We begin by briefly reviewing a number of key concepts associated with the transformation of military operations that involve changing the way we operate and the nature of the effects we attempt to achieve. Next we review the definitions for a set of functions that are common to all organized endeavors including the subject of this book—planning. Having laid the semantic foundation for a discussion of planning for complex endeavors, we provide a historical perspective – tracing the development of planning, particularly planning for military operations to their Industrial Age instantiations. The reasons why Industrial Age or traditional military planning approaches, processes, and products do not work well for the kind of complex endeavors we can expect to undertake in the 21st century are then delineated.

At this point we introduce a conceptual model for planning that can form the basis for the development of new, more appropriate approaches to planning. This model is an extension of the conceptual model provided in *Understanding Command and Control* and depicts the relationships between and among command, control, planning, and execution. Measures of value that are deemed appropriate for assessing the utility of various approaches to planning in the context of different approaches to command and control are discussed.

The discussion then shifts to the way ahead – the formulation and conduct of a campaign of experimentation and an associated program of research designed to understand planning in complex endeavors and explore and assess a variety of new approaches to planning. This discussion begins with a review of the nature of experimentation

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[1] David S. Alberts and Richard E. Hayes, *Understanding Command and Control* (Washington: CCRP, 2006), 75.

[2] The definitions provided are consistent with those provided in *Understanding Command and Control*.

campaigns and concludes with a formulation of such a campaign and the identification of priority research issues. The book concludes with some thoughts about pursuing these and some reflections about the challenges that lie ahead.

Chapter 2. Key Concepts

This book focuses on the nature of the planning approach required for complex endeavors. As we will show, a mature network-centric, effects-based approach to planning is better suited than traditional military planning approaches for complex endeavors. To lay a foundation for this discussion, a number of key terms need to be defined. We start with what we mean by a *complex endeavor*.

Complex Endeavors

Complex endeavors are characterized by both the nature of the collection of participants who are working toward a shared purpose[3] and the nature of the effects of interest. Put succinctly, complex endeavors are characterized by a large number of disparate cooperating entities that include not only various military units but also civil authorities, multi-national and international organizations, non-governmental organizations, companies, and private volunteer organizations. The effects of interest go far beyond military effects to include social, political, and economic effects. The nature of the participants makes the collective action space complex while the multi-domain effects space[4] contains complex interactions among effects of various types. In addition, the relationships between the action and effects spaces further contribute to the complexity of the endeavor.

The implications for the planning processes required for complex endeavors are not fully understood at this time; however, certain observations seem obvious and should be taken as points of departure for research, analysis, and experimentation. First, the collection of planning processes employed need to be mutually inclusive rather than exclusive. It is hard to see how planning for complex endeavors can be effective if it only consists of the development of individual plans by each of the participating entities (or subsets of the entities). A basic tenet of network-centric thinking holds that self-synchronization is enabled by shared awareness.[5] In this case, that means cross-domain awareness as well as awareness across domains.

Proper treatment of the effects space is equally important if actions are to be synergistic and, hence, is important for mission success. Military organizations have, with the growing acceptance of the need for effects based approaches to planning and operations, begun to seriously consider effects beyond those that are a direct result of military action

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[3] In reality the participants do not in fact completely share values or an objective function. However, the participation of individual entities reflects the fact that on balance participation and/or the projected outcomes associated with the endeavor have value for them.

[4] "Effects space" is a term that describes a multi-dimensional space where the dimensions (axes) correspond to the types of effects (social, economic).

[5] One of the peer reviewers suggested that this assertion would make an excellent hypothesis for experimentation.

and those that directly impact adversary capabilities. However, legacy systems and processes do not provide for the collection and analysis of much of the information that is necessary to assess the direct and indirect effects of military actions. Furthermore, the expertise necessary to understand what information is needed, what information is available, and where it can be obtained as well as the expertise to understand potential impacts in the social, political, and economic domains are in short supply in military organizations. However, much of the needed information and expertise is available in the variety of other organizations that are likely to participate in an endeavor.

Thus, the development of individual plans in relative isolation clearly would inhibit both an adequate assessment of potential effects and the development of the shared awareness that is required for effective collective action. The real issue is the nature of the sharing of information and the interactions that are necessary, not whether there should be more sharing of information and interactions. Current planning approaches do not provide for sufficient levels of information sharing and collaboration to properly assess potential effects or to achieve the necessary shared awareness. Thus, until this is remedied, they cannot succeed.

Complicated versus Complex

The mechanisms associated with network-centric approaches to decision making and planning can arguably apply to any set of problems that require sensemaking and coherent or synchronized actions. The benefits of information sharing, collaboration, and even self-synchronizations can accrue wherever the conditions necessary for implementing them are found. However, these network-centric mechanisms are not necessary for all situations—more traditional military approaches have proven useful and robust across a variety of challenging Industrial Age situations from Operation OVERLORD for the Allied invasion of France during World War II to the development of major corporations in mature industries.

While traditional military planning has proven adequate for dealing with a set of challenging situations that were *complicated*, this Industrial Age approach is inherently inadequate for coping with the genuinely *complex* situations and systems that are found in complex endeavors. Complicated systems, in our vocabulary, are characterized by having many moving parts or actors and are highly dynamic, that is, the elements of these systems constantly interact with and impact upon one another. However, the cause and effect relationships within a complicated situation are generally well understood, which allows planners to predict the consequences of specific actions with some confidence. In addition, the temporal dynamics of a complicated situation are available to those analyzing it and planning actions to impact on it.

Warfare, as practiced between conventional forces in recent history, is a complicated system. Planners today can predict the kinetic consequences of placing a particular weapon on a specific target, analyze how long it will take for a force element to move from one location to another (and therefore respond to a contingency), and assess the military impact of a combined arms attack on a particular set of defenses. Indeed, knowledge of conventional warfare dynamics is such that detailed simulations and

models are routinely used to assess the value of alternative investment strategies, conduct rehearsals and exercises to train and prepare participants and to improve war plans, explore the capabilities of alternative information flows and architectures, and to identify force vulnerabilities—both our own and those of adversaries. There are still important intangibles in any warfighting situation (leadership, morale, etc.) and serious analysts recognize that these models are limited and should be used, not as sources of truth, but as decision support tools to help humans make better judgments. The development and use of these tools reflects a Western, Industrial Age, positivist philosophy that assumes problems can be decomposed, analyzed, and treated successfully.

Other techniques have been successfully employed to deal with complicated situations include doctrine and exercises. Armed forces around the world develop, teach, and rely on doctrine designed to ensure their officer corps and decisionmakers understand the warfare arenas where they are likely to be engaged and will be able to take the actions expected to generate successful outcomes. Exercises are also widely employed in Industrial Age militaries because they are seen as effective ways to educate and train forces for the complicated tasks of organizing and conducting operations. The quality of the command and control within these Industrial Age militaries is traditionally judged by their capability to (a) identify crucial features of their operating environment and (b) control them. Hence, depending on the type of warfare, the appropriate Measures of Force Effectiveness (MOFE) may include territory won or lost, loss exchange ratios, capture of key terrain (e.g., the enemy's capital city or terrain that dominates lines of communication). Military analysts and planners are constantly seeking to understand the enemy's "center of gravity," that key issue or capability that enables him to maintain the will and capability to continue the fight.

All of these practices underscore the assumption that conventional warfare, while complicated, is ultimately understandable and the consequences of actions taken during combat are predictable to a meaningful extent.

Increasingly, however, military organizations and the endeavors they join (which may involve interagency partners, international organizations, NGOs, private companies, and host governments) are faced with situations that are not merely complicated but are truly complex. Efforts to deal with these complex situations, undertakings we refer to as complex endeavors, involve changes and behaviors that cannot be predicted in detail, although those behaviors and changes can be expected to form recognizable patterns. Complex endeavors are also characterized by circumstances in which relatively small differences in initial conditions or relatively small perturbations (seemingly tactical actions) are associated with very large changes in the resulting patterns of behavior and/or strategic outcomes.

Some complex situations develop into Complex Adaptive Systems (CAS), which tend to be robust—to persist over time and across a variety of circumstances. These are often observed in nature in the form of biological or ecological systems. The complex adaptive systems that have emerged in the oceans or land habitats are typical of CAS. However, while these systems are thought of as robust, they can be pushed out of balance even to

the point of collapse through cascades of negatively reinforcing conditions and behaviors. Such perturbations are what ecologists fear when habitat is reduced to isolated geographic areas or when invasive, non-native species are introduced. In fact, when an effort is made to influence a complex adaptive system, the actor or actors seeking to exert that influence actually become part of that CAS. For example:

- ecologists who construct a fish ladder to enable salmon to reach their spawning ground have become part of that ecological system;
- military aircraft used as sensors to track illegal shipments cause the smugglers to alter their routes and means of transportation; and
- the creation of micro-lending institutions to improve economic conditions in a Third World country alters the social and economic system by introducing a new type of entity.

One example of a complex adaptive system in which militaries are currently engaged involve international criminal networks (trading in all types of illicit goods including illegal drugs, counterfeit consumer goods, banned substances such as ivory and rhinoceros horn, illegal immigration, and human trafficking) and in money laundering.[6] International terrorist networks and insurgencies also can take the form of complex adaptive systems if they are successful in establishing themselves over time. Complex adaptive systems involving humans are typically linked across a variety of arenas (political, economic, military, and intellectual) and well as the four domains recognized in the study of network–centric approaches (physical, information, cognitive, and social).

Implications for Planning

Traditional military planning has applied principles from the Industrial Age because the problems it addressed were seen through the analytical lenses developed during that era. Through this lens problems are seen as being complicated (made up of many discrete parts) and approachable by decomposition of their constituent elements. Understanding cause and effect was viewed as possible and the relationships largely linear (the consequences of a given action or set of actions within an operating environment could be predicted). As a result, the tasks of integration and synchronization were viewed as manageable by a commander and his staff. These approaches were widely adopted because they proved robust across the Industrial Age challenges facing military organizations—peer competitors relying on established doctrine and familiar systems and undertaking warfare in familiar terrain. They proved themselves during World War II and the Korean Conflict. They proved useful even when the operating environment was complicated: large in scale, involving a variety of actors, with inherently dynamic interactions.

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[6] Moises Naim, *Illicit: How Smugglers, Traffickers, and Copycats are Hijacking the Global Economy* (New York: Anchor, 2006).
Margaret Daly Hayes, "Challenges to Democratic Stability and Security in the Western Hemisphere" (Vienna: EBR, 2006), 4.

However, these assumptions fail when a genuinely complex situation occurs as does in complex endeavors. This is because the elements of a complex situation are coupled in ways that are not completely understood. Couplings exist between apparently distant (and disparate) elements of the operating environment and little or no coupling exists among elements thought by some to be closely coupled. As previously pointed out, the elements of the endeavor attempting to deal with the complex situation (whether it is joint, coalition, interagency, or include private industry, non-governmental actors, international organizations or state and local officials) are actually part of the complex adaptive system they are seeking to influence. This creates a Heisenberg's-like uncertainty.[7]

Creation and maintenance of the endeavor (who joins, with what level of commitment) and creation and maintenance of collective intent across the elements within the endeavor are crucial tasks that help shape the complex adaptive system. In addition, couplings across the arenas of the operating environment mean that cause and effect are all but impossible to forecast and at times very difficult to understand in retrospect. This occurs because secondary and tertiary effects may prove crucial and because of the potential for cascading effects and influences across arenas (for example, military to political, economic, and informational) and domains (physical, informational, cognitive, and social).

Faced with complexity situations, traditional military planners could continue to decompose the problem or mission into discrete elements and create a campaign plan, including explicit branches and sequels dealing with contingencies (or pre-established alternative futures) that they believe will lead to success. However when setbacks invariably occur, ones that experienced that move the situation beyond the boundaries established for the plan, these planners could try to understand where the differences lay and generate an alternative plan. In complex situations, they are unlikely to be successful. In these cases, not only the plan fails but the planning process fails as well.

Planners in complex endeavors need to follow a very different set of principles

1. First, they must be aware of the numerous arenas and domains involved in complex adaptive systems.
2. Second, because of the lack of predictability in complex systems, planners must take steps to produce agile plans.

They should focus on a set of actions consistent with maintaining agility. This implies that actions

1. Commit relatively small amounts of resources irretrievably, making it possible to reallocate as required.

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[7] David Cassidy, "Quantum Mechanics 1925-1927: The Uncertainty Principle" (The American Institute of Physics, 2006). http://www.aip.org/history/exhibits/heisenberg/p08_text.htm (Dec 2006)

2. Improve their information position—probes that will improve information collection and actions that reduce the quality of information available to the adversaries.
3. Provide feedback on the impact of actions taken.
4. Gain and maintain the initiative and to place the adversary on the defensive or in a reactive mode.

These are highly abstract concepts, so an illustrative case may be useful. Recently the US Army's Third Armored Cavalry Regiment was assigned the task of reducing the level and effectiveness of the Iraqi insurgency in and around the town of Tall Afar. This, as it turned out was a complex endeavor. The brigade commander recognized this fact and took appropriate actions. First, and most fundamentally, he recognized that the relevant effects space included much more than the military arena. Secondly, he understood that he had opportunities and options that extended well beyond the use of force. Thus he decided not to rely solely on his military assets and overwhelm the adversary. As a result, he undertook several initiatives, each one modest in scope.

The actions he took included, roughly in order over time (many of these actions overlapped, but the later ones were initiated after the earlier ones were well underway and apparently successful).

- Train the troops for dealing with Iraqi's in ways that (a) were effective but (b) did not insult or demean the individual before deploying to Iraq.
- Seal the nearby border with Syria and reduce or eliminate the flow of foreign fighters and weapons entering the area.
- Create facilities for handling detainees safely and humanely. Develop feedback mechanisms, including interviews with detainees, to ensure appropriate treatment.
- Provide robust training and support for the Iraqi police within Tall Afar to ensure their behavior was professional.
- Open dialogue with the tribal and other local leaders in the small towns between the border and Tall Afar and within that city.
- Seek specific suggestions from those leaders about how to achieve his goals.
- One by one, isolate and search the small towns for weapons caches and insurgent fighters.
- Create a series of police and military posts within Tall Afar that were (a) close enough to support one another, (b) provided observation into almost every party of the town, and (c) occupied 24 hours per day.
- Explain to the elders and clan leaders that Tall Afar would be searched soon and encourage non-combatants to leave.
- Seek dialogue with the town's leadership and their suggestions about how to achieve his goals.
- Conduct house by house and block by block searchers to secure the town. These turned up a variety of weapons caches, bomb factories, and a relatively few insurgents.

- Maintain presence by continuing to occupy the police and military posts throughout the town.

This step-by-step approach, with minimal risk and force commitment in each step resulted in (a) a rapid reduction in attacks and improvised explosive devices in the area over time, (b) steadily improving intelligence from locals, (c) abandonment of Tall Afar by many of the insurgents who had been operating from there. Casualties to the Third Armored Cavalry Regiment were much lower than had been expected or that were experienced by other units of comparable size during this period. Because the commander was aware of the physical, informational, cognitive, and social domains and brought his resources into play intelligently across the military, political, economic, and intellectual arenas, he was able to influence the complex adaptive system in his area of responsibility.[8]

Effects Based Approaches to Operations (EBAO)

In the discussion of the nature of complex endeavors above, it was noted that the effects of interest go far beyond the military effects considered in traditional military planning processes. Recently there has been a recognition that the military needs to consider a broader range of effects. This idea has been explored, most notably in *Effects Based Operations* (2002) and *Complexity, Networking, and Effects Based Approaches to Operations* (2006). The acronyms EBO and EBAO have come to embody these ideas.

While NCO embodies a set of principles (more recently elaborated upon in the articulation of Power to the Edge[9] principles, policies, and practices) that address how an enterprise functions, effects based approaches to operations (EBAO) speak to the substance of command intent and to the need to focus on the ultimate effects that are desired rather than solely upon the actions taken or the immediate effects of these actions. In earlier writings, this has been termed "policy effectiveness."[10] Given that the fulcrum of any operation is shared awareness, success requires planning for complex endeavors that achieved rich shared awareness.

EBAO requires developing shared awareness that is also richer than traditional military situation awareness and being able to leverage shared awareness by orchestrating effects in multiple domains. Thus, awareness must include an understanding of intent, where the

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[8] Thomas E. Ricks, *Fiasco: The American Military Adventure in Iraq* (New York: Penguin Press HC: 2006).
Thomas E. Ricks, "The Counterinsurgency" (*Washington Post*. February 16, 2006). http://www.washingtonpost.com/wp-dyn/content/article/2006/02/15/AR2006021502586_pf.html (Dec 2006)

[9] David S. Alberts and Richard E. Hayes, *Power to the Edge* (Washington: CCRP, 2003).

[10] NATO, *Code of Best Practice for C2 Assessment* (Washington: CCRP, 2002), 91-92.

quality of the intent will be a function of the degree to which both the immediate and consequential effects (a cascade of effects) in all of the relevant domains are understood.

Among the most important effects to be considered in planning for complex endeavors are those that are perceived by various entities because they impact adversary awareness, shared awareness, will, and ability. Effects based approaches to operations place military or civil-military operations in context, seeing the role of the military as establishing the environment (secure and peaceful) necessary to achieve political, economic, and social objectives.[11] This has implications for the nature of a planning process for complex endeavors, both for the planning processes of individual organizations' contributions and the explicit, implicit, or emergent collective planning process.

Network Centric Concepts

NCO and effects based approaches to operations are complimentary concepts. In fact, NCO appears to be a necessary prerequisite for successful effects based approaches to operations.[12]

Despite the fact that key terms associated with Information Age military transformation such as "Network Centric Warfare" and "Network Centric Operations" (and Network-Enabled Capabilities and Network-Enabled Defense) are in widespread use and that many profess to understand these concepts, these terms are often used inconsistently, and often incorrectly.

Traditional concepts such as "Command and Control" and "Planning" are in the process of being reinvented and redefined to make them compatible with new Information Age concepts. Although these terms may have "official" definitions, those definitions often no longer make sense in light of the dramatic changes that have taken place in both the nature of the missions to be undertaken and the opportunities afforded by advancing technology, particularly information technologies, to do things differently.

However, these key terms must be properly defined and understood to enable the systematic exploration of the suggested approach(es) to planning. These definitions are also prerequisites for understanding and employing the conceptual model presented here required to formulate and guide a successful campaign of experimentation so that we can fully leverage the data collected and the results of the analyses that are part of that campaign. For these reasons, the meanings of key terms are discussed here and citations are provided for readers who would like to have more detailed treatments of these concepts.

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[11] Edward A. Smith, *Effects Based Operations* (Washington: CCRP, 2002), 1.
Edward A. Smith, *Complexity, Networking, and Effects based Approaches to Operations* (Washington: CCRP, 2006).

[12] Smith, *Effects Based Operations*, 59.

The earliest term used to describe an approach to military operations that leveraged the power of information was "Information Superiority."[13] Variants on this term have included Information Dominance, Knowledge Superiority, and Decision Superiority. These terms focused on the value that improved information has on the quality of decision making. They did not focus on the potential impact of networking on the information, cognitive, or social domains. Network Centric Warfare (NCW) was the earliest term that explicitly focused on the power of networking and was, in a DoD report requested in legislation by the Congress, described as "no less than the embodiment of an Information Age transformation of the DoD."[14] NCW and the variants of this term that have emerged since (e.g., Network Enabled Capability)[15] defy bumper-sticker definitions. The term Network Centric Operations (NCO) was introduced to emphasize that the principles of NCW and NEC are applicable to operations of various kinds in many arenas.

While it is easy to make simple statements that are true about a network-centric approach to enterprises and the endeavors that they undertake (e.g., it is about a robustly networked force; it is about leveraging Information Age technologies), these simple statements fail to adequately convey the intended meaning and as often as not lead to misunderstandings regarding the scope and implications of NCW/NEC/NCO.

For the remainder of this book we will use NCO to refer to these arrangements and approaches. NCO involves a number of interrelated concepts that form an intellectual basis for this Information Transformation of the DoD, which "is about human and organizational behavior…is based on adopting a new way of thinking—network-centric thinking—and applying it to military operations…. focuses on the power that can be generated from the effective linking or networking of the enterprise."[16]

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[13] Berkowitz. "Warfare in the Information Age" in *Information Age Anthology Volume I*, eds. Alberts and Papp (Washington: CCRP, 1997), 533.

[14] "Network Centric Warfare – A DoD Report to the Congress 27 July 2001" (Washington: Department of Defense, 2001), Executive Summary, i.

[15] Network Enabled Capability: the coherent integration of sensors, decision-makers, weapon systems, and support capabilities to achieve the desired effect. JSP 777, NEC Handbook. http://www.mod.uk/NR/rdonlyres/E1403E7F-96FA-4550-AE14-4C7FF610FE3E/0/nec_jsp777.pdf (Aug 2006)

[16] David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leverage Information Superiority* (Washington: CCRP, 1999), 88. Originally, this quote contained the phrases *combat power* and *warfighting enterprise* instead of military operations. We have made the change that, in effect, extends the NCW quote to NCO so that it is more reflective of the full mission spectrum.

NCO involves actions and their effects in four domains: physical, information, cognitive, and social. The fundamental capabilities that characterize a network-centric enterprise, organized by domain, are as follows:[17]

- Physical Domain: All enterprise entities[18] are robustly networked, achieving secure and seamless connectivity and interoperability.
- Information Domain: All participants have the capability to share, access, and protect information, not only within their organizations, but with other enterprise entities as appropriate as well as others. Participants have the capability to collaborate in the information domain and to individually or collectively conduct information operations.
- Cognitive Domain: Each participant has the capability to develop high quality awareness.
- Social Domain: The enterprise has the capability to develop shared awareness and understanding, including an understanding of command intent. The participants are capable of self-synchronization.

Tenets of Network Centric Operations

NCO requires[19] the existence of a robustly networked enterprise (networked not just in the information domain, but also in the social domain as well). The value chain of a network-centric enterprise is:

- Robustly networking an enterprise leads to widespread information sharing and collaboration.
- Increased sharing and collaboration improve both individual and shared awareness.
- Shared awareness and collaboration improve decisions and, in the presence of edge approaches to command and control, enable self-synchronization.
- The result is dramatic improvement in mission/enterprise effectiveness and agility.

Network-Centric Maturity Model

The co-evolution of mission capability packages[20] and an understanding of the network-centric maturity model[21] are integral to transforming network-centric concepts into fielded capabilities.

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[17] Adapted from: David S. Alberts, John J. Garstka, Richard E. Hayes, and David T. Signori, *Understanding Information Age Warfare* (Washington: CCRP, 2001), 57.

[18] The word *enterprise* is used here instead of *force* or organization because 21st century missions will involve both military forces and civil organizations.

[19] This is not an all-or-nothing requirement. Improvements in networking will lead to commensurate improvements in information sharing and collaboration.

The network-centric maturity model, depicted in Figure 1, defines 5 levels of maturity and a hypothesized migration path for the implementation of network-centric capabilities in an organization.

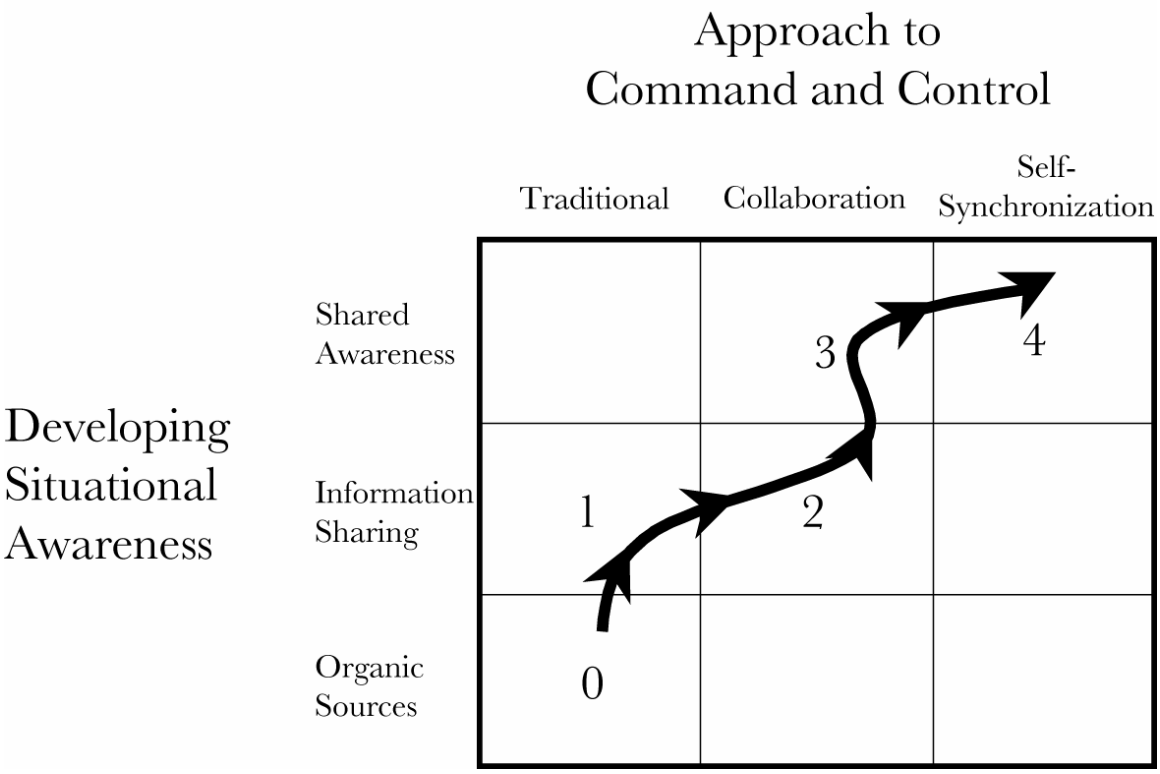

Figure 1: Network-Centric Maturity Model[22]

In a pure platform-centric, stove-piped world, sensors are owned by the platforms and the information available to those on a given platform comes, for all intents and purposes, solely from these "organic" sensors. Thus, situation awareness is developed only from organic sources. Level 0, the baseline, is defined as operations that employ traditional command and control processes (e.g., centralized planning) with an information position[23] that is created solely from organic sources.

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[20] First proposed in INSS Strategic Forum of the same name.

[21] Alberts et al., *Understanding Information Age Warfare*, Figure 76, 241.
David S. Alberts and Richard E. Hayes, *Power to the Edge* (Washington: CCRP, 2003), 109.

[22] In Power to the Edge (109), this is referred to as the NCW Maturity Model. David S. Alberts and Richard E. Hayes, *Power to the Edge*, 109.

[23] Information position: the state of an individual's information at a given point in time. See: Alberts et al., *Understanding Information Age Warfare*, 106.

Level 1 is a mini-step in the direction of Network Centric Operations. Although it employs traditional approaches to command and control, it involves a significant amount of information sharing among the participants in an operation. Level 1 requires a somewhat connected (networked) force, but without a requirement for information services beyond those necessary to support information sharing.

Level 2 takes the next step and introduces some collaboration among participants across location, function, and organization. The collaboration involved here is focused on the nature of the information being shared in order to identify inconsistencies and sort out incorrect, out of date, or questionable information. Level 2 requires a more robustly connected network, including a collaboration environment. It enables a higher level of information sharing and some (largely factual) shared awareness.

Level 3 differs from Level 2 in the nature of the collaboration and the level of shared awareness that is achieved. At Level 3, collaboration is focused not on the information but on what it means, its implications, and the nature of a response. Thus, the collaboration that takes place at Level 3 involves an increase in distributed decision rights. It results in richer shared awareness and some shared understanding of the temporal relationships, cause and effect, and potential effect.

Level 4 takes the final step to Network Centric Operations and involves an approach to command and control that at least permits, if not encourages, self-synchronization. The DoD's Joint Operating Concept for C2 explicitly encourages self-synchronization when appropriate.[24] Self-synchronization requires a significant increase in the distribution of decision rights. In addition, it requires a combination of competence, trust, and willingness to be interdependent.

Network-centric enterprises are not created by effecting incremental improvements alone. Rather, disruptive innovations are required. This involves coevolution, that is, changes to many, if not all, of the elements of a mission capability package—a significant departure from business as usual. Changes to the way the functions of command and control are accomplished are essential to network-centric mission capability packages. The maturity model posits stages in the transformation of an organization that may be used as a basis for an evolutionary approach that can be employed to manage the risks associated with a transformation to a network-centric enterprise.

Command and Control

New approaches to both command and control are necessitated amongst other things by (1) a need to accommodate the realities of complex operations such as coalition and civil-

[24] "Joint Transformation Roadmap" (USJFCOM, Office of Force Transformation, 2004). http://www.ndu.edu/library/docs/jt-transf-roadmap2004.pdf#search='joint%20operating%20concept' (Nov 2006), 18.

military operations and (2) a desire to increase awareness and leverage shared awareness across a large, distributed enterprise consisting of many different kinds of participants.

Command needs to be separated from control. Command should be equated with the establishment of a set of initial conditions, including the rules and/or mechanisms by which these conditions are adjusted dynamically. Control needs to be looked at as an emergent property, one that is a function of initial conditions, including those established by command.

Command is a scalable concept. It applies at the enterprise level where it might be referred to as governance; it applies to endeavors that may involve multiple organizations that may view themselves as enterprises; and it applies at the small unit or individual level where specific tasks or a specific mission is involved. At each level, understanding command begins with an appreciation of what the functions of command are. Command functions include:[25]

- Establishing the goal or objective (the intent)
- Determining roles, responsibilities, and relationships
- Establishing rules and constraints
- Monitoring and assessing the situation and progress

There are a set of other functions that are traditionally associated with commanders that include inspiration, motivation, training, and preparedness. These are the functions that are often associated with leadership. For the purposes of this examination of planning in complex endeavors, specifically those that involve network-centric command, these leadership functions are not considered. That does not deny their importance, but rather recognizes that they are not central to mission planning or plans.[26]

There are many different approaches that have been taken to accomplishing the functions associated with command that have proven successful. Traditional military approaches are, however, a reflection of Industrial Age thinking and capabilities. Six Industrial Age approaches or philosophies were successfully employed by 20th century militaries.[27] These approaches "decomposed the battlespace *(or problem)*, created layered organizations, divided into specializations, and organized forces into hierarchies."[28] The assumption that was made was that this type of approach to C2 and organization was

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[25] Alberts and Hayes, *Understanding Command and Control*, 35.

[26] This is not to say that leadership itself is not a factor to be considered in the development of a given plan if the situation warrants.

[27] For a discussion of Industrial Age approaches to Command and Control see:
Alberts and Hayes, *Power to the Edge*, 18-26.
Alberts and Hayes, *Command Arrangements for Peace Operations*, 77-100.

[28] Alberts and Hayes, *Power to the Edge*, 44.

what was needed to transform the complexity of war and large operations into a collection of simple, manageable tasks—tasks that, if accomplished individually, would collectively accomplish the larger mission. A lot of time and effort was spent in finding ways to (1) optimize the performance of individual tasks and (2) de-conflict the units that were undertaking these tasks from adversely impacting one another. De-confliction efforts involved several dimensions: functional, spatial (geographical), and temporal. Only complicated problems,[29] that is, problems that, regardless of the number of parts, behave in an understandable fashion and whose behaviors can be adequately predicted, are amendable to this Industrial Age approach to C2. When the problem defies decomposition, as most requiring effects based approaches do, these approaches have proven very challenging to implement successfully.

The objective of command is to create the best conditions possible, conditions that are more, rather than less, likely to give rise to the desired result(s), or the converse, less likely to have less desirable results. Thus, the functions associated with command involve understanding the risks inherent in the situation and managing those risks across the entire relevant effects space.

Sensemaking

Endeavors are all about accomplishing something. Thus, endeavors have intent, one that is shared to different degrees by those participating. Successful accomplishment requires that the individual participants (individuals, teams, and organizations) are able to make sense of the situation individually, in the context of their respective roles, as well as the collectively as an enterprise. Making sense of the situation, *sensemaking*, begins with putting available information into context and identifying the relevant patterns that exist.[30] In other words, sensemaking begins with the development of situation awareness.

Situation awareness[31] includes awareness of intent[32] (purpose, considerations, and constraints). The intent of interest is not only that of the endeavor but also includes differences in intent among participants and if there are adversaries, the intent of those adversaries. In the process of developing situation awareness, it may be determined that more information is needed before an actionable response can be formulated. As a result, a decision may be made to seek additional information (to task collection and analysis assets, or to take probing actions and observe the responses).

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[29] Simon Reay Atkinson and James Moffat, *The Agile Organization: From Informal Networks to Complex Effects and Agility* (Washington: CCRP, 2005), 27.

[30] Alberts and Hayes, *Power to the Edge*, 101.

[31] Alberts et al., *Understanding Information Age Warfare*, 120-125.

[32] Awareness of intent, like all forms of awareness, is a perception, not knowledge of intent.

Sensemaking involves more than developing situation awareness, it goes beyond what is happening to include what may happen and what can be done about it. This involves analysis and prediction, both of which require a model (mental or explicit) and the knowledge of or development of decision options that map to various alternative futures.

The need to consider a wide range of effects and the cascades of effects that take place in multiple domains and contexts (social, economic, political) requires more knowledge, experience, and expertise than when the only effects that are considered are direct military effects. This is one of the major reasons why effects based approaches to planning benefit from, some would say require, a network-centric approach.

Decisions

A decision is a selection[33] from alternatives or choices (e.g., take action vs. take no action; do A vs. do B or C or D). At some point, the focus of the decisions changes from situation awareness - what information is needed and how to collect and interpret it -- to what to do about the situation. Decisions about what to do about a situation may involve developing a proactive strategy to shape events, or they may involve an immediate or a delayed response to events. Responses to a situation could include not only direct action(s) but, as a result of a conclusion/decision, that more information is needed, action(s) to get additional information, either directly by tasking some other entity, or by initiating information exchanges. As far as a determination of whether to be proactive or reactive, decisions can also involve taking actions or steps to prepare for taking action (again these decisions could be to delegate, form a team, or undertake preparations for an action).

Decisions are, in fact, ubiquitous. To understand the differences among command, control, sensemaking and planning, one must understand the nature of the decisions that each of these involve. The nature of decisions can be understood by examining the question(s) that they address. Below is an illustrative set of questions mapped to the functions to which they are most closely associated.

- Command Decisions
  - What should be accomplished?
  - What limits/conditions/priorities should apply?
  - Who is responsible for…(roles responsibilities, authorities, and relationships)?
  - How should resources be allocated?
  - How should information be distributed?

[33] A decision not to decide is also a decision.

- What interactions between/among participants should be allowed, required, or prohibited?

- Sensemaking
  - What is the situation?
    - Who are the actors (friendly, adversary, neutral)?
    - What are their capabilities and intentions?
    - How are assets distributed: functionally, in space, over time?
    - What are the crucial factors determining likely futures?
  - What can be inferred about intent?
  - Do I understand the situation well enough to develop options?
  - What information do I need to understand the situation better?
  - What can be done to improve the situation?
  - What is the most appropriate course of action?
  - What if this approach does not achieve its aims?

Planning as an element of sensemaking

Sensemaking spans a set of activities that begins with developing situation awareness and ends with preparing for action. Sensemaking activities begin with the creation of the endeavor itself and continue until the situation is resolved. The products of sensemaking include the development and communication of plans in a variety of forms. Sensemaking is dynamic. Its products are therefore subject to continual revision or replacement. Thus, planning is a subset of the activities we consider to be sensemaking. Sensemaking at times overlaps or occurs simultaneously with execution.

Some decisions are for all intents and purposes contemporaneous with some action[34] while others are anticipatory. For example, the last question, "What if this approach does not achieve its aims?", addresses a potential situation that may occur sometime in the future and if "acted on" by undertaking appropriate analysis prepares for this contingency

[34] The word *action* here refers to more than physical action. The acceptance of an information source is just as much an action as the engaging of a target.

by "pre-deciding" what to do. This is sometimes termed "contingency planning." Planning decisions fall into this class.[35]

Planning thus begins on the cusp of understanding, when there is sufficient situation awareness to recognize that there is a problem or an opportunity and potential responses are emerging.

At the enterprise level, the command function determines intent and the respective roles and responsibilities for each participating organization. At the task level, the command function establishes the subset of participants focused on a specific undertaking at hand. Thus, the command function shapes both the substance and the processes of sensemaking and, in turn, shapes planning.

The relationships between/among command, control, sensemaking, and planning have blurred over time as individuals and organizations have confused why these functions are performed with how they are performed. As we noted in *Understanding Command and Control* the ability to fully explore the possibilities depends on our separating the why from the how. This book provides a definition of planning that is consistent with the definitions provided in *Understanding Command and Control* and relates the concepts of command, control, and planning to sensemaking—how humans and groups of humans make sense of situations. These definitions and relationships are discussed as part of the conceptual model introduced after the stage has been set with a historical perspective on planning, the nature of traditional approaches to planning in military operations, and the challenges that need to be addressed.

[35] While many planning decisions, particularly those that involve the substance of a plan, are anticipatory, not all planning decisions are anticipatory. For example, a delegation of authority for immediate effect.

Chapter 3. History of Planning

This chapter and the two chapters that follow trace the development of planning from pre-history to the Industrial Age. This section of the book discusses the evolution of military planning during this period. It explains the shortcomings of traditional military planning in the context of effects based, network-centric operations, particularly when these concepts are applied to complex endeavors such as civil-military operations such as stabilization, security, transition, and reconstruction, known as SSTR.[36] It reviews recent changes in military planning practices that have attempted to incorporate network-centric thinking. This section of the book concludes with an assessment of current planning approaches in light of the requirement to be able to conduct SSTR.

Origins of Planning

The origins of planning and plans are lost in history. However, early evidence of them is readily available. While hunter-gatherers had to have some capacity to plan in order to find their prey and coordinate to hunt large game, the planning necessary for their efforts is not much greater than that shown by packs of carnivores, such as wolves or prides of lions. However, the existence of more complicated planning can be reasonably deduced from early agricultural settlements. Growing crops requires a series of time-phased steps and the capacity to respond to the dynamics and uncertainties associated with weather and naturally occurring events such as annual floods. Settling down to grow crops is not a spontaneous occurrence.

Ancient architecture, like agriculture, also implies planning. Both require considerable preparation. Their accomplishment demonstrates a series of steps including development of an overall concept, selection of sites, assembly of tools and materials, assembly or development of appropriate skills, and sequencing tasks across functions and over time.

For example, Stonehenge (3,100BC to 1,500BC) could not have been created without a planning process and the development of one or more plans. Indeed, the evidence is clear that the site at Stonehenge changed over time as the capabilities of the builders increased and the design evolved. [37]

- The creators of Stonehenge wanted to create a “religious” site at that location.

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[36] From DoD 3000.5: “4.1. Stability operations are a core U.S. military mission that the Department of Defense shall be prepared to conduct and support. They shall be given priority comparable to combat operations and be explicitly addressed and integrated across all DoD activities including doctrine, organizations, training, education, exercises, materiel, leadership, personnel, facilities, and planning.” DoD Directive 3000.05, “Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations” (Washington: Department of Defense, 2005).

[37] “Stonehenge: How it was built” (Stonehenge.co.uk, 2006). http://www.stonehenge.co.uk/history.htm. (July 2006)

- They saw creating a circular structure aligned with the heavenly bodies as the means of resolving their need.
- They developed a series of specific plans reflecting dynamics in the planning process; beginning with simple earthworks, then adding the arrangement of bluestones, and finally erecting the sarsen stones.[38]
- Each of these phases required a set of integrated activities and steps – assembling the personnel needed and ensuring they had the knowledge, skills, and materials necessary, providing provisions for those working at the sites, and locating and transporting the materials to the site.
- Work continued until the creators believed they had resolved the situation. The phases of construction indicated changing circumstances, including changes in the technologies available and changes in the perception of successful resolution.

The need for planning, indeed dynamic planning, can be deduced from all of the great engineering feats of antiquity, including building the Sphinx and pyramids of Egypt (roughly 2600 BC)[39] and constructing the temples and cities of the Olmecs (1200-0400 BC) in the Western Hemisphere.[40] Similarly, major agricultural efforts, such as using the flood of the Nile to support Egyptian agrarian society, also imply considerable planning and the adaptation of those plans in a dynamic environment.

Planning and Plans for Civil Societies

On a societal level, there is also evidence of broad plans for how people were to be organized and live together. Universally, the rules governing societies evolved over time based on practices suited to their specific environment (physical, economic, social, political and religious) and these rules were locally adapted as that environment changed. However, by 1750 BC a more general model, the Code of Hammurabi, was promulgated across the Babylonian Empire to integrate tribal practices, establish ethical standards, generate tax revenues and regulate commerce and industry.[41] The development of Hammurabi's code began with a planning process during which information about current practices were assembled and reviewed by courtiers familiar with Hammurabi's kingdom and purposes (intent) before being integrated into a plan of action.

Historical examples of broad guidelines analogous to the command function are also familiar. Very general policies appear continuously throughout history in order to provide frameworks that create, organize and limit (or control) political, economic and social

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[38] "Stonehenge." (Britannia.com, 2003). http://www.britannia.com/history/h7.html. (Nov 2006)

[39] Jay Pascal Anglin and William J. Hamblin, *World History to 1648* (New York: HarperCollins, 1993), 24-25.

[40] Anglin and Hamblin, *World History to 1648*, 356-357.

[41] Anglin and Hamblin, *World History to 1648*, 21-22.

interactions. Perhaps the best example is the United States Constitution, which only gives very broad guidance about how the country is to be governed. Rather, the Constitution and Bill of Rights put in place a philosophy and an approach under which specific laws and regulations are to be developed and implemented. Similarly, the Napoleonic Code (1804), was developed to provide a set of principles that reflect a political and social philosophy and the guidelines to govern the French Empire of the 19th century. The Napoleonic Code remains widely influential today in the legal and administrative systems in France, the Iberian Peninsula, Latin America, as well as former French, Spanish, and Portuguese colonies despite the fact that each of these countries is governed by specific laws they perceive to be consistent with the general philosophy of the Napoleonic Code.[42]

Note the importance of understanding the distinctions between the functions of command and of planning, while at the same time recognizing that this distinction will not always be clear cut. In virtually all cases of planning, some prior constraints and policies have been put in place that serve as guidance for the current effort. For example, no law can be written within the United States that violates the Constitution. Similarly, no planning can be done at a U.S. Government Department level that ignores budgetary realities and no local plan can be created (for example for transportation or health) that ignores existing standards that are intended to ensure safety. Both the function of command and planning processes tend to be fractal – command constrains planning at one level and that set of interrelated choices provides the guidance that controls planning at the next (lower) level. Even when hierarchies do not exist, the pattern of agreed practices and the roles of the different actors provide this same set of constraints – planning is never independent of the C2 approach and command role even when decision rights are distributed, information is widely distributed, and interactions are unlimited.

Military Plans and Planning

Evolution of Military Planning

Military plans and planning date back to the earliest times. However, the interesting set for our purposes are those involving large, complicated projects. This began when warfare came to involve relatively large numbers of personnel, multiple types of weapons, and delegated authorities (distributed decision rights). The Peloponnesian Wars (431-404 BC) fought across the length and breadth of the Greek Isles,[43] the campaigns of Alexander the Great (334-323 BC),[44] and Chin Empire campaigns that united China for the first time (280 AD)[45] all required the development of planning processes and plans to

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[42] J. Cristopher Herold, *The Age of Napoleon* (Boston: Mariner Books, 2002), 456.

[43] Anglin and Hamblin, *World History to 1648*, 98-99.

[44] Anglin and Hamblin, *World History to 1648*, 101.

[45] "Chin Dynasty" (Minnesota State University, Mankato, 2006). http://www.mnsu.edu/emuseum/prehistory/china/early_imperial_china/chin.html.

coordinate the efforts of large, complicated military organizations. Military campaigns covering hundreds of miles occurred on every heavily inhabited continent – Africa, Asia, Europe, and in the Americas almost as soon as transportation and trade routes made it possible to create empires.

The creation of early armies and navies required planning processes and military plans. The natures of these military organizations reflected the societies that spawned them. Establishing a military force requires assembling the required manpower, weapons, logistics, provisions, and mechanisms for provisioning. In most societies, manpower was initially drawn from the male population, often as an undifferentiated group. Later, attention had to be paid to obtaining or developing specialized skills, roles, and capabilities. Weapons, originally those used for hunting and fishing, soon evolved into specialized forms such as swords, spears, shields, bows and arrows designed for war, war chariots, and specialized boats and ships designed for fighting. The third crucial element was logistics. This typically evolved from everyday life. For example, when campaigning, the Mongol hordes fed themselves by bleeding their horses, the same technique they used on the steppes when away from their homes. Zulu armies as late as the 18th and 19th centuries were followed by their cattle herds in the charge of their women and children.[46] In many cultures, however, armies fed themselves by taking food and forage from the territory in which they found themselves—a clear incentive to fight on land that belonged to the adversary. This practice dominated European warfare from early times through the medieval period.

The earliest tactical plans were derived largely from (a) the types of forces and weapons available, (b) the terrain (including prepared positions), and (c) the creativity of the leaders on both sides. Primitive forces often linked their tactical plans to familiar elements of their belief systems. For example, the Zulu believed in using a wide formation called "The Horns of the Bull" that allowed them to envelope their enemies.[47] In addition, primitive forces developed tactics around their specialized capabilities. The Mongols, for example, relied on their superior mobility and their excellent archery to defeat adversaries in the relatively open terrain of the steppes.[48] They only learned siege warfare after encountering walled towns and castles as their forces moved toward Europe. Viking armies relied on shield walls for combat in open terrain on land.[49]

The use of tactical formations emerged as military engagements grew in scale. The early wars of the Near East and in China employed foot soldiers armed with edged weapons, war chariots, thrown spears and bows and arrows.[50] The early Greeks developed the

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[46] Ian Knight and Ian Castle, *Zulu War* (London: Osprey Publishing, 2004).

[47] Knight and Castle, *Zulu War*.

[48] Anglin and Hamblin, *World History to 1648*, 421.

[49] Anglin and Hamblin, *World History to 1648*, 258.

[50] Anglin and Hamblin, *World History to 1648*, 72-73.

phalanx as a way for foot soldiers to create shock that could not be withstood by the open formations of their enemies and developed both formations and tactics to increase their impact. Once the stirrup was invented, cavalry was often employed in heavily armored charges and assaults to destroy infantry formations.[51]

Of course, tactics and battle plans have changed as weapons, logistics capacity, and communications mechanisms have changed over time. The roll of cannon in altering defensive positions and tactics was important in the 16th century. Changes in naval technologies (propulsion, gunnery, and communications) were crucial in the 19th and early 20th centuries. The implications of repeating rifles and machine guns were clearly significant during those same eras. The combination of air power, radio communications, radar, and mobile armor dominated World War II and the period to the end of the 20th century. In every case, these developments altered both planning processes and the nature of the plans that were employed.

The concepts and processes of military planning have gone through multiple phases. In the case of the Chin dynasty in China, the Peloponnesian Wars, the campaigns of Alexander the Great, or warfare in Medieval Europe, once governments began fielding armies and navies the broad pattern was the same. First, the decision to go to war involved deciding on objectives (goals), forces, alliances, the resources needed, and how the required resources would be raised (who would pay for them). This was followed by a preparation phase during which command arrangements were agreed (often based on traditional relationships). Then men and material were assembled and organized. Once a force was fielded, the goals were often territorial and the forces were moved to what were perceived to be crucial terrain in an attempt to dictate where the battles would be fought. Planning activities involved coordinating force movements (meet at Thebes in the Spring, move through these river valleys to converge on the enemy's capitol in April, etc.). Battle plans were developed based on the perceived capabilities of friendly forces, enemy forces, terrain, weather, and temporal issues (daylight, speed of maneuver, etc.).

War planning underwent a significant change away from this paradigm beginning in Sweden when their king, Gustavus Adolphus (1594-1632), created the first modern European army to replace the bands of mercenaries then in use.[52] Institutionally, he created universal conscription, established permanent units, and developed a fixed chain of command. Individual soldiers were subject to strict discipline, but were rewarded with regular pay and land grants. Units engaged in regular drills and larger organizations conducted field maneuvers. Adolphus also recognized the importance of logistics and initiated a system of supply bases and lines of communication to support the forces in the field.[53] Simple innovations, like adding metal sheaths to pikes to prevent them being cut

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[51] Albert Dien, "The Stirrup and its Effect on Chinese Military History." (Silk Road Foundation, 2000). http://www.silk-road.com/artl/stirrup.shtml (Dec 2006)

[52] Byron J. Nordstrom, *Scandinavia since 1500* (Minneapolis: University of Minnesota Press, 2000), 62.

[53] Nordstrom, *Scandinavia since 1500*, 70.

and standardizing the cannons in the force so that ammunition resupply was simpler, reflected the forethought and planning that made his forces dominant in their time. Tactical planning was also changed in radical ways by integrating artillery, infantry, and cavalry as well as their immediate supporting logistics.[54] All this required the development of specific plans and schemes of maneuver adapted to the situation at hand. Gustavus Adolphus is recognized as "The Father of Modern Warfare" and was regarded as one of the great military commanders by both Napoleon and Clausewitz.[55]

Napoleon Bonaparte forged the next major advance in European military planning in the early 19th century. At the time, France relied on conscripted forces and was fielding very large forces badly in need of training. The sheer size of these forces and the demands of the conflicts they involved rendered the established processes for command and planning inadequate. Napoleon was, however, a genius at organization as well as battle tactics. He developed what we still refer to as the "Napoleonic Staff System," in which the tasks necessary to organize and command forces were divided into components, such as training, operations, and logistics.[56] These specialized functional areas were, in turn, assigned to groups of staff officers. While the commander (whether Napoleon or one of his Marshals) was responsible for integrating the efforts of these staff members, these staff officers had individual authority and responsibility for the tasks in their assigned arenas. Napoleon also developed operational level planning that called for different components of his forces to move in coordinated ways over land in order to ensure each of them had access to supplies of food and forage, while retaining the ability to concentrate his forces rapidly.[57] This required specialized capability for gathering intelligence and for communications. For example, he was responsible for developing a set of signaling (semaphore) stations that allowed rapid relay of important information (sighting of enemy forces, locations of maritime raids, etc.) within territories controlled by France. Thus, Napoleon was an innovator who took advantage of the concepts and capabilities arising from the Industrial Age and made them cornerstones of his military efforts.[58]

However, this newly emerged planning process and the professional staff were raised to their highest level by the Prussians in the later half of the 19th and early 20th centuries. During this era General Eisenhower remarked that "plans are useless, but planning is

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[54] Nordstrom, *Scandinavia since 1500*, 62.

[55] Theodore Ayrault Dodge, *Gustavus Adolphus* (New York: Da Capo Press, 1998).

[56] H.C.B. Rogers, *Napoleon's Army* (Barnsley: Pen and Sword, 2005), 127.

[57] Rogers, *Napoleon's Army*, 127.

[58] Richard Moore, "Arthur Wellesly" (NapoleonicGuide.com, 2006) http://www.napoleonguide.com/leaders_welling.htm. (Nov 2006)

indispensable,"[59] and Von Moltke the Elder made the important statement that "no plan survives first contact with the enemy."[60] The flexibility that arises from a thorough planning process considering all of the key elements of a potential conflict provides the basis for flexible, responsive, and innovative decision making when they are required.[61] In today's language, thorough planning increases agility.

Of course, planning is not an end in itself. Inappropriate planning approaches and an over-emphasis on planning and execution can do more harm than good. The German General Staff was also responsible for one of the most dramatic demonstrations of the dangers inherent in rigid planning. Early in the 20th century, military planners in Europe anticipated that wars would be fought by very large armies of conscripts who would be mobilized to do battle at key points along the borders. No country could afford to allow its enemies to mobilize first and therefore have its defenses smashed and enemy forces advancing into its interior. The German General Staff believed, based on the alliance structure of the time, they would have to fight simultaneously on their borders with France and Russia. Hence, they developed mobilization plans that would allow them to move very rapidly to put forces in place on both borders. However, during the 1914 July Crisis,[62] the Russians (feeling threatened) decided to mobilize without a firm or clear commitment from their allies. The Kaiser wanted to mobilize only against Russia, but was told that the war plan, based of very efficient use of the railroad system, could not be changed to do that. As a consequence, Germany mobilized on both borders, which triggered a mobilization by France, thus accelerating the rush to war and denying the diplomats important opportunities to make peace.[63]

Between the two world wars, planning was a major activity in the very lean professional military forces maintained in the United States and the European democracies. The most famous of these efforts were the war games conducted at the Naval War College in Newport, Rhode Island. Naval personnel who participated in these efforts were to later

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[59] General Eisenhower: "In preparing for battle, I have always found that plans are useless, but planning is indispensable " (Columbia World of Quotations., #18611., 1996). http://www.bartleby.com/66/11/18611.html (Dec 2006)

[60] This quotation is the common version of the writings by Prussian field marshal and chief of staff Helmuth von Moltke (1800-1891). The original quote is: "No operational plan will ever extend with any sort of certainty beyond the first encounter with the hostile main force. Only the layman believes to perceive in the development of any campaign a consistent execution of a preconceived original plan that has been thought out in all its detail and adhered to the very end."
Tsouras, Peter G. *The Greenhill Dictionary of Military Quotations* (London: Greenhill Books, 2004), 363.

[61] Alberts and Hayes, *Understanding Command and Control*, 61.

[62] Michael Duffy, "The July Crisis" (FirstWorldWar.com, March 27, 2004) http://www.firstworldwar.com/origins/julycrisis.htm. (Nov 2006)

[63] Richard F. Hamilton and Holger H. Herwig, *Decisions for War, 1914-1917* (Cambridge: University of Cambridge, 2004), 120-121.

note that virtually every situation that occurred later in the war in the Pacific (the successful Japanese attack on Pearl Harbor being the obvious exception) was well understood because of those war games and the planning processes they involved. This is genuine validation of the argument that planning, not plans, matter. In addition, during war games conducted prior to the Battle of Midway, Japanese planners raised the possibility of an American counterattack by carrier-based aircraft, however the staff had no planned response, nor did they devise one prior to the operation.[64]

During the Cold War, partly as a result of the total war efforts associated with World War II, military planning became important at the strategic, operational, and tactical levels with the Warsaw Pact and NATO studying one another's forces, capabilities, and military practices closely and conducting almost continuous planning at all three levels in order to ensure maximum deterrence and military preparation. Both NATO and Warsaw Pact planners (under the leadership of the Soviet Union and the United States respectively) had a specific adversary in mind and believed they knew the terrain on which major wars would be fought. This included not only ground wars (in Europe and Korea) but also the air space where nuclear warfare would play out. Hence, they could and did study one another (as societies as well as in terms of forces, capabilities and intentions) and the relevant operating environments where clashes might occur. This enabled them to believe that they could develop and optimize their forces, planning processes, and plans.

Traditional Approaches to Mission Planning

Traditional approaches to military mission planning[65] remain prevalent to this date, although increasing attention is being focused on improvements that would make them more responsive to current mission challenges. Traditional military planning processes are typical Industrial Age processes that are hierarchical and stovepiped.

Military planning usually begins with an understanding of command intent in the context of the specific situation. Thus, military planning processes involve the interpretation and/or amplification of intent and its re-expression in the form of a plan or set of plans that is conveyed "down the chain."

Military planning processes involve more than "planning"[66] because they serve to accomplish a number of the functions associated with command and control (e.g.,

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[64] Major B.T. Fenlon, USMC, "Remember Midway" (Global Security). http://www.globalsecurity.org/military/library/report/1989/FBT.htm. (Dec 2006)
Citation: Capt. Mitsuo Fuchida and Cdr. Masatake Okumiya, "Midway: The Battle That Doomed Japan." (Annapolis: U.S. Naval Institute, 1955), 134.

[65] Mission planning is the focus of the campaign of experimentation discussed here. Planning, like command and control, can occur at any and all levels and serves to support the functions of C2.

[66] Planning can be thought of anticipatory decisionmaking. This would include all manner of decisions, some of which are command and control decisions (see *Understanding Command and Control*).

allocation of resources). In fact, military planning processes are shaped and constrained as a result of command and/or control decisions and are often delegated to staffs. Military planning processes are supported by what are referred to as C2 or C4ISR systems that, in addition to providing the necessary information infrastructure, also provide applications that structure and support planning decisions. Given that planning is an integral part of the functioning of a headquarters, and headquarters are associated with "commanders," it is no wonder that a great deal of confusion exists regarding the distinctions between command and control per se and the processes and systems, including planning processes and systems, that support C2 (e.g., C2 processes, C4ISR systems).

Planning includes both decisionmaking and anticipatory decisionmaking (contingencies) and produces one or more plans that, in traditional military organizations, should address the following elements:[67]

- An (re)expression of intent
- Allocation of roles and responsibilities
- Allocation of non-organic assets
- Setting boundaries and establishing constraints
- Establishing milestones and schedules
- Articulation of contingencies

Decisions regarding the allocation of resources, the setting of boundaries, etc. are subject to inherited[68] intent and established conditions and constraints (if any). In other words, these have been determined by command (and control) and are merely reflected in plans, not determined by the planning process. The nature of the plan itself (its expression and level of detail) can vary significantly as a function of the operable approach to command and control.

Plans can be explicit or implicit. They can vary in the degree of detail/granularity from just an expression of intent to a complete specification of the "who, what, where, when, and how." The process of planning can be centralized or decentralized, formal or informal, exclusive or inclusive, cyclical or dynamic and interactive, authoritative or collaborative.[69]

Centralized planning is a hallmark of traditional military approaches to command and control.[70] It is well adapted to the limits of Industrial Age communication (and

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[67] Adapted from: Alberts and Hayes, *Power to the Edge*, 47.

[68] *Inherited* here refers to a chain of command. The chain, while formally established in military and other hierarchal organizations, need not be formal nor static.

[69] David S. Alberts and Richard E. Hayes, *Command Arrangements for Peace Operations* (Washington: CCRP, 1995), 82-89.

[70] This discussion of centralized planning is paraphrased from: Alberts and Hayes, *Power to the Edge*, 46-50.

information gathering and dissemination). Industrial Age militaries employed these centralized plans as the mechanisms by which military commanders sought to impose their "will" on their organizations as well as on the situation. Large organizations dealing with major operations created comprehensive and fairly detailed plans that required considerable time and resources to develop.

A classic large-scale, Industrial Age plan is the U.S. Air Force's Air Tasking Order (ATO) that was perfected during the latter decades of the 20th century.[71] The ATO can be thought of as a specification of a *course of action,* a set of actions to be taken by various entities, arranged both temporally and spatially. Despite automation and a number of process improvements, the ATO process requires a relatively large headquarters staffed by highly skilled and trained individuals. Moreover, a considerable amount of time (doctrinally 72 hours) is required to produce an ATO that tasks every aircraft and provides them and their units with all the information they need to execute the plan. The C2 emphasis of the ATO planning process is on the de-confliction of airspace.

While this approach may work well enough in a somewhat static environment of fixed targets, it is less than ideal in a more dynamic situation with changing priorities and moving forces and targets, and even less effective for irregularly dispersed forces and fleeting targets.

Plans for air operations can have an adverse effect on the conduct of ground operations, constraining them by placing certain areas off limits to friendly ground forces in order to de-conflict air and ground forces to prevent fratricide. Indeed, Gordon and Trainer report that when General Franks sought to advance the U.S. attack into Iraq by 48 hours, he was told by his Air Component Commander that the air war could not be started early: "there were too many moving pieces to change the plan."[72] The effectiveness of this approach (or indeed any approach) to planning is determined by the impact that it has on mission effectiveness, not just the effectiveness of an air campaign or fratricide. Thus, any assessment of the effectiveness of, for example, air and space planning needs to be viewed in the context of the overall operation, taking into consideration the needs of the joint or coalition force and the totality of the effects that are sought. Viewed from this perspective, the current ATO process can adversely affect mission performance by the constraints it imposes on other elements of the force and its inability to be responsive to the dynamics of a situation.

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[71] Air Tasking Order: A method used to task and disseminate to components, subordinate units, and command and control agencies projected sorties, capabilities and/or forces to targets and specific missions. Normally provides specific instructions to include call signs, targets, controlling agencies, etc., as well as general instructions. Also called ATO. (Department of Defense Dictionary of Military and Associated Terms. Joint Publication 1-02. http://www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf)

[72] Michael R. Gordon and Bernard E. Trainor, *Cobra II: The Inside Story of the Invasion and Occupation of Iraq* (New York: Pantheon, 2006), 167.

Adaptations and Innovations in Military Planning

Militaries have made a variety of adjustments in order to deal with post-Cold War challenges. These adjustments have included changes to traditional planning approaches and processes that have proven to be not particularly well suited to today's missions. Changes have been made and more are under consideration. These adaptations have often focused on the relationships between planning and execution. Industrial Age approaches to planning separate planning and execution both functionally and organizationally. They periodically develop plans as the products of a cyclic process. In traditional military planning, the selection of a course of action kicks off a planning cycle that results in the creation of a plan. One of the major purposes of the plan is to synchronize the actions of the various components or elements of "controlled" forces. Once disseminated, this plan becomes the blueprint for execution until the plan is updated or changed.

Innovations regarding Planning vs. Execution

The process of delivering air support to ground forces provides an excellent historical example of how traditional military planning processes have evolved over time in response to changing circumstances. Early in World War II, the Germans demonstrated that strikes by their dive bombers could disrupt enemy forces and make them much easier for their ground forces to defeat. However, they had no mechanism for controlling these air strikes once the aircraft were in the air, so planning was done at a joint army headquarters and strikes were made against pre-selected targets, often lines of communication, fixed military positions, or supply depots close to the forward edge of the battle area. These tactics were an important part of the German Blitzkrieg (lightning war) that led to the rapid conquest of Western Europe.[73]

As technology improved, the Allies, led by the United States, sought to improve coordination and effectiveness by using air to ground radio communications and precision bombsights. However, under the command arrangements of the time, different chains of command existed for air and ground forces. Indeed, air forces adopted a doctrine that set their first priority as achieving control of the airspace: defeating the enemy's air force. They also saw strategic bombing as their next most important mission, arguing that destroying the enemy's capacity and will to fight were the best ways to bring an early end to the war on favorable terms.[74] As a consequence, air forces were neither robustly resourced to carry out missions to support the ground forces, nor trained to do so. This became painfully clear when the Allies sought to use air attacks in order to open the way for ground forces breaking out of Normandy in 1944.[75] The plans were to use

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[73] Hussein, Jamal Air Commodore (Ret), "Evolution of Air Power" in *Defence Journal* (Nov 2001). http://www.defencejournal.com/2001/november/evolution.htm (Aug 2006)

[74] "Douhet, Giulio" (Encyclopædia Britannica, 2006). http://www.britannica.com/eb/article-9031057 (Aug 2006)

[75] William M. Hammond, *Normandy: The U.S. Army Campaigns of World War II* (U.S. Army, 2003), 28. http://www.army.mil/cmh-pg/brochures/normandy/nor-pam.htm (Aug 2006)

large numbers of medium bombers to blast whole areas of the German positions so the ground forces could advance rapidly through the defensive belts and cut off or capture significant enemy forces. However, planning for these efforts had to be carried out well in advance of the attacks and plans were created by separate staffs; one for the ground forces and one for the air forces. Despite efforts to synchronize these plans and hence these attacks, Allied bombers, following their plans, killed hundreds of British and American troops on the ground, who were also following their plans.[76] The combination of separate planning and poor communications (the aircraft had no way to talk with the ground forces) often proved deadly.

These problems could, however, be overcome by experienced forces. As Patton's Third Army moved through France toward Germany, he was able to develop a relationship with the U.S. Army Air Corps commander responsible for his sector. The two developed an approach that proved very effective. First, attack aircraft were positioned well forward, close to the fighting lines, but far enough back to be safe for fueling and arming. Second, communications were improved so that ground forces could summon air strikes when difficult situations arose. Third, a certain percentage of the aircraft were always on "strip alert" to take off within a few moments. As a result, aircraft within this sector were able to reach and attack targets within 30 to 40 minutes from the time an attack was requested. However, Patton and General Weyland, who worked with him, had to constantly battle to keep enough aircraft in their sector to make this a capable force. This approach is an excellent example of shifting control from the planning function toward the execution function in order to create a more responsive overall capability. Despite this demonstration of the effective use of air power, the prevailing thinking remained that strategic bombing and interdiction were more effective ways to employ aircraft.[77]

The tactical flexibility achieved within Patton's sector not withstanding, mainstream planning for air-to-ground support remained tied closely to the larger U.S. Air Force process for producing an Air Tasking Order. This process has been traditionally initiated 72 hours before it is implemented and produces an integrated plan that synchronizes the actions of every aircraft in a theater of operations. This proved necessary as air warfare became more and more complicated, requiring bombers, fighter, tankers, reconnaissance aircraft, electronic warfare aircraft, search and rescue aircraft, and others to share the airspace. ATOs became so large and cumbersome that during Operation Desert Storm

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[76] Richard P. Hallion, *D-Day 1944: Air Power over the Normandy Beaches and Beyond* (Air Force History and Museums Program, 1994), 21-24. http://www.ibiblio.org/hyperwar/AAF/AAF-H-DDay/ (Aug 2006)
John C. McManus, *The Americans at Normandy: The Summer of 1944—The American War From the Normandy Beaches to Falaise* (New York: Tom Doherty Associates, 2004).
Gordon R. Sullivan, "From Cobra to Anaconda: Some Thoughts on Air-Ground Cooperation" in *AUSA: Army Magazine*. April 1, 2003. https://www.ausa.org/webpub/DeptArmyMagazine.nsf/byid/CCRN-6CCS83?OpenDocument&Print=1 (Oct 2006)

[77] David N. Spires, *Patton's Air Force* (Washington: Air Force History and Museums Program, 2002), 64-68.

they had to be flown from the land base where they were created to U.S. Navy aircraft carriers.

During the Korean War and Vietnam, the process of providing close air support evolved to include air liaison officers (ALO) with ground forces to coordinate with aircraft. ATOs were developed to provide some aircraft appropriately configured and armed to conduct these missions at times and in areas identified by the ground forces through their ALOs. However, these requirements needed to be expressed at least three days in advance. While, at times, ground forces were able to foresee their needs that far in advance (for example, when planning a major offensive), on many or most occasions it was unrealistic to expect that ground forces could accurately predict the situation that far in advance. As a result, ground forces simply learned to request that air support be available so it would be there if they needed it. Thus ground forces had to "game the system" to make it work for them. With this comes a certain amount of misdirected capability. Again, as in the case of Generals Pattern and Weyland, this meant that ATO planners were again relinquishing control in order to create capabilities that could be used by those executing the missions. However, only the ALO teams had radios capable of communicating with the aircraft, so only they could redirect air support for maximum effect.

This liaison-based process perhaps reached its most mature form when air power was used by U.S. forces in Afghanistan to greatly enhance the fighting abilities of its forces. On one hand, Special Forces proved able to use a combination of specialized communications (with some workarounds, they could talk directly with the aircraft), laser designators and GPS to identify targets positively, and precision munitions to great effect. Indeed, the U.S. Air Force has reported increasing the proportion of aircraft that either took off with no specific target or had their target changed while in the air.[78]

When problems arose, as during Operation Anaconda during which small elements of U.S. forces found themselves surrounded in a remote and hostile area, aircraft that were in the area on other missions were able to provide vital support. For example, a C-130 gunship that had not been briefed for the mission was able to join the battle and provide significant support. Its pilots made the unilateral decision to stay on station well after they had been ordered to return to base. They held their position until a flight of F-15 Strike Eagles was able to reach the area and take over the support mission.[79] Here, again, the planners had become enablers and relinquished detailed control to those responsible for execution.

Overall, this change in the role of the planning process vis-à-vis execution, changing it from one of controlling to one of enabling has proven to be a very significant trend. It

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[78] "Indeed, 80 percent of the targets struck by US airpower were 'flex targets'- those given to pilots en route." Rebecca Grant, "An Air War Like No Other" in *Air Force Magazine Online* (Nov 2002, Vol. 85, No. 11). http://www.afa.org/magazine/Nov2002/1102airwar.asp (Aug 2006)

[79] Sean Naylor, *Not a Good Day to Die: The Untold Story of Operation Anaconda* (New York: Berkley, 2005).

means that the traditional clear line between planning and execution is becoming increasingly blurred. In the context of traditional military C2, this constitutes a de facto delegation of decision rights downward.

It is becoming more widely recognized that complex endeavors require that planning be accomplished collaboratively among the participants. The concept of collaborative targeting, a somewhat limited attempt to make traditional planning more collaborative, is indicative of what is currently possible given today's mindsets, personnel, and information sharing capabilities. The idea originated within U.S. Joint Forces Command (USJFCOM). Its focus was to integrate the work of the different people and organizations responsible for targeting, from the national level intelligence analysts to the forces in the field that are ultimately responsible for executing flights and delivering weapons on target. This was first implemented during exercises, notably those involving the defense of South Korea. It quickly proved popular; so popular, in fact, that a variety of organizations and groups wanted to be included. The desire of many to adopt collaborative planning resulted in the development of a handbook that documented the new approach. This handbook specified the processes and procedures involved, identified the hardware and software requirements for effective participation. It sought to ensure that there were facilitators for each of the key functions and networked meetings. Success in exercises resulted in further applications, first in other exercises, then in real-world events. The success appears to have resulted from the fact that targeting is a multi-disciplinary process and those involved are heavily interdependent. Also, the mission involved repetitive tasks that could be handled very rapidly, while other tasks could be assigned to specialized subgroups tailored to provide the necessary expertise and experience. These subgroups could work independently and report back recommendations without holding up progress on the simpler taskings. This type of collaboration, cutting across echelons and functions, is a prototype for the planning processes that are increasingly needed.

The Impact of Other Innovations

In some cases elements of adopted network-centric approaches have resulted in changes to planning within military organizations. Three such cases are included here in order to illustrate the ways in which network-centric thinking and capabilities have affected planning: Task force 50 off the coast of Afghanistan during Operation Enduring Freedom, the design and development of the Stryker Brigade for low intensity operations, and the Command Post of the Future program. None of these initiatives was a fully mature[80] network-centric approach or system, but each of them involved meaningful innovations that proved valuable.

[80] See discussion of network-centric maturity on pages XXX.

Task Force 50

Task Force 50 was formed around a US carrier battle group deployed off Afghanistan as part of Operation Enduring Freedom to defeat the Taliban and deprive Al Qaeda of that country as an operating base. RADM Zelibor had deployed into the Pacific for routine operations and was carrying a DARPA system, called the "Knowledge Wall" for test and evaluation on his flagship, the USS Carl Vinson. He found the suite of tools useful and made the decision to incorporate it into day to day operations. The tools were essentially designed to support widespread information sharing and to make simple collaboration (primarily via chat, but at times incorporating voice discussions while looking at common displays).[81]

Zelibor also made major changes to the processes by which information was handled. In essence, each functional activity (weather, personnel, strike, logistics, etc.) was tasked to maintain a web page on the flag ship's local area network and on the wide area network that encompassed the U.S. ships in his task force. This meant that rather than relying on a fixed schedule (based on the concept of a 24 hour battle rhythm) for information updates, all information was posted to the appropriate web page(s) as soon as it was available. This had the twin advantages of making information available "on demand" around the clock and also avoiding the practice of a "cut off time" when preparing for daily briefings when new information would only be added if it were extremely important. Planners could have confidence that the information available to them was as current as possible and they could consult it (and dialogue with others about it) at any time.

While there was some resistance to this new approach, it was nevertheless adopted everywhere because it was a point of command emphasis. Several positive results were reported. First, the task of maintaining information currency rapidly passed to those personnel with the greatest information – technical specialists rather than to the officers responsible for the function, who typically brief the commander. Secondly, because RADM Zelibor and his senior staff used the web sites and commended those who kept them informative and interesting, morale rose and buy-in increased throughout the force. Third, everyone, from senior staff to planners and those responsible for execution reported that they felt better informed and that their information was timelier. Interviews also indicated that discussion turned from reporting status and other information to operational issues – what to do about the situation. Web pages also improved based on feedback from those using them, which further improved the quality of the information available and the quality of people's awareness throughout the command. Several officers reported that they spent their time on watch updating themselves and that they spent considerably less time reading message traffic.

The impact on planning was observable, but relatively modest. The command was able to plan more quickly because actionable information was readily available as decisions were made. They also found themselves undertaking planning that enabled, rather than

[81] Alberts and Hayes, *Understanding Command and Control*, 152.

restricted, those responsible for execution because they had greater confidence that the information they were using was of high quality.[82] However, the impact of these innovations was limited because the planning processes remained largely unchanged. Tis inertia is typical when a novel technology is introduced without accompanying shifts in organization, training, and doctrine. Also, the Task Force grew to include a number of ships form other nations, which could not participate fully in the wide area network, which meant that planning involving them had to be based on less current information and lower levels of confidence in the information.[83]

Stryker Brigade

The Stryker Brigade, a U.S. Army innovation intended to create a relatively light, transportable force that trades better information and information processing for mass, is a relatively recent development that provides the potential for a more network-centric approach to military missions. This force is mounted on a light weight vehicle chassis, the Stryker, which is faster and quieter than its predecessor. It also has additional information assets, including its own unmanned vehicles, a robust local area network that links together almost all of its vehicles as well as the command centers, and a military intelligence company included in its basic structure. In addition, the entire unit is populated with personnel trained to collect and assess human intelligence. Hence, the design of the organization is intended to make information sharing and collaboration much easier and much more common.

Data about the first Stryker Brigade, its development, and its training prior to deployment to Iraq were collected and analyzed by RAND.[84] The pre-deployment exercise conducted after the unit was fully trained against a low-intensity (insurgency) scenario provides the best insight into the impact of these movements toward a network-centric approach. Force performance was outstanding when compared with light infantry brigades that had been run through the same scenario. First, no light infantry brigade had ever achieved the objective within the time available, but the Stryker Brigade accomplished it. Second, the casualty ratio for light infantry in this scenario had historically been approximately 10:1, with the friendly forces suffering the higher casualties. Stryker accomplished the mission with a casualty ratio of 1:1, a vast improvement. These improvements were due to more than differences in planning – Stryker is a mounted unit and moved faster than its light

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[82] The quality of information consists of the following attributes: currency, accuracy, precision, completeness, relevancy, and timeliness. Alberts and Hayes, *Understanding Command and Control*, 123-130.

[83] John Garstka, Kimberly Holloman, Christine Balisle, Mark Adkins, and Jon Kruse. "Network Centric Operations: U.S. Navy's Fifth Fleet Task Force Fifty in Operation Enduring Freedom" in *Transformation Case Study Series* (Washington: U.S. Department of Defense, 2006), 7.

[84] Daniel Gonzales, Michael Johnson, Jimmie McEver, Dennis Leedom, Gina Kingston, Michael Tseng. "Network-Centric Operations Case Study: The Stryker Brigade Combat Team." Report prepared for the Office of the Secretary of Defense (OSD). (Arlington: RAND, 2005).

infantry counterparts and it has information assets and a local area network that they do not possess.

However, RAND reports that there were planning differences. First, the better information enabled planners to act with confidence – moving troops aggressively through gaps in the defenses and observation positions of the insurgents. Secondly, the planning was in parallel, with the different elements of the force discussing their plans as they were working on them, across echelons (from brigade to its constituent battalions), across functions (intelligence, operations, and logistics) and among peers (battalion to battalion). Third, final decisions were made later – after the enemy situation was more fully developed. In essence, the initial actions were probes to both gain or verify information about enemy locations and activities and as well as to cause the insurgents to react to a diversionary attack, moving some of their assets away from the route chosen for the main Stryker attack.

Command Post of the Future

Command Post of the Future (CPOF) started as a DARPA technology program intended to enable distributed, collaborative planning. The technologies, doctrine (really tactics, techniques, and procedures) needed to use them, and their organizational implications were all explored during a DARPA program that lasted four years. The key technology turned out to be a shared screen on which commanders and staffs in different echelons or peer organizations could both see one another's perceptions of the situation and interact (both by voice and by images such as maps, overlays, and line of sight charts) with one another as they developed situation awareness and plans. This was refined through a series of focused war games used to provide feedback to the developers.

The US Army agreed to field the system in the First Cavalry Division area of operations in Iraq, at least partly because the Army Science Board thought the system worth further exploration and partly because the division commander thought it would be helpful. DARPA both deployed technical support to enable the CPOF system to be improved based on user comments and experience and also instrumented the system to see how it was actually used. Reportedly the system started as a division only system, was extended to the brigades as it matured, and was extended to include some battalions relatively late in the deployment period. It was perceived as very successful and is now being considered for adaptation and adoption US Army wide and (by Joint Forces Command) for Joint Task forces.

The idea behind CPOF is very simple: it provides an interactive screen or set of screens that allow decision makers and planners in distributed locations to examine displays related to the current situation and to plan together about what actions to take and how they might be synchronized. As such, it directly implements some of the features called for in network-centric operations. Planners working across functional areas and across

echelons are able to work in parallel, identify potential cross-impacts (negative or positive) and synchronize their actions intelligently.[85]

Attempts to Include or Plan with Others

A second major trend in military planning has been the recognition that since operations now, more often than not, involve a civil-military coalition, planning cannot remain a purely military function. Because of the variety of actors involved and the fact that a decreasing proportion of those who must be relied upon for most missions are military, planning processes have had to change. Important changes to date include:

- The development of Civil Military Information Centers (CMIC), Civil Military Operations Centers (CMOC) and Humanitarian Operations Centers (HOC). Originally, these were located with other military functions, but increasingly they are located in civilian facilities. These organizations exchange information and develop plans for working with IOs and NGOs.
- The development of Joint Inter-Agency Working Groups (JIAWG) and Joint Inter-Agency Task Forces (JIATF) as important components of the Joint planning process.
- The development of acquisition processes and regulations for dealing with private corporations as service providers during a wide range of operations, including humanitarian relief as well as stabilization and reconstruction missions. These processes and regulations are based on plans developed that define the roles and responsibilities of these actors.

While the above developments have been important and reflect Department of Defense policy and guidance that increasingly emphasize the need to work with multi-national, interagency, international organizations, non-governmental organizations, and private industry partners in order to carry out missions such as stabilization, reconstruction, peacekeeping, and humanitarian assistance, the state of the art remains very immature.[86] There are a variety of reasons for the relative immaturity of the state of the practice, including, but not limited to:

- The military is comfortable with the Joint Planning Process, which is supported by planning processes developed by each of the Services. However, this process is not understood by the partner organizations with which the military must work with across the mission space. As a consequence, the military often feels compelled to assume responsibility for planning in these

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[85] STO: Command Post of the Future *DARPA*, 2006. Online. Internet. Accessed December 8, 2006, http://www.darpa.mil/sto/strategic/cpof.html

[86] DOD Directive 3000.5, "Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations." November 28, 2005. http://www.dtic.mil/whs/directives/corres/html/300005.htm (Dec 2006)

situations, which leaves the partner organizations marginalized during the process.

- Interoperability is relatively poor. This starts with technical interoperability or the capability for systems to interface (one DoD doctor found that he needed 6 different radios to communicate with those responsible for medical assistance in Afghanistan). Semantic interoperability, the ability to be understood in addition to being heard, and "cooperability," a willingness to work together, have not as yet received adequate attention. Almost all of the attention and effort are still focused on technical interoperability.
- The processes of information sharing and generating shared awareness are highly constrained because of security issues and an unwillingness or inability to work together. This has been a major focus in JFCOM's Multinational Experimentation series.
- The organizations involved have not developed (mutual) perceptions of competence or the trust necessary to plan together and be genuinely interdependent. This, in turn, impacts the willingness and ability to share information and/or rely upon one another.
- The variety of situations and missions where the military needs to plan with (and take advantage of the capabilities of) its mission partners is vast, making it very difficult to pre-identify the relevant partners and develop working relationships with all of them.
- Many of the interagency, NGO, and private partners have very limited resources for training and exercises and lack an operational level of organization for planning. They are typically composed of strategic and tactical components, so they find it difficult to work with the military where operational level headquarters carry out much of the planning needed for success.[87]
- The military lacks the depth of expertise in the subjects relevant for many of these mission areas. For example, reconstruction implies in-depth expertise in urban planning, infrastructure (power, water, sewage, roads, solid waste etc.), education, law (legal codes, courts, etc.), police functions, development, media relations (local, national, regional and international), taxes (traditions, laws, collections, audit, etc.), construction (housing as well as industrial and office space), corrections, economic development, and a variety of other topics not the least of which is cultural awareness.

Virtually every Combatant Command is aware that it must find ways to work and plan with a variety of non-military partners, but also they find that they often have to develop ad hoc processes to do so during each mission. This is somewhat less true with coalition partners who work together routinely in NATO or bilateral relationships simply because they train and exercise together. However, these relationships almost never extend to the

[87] Margaret Daly Hayes and Gary F. Wheatley. *Interagency and Political-Military Dimensions of Peace Operations: Haiti - A Case Study* (Washington: CCRP, 1996), 28-30.

host governments, the less capable military partners in coalitions of the willing, or the non-military actors (interagency, international organizations, NGOs, or private industry). Even where the problems have theoretically been "solved" (e.g., the U.S. in the domain of disaster relief), planning processes, and plans have proved to be too brittle for the situations arising after events like Hurricane Katrina. Proposed planning processes and plans often floundered under the pressures of real events. A lack of acceptable plans or practiced planning processes breaks down into "ad hoc" planning and plans. "Ad hockery" has proven necessary (and costly) in Bosnia, Kosovo, Darfur, East Timor, and tsunami relief.

SARS in Singapore

One positive example of militaries working well with civilian counter parts occurred when Singapore confronted SARS (Severe Acute Respiratory Syndrome). This was clearly a medical problem, but it had serious implications for the economy of Singapore, which depends heavily on trade and international travel. Recognizing this, the city state rapidly mobilized its public and private medical communities, police, transportation officials, military, and selected private sector companies. Relying on a strong internet infrastructure and creating a collaboration environment, Singapore was able to plan and execute a multi-faceted approach including:

- Converting selected hospitals into SARS treatment centers;
- Isolating apartment complexes where people had been exposed to the disease;
- Responding promptly to any report of new illness;
- Establishing a network of video cameras and security personnel to monitor people entering and exiting these facilities;
- Establishing emergency logistics services to ensure a continuous and adequate supply of medicines and medical supplies;
- Closing schools and areas where people tend to gather in large groups;
- Setting up scanners to monitor people arriving at the airport that checked body temperature in order to identify potentially infected people both entering and leaving the country;
- Monitoring individuals using mass transit to identify those who might be ill; and
- Using the city's taxi companies to deliver medicine and other necessary items throughout the city.

The keys to this success (which contrasted markedly with the experiences of China and Canada) were the abilities of people from different parts of the bureaucracy to agree on common goals, to share information, and to plan their approach together. Obviously the size of the city and the fact that senior personnel from different organizations were likely

to know one another made it easier for them to adopt this network-centric and highly collaborative approach.[88]

[88] "Situation in Singapore" (World Health Organization, May 12, 2003). http://www.who.int/csr/sarsarchive/2003_05_12/en/ (Dec 2006)

John J. Garstka, Scott Buchanan, Greg Boehmer, et al. "Network Centric Operations in Support of the Singapore Response to SARS" in *Transformation Case Study Series* (Washington: DOD, 2006), 39-44.

Chapter 4. An Assessment of the State of the Practice: Military Planning

While traditional military planning practices have been employed successfully for some time, the question that currently needs to be addressed is whether or not these approaches are effective for complex endeavors. If the answer is less than a resounding Yes, the next question is: what approach promises to be effective for complex endeavors?

This section explores why the answer to the first question is an unequivocal No. The answer to the second question is explored throughout the remainder of this book.

The factors that make Industrial Age planning processes and plans unsuitable for complex endeavors are analogous to the factors we previously documented in our discussions of the inadequacies of Industrial Age C2 approaches.[89] By their very definition, recently conducted complex civil-military endeavors have responded to a wider range of threats (both man made and natural) than the operations undertaken throughout most of the 20th century by traditional militaries. Moreover, public expectations about the effects of these operations (minimal collateral damage and friendly casualties) make it even more important that military activities be guided by a more inclusive set of metrics and rules of engagement; supported by better information and greater shared awareness, and involve more precisely targeted actions. The circumstances surrounding these endeavors result in increased risks and uncertainties that must be managed and resolved. The complexity of these endeavors and the significant risks and uncertainties present imply a need for greater agility.[90] Contrast this requirement for both a multidimensional objective function and agility with the narrowly defined objective function and frailty of the ATO.

Industrial Age militaries have developed an exceptional capacity for threat-based planning in the context of the traditional functions of combat readiness, conducting combat operations, and combat service support. These planning processes maximize the benefits available from problem decomposition, de-confliction, and specialization. However, this means that these military establishments can only achieve synergy by integrating (centralizing) their planning as part of headquarters and command post operations. For example, militaries conduct command post and field exercises that allow them to plan and practice together on a specialty-to-specialty basis. As a result, legacy forces are heavily focused on a very narrow slice of the relevant mission space and have been designed to optimize planning processes and plans for that set of "pure" military operations.

At this writing, the Israeli military finds itself attempting to use its military assets (aircraft, missiles, naval platforms, etc.) to defeat Hezbollah, an extremist group that controls portions of Lebanon and depends upon foreign powers for support. In an effort

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[89] Alberts and Hayes, *Power to the Edge*, 53-70.

[90] Alberts and Hayes, *Power to the Edge*, 123-163.

to reduce the capacity of Hezbollah fighters to attack Israeli territory with rockets and cross-border raids, the Israeli military is destroying infrastructure and adversely affecting the Lebanese economy. Indirect effects of these actions include increased hostility toward Israel and enhanced recruitment by extremist organizations. At the same time, Israel appears to be mobilizing Arab governments who fear Hezbollah and see it as an extension of Iran's military power in support of its goals within Lebanon. It is also seeking to persuade the Lebanese government and population that it is in their interest to rein in this terrorist group. All these are effects that are well beyond the realm of traditional threat-based military plans and actions. Effects based approaches, with major emphasis on non-military effects, are increasingly being advocated by knowledgeable practitioners.[91]

The failure of the traditional threat-based approach has a variety of causes, many of which are associated with changes to the operating environment. These include:

- the multiplication of threats, both in terms of the increasing number of conflicts that are no longer regulated by the nation-state system and the international Cold War structures and the increasing number and variety of actors capable of generating meaningful threats;
- globalization, which has both reduced the protective effects (sanctuary) of distance and time that had previously allowed the development of appropriate defenses as threats changed;
- the increasing pace of change throughout the globe; and
- the arrival of the Information Age, which creates opportunities for organizing and directing endeavors (one's own and adversarial) and for instant and continuous global reporting of events.

Traditional planning approaches are simply not agile enough to meet today's mission challenges. They cannot accommodate the need for increased decision tempo, the need for greater "speed of command," nor can they adequately support the greatly increased frequency with which elements of an endeavor are required to make decisions. The increased time pressures primarily come from both the dynamics of the situation and the improved information systems supporting military organizations today. Rather than waiting for reports, headquarters at all levels are capable of near real time observation of critical aspects of their operations arising from automated tools, such as Blue Force Tracker, that provides nearly continuous information about the location of friendly platforms, unmanned aerial vehicles (UAV) that feed continuous digital images to selected locations, and networks that enable both information sharing and collaboration across communities of interest. For many operations this vastly increased flow of information is further expanded by media reports, which often reach senior political and military leaders before the military reporting process provides formal inputs. In both

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[91] General Sir Rupert Smith (British Army (Ret.), "The Utility of Force" (Presented at the 11th ICCRTS in Cambridge, September 27, 2006).
http://www.dodccrp.org/events/11th_ICCRTS/html/presentations/Smith_Utility.pdf (Nov 2006)

Bosnia and Kosovo, NATO leaders found themselves besieged by press requests for comments on situations in the field that had not yet been reported to them.[92]

In essence, the increased speed and volume of media and independent information flows prevents traditional military planning processes from using its well-established practice of battle rhythm that spreads the work load for commanders and staffs over time, with cyclic planning, decision making, and plan development. Instead, planning and decision making are under pressure to become seamless 24 hour a day, seven day a week processes. This requires networked arrangements for planning and shortens the life of specific plans. Indeed, research on U.S. Army division level planning (during Warfighter exercises) before Operation Desert Storm showed that planners were seeking to develop plans that would, including the contingencies they specified, last 72 hours.[93] However, those plans actually survived only an average of 9 hours before they were replaced. As a result, during Desert Storm the Army found itself conducting "planning on the fly" since the pace of operations greatly exceeded the pace of planning and/or planning assumptions.

The change in the character of the relevant actors during complex endeavors also challenges traditional military planning processes and plans because both the process and the plans that are produced need to accommodate a variety of different, often conflicting perceptions, motivations, and intents. Another obvious change is the nature of the adversaries. Rather than just the military forces of a sovereign state, 21st century militaries confront irregular forces who may be insurgents, terrorists, drug lords, or smugglers (of humans, drugs, weapons, currency, or counterfeit goods). Military forces may also be "battling" diseases, famine, drought, hurricanes, floods, earthquakes, volcanoes, tidal waves or forest fires. Hence, the level and depth of training that were available for specialized capabilities within purely military organizations are simply not available today, given the increased number and range of competencies required. Adversaries and relevant cultures can be studied and both education and training are possible, but more general capabilities are now required for planning, information sharing, collaboration, decision making, and learning during operations.

The nature of the relevant cooperating entities has changed at least as much as those of adversaries. That has profound implications for planning and plans. First, in many missions where the military plays a role, the perceptions of the population are crucial to success. Whether the mission is combating an insurgency or bringing relief to a population, the willing cooperation of the public is essential. Hence, *virtually all operations are not only complex endeavors but information operations as well*. Planning

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[92] Larry Wentz, *Lessons from Bosnia* (Washington: CCRP, 2002).
Larry Wentz, *Lessons from Kosovo* (Washington: CCRP, 1998).
Kevin Avruch, James Narel, and Pascale Combelles-Siegel, *Information Campaigns for Peace Operations* (Washington: CCRP, 1999).

[93] Richard E. Hayes and Kristi Sugarman, "Thunder Run" (Presented at the 11th ICCRTS in Cambridge, September 2006). http://www.dodccrp.org/events/11th_ICCRTS/html/papers/150.pdf (Nov 2006)

that ignores this basic fact is doomed to failure. This makes media-related effects an important part of any planning process for complex endeavors.

Second, the number and variety of cooperating entities has grown dramatically. The time when a single nation's military could independently undertake a military mission is over. The categories of cooperating entities are daunting enough: military coalition partners, interagency partners, host governments, international organizations, non-governmental organizations, private voluntary organizations, private industry, and the media. However, thinking in terms of categories alone, obscures the sheer volume of entities. For example, at one point more than 800 non-governmental organizations were present in Bosnia. When the U.S. occupied Haiti, over a dozen U.S. agencies were represented and 12 foreign countries sent formal help. The number of coalition partners contributing military forces during Operation Desert Storm was 37. Operation Enduring Freedom comprised 90 nations, with 27 contributing combat forces and 39 represented at CENTCOM.[94] In addition, an estimated 3,000 NGOs set up operations in Afghanistan.[95] More than 140 nations offered assistance to the United States during Hurricane Katrina and the floods that followed. The United Nations is often represented by several different entities, each with a different charter and functional capability. Thousands of members of the media show up in any crisis region of the world. Many of them do not register with the military. Many of these entities provide important capabilities. Without the presence and cooperation of most of these entities, mission success would often be impossible and would always require much greater military resources.

Note that most of these entities are not obligated to cooperate in planning undertaken by the military, or to follow plans developed by the military. They are not part of any recognizable "chain of command." Hence, their cooperation requires better knowledge (who they are, their capabilities, their intentions, their incentive structures, where they are located, what they are doing) of precisely the same type that would be needed to assess a military situation. Hence, shared awareness is an important prerequisite of success, including awareness of what cannot or will not be done by any given actor. Success also requires that military forces and their leader are skilled in collaboration and negotiation. Of equal importance is a relatively open planning process where good ideas are more important than where they come from. To function effectively, such a multi-faceted endeavor must involve self-synchronization and effective planning that supports self-synchronization.

Finally, the military must recognize that in many of these non-traditional mission areas they will not be in charge. In some cases no single entity will be in charge. Rather they and, indeed at times, every entity, will be in a supporting role. Hence, military planning

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[94] "Operation Enduring Freedom: One Year of Accomplishments." Whitehouse.com. http://www.whitehouse.gov/infocus/defense/enduringfreedom.html (Dec 2006)

[95] Ramtanu Maitra, "The party's over for Afghan NGOs" in *Asia Times Online*. April 21, 2005. http://www.atimes.com/atimes/Central_Asia/GD21Ag01.html (Dec 2006)

processes will at times be subordinated to those of others. These may be foreign governments (for example the excellent experience of the USMC and U.S. Navy in responding to the hurricane in Bangladesh during Operation Sea Angel in 1991), local leaders (as when fighting forest fires), or political leaders (as in responding to Hurricane Katrina). While military organizations should still conduct their own internal planning, these planning processes will need to be more transparent to other actors and enable interdependence where needed for mission success.

In summary, a variety of contemporary factors make traditional military planning processes unsuited for complex endeavors. These factors include growth in the:

- number and variety of entities that matter;
- interdependencies and degree of coupling between those entities;
- dynamics of the situation;
- extent of uncertainty in the situation;
- degree of precision required in actions intended to influence the situation;
- variety and amount of relevant actions and phenomena not directly included in the physical domain; and
- the opportunities to substitute information for mass.

Rethinking military planning in the context of a complex civil-military endeavor is thus not merely desirable, it is essential.

Rethinking Planning

Having addressed the question of the suitability of traditional military planning processes and plans, we now turn our attention to what approach to planning makes sense for complex endeavors. At this point in time, the general nature of the planning approach that is needed for complex endeavors is generally understood, while the details remain to be better understood.

The remainder of this book first explains the nature of the approach to planning that is required for complex endeavors and then lays the foundation for the exploration and assessment of specific instantiations of this general approach.

In order to be successful in complex endeavors, a coalition approach to planning must be able to accommodate a heterogeneous set of participants with multiple objective functions and the absence of a single chain of command among or across the actors who are attempting to deal with a dynamic, multi-faceted situation in the face of significant uncertainties.

The heterogeneous set of participants with multiple objective functions and no unifying chain of command is an inescapable fact of life because of the need to create effects in multiple arenas. This requires the participation of military and civilian authorities from a number of countries as well as international organizations, NGOs, and PVOs. This means, in turn, that no institution or nation, regardless of its relative size and reach, can

successfully operate in a stand alone manner. This inevitably creates interdependencies between and among organizations that have long cherished their independence. It also, as we will see, makes it necessary for each participating organization to adopt internal processes that are compatible with the planning approach required for complex endeavors.

The keys to success for both the coalition (collective) and each of its participatory entities are achieving shared awareness, enabling self-synchronization, and developing agility across the range of participating entities.

Achieving shared awareness and enabling self-synchronization are prerequisites for operating at the highest (Level 4) level of C2 Maturity (see Figure 1). Operating at this level significantly enhances agility. However, coalitions in complex endeavors require more than an agile planning approach and agile plans to be agile. These coalitions need to comprise a set of entities that collectively have the means to deal with the situation: the right sets of information, experience, expertise, and resources.

Agility[96] is a complex, multi-dimensional concept, a capability that has been associated with Command…Control…in the Information Age.[97] The recognized dimensions of agility[98] are:

- Robustness
- Resilience
- Responsiveness
- Flexibility
- Innovation
- Adaptation

Agility, of course, has no value without the ability to be effective. Thus, for example, responsiveness does not mean only the ability to react quickly, but rather the ability to react at an appropriate time and in an effective manner. Agility is also often associated with efficiency. For example, responsive actions (e.g., getting it right the first time) often enable a force to accomplish their missions using fewer resources. Similarly, plans that generate synergistic effects will often require fewer resources. Being agile allows, for example, one to substitute appropriate information, the planning it enables, and appropriate actions for mass because a doctrinal response to uncertainty is to plus up forces and/or create reserves that can be thrown into the battle when the disposition of the

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[96] Alberts and Hayes, *Power to the Edge*, 123-59.

[97] Alberts and Hayes, *Power to the Edge*, 201-212.

[98] Alberts and Hayes, *Power to the Edge*, 127-128.
NATO SAS-050. Final Report, January 2006. http://www.dodccrp.org/files/SAS-050%20Final%20Report.pdf (Oct 2006)

enemy is known. Simply put, agility provides more options, better options, and permits a richer set of tradeoffs.

Shared awareness and self-synchronization are not new ideas; they are, in fact, intrinsic to a network-centric approach. Network-centric approaches require (1) the existence of a robustly networked set of participants, (2) an approach to command and control that encourages widespread information sharing and collaboration and, (3) the distribution (as opposed to the centralization) of decision rights. The objective is to enable appropriate self-synchronization by achieving high quality awareness that is widely shared.[99]

Given that it is the policy of DoD[100] to develop effective network-centric approaches and implement the principles associated with the concept of "power to the edge," these institutions must as a consequence co-evolve their planning processes and products (plans) to make them network-centric. This is a fortuitous development because developing a network-centric approach to coalition planning (for the collective) will be facilitated if the individual participants adopt network-centric concepts and approaches to their enterprises and operations.

In summary, complex endeavors require a mature network-centric planning approach because they offer the best chance, all things being equal, of achieving shared awareness, enabling self-synchronization, and developing agility.

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[99] LTC Nicole Blatt, *Command and Control Joint Integrating Concept (C2 JIC) Information Briefing for the Joint Concept Steering Group*. (USJFCOM/J9, August 24, 2005). http://www.dtic.mil/futurejointwarfare/strategic/jcsg0805_c2.ppt (Oct 2006)

[100] As well as many other military institutions, including NATO.

Chapter 5. Network-Centric Planning

In the previous section, the keys to success were identified and it was asserted that a mature network-centric approach to planning was appropriate for complex endeavors. This section discusses in more detail network-centric concepts and power to the edge principles as they apply to planning.

An accepted tenet of network-centric theory is that widespread information sharing and collaboration in the information domain lead to improved awareness, improved shared awareness, and collaboration in sensemaking and execution.

Thus, collaboration is central to developing a network-centric approach to planning. The subject of collaboration cannot be limited to planning but must encompass sensemaking, planning, and execution.

Collaboration means working together for a common purpose. This key concept is seen as having several very positive impacts:

- First, when information is shared and the parties are able to collaborate about it, the information often improves. This sometimes occurs when the collaborators find they have either contradictory or complementary information. It also occurs when one of the collaborators finds that the new information helps complete or fill in gaps on topics important to them or allows them to update earlier information. Very often the information is improved because of a richer dialogue about what it means or where it came from. Hence, collaboration is a mechanism for improving the quality of information.
- Secondly, collaboration often improves situation awareness and the in-depth understanding of the situation. The importance of collaboration stems from being able to consider alternative perspectives. Having multiple perspectives is particularly useful when the collaborating organizations come from different professional or national cultures.
- Third, collaboration often improves planning because it ensures that the views of the different entities involved are included in those decisionmaking processes included in planning—those needed to translate intent and course of action selection into specific synchronized activities. There is strong empirical evidence that, all other things being equal, groups with different backgrounds or perspectives will generate better plans and decisions than homogeneous groups. They are better able to avoid "groupthink."
- Fourth, collaboration improves the knowledge of the other actors. This includes their understanding, their areas of competence, capabilities, motivations, and willingness to contribute to the larger endeavor. Negative knowledge of others—the limits of their competences and motivations—are also important.
- Fifth, collaboration enables more synchronized and more agile execution, execution monitoring, and adjustments of actions at all levels. People and

organizations who have explored the problem together understand command intent more thoroughly and see the role of their actions in carrying out that intent more clearly. This gives them a greater capacity for adaptation and innovation within those boundaries. Senior commanders (when that concept applies) have a richer understanding of the situation and can better decide how to enable those responsible for execution, how to allocate resources, and when changes in tasking are appropriate.

- Sixth, collaboration builds trust, both between entities and in the decisions and plans that are adopted. Parties who have been involved in the processes of generating awareness and understanding, generating and assessing options, and planning have greater confidence in the relevant products as well as being more committed to make the selected courses of action work.

Collaborative processes are sometimes criticized as (a) too slow and (b) not authoritative. Neither of these characteristics will necessarily be present when collaboration occurs. Collaboration can be quite rapid, particularly if groups have worked together before, whether in exercises or in operational settings. They can also be speeded up by simple situation urgency. Moreover, a collaborative process can be used to support or make authoritative decisions. Allocation of decision rights is a different dimension from the patterns of interaction that are prohibited, allowed, encouraged, and required. Indeed, collaborative decisionmaking is one of the "styles" recognized in the literature.[101]

When they engage in collaboration, planners are much more likely to understand the operation more thoroughly. A network-centric planning approach, even with extensive collaboration, offers the possibility of more rapid planning when compared with traditional planning processes. This is because traditional planning is largely sequential, with each echelon dependent on its higher headquarters establishing intent and some broad planning guidance before they can initiate decision making and the associated planning. Moreover, in traditional planning approaches functional linkages tend to be sequential, with the operations function positing courses of action that are then reviewed by the other staff sections. For example, General Omar Bradley is reported to have said, "My 3 (Operations) tells me what I can do, and my 4 (Logistics) tells me what I cannot do." If, however, planning is done collaboratively across functions and echelons, the variety of perspectives involved (a) catches important issues early and (b) allows development of plans in parallel. Hence, planning collaboratively provides the opportunity to improve both of the core measures of effectiveness for plans: Quality of Plan and Speed of Planning.

Classic military planning, although not network-centric, often included some collaboration. For example, research using the Headquarters Effectiveness Assessment

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[101] See: Howard Raiffa, *Negotiation Analysis: The Science and Art of Collaborative Decision Making* (Cambridge: Belknap Press, 2003).
Angelika Menne-Haritz, *Business Processes: An Archival Science Approach to Collaborative Decision Making, Records, and Knowledge Management* (New York: Springer, 2004).

Tool (HEAT) during the 1980s on U.S. Army brigade, division, and corps headquarters in Cold War exercises showed that the Number of Personnel and the Variety of Staff Sections involved in plan creation correlated positively with the Quality of Plans developed.[102] At the time, this simply meant that when the engineers, logisticians, artillery, and other planners participated in the future plans activities, the results were improved plans. Collaborative targeting, developed as an idea by JFCOM, tested in exercises, and ultimately adopted as a common practice,[103] has demonstrated that the quality and speed of targeting improve when the process extends across echelons and functions. JFCOM also learned, as a by-product of one of its major experiments, that allowing junior staff to "listen in" on daily VTC meetings among senior commanders resulted in (a) catching errors of facts and untested assumptions much earlier and (b) increasing speed of staff activities based on a more thorough understanding of the issues and decisions addressed. Therefore, time was saved by minimizing the need for sequential meetings to pass along new information and guidance.[104]

The challenge arises when, as in the case of complex endeavors, a planning process is made more inclusive and the set of participants extended to include entities (more correctly people representing entities) that have not worked together in the past, do not know one another, do not share common language (technical or national) and do not have either common chains of command or fully common intent.

A paradox arises here: the circumstances in which planning may benefit the most from collaboration are precisely the circumstances in which it is most challenging.

Indeed, the case where the military is in a supporting role, and therefore not able to decide or control the planning process, needs to deal with this paradox. The larger the number of people directly involved in the collaboration process is, the more challenging it may be. The ideal size for a group working together directly is relatively small, perhaps between eight and twelve.[105] Hence, collaborative planning for complex endeavors will need to overcome several related barriers:

- Number of participants;
- Variety of participants;

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[102] Richard E. Hayes and Gary F. Wheatley, *The Evolution of the Headquarters Effectiveness Assessment Tool (HEAT) and Its Applications to Joint Experimentation* (Vienna: EBR, Inc., 2001). Presented at the 6th ICCRTS in Annapolis. http://www.dodccrp.org/events/6th_ICCRTS/index.htm (Oct 2006)

[103] Joint Warfighting Center, "Targeting" in *A Common Perspective* (JFCOM, October 2000, Vol 8, No. 2), 3. http://www.dtic.mil/doctrine/jel/comm_per/acp8_2.pdf (Nov 2006)

[104] Joint Fires Initiative Block 2 in FY 04-05. See: LT Mark Werth, *Joint Fires Initiative Supporting the Joint Operations Concepts*. http://sill-www.army.mil/conf/briefings/LTCOLWERTH.pdf (Oct 2006)

[105] "Research with business groups, athletic teams, and even armies around the world has revealed there is an ideal size for a working group. This ideal size is between eight and twelve individuals." Edward Hall, *Beyond Culture* (New York: Anchor, 1976).

- Need for common purpose; and
- Need for common language.

The "book solution" for these problems is to seek to create "hardened groups," or groups of people who have worked together in the past on problems similar to those at hand. Hardened groups have both better "team knowledge" and "task knowledge."[106] Their team knowledge extends to understanding one another's relevant expertise, the roles each plays, and their working styles. Task knowledge deals with the substance of the problem. Hardened teams have developed (a) work processes they find useful, (b) specialized language, and (c) methods for dealing with a familiar problem or set of familiar problems.

The military is used to training together and exercising together in order to reap the benefits of hardening. Similar approaches need to be used, when possible, to harden groups for endeavors involving multi-national, interagency, and other types of partners. Gaining the cooperation necessary for these "hardening" activities has proven very difficult because many of the partner organizations lack the resources and staff necessary to participate in training and exercises outside their day-to-day operations. There may also be the impediment of cultural barriers. For example, many NGO personnel find the idea of working with the military distasteful and indeed the antipathy may at times be reciprocated. These prejudices will require time and effort to overcome, but success requires that they are overcome.

Despite best efforts, many complex endeavors will begin with little or no shared experience. Responses to natural disasters such as the 2005 Tsunami in the Pacific or Hurricane Katrina in the United States involved a wide variety of entities with little or no common training or prior opportunities to work together. Peacekeeping operations of all types (peace making, peace enforcement, etc.) often involve coalitions of the willing, in many cases bringing together regional and global actors. SSTR operations involve multiple agencies, host governments, private companies, and NGOs working in combinations that develop as a result of needs, geography, capability and relationships established outside the current context.

A second classical technique is often used to overcome the challenge of having too many people involved in the collaborative process. This technique involves decomposing the issues, typically functionally but also across time (e.g., differentiating future plans from current plans from current operations), and having (a) smaller groups work on the elements of the plan while (b) convening linkage sessions to integrate the elements. In an extreme form, of course, this is the classic Napoleonic staff system. However, the modern instantiation enabled by 21st century information technologies takes the form of distributed collaborative planning.

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[106] David Noble, *A Cognitive Description of Collaboration and Coordination to Help Teams Identify and Fix Problems*. (Vienna: EBR, Inc., 2002). Presented at the 7th ICCRTS in Quebec. http://www.dodccrp.org/events/7th_ICCRTS/Tracks/pdf/089.PDF (Oct 2006)

Network-centric planning can be synchronous, asynchronous, or both. Properly organized, it approaches a "small world"[107] system in which clusters of actors or entities are linked through a limited number of key nodes that act to keep each of the clusters aware of the activities going on across the network; the links between/among these nodes convey questions, information, or ideas between and among the clusters.[108] In a complex endeavor, the clusters would probably encompass the different entities and organizations participating and the key nodes would be the active members of communities of interest.

The challenges inherent in network-centric planning can also be met, at least partially, by using a common visualization of the problem space and the relevant activities to enhance shared awareness. The long-standing emphasis on developing and implementing a "common operation picture"[109] and its many pseudonyms (common relevant operating picture, user developed or tailored operating picture), while challenging to implement, is a recognition of the value of creating common visualizations. The DARPA-developed Command Post of the Future (CPOF),[110] which has been further refined by its use in Iraq and is (at this writing) being considered for broader implementation within the U.S. Army and the Joint community, is a richer instantiation of the needed visualization. However, beyond providing tailored displays and allowing different actors (commanders, key staff officers, etc.) to look at the same screen displays, CPOF technology also permits the actors to discuss the meaning of the picture they are seeing and to physically draw or sketch alternative ideas (avenues of advance, phase lines, objectives, etc.). Hence, they have a greater capability to collaborate while planning, discussing new information, or deciding how to adjust their actions as the situation changes. The positive reaction from those who have used this tool set reinforces the idea that common visualizations will support distributed collaborative planning.

Unfortunately, CPOF and the vast majority of the efforts at creating common visualizations within DOD are primarily tailored for combat situations and are designed around symbology developed for the military. This limits the value of this capability when a collaboration includes civilian actors and when dealing with other types of missions. Fortunately, many of the relevant arenas (e.g., disaster relief, health, economics) have visualization tools that might be drawn upon or included into templates or tools for these areas.

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[107] Atkinson and Moffat, *The Agile Organization*, 46, 99.

[108] David S. Alberts and Richard E. Hayes, *Understanding Command and Control* (Washington: CCRP Publication Series, 2006), 105-6.

[109] JFCOM, "Joint Forces Command Glossary." http://www.jfcom.mil/about/glossary.htm (Nov 2006)

[110] "Command Post of the Future CPOF," in *Defense Update* (2004, Issue 4). http://defense-update.com/products/c/cpof.htm (Nov 2006)

While activities such as creating shared visualizations, decomposing problems, and building hardened groups can be used to improve distributed collaborative planning, more research is needed on core issues such as how to:

- Generate appropriate trust and distrust promptly;
- Develop or negotiate common goals and intentions;
- Develop common language quickly;
- Develop agreed work processes and methods for unfamiliar types of problems;
- Collaborate effectively when large numbers of people and organizations are involved; and
- Develop tools to visually represent missions where non-military factors are important (humanitarian assistance, disaster relief, peacekeeping, SSTR, counter-insurgency, counter-smuggling, illegal immigration, etc.).

These are all issues upon which considerable basic research and some applied research have been conducted. Hence, it should not be difficult to identify promising alternative approaches. These, in turn, would be excellent candidates for experimentation in order to identify the most appropriate approaches, their uses, and their limits.

The network-centric approach to planning described in this section differs significantly from traditional military planning. These differences are discussed in some detail later when a three-dimensional planning space is introduced. This space is anchored by traditional military planning in one corner of the space and bounded by network-centric planning in the opposite corner.

The Way Ahead

A new generation of planning approaches and the systems that support planning are needed. These planning approaches must be co-evolved with the various elements of mission capability packages including, but not limited to, concepts of operation, approaches to command and control, organization, systems, and training.

The function of command includes the specification of sensemaking processes,[111] which includes planning. Therefore, those interested in exploring and understanding new approaches to planning are advised to begin with a basic understanding of the command and control approach space[112] that depicts the full range of options to choose from; options that provide different ways to accomplish the functions that are associated with

[111] Alberts and Hayes, *Understanding Command and Control*, 57-66.

[112] Alberts and Hayes, *Understanding Command and Control*, 75.

command and control[113] and options that set the context within which planning must operate.

The way ahead involves (1) developing a conceptual model of planning that is consistent with the conceptual models of command and control recently developed,[114] (2) conceiving and implementing a campaign of experimentation focused on various approaches to planning in complex endeavors, and (3) undertaking a correlative program of research.

The remainder of this book is devoted to discussions of these steps on the critical path to a new generation of planning approaches, approaches that are better suited to the C2-related challenges we face in the 21st century.

[113] Alberts and Hayes, *Understanding Command and Control*, 75.

[114] NATO SAS-050 Working Group. Command and Control Conceptual Reference Model, 2005. Alberts and Hayes, *Understanding Command and Control*, 53, Figure 4.

Chapter 6. Conceptual Model for Planning: Overview

As indicated previously, a conceptual model provides the framework needed to organize what is known and what is not known, as well as guide both experiments and analyses. An initial conceptual model of planning in the context of NCO is developed in this section. The model provides a point of departure for a campaign and can expect to be enhanced and refined during the course of such a campaign.

The level of detail and specificity of this conceptual model is consistent with what would normally be generated during a campaign's formulation phase. This model contains variables that reflect the key concepts and the relationships among them, including a set of variables that form a value chain that provides a basis for comparing existing approaches to planning to network-centric approaches. This section provides a high-level overview of a conceptual model that can be employed in a campaign of experimentation to explore network-centric approaches to planning.

Figure 2 is a high level depiction of planning in the context of command and control and operations. It depicts the relationships among Command, Control, Sensemaking, Planning, and Execution. Note that the command approach adopted (allocation of decision rights, patterns of interaction, and distribution of information) or that is available is established outside of the operational environment and conditions the interactions. Note also that the initial competence of those involved in the endeavor is also established outside the operating environment. The appropriateness (expected effectiveness) of a particular planning approach depends on both how well matched it is to the selected C2 approach and on how appropriate the selected C2 approach is to the situation (including the nature of the coalition). Finally, it should be noted from Figure 2 that the plans are located in both Planning and Execution. This indicates that plans need to be developed and updated interactively.

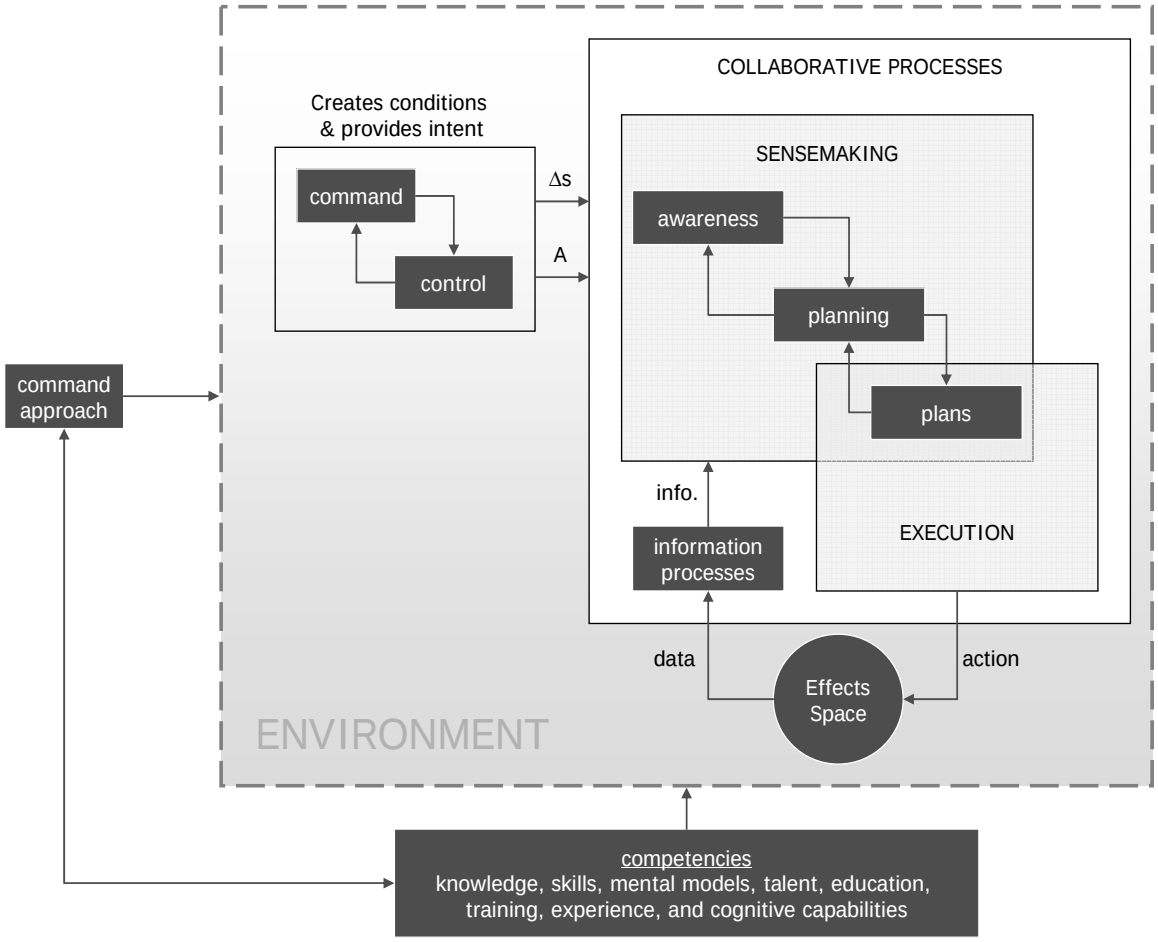

Figure 2: Planning in the Context of C2 and Operations

Command initially, and control during the course of an endeavor (as long as the situation remains within the parameters set by command), determines the conditions that shape the sensemaking process. These functions shape both the substance and the nature of the sensemaking process. They shape the nature by determining goals and objectives as well as the value proposition that determines what is desirable and what is not. They shape the substance of the sensemaking process by determining roles and responsibilities, allocating resources, determining the nature of the interactions that take place among the participants in the sensemaking process, and deciding how information is distributed among the actors.

Planning is shown as an integral part of the sensemaking process. Planning is about the visualization of alternative futures. Once a plan (a course of action) is selected (a function of command), planning refocuses on preparing for action. A "plan" is an expression of the set of decisions that defines the selected response to the situation as well as contingencies mapped to future conditions. Plans can vary greatly in level of detail and form (from verbal to in-depth documentation), while execution is focused on implementing the plan, and if necessary, fleshing the plan out. The plan will invariably

evolve and in most cases be replaced. This requires, at a minimum, a dynamic interaction between planning and execution.

The plan is then executed. Execution consists of a set of actions taken in various domains. They are distributed in space and time. Their actions result in changes to a set of state variables and in turn create a set of effects in a variety of domains, also distributed in time and space. To the extent that actions are specified in a plan, they are usually linked to one another either directly or conditionally as a function of the situation and/or the effect(s) that they are intended to create.

The Functions of Command

The functions of command, sensemaking, and planning (see Figure 2) are accomplished concurrently and interactively. Command establishes important conditions that affect the sensemaking and planning processes. Sensemaking determines what needs to be accomplished and (to some degree of specificity) the approach. Planning fills in the gap from an expression of intent to actionable decisions that can be understood and executed.

Figure 3, Critical Command Functions, identifies the key command functions, putting them in the context of the domains.

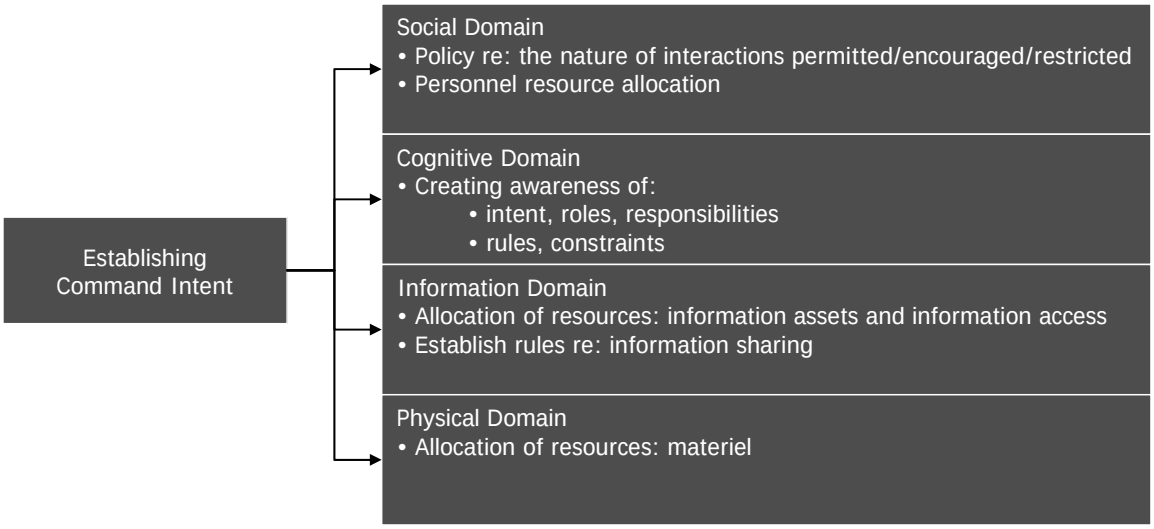

Figure 3: Critical Command Functions

In the social domain, command establishes the rules that govern interactions among participants and participating organizations and also allocates resources. Other functions of command are to articulate command intent, assign roles and responsibilities, and establish rules of engagement and constraints. The actions of command that convey the decisions result in a particular state of awareness regarding command intent and guidance that exists in the cognitive domain. Among the rules that govern interactions and the resources that are allocated are those regulations that affect the information domain,

specifically those that grant access to or allocate the use of information assets, access to information, and information sharing. These are critical enablers of network-centric approaches and need to be considered controllable independent variables that, in part, determine the approach to C2 and the associated planning function. The allocations of materiel are located in the physical domain.

Sensemaking

Figure 4, Sensemaking, identifies key concepts related to sensemaking and the relationships among them. This figure also puts these concepts and the relationships between and among them in the context of the social, cognitive, and information domains.

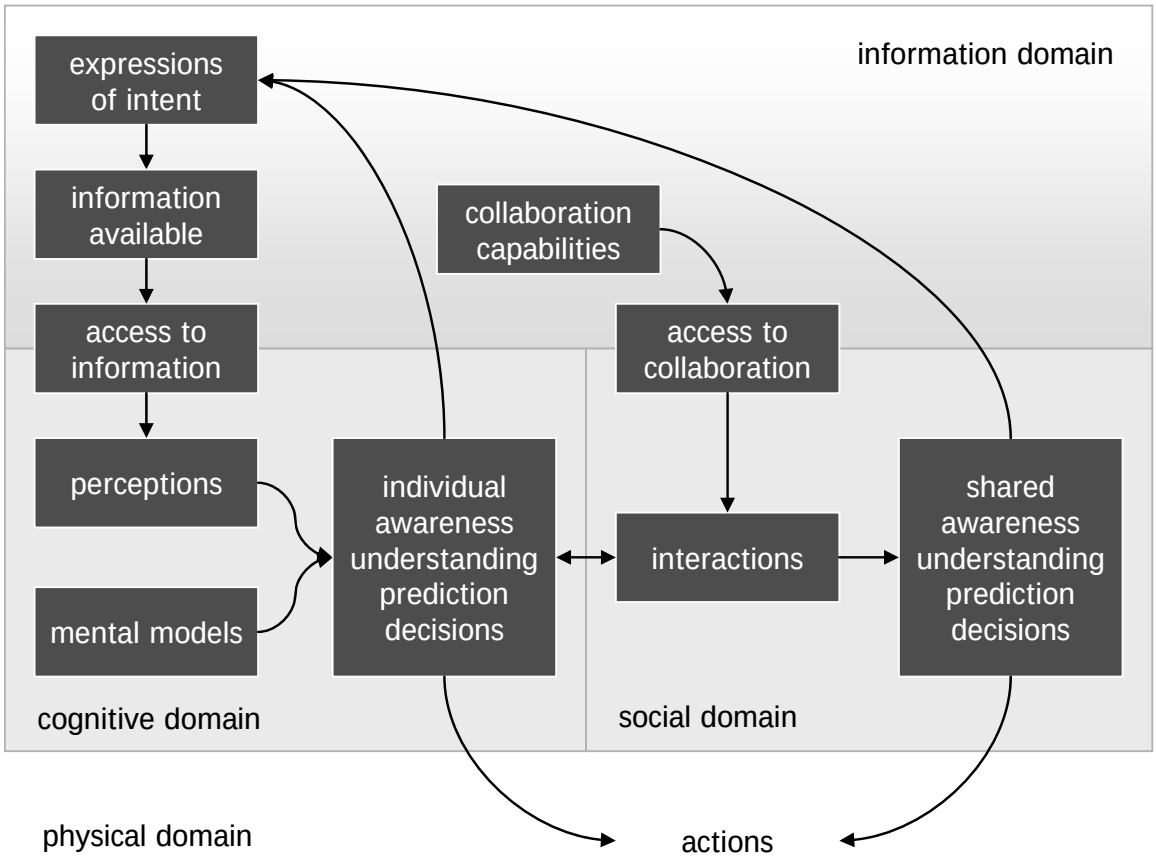

Figure 4: Sensemaking

The key outputs of a sensemaking process that involve two or more entities are individual and shared awareness, understanding, prediction, and decisions. The individual and shared decisions that are made lead to actions.

Planning

Planning is an integral part of sensemaking. It is not productive to attempt to define where the other components of sensemaking leave off and planning begins. Like command and control, sensemaking and its planning component are each scalable. Sensemaking can be undertaken by a single individual, a pair, a small team, and by large collections of individuals who are members of an organization. Indeed, planning may be undertaken by groups of individuals from various organizations. As a process, planning involves the arrangement of tasks in time and space required to achieve the desired result, tasks that are undertaken by individuals or groups of individuals interacting with one another.

An effects based approach to planning involves the identification and synchronization (purposeful of arrangement in time and space) of desired effects as an input to the process that identifies sequences of necessary tasks. As is stressed by Smith, the effects based approach is not new; it has been used by political and military leaders throughout history.[115]

Planning Space

In order to permit a full exploration of different approaches to planning, different planning processes, and different types of plans, it is important to define these, not as practitioners understand and practice them, but by (1) their functions and purposes and (2) the space of possibilities.

The generic planning process involves entities, interactions among entities, information, the distribution of information, and the sharing of information. Entities are assigned or take on a variety of roles and responsibilities. Furthermore the process begins with an expression of intent and produces a product, a plan, or set of decisions.

The Planning Space encompasses all of the variations that are possible across the three dimensions listed below.

- The nature of the planning process
- The nature of the plan produced
- Information dissemination and sharing

Figure 5, Planning Space, graphically depicts a space defined by these three dimensions. The dimension “nature of the planning process” is anchored at one end by traditional planning processes commonly in use in Industrial Age military organizations. This would be typical of headquarters that focus on planning. At the other end of this dimension are mature network-centric or edge approaches where planning, to the extent that planning is done, involves widespread sharing of information, peer-to-peer interactions, and

[115] Smith, *Effects Based Operations*, 1.

extensive collaboration. The "nature of the plan produced" varies widely across this space, from a detailed plan, typified by the Air Tasking Order that provides an assignment to each tail number, to just an expression of intent. "Information dissemination" can, on the one hand, be restricted to following the chain of command, or on the other hand, information can be universally posted so that it can be pulled by those qualified users who need it.

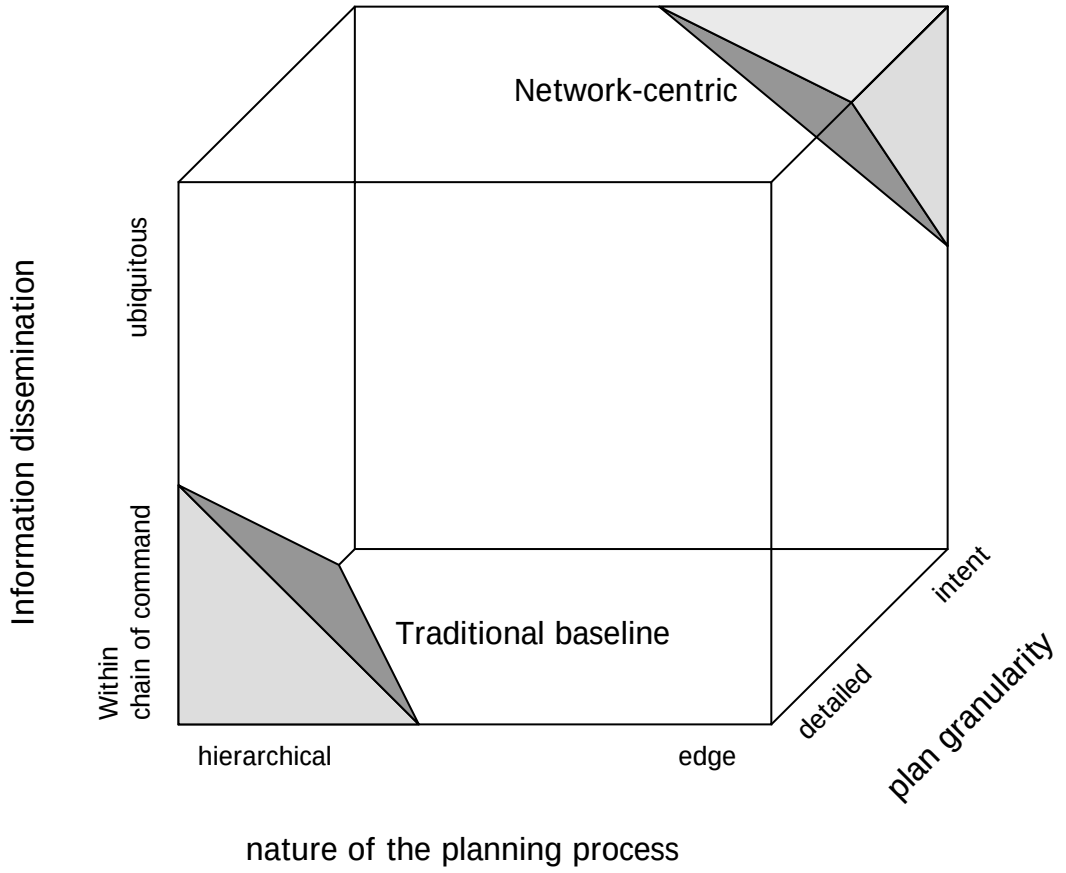

Figure 5: Planning Space

Traditional approaches to planning (the experimental baseline) occupy the lower left of this space while network-centric approaches (a focus of experimentation) primarily occupy the upper right.

Chapter 7. Traditional vs. Network-Centric Planning

There are a number of significant differences between these two "corners" of the planning space, differences that make network-centric approaches relatively well-suited for complex endeavors.

Figure 6 contrasts the key differences between traditional military planning and mature network-centric planning approaches and processes.

	Planning Approach and Process	
	Traditional military	**Mature network-centric**
Information	Mainly from military sensors and systems Distribution follows the chain of command Push Very limited access to information & non-organic expertise Information conveyed with plan	Variety of information sources Widespread dissemination Post/pull, Smart push Widespread access to expertise Information shaped by each entity
Decisions	Centralized Global	Distributed Local in context of intent
Process	Hierarchical Responsibilities fixed by chain of command Some collaboration Sequential Cyclical Separate planning from execution	Peer-to-peer, small world Dynamically allocated responsibilities, by merit Extensive collaboration Parallel Continuous Interactive planning and execution
Focus	On BDA	On effects in multiple arenas
Plan	Detailed Objective: de-conflict, selected synergies	Intent: enable self-synchronization, seek synergies
Goal	Optimization	Agility
Applicable Situations	Complicated	Complex
Assumptions	Adequate understanding Predictability Close-coupling is good	Lack of understanding Uncertainty (unpredictability) Close-coupling is bad

Figure 6. Planning Approach and Process

Figure 6 depicts the differences between a traditional military planning process and a mature network-centric approach to planning. It looks at how information is handled, the characteristics of the process and its focus, as well as the nature of the product, the plans that are produced, including the relevant goals, applicable situations, and assumptions.

In essence, traditional military planning effectively used the Industrial Age logic of optimization to the complicated situations for which it was suitable. This was the case because the warfare arena for which this type of planning was developed can be decomposed into elements, each of which can be adequately understood. The assumption is that these elements are loosely coupled with one another but are closely coupled internally. Since each action is designed for optimal impact within a specific element, the close coupling internal to an element makes close coupling between these actions (integration and tight synchronization) desirable. Furthermore the loose coupling across

elements does not require that actions be integration across the entire endeavor which would greatly increase the degree of difficulty.

By contrast, planners dealing with complex situations must seek agility: sets of actions that ensure their approaches are flexible (provide more than one way to achieve success), robust (are effective across a variety of circumstances in order to allow for changes in the situation), resilient (permit recovery from missteps or adversity arising from a lack of full understanding), responsive (capable of acting within windows of opportunity), innovative (doing new things or old things in new ways so that they have a greater chance of success than taking actions adversaries can anticipate) and adaptive (permitting changes in both processes and organization as information is gained about the complex situation). These aspects of agility are needed in order to overcome the incomplete understanding that characterizes complex systems and the uncertainty (or unpredictability) associated with them. For planners, this implies that close coupling between the actions they want to create is bad—if one of them fails or has unintended consequences and they are closely coupled the entire set may fail. Interestingly, close coupling between actions also makes it more difficult to identify their individual impacts.

Recalling the earlier discussion of how complex endeavors influence (not control) complex situations and complex adaptive systems and recognizing the need for agility, some guidelines for planning come into stark relief.

- Planners should favor actions that improve their information positions – specific activities that will allow them (and decisionmakers) to learn about the complex situation and will result in observable effects of behaviors that provide feedback on their impacts
- Planners should prefer actions that (a) do not commit high levels of resources and/or (b) are reversible. This allows them to react quickly and effectively as they (and the decision makers) learn what works, what doesn't matter, and what is counterproductive.
- Planners should husband resources over time so they are able to change approaches as the complex situation or complex adaptive system changes.

Traditional military planning processes get their information mainly from traditional military sources and systems. This provides an important but incomplete component of the information position required for complex endeavors. Furthermore, in traditional military planning processes, information is distributed via the chain of command. This can and often does result in information arriving too late or (in the case where others not in the chain of command require the information) not at all. Information is pushed to individuals and organizations. Thus, individuals and organizations get the information that someone else thinks they need, but not necessarily the information that they need. This, in the worst case scenario, can result in information overload. However, even under the best of circumstances, when push is the primary mechanism for information dissemination, individuals and organizations will receive a lot of information they do not need, which also masks information that is missing and can make it difficult to find

relevant information. On the other hand, when it works well, important information that may not have been recognized as being of interest will be brought to their attention.

Traditional planning processes usually do not provide entities with direct access to a variety of sources or to expertise. It is assumed that those who have a responsibility for different parts of the plan are the only ones who need this access. In contrast, a network-centric approach, by virtue of the supporting information infrastructure and its adherence to power to the edge principles, provides individuals and organizations with access to a wide variety of sources and expertise. This results in the available information being widely disseminated. The post/pull approach to information does not assume that someone else knows what each actor needs/wants. Rather, it transfers the burden of getting information to the person/organization with the need. To work as intended, this requires tools and training: tools that let individuals find the information they need and training to learn how to properly shape one's information position.

In traditional military planning processes, decisions are centralized. This means that a relatively small group of people need to develop an understanding of the situation that is good enough to develop appropriate responses. In addition, this small group must be able to recognize changes to the situation and modify plans in a timely manner. Given the nature of complex endeavors, this is enormously difficult, in part because of the rapid pace of change. Consider the nature of the understanding of the multi-dimensional effects space and the need to consider a wide variety of responding entities and their capabilities. The demonstrated failure to successfully deal with an ATO in a joint environment suggests this approach would not be successful in complex endeavors where many more factors than a set of targets and the air space must be considered.

Network-centric planning approaches distribute decisionmaking. This makes it possible to more quickly notice changes in the situation that may be important.[116] Decentralization means that more decisionmakers will be involved and that each decision will focus on only a small fraction of the entire situation. It is more likely that these individual decisions will be more timely and better informed. Whether or not the set of distributed decisions will be sufficiently timely and informed to be successful depends on many factors. It is not a foregone conclusion that an "edge" approach will produce the desired behavior. This needs to be the subject of research, analysis, and experimentation.

With respect to the nature of these two different processes, the traditional approach is hierarchical, sequential, and cyclical while a mature network-centric approach revolves around peer-to-peer and/or small world interactions, processes in parallel, and is continuous. These attributes affect both potential responsiveness and capacity with arguably the network-centric approach having the capability to respond more rapidly to localized dynamics and be able to handle larger numbers of total participants while maintaining or even improving responsiveness. In traditional military planning processes,

[116] When decisionmaking is widely distributed, there needs to be a mechanism that facilitates pattern recognition on an aggregate basis. Widespread information sharing and collaboration facilitates this.

responsibilities are generally fixed (although specific delegations occur) while in network-centric approaches, responsibilities are negotiated or emergent and thus more dynamic.

A final point to be made with respect to the differences between these two processes is that in the traditional military approach, *planning is separate and distinct from execution*, whereas in network-centric approaches the two functions are intimately related (this is an important difference and is discussed in more detail later).

Other major differences involve both the focus and the product of the planning process. In traditional military planning, the focus is on damaging an adversary and/or preventing an adversary reaching an objective. Mature network-centric planning approaches consider the full range of objectives associated with the participants in the endeavor. The plans produced by these two processes also differ. A traditional military planning process creates a series of detailed plans while network-centric approaches produce statements of intent with necessary caveats and distribute more detailed instantiations of plans.

Sources of Uncertainty in Complex Situations

In complex situations the following five different layers of uncertainty exist.

- Uncertainty about the possible states of nature: what situation(s) might exist; where a "situation" is defined in multiple domains (physical, informational, cognitive, and social) and arenas (military, political, economic, and intellectual). The situation equates to the operating environment.
- Uncertainty about the probability that each alternative situation exists now and/or in the future.
- Uncertainty about the possible set of actions that can be taken to influence the situation in the future (the available choices or options).
- Uncertainty about the impact(s) that various action(s) might have given each possible state of nature (the outcome that occurs if a particular action(s) is taken and a particular state of nature obtains). This outcome includes the interactions between and among effects (including second and third order effects).

Uncertainty about the value of the outcomes

Of course, each of these sources of uncertainty is also present in complicated situations and has, in many cases, been adequately dealt with by traditional military decision making and planning. However, the inherent coupling between and among domains and arenas in complex situations makes it difficult if not impossible to reduce these uncertainties to manageable levels.

First, complex situations, particularly those that involve complex adaptive systems are so intricate and involve so many links between and among elements that those planning for them are seldom confident that they understand all the factors involved or how they fit together (in complex situations this is a correct perception). Even in cases amenable to

traditional military planning, some uncertainty about the current situation (state of nature) had to be recognized: possible changes in the weather, lack of clear understanding of the enemy's will or capabilities, lack of confidence in the capabilities of some elements of the friendly forces, etc. Ways of dealing with these residual uncertainties, such as contingencies or reserves, were developed and proved reasonably effective.

However, when dealing with a complex situation whole aspects of the operating environment may not be recognized nor understood (for example the clan structure in Somalia during efforts to provide food and stability there) or poorly understood (for example, the willingness of the rebels to work constructively in tsunami reconstruction in Ache province or the capability of terrorist organizations to exploit the internet). This forms the first layer of uncertainty.

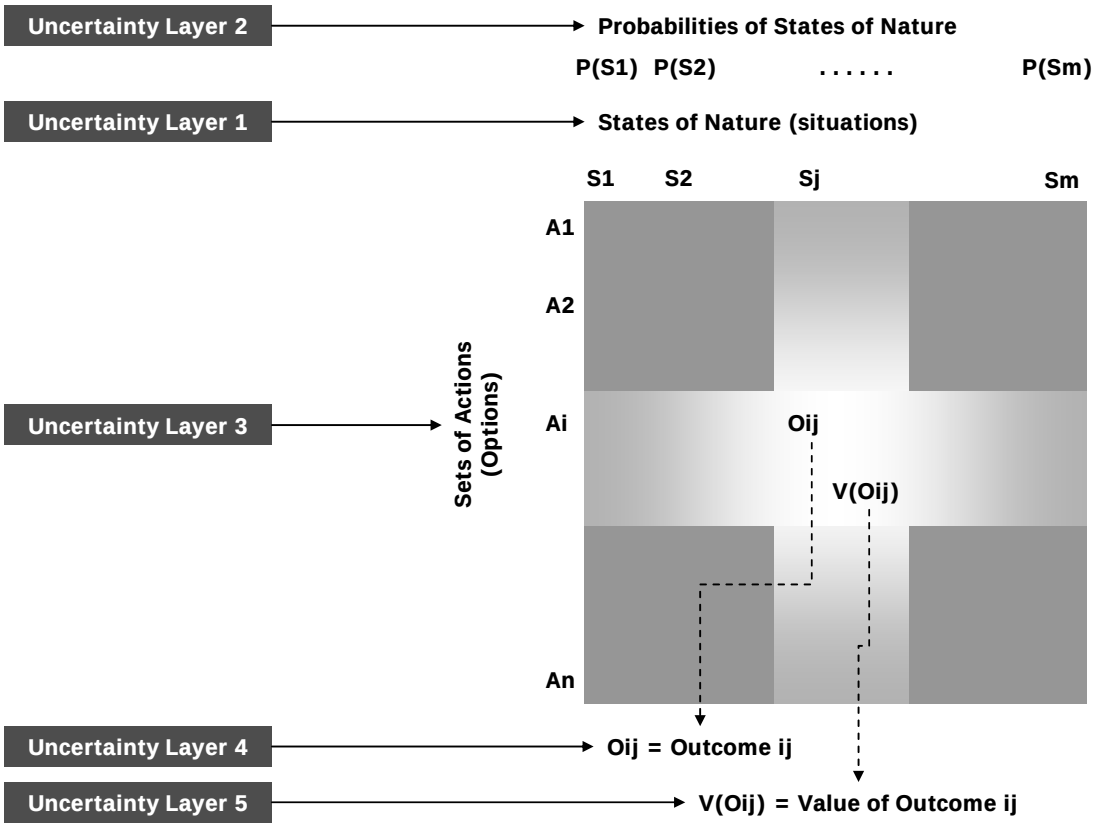

Figure 7: Situation and Decision Uncertainty

Despite attended uncertainties, decision makers and planners will, of necessity, form some understandings of the operating environment because they must engage in sensemaking in order to focus their efforts. These may be thought of as "hypotheses" about the current state of nature and the emergent states of nature that pertain as the assessment of the situation is being formed. Sophisticated and experienced people will hold more than one possible hypothesis about the current and emergent states of nature. Some of these will be inconsistent with one another, but many will be overlapping and

complementary. The probability that any of these specific current or emergent states of nature is correct forms a second layer of uncertainty.

The third layer focuses on the alternative options or sets of actions the decisionmaker or planner considers. Not everything that can be imagined or that might be helpful is feasible. In traditional military planning options that are infeasible arise because of unknown (by the planners) or misunderstood physical limitations: how fast forces, people, or supplies can move form place to place and prepare to carry out missions or tasks. It may also have to do with will (the morale of elements of the force, whether people need rest, etc.) or with speed of command (how long it takes to generate the elements of a plan). In complex situations the uncertainty with respect to these same factors is exacerbated by the fact that the entities involved may not have common intent or resources may need to be mobilized across organizational boundaries. For example, a coalition of the willing often spends considerable time reaching agreement on the common objectives. Once that has been achieved, planning for operations often requires accommodating national mandates that specify what types of missions the different elements of the force may undertake and the levels of threat under which they are willing to participate.

Even when an option or set of actions is feasible, its impact is much more difficult to project when facing a complex situation. A great deal of the discussion of effects based approaches to operations has centered around second and third order effects and cascades of effects that lead to unforeseen outcomes. This is the fourth layer of uncertainty listed above. Given the inherent inability to predict specific impacts in complex situations and the likelihood that some parts of a complex adaptive system will react to any perturbation, this type of uncertainty is particularly difficult for planner. The British often lamented that fact that while they could purchase the loyalty of almost any warlord in Afghanistan during the 19th century, they could not predict how long that loyalty would last. Similarly, when combating an infectious disease the medical community must assume that any given antibiotic will work for only a limited time before the germs develop immunity to it. Widespread looting in Iraq was an unexpected consequence of the rapid defeat and disappearance of the Iraqi armed forces and police.

Finally, complex situations also involve uncertainty about the value that will be created when a particular set of actions are implemented and a given situation obtains. This arises partly because of unintended consequences (another crucial aspect of effects based approaches to operations). However, it also arises because of the fact that the complex endeavor becomes part of any complex adaptive system that it seeks to influence. Hence, the elements of the endeavor may have differential valuation schema when the resulting outcome emerges and is recognized. Coalitions may split not over the actions they take, but over differences in the way they evaluate the resulting situation. For example, some may consider the reasons for the endeavor to have been accomplished while others see a need to continue the effort. Hence, the "negative consequences of success" is one of the factors that form a fifth layer of uncertainty. This aspect of the nature of uncertainty in complex situations makes it clear that planners need to have a robust set of metrics that

examine all domains and arenas when attempting to select the appropriate options or set of actions for implementation.

Planning vs. Execution

As previously mentioned, an important difference is that in traditional military approaches to planning, planning is thought of as a separate and distinct process and activity from execution, while in network-centric approaches it is expected that appropriate participants will share information and collaborate. This includes an on-going collaboration between participants engaged in planning and those engaged in execution. Given the importance of this difference, the relationship between planning and execution and the implications for an endeavor is discussed below.

Traditional notions of planning and execution assume an Industrial Age organizational structure with planning occurring at headquarters and execution involving subordinate units. These subordinate units also engage in sensemaking (including planning that is necessary to carry out the broader plans that higher headquarters produce).

The Traditional (Stovepiped) Approach

Traditional notions of planning and execution are distinguished from one another more by the nature of the distribution of decision rights than by the nature of the activity. Traditional notions of planning and execution implicitly assume a specific approach to C2 and organization. While it has been recognized that the separation of planning and execution inhibits the ability to rapidly respond to changing situations, the solutions under consideration involve, for the most part, incremental changes to process; for example, a "collaborative" approach to planning in which "executors" can listen in, and interject if useful or necessary.

Figure 8 provides a generic process view of the traditional approach to planning in relationship to execution. This generic model, when instantiated for a particular process, can serve as a *baseline* in an analysis that explores non-traditional or network-centric approaches to planning and execution. Experiments that look at the relationship between planning and execution should be part of a larger campaign of experimentation devoted to finding and assessing new approaches to planning.

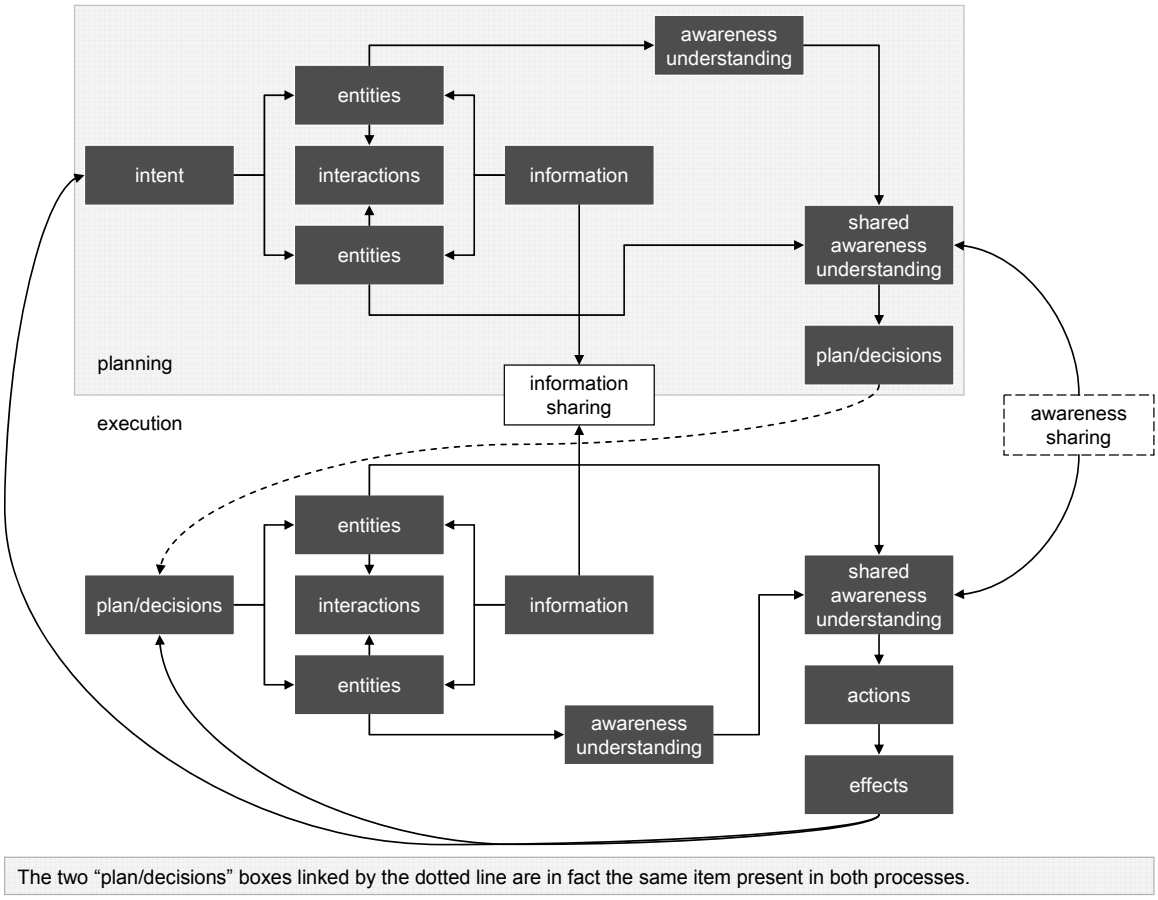

Figure 8: A Generic Process View of Traditional Planning and Execution

The sensemaking aspects of execution in the traditional approach to planning and execution, as depicted in Figure 8, constitute fractals that are related to the sensemaking that takes place during planning. Planning processes and activities are usually nested and differ from one another with respect to scale and the nature of delegated responsibilities and authorities. The process labeled *planning* begins with an expression of (command) intent. The expression of intent can vary in its specificity. In turn, planning processes produce a set of decisions that collectively constitute what is called a *plan*. The nature of a plan can differ widely from an interpretation or re-expression of intent to a set of specifications about what actions are to be taken, when and where they should be taken, and even how they should be taken. Thus, the nature of the sensemaking involved in these processes differs as well. A major difference in traditional approaches is the nature of the entities involved (e.g., planners, representatives of different functional capabilities, executors, or some combination) and the interactions between and among them. However, traditional approaches all have very limited interactions between planners and executors. The processes depicted can also differ with respect to how and to what extent information is shared and the nature of the interactions among the participants. The interactions that take place determine, in part, at which network-centric maturity level the organization is operating. Similarly, different distributions of information are possible and will impact the planning and execution processes.

Because an experimental campaign to explore new approaches to planning will involve both Network Centric Operations and effects based approaches to operations, Figure 8 depicts not only the usual link between actions and effects but also a link between decisions and effects. This is because the decisions made, particularly when made known to an adversary, can have a profound effect on the cognitive state of the adversary independent of the physical actions taken.

Network-Centric Planning

Figure 9 depicts a network-centric approach that offers the opportunity, when it is appropriate, for planners and executors to have a continuous and rich collaboration.

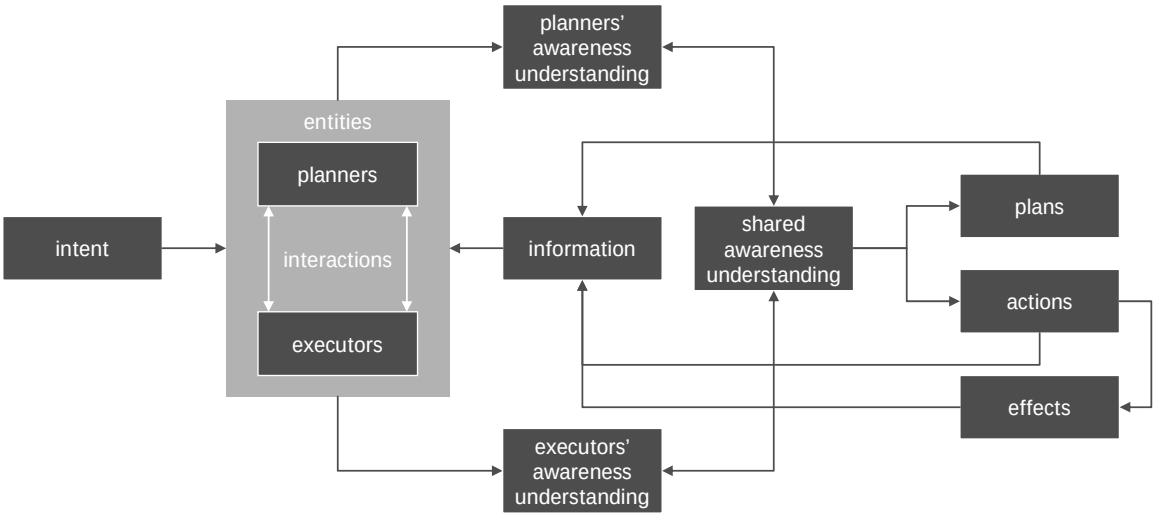

Figure 9.

In network-centric approaches, one does not think about two separate "networks" and sets of information, but one network where all participants are connected.

The Value View and Measures of Merit

Value-related variables or measures of merit are used to differentiate how well the functions depicted in Figure 8 and 9 are performed and the value or desirability (from a specific perspective) of the effects. Figure 10, Measures of Merit for Planning, depicts the value-related measures that are needed to explore and assess different approaches to planning.

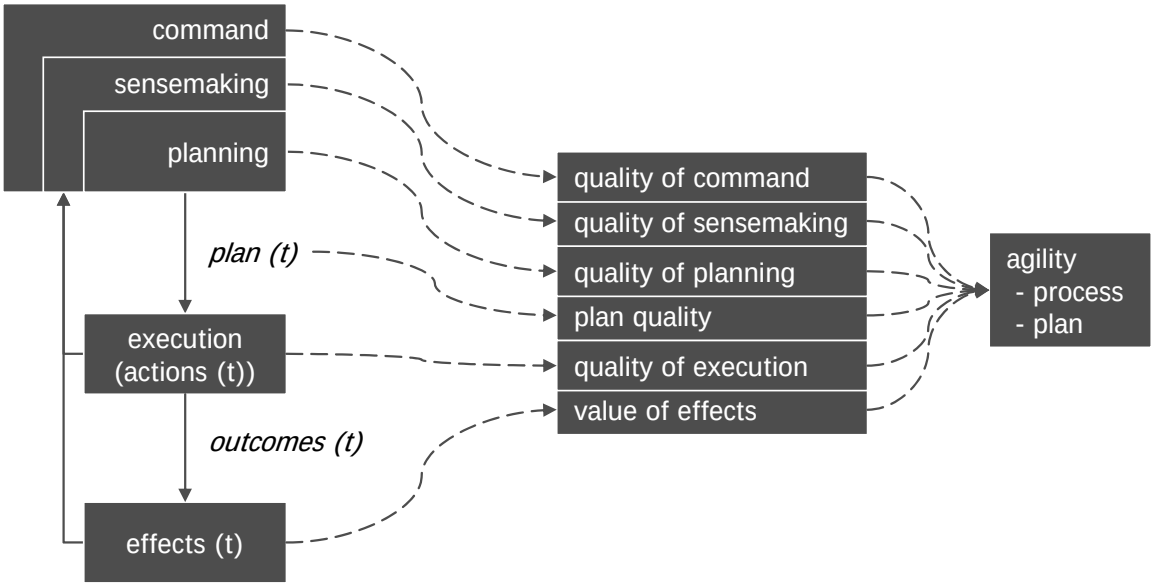

Figure 10: Measures of Merit for Planning

The value of outcomes was purposefully omitted from Figure 10 because the purpose of this campaign of experimentation is to explore planning for effects based approaches to operations (effects based planning). Exploring the hypotheses implied by Figure 10 to determine the extent of our knowledge should be a primary focus for the campaign in its early stages. It is a well known axiom in military circles that proper planning leads to effectiveness, although no quantifiable research exists. However, the ability of a plan to guarantee a good outcome is limited by a host of other factors including the quality of execution. Thus relying on outcomes to assess quality may be misleading.

We cannot simply assume that the relationships that have been previously observed between good planning and good outcomes will hold. In fact, the relationship between the quality of a plan and our ability to generate the effects we want may itself be a function of our approach to planning, the quality of that process, and our concept of what constitutes a plan. For this reason we need to include in this campaign of experimentation both experiments and analyses that test the hypothesized relationships among the measures of merit identified in Figure 10. The depiction of these relationships is referred to as the Value View and is shown in Figure 11.

The Value View depicted in Figure 11 needs to be "operationalized" before it can be applied to specific analyses or experiments. This involves refining the quality and value concepts in Figure 11 to the point that we have put those concepts into the context of the network-centric value chain and decomposed them into value-related variables that are amenable to measurement.

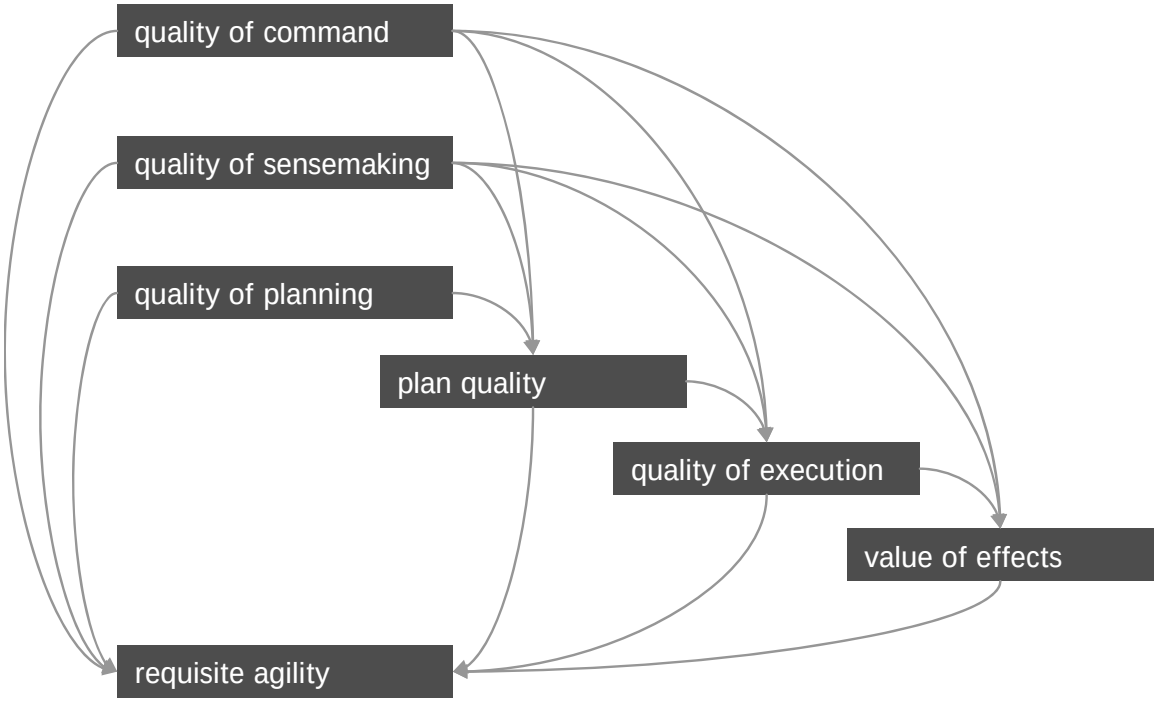

Figure 11: Conceptual Model: Value View

The six specific value variables shown, being derived from the key processes associated with planning and plans in Figure 10, have been assembled and the basic linkages among them are shown in Figure 11. This figure also introduces the cross-cutting concept of "Requisite Agility,"[117] which must also be considered when assessing alternative approaches to planning and plans. Note that all seven of these value variables have two things in common:

- They are composite variables, meaning that they are composed of more than one attribute and can only be assessed when (a) their components have been fully specified and (b) each component has been operationalized, either by direct measurement or by specifying indicants that provide valid, reliable, and credible measurement of the variables of interest. Quality of command, for example, is broken out into several different components, as is shown in Figure 12. No one of these aspects of command, in itself, is an adequate measure. The entire set must be considered when conducting an assessment.
- They are made up of both "absolute" variables and "fitness for use" variables. For example, quality of planning will include both measures of the time required to generate a plan (an absolute measure) and whether a planning process is rapid enough to seize opportunities, avoid dangerous threats, and

[117] Atkinson and Moffat, *The Agile Organization,* 126-127.

maintain continuity of operations in a given context (a fitness for use measure that reflects the timeliness of the process). Fitness for use measures can only be calculated within some context, while absolute measurements can be taken independent of particular context.

Requisite Agility

The concept of "requisite agility" is important in two different ways. First, it points out the requirement for planning processes and plans. As discussed earlier, the wide range of threats faced today, their dynamic nature, and the complexity of the environments in which they must be defeated make it imperative to avoid "optimizing" (perhaps more clearly said, "fixating") on an approach that handles only one type of threat or situation well. Hence, the value chain must reflect this need for agility, precisely as it has been defined for C2 in general: robustness, resilience, responsiveness, innovation, flexibility, and adaptation. The operationalization of agility requires that data be available from a variety of situations. Following the *NATO Code of Best Practice for C2 Assessment* (and recognizing that assessments of planning and plans are always C2 assessments), the goal is to sample the interesting, important, and relevant problem space. Of course, identifying that space and deciding how to sample it are challenges for any implementation.

Secondly, the idea of "requisite" agility, which has arisen in several discussions over the past few years and has most recently been explored by NATO SAS-065, appears to be important. The idea is related to the concept of "requisite variety" from cybernetics.[118] Rather than searching for an infinite amount of agility or viewing agility as an unmitigated good, the goal here is to ensure that the planning process and plans have adequate agility for the situation(s) at hand. This points, again, to sampling the interesting, important, and relevant problem space. As an example, if we assume that future operations are very likely to be multi-national, interagency, and involve a variety of non-governmental actors, our efforts to assess planning processes and plans must include situations where these actors are present and playing meaningful roles.

Quality of Command

Figure 12 provides the functions of command organized by domain. The Quality of Command can be measured by how well each of the functions identified in Figure 12 is accomplished. For example, is the allocation of resources appropriate for the situation? Given that there are invariably limited resources, tradeoffs need to be made regarding the tasks that are resourced and those that are not resourced or are only partially resourced. The metrics of quality for this decision are "fitness for use"[119] metrics. For all intents and purposes, an optimization model or algorithm will not exist and the quality of such

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[118] W. Ross Ashby, *An Introduction to Cybernetics* (London: Chapman & Hall, 1956), 206.

[119] NATO SAS-050, "Exploring New Command and Control Concepts and Capabilities." January 2006. http://www.dodccrp.org/files/SAS-050%20Final%20Report.pdf (Nov 2006)

decisions will need to be determined by (1) expert opinion and/or (2) a simulation model capable of exploratory analysis; one that accounts for adversary adaptation to changes in the allocation of resources.

Breaking down the "Quality of Command" variable into its constituent parts illustrates how each of the elements of the value chain must be treated in order to assess any given approach to planning and plans. The quality of intent (which also includes the "quality of the expression of intent" in the NATO Conceptual Model) is a direct attribute of the command function. The other elements can be classified as aspects of one of the four classic domains: physical, information, cognitive, and social. Note that the specific variables identified are a mixture of absolute and fitness for use measures.

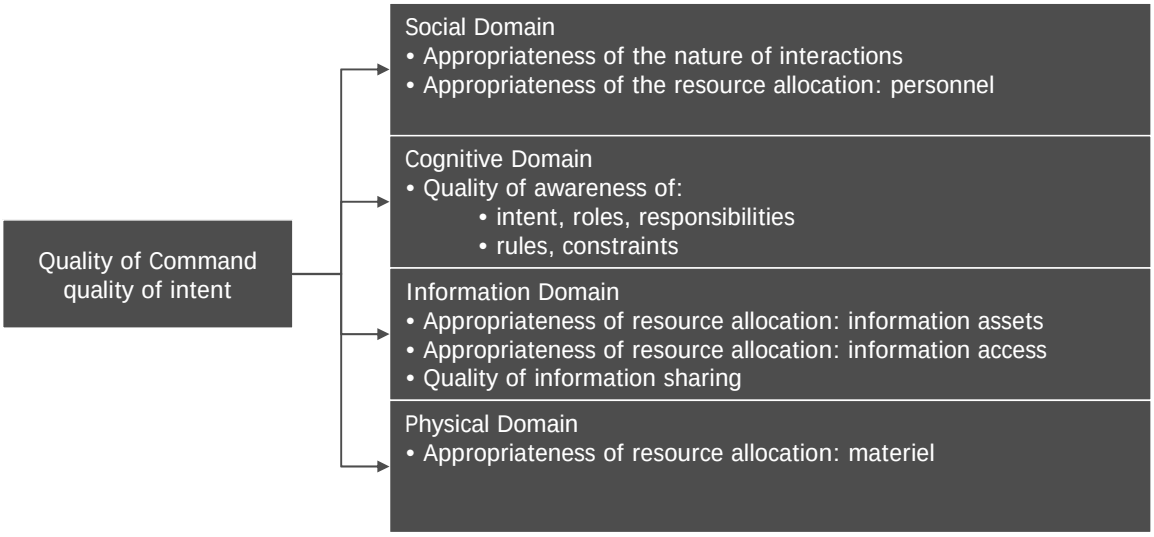

Figure 12: Quality of Command

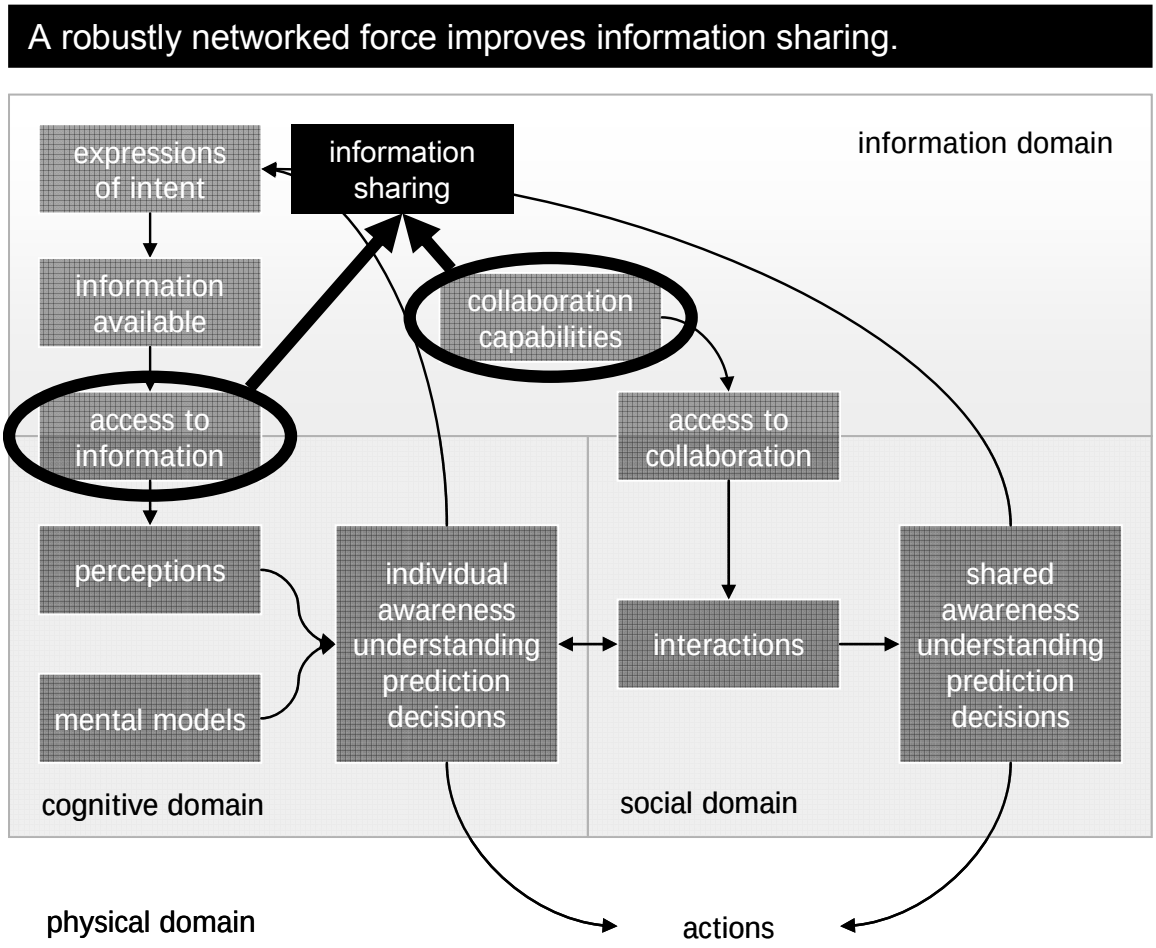

Figure 13: Value of Information and Collaboration

Quality of Sensemaking

Figures 13, 14, and 15 relate the components of the Quality of Sensemaking to the tenets of NCW that form its value proposition. Figure 13 graphically depicts one of the major characteristics of a robustly networked force, namely access to information and collaboration that is provided across the force and specifically to participants in an operation.

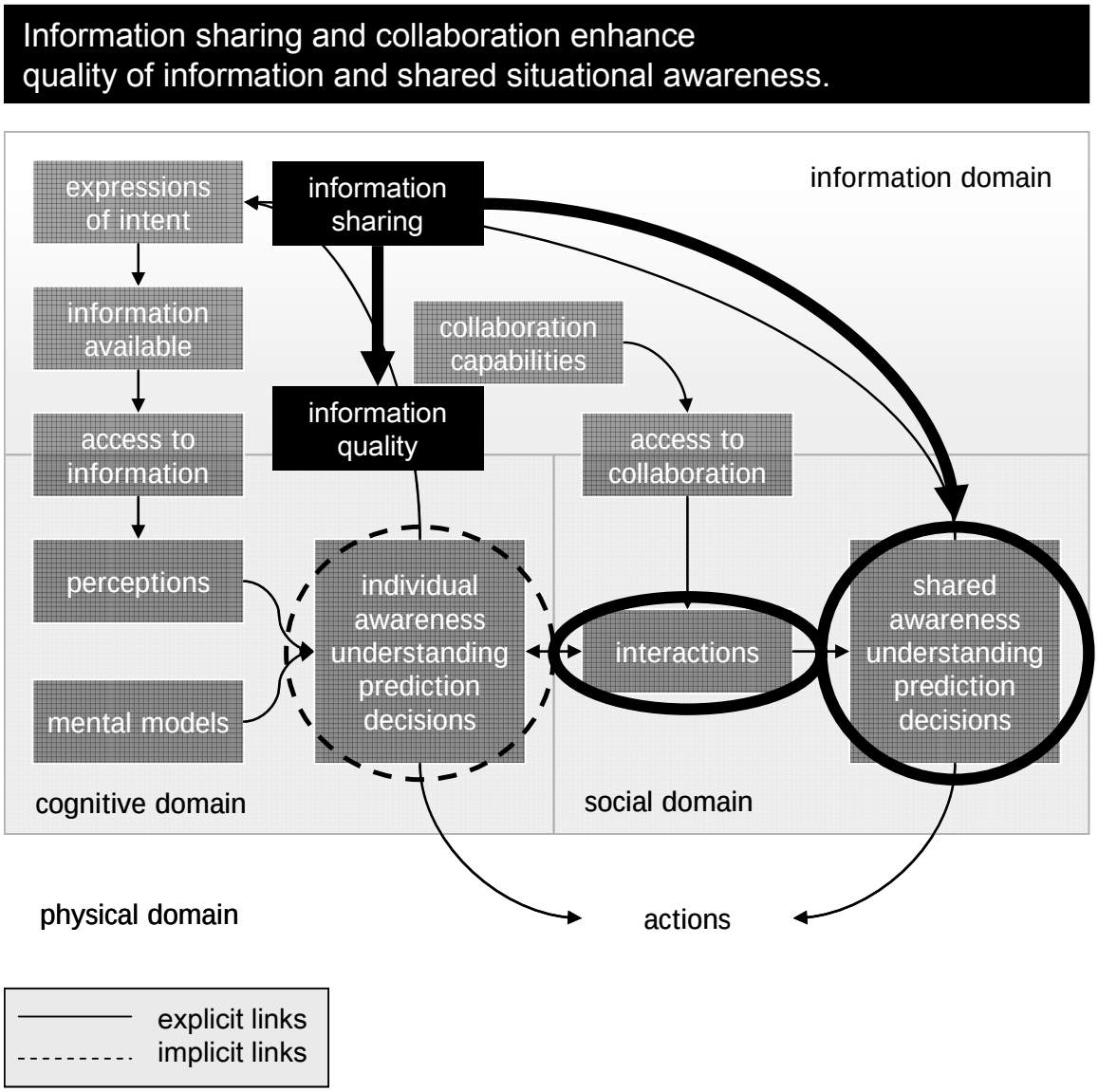

Figure 14: Improving the Quality of Information and Shared Awareness

Figure 14 depicts the proposition that increased sharing of information (information domain) and collaboration (social domain) improves both the quality of information and the quality of shared awareness. Implicit in this statement is that the quality of individual awareness is also improved.

The final link in the chain, depicted in the Figure 15, involves the relationship between shared awareness, collaboration, and self-synchronization. The hypothesis that, when the quality of shared awareness reaches some level, self-synchronization is enabled, may be self-evident. Nevertheless, this is one of the hypotheses that should be explored as part of this campaign of experimentation.

The apparent two-way relationship between collaboration and shared awareness requires some explanation. Collaboration (working together for a common purpose) is an umbrella term that applies to a variety of activities that vary in degree and intensity. Collaboration is a social domain activity but the object of collaboration can be in the information, cognitive, social, and/or physical domains. Sharing of information falls short of collaboration but is expected under the right circumstances to result in collaboration aimed at sorting good information from bad or improving information by fusion or integration. This form of collaboration can evolve into interactions that involve the meaning and interpretation of information. Collaborative decisionmaking usually involves a redistribution of decision rights. Self-synchronization is a form of collaboration in the physical domain. Thus, while collaboration in the information domain aimed at the sorting and understanding of information can lead to improved information, awareness, and shared awareness, it can also lead to richer forms of collaboration.

The building of trust is an important factor in this movement up the scale of collaboration. The richer forms of collaboration, particularly those that involve a redistribution of decision rights, are enabled and facilitated by shared awareness. Thus, the two-way relationship between collaboration and shared awareness involves different types of collaboration. The conditions necessary for this relationship to hold, such as trust and competence, need to be identified and examined both analytically and experimentally.

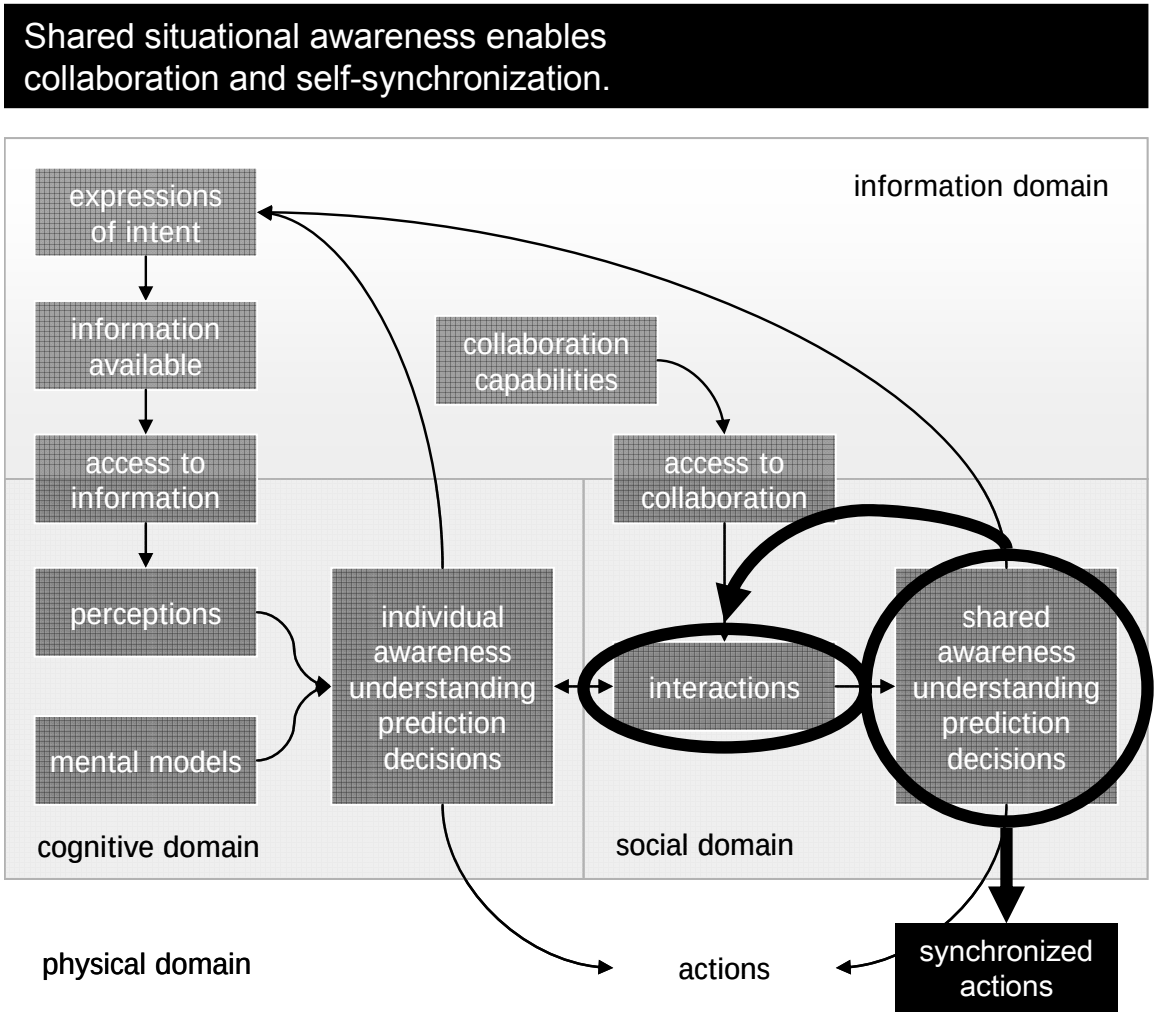

Figure 15: Achieving Self-synchronization

Quality of Planning and Plan Quality

The value in planning comes from the process and not the plan. This is because, as Prussian General Field Marshal Helmuth von Moltke said, "no plan survives first contact with the enemy."[120] As the situation changes and as plans fail to achieve their desired effects, plans needs to be reassessed and modified or sometimes even completely replaced. Traditional methods of assessing the quality of a plan looked at how long the plan remained viable, that is, how long did the plan survive without needing to be adjusted, and how long did it survive without needing to be replaced?[121] This is not an

[120] Tsouras, *The Greenhill Dictionary of Military Quotations*, 363.

[121] Richard E. Hayes, Richard L. Layton, William A. Ross, Jan W.S. Spoor, and Theresa A. Hollis, *Enhancements to the Army Command and Control System* (Vienna: Evidence Based Research, Inc., 1993).

adequate measure in and of itself and may, in fact, be misleading. This is because the length of time that a plan survives is a function, not only of its quality, but of how ambitious it is. More conservative plans may survive longer than aggressive plans, but in the final analysis, may not be as effective in achieving the desired effects. In addition, different approaches to planning require different actions to be taken when things do not go according to plan. Thus, what constitutes the survival of a plan differs. For these reasons, these traditional metrics and approaches to assessing the quality of a plan may not be particularly useful in the Information Age or may need to be supplemented with other measures. Here, again, assessment of unstated conditions such as risk and risk propensity will need to be introduced both analytically and experimentally.

There are *objective* measures of planning process quality and plan quality (ones that can be measured relative to an objective standard). There are also *fitness* measures that relate to the quality of a plan in a specific context. Objective measures of the planning process include the time and resources required to produce a plan of some given size and level of detail. An objective measure of plan quality would be its completeness (conditioned on the approach to planning that is being taken). An example of a fitness measure of the planning process would be the timeliness of the plan, that is, when the plan was produced relative to the need for a plan, given the situation. Two fitness measures for plan quality are its *feasibility*, the extent to which the plan can be implemented, and its *relevance*, the extent to which the plan relates to achieved intent in the context of the situation.

In general, it is easier to collect data that provides values for objective measures, like the time it takes to produce a plan, and more difficult to assess fitness measures, such as relevance or feasibility. The exception is when data is being generated by simulations or in controlled experiments. In these cases, when ground truth is known, it is far less difficult to determine values for fitness measures. A conceptual model and an instrumented working model that instantiates the appropriate variables and relationships provide what is required to generate the data that is needed. Parametric assessment should then be conducted.

Agility

Agility is the appropriate response to uncertainty and risk. Agility is an attribute of a process and the products of a process. Agile command and control, sensemaking, planning, and execution individually and in combination guard against surprises, are more likely to be responsive, can make up for not getting it absolutely right initially, and thus, other things being approximately equal, will tend to be both more effective and efficient. Agility is a scenario-independent measure of merit, one that should figure prominently in any campaign of experimentation designed to explore approaches to planning and plans. Indeed, agility must be assessed across a set of situations or scenarios.

Agility is a multidimensional concept that is predicated on the achievement of a threshold level of effectiveness. In other words, by definition, one cannot be ineffective *and*

agile.[122] As noted earlier, the dimensions of agility[123] include: responsiveness, robustness, flexibility, innovativeness, resilience, and adaptability.

[122] "Leadership Agility: Definition," *Changewise*. http://www.changewise.biz/la-definition.html (Nov 2006)

[123] Alberts and Hayes, *Power to the Edge*, Chapter 8.

Chapter 8. Maturity Models

The Network-Centric Maturity Model, Figure 1 in the Introduction, was introduced in *Understanding Information Age Warfare* and conveyed to Congress in 2001.[124] This model was created in order to clarify how a force could move logically and smoothly from traditional (Industrial Age) command and control policies and practices toward network-centric command and control. It actually follows the logic of the tenets of Network Centric Warfare by indicating that information sharing is the first step because it is a requirement for the other changes needed. It then recognizes that collaboration is the next crucial element. Together, shared information and collaboration enable the elements of a force to generate shared awareness. Only when a sufficient level of shared awareness has been achieved is self-synchronization possible. Hence, the Network-Centric Maturity Model can be seen as both a guideline for those who want to move toward net-centricity and also a measurement scheme by which progress can be assessed.

Indeed, it is possible to argue that movement between maturity levels in this model is a natural progression and will occur if (a) the necessary linkages are established, and (b) the actors within the system are not prevented from taking advantage of them. In simple terms, allowing actors to share information sets the stage for them to collaborate about (a) differences in the information available to them and (b) what that information means. As they have those discussions, it becomes a small step to begin collaborating (working together for a common purpose), not only on the information itself, but also working with one another to explore what that information means and the characteristics of the situation it describes. Hence, collaboration enables shared situation awareness. Shared situation awareness is one of the requirements for self-synchronization (though there are other requirements as well, including perceptions of competence and mutual trust among the actors). However, actors with shared situational awareness are in an excellent position to collaborate in identifying useful actions and planning for them.

Maturity models are not only conceptual but are analytic tools that help us understand the patterns visible in the "real" world of organizations and operations. Hence, while it may be possible to characterize the overall level of maturity of a given endeavor, it is likely that different elements of that endeavor are at meaningfully different levels of maturity. For example, the logistics element of a military force may not have the same level of network-centric maturity as the fighting forces, or the NGO participants in a disaster relief effort may have a very different level of C2 maturity than the military organizations supporting them.

Planning Maturity Model

To support exploration, a new planning approach, a maturity model specifically developed for planning, is needed. While it was possible to build on the widely accepted model previously developed for NCW, this planning maturity model needed some new

[124] "Network Centric Warfare Department of Defense Report to Congress." July 2001.

language and ideas. Figure 16, the Planning Maturity Model, resulted. This model also reflects some of the intellectual developments that have occurred over the past five years since *Understanding Information Age Warfare* was published.

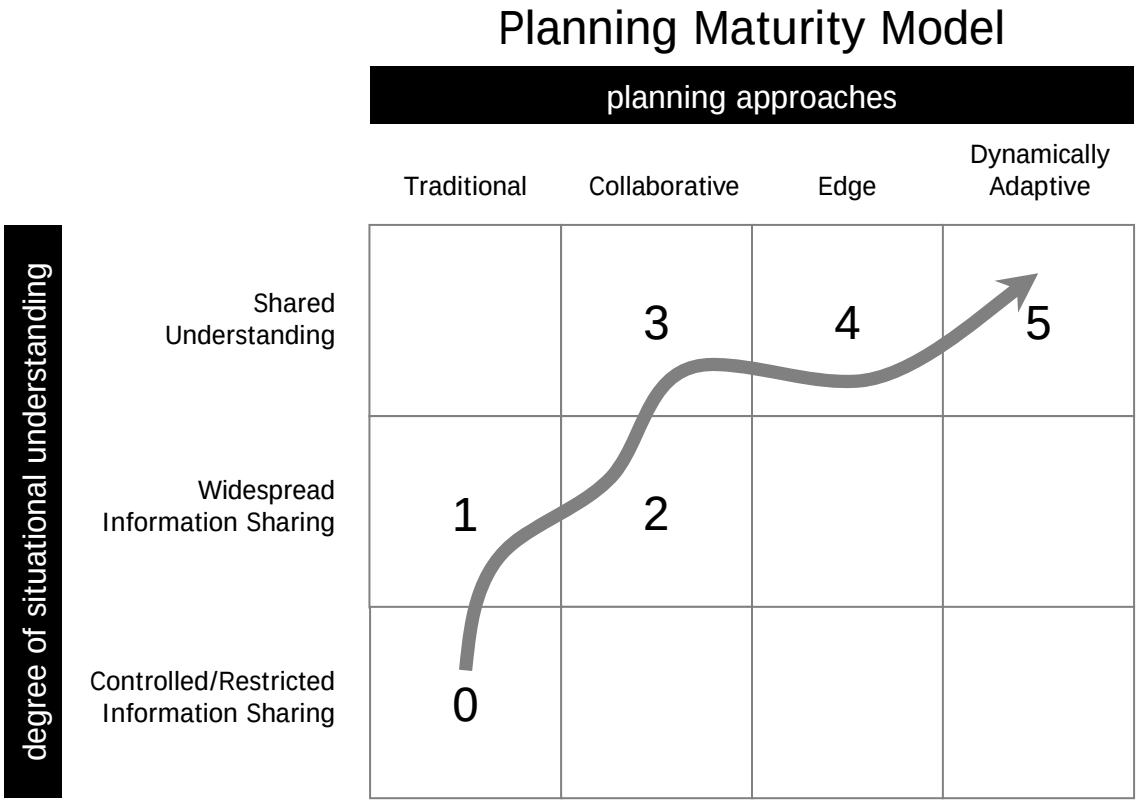

Figure 16: Planning Maturity Model

The vertical axis of the Planning Maturity Model deals with the degree of situation understanding achieved. The three regions recognized are (a) controlled/restricted information sharing, (b) widespread information sharing, and (c) shared understanding. Hence, this axis (understanding) focuses on two concepts – the distribution of information across the elements engaged in the endeavor and the extent to which that information is brought together to generate an understanding of the situation. The choice of the term "situation understanding" takes the information position beyond the state of "shared awareness" recognized in earlier work. Awareness, as the term is used, deals with what people know (cognitive domain) about the current situation and the obvious emerging situation (what is currently happening and about to occur – e.g. two opposing forces moving toward one another are about do battle, or a warehouse that is nearly empty of food and located in an active refugee camp is about to be empty) to include perceptions of cause and effect and the temporal dynamics of the endeavor. Understanding is required for planning because (a) planners can only impact future events and (b) successful planning is informed by a grasp of the effects that can be expected.

The horizontal axis of the planning Maturity Model focuses on the planning approach taken by those participating in the endeavor. The least mature endeavors employ traditional planning processes in which each element does its own planning relatively independently. Collaborative planning, in which the planning processes are more integrated, form a second level of planning approach. Edge approaches, which are substantially more richly linked, but confined to the particular endeavor, are also distinguished. The most mature type of planning approach is one where the planning efforts are dynamically reconfigurable. This is the most likely approach for achieving requisite agility.

The path of progress through the Planning Maturity Model begins in the left-most bottom cell with traditional planning approaches and controlled or restricted information sharing. This is where many coalitions of the willing and civil-military partnerships in complex endeavors begin. As with Network-Centric maturity, information sharing is the first and most fundamental step needed to move forward. When this is coupled with a collaborative process, planning becomes more mature. This collaboration, in turn, will (with proper tools available and appropriate processes) yield shared understanding among the planners from the elements engaged in the endeavor. This provides the basis needed for edge planning. If the endeavor extends over time such that the challenge(s) it faces morph into a form that requires change or is used in different contexts, the opportunity (and necessity) for dynamic reconfiguration becomes relevant.

NNEC Command and Control Maturity

The levels of planning maturity discussed here are a reflection of the insights developed in recent work with a NATO Working Group, SAS-065. This working group is charged with the development of a NATO Network Enabled Command and Control Maturity Model (N2C2M2). Their intention is to create a maturity model that can both provide guidance to the NATO nations as they seek to develop the C2 approaches and capabilities needed for them to analyze to contribute to the goal of NATO Network Enabled Capability (NNEC). The work and products of this group will offer NATO a way to measure progress toward NNEC in the C2 arena, one that can be employed by both individual nations for their forces as well as NATO forces such as the NATO Response Force (NRF) or NATO supported coalitions of the willing such as those in Afghanistan or peacekeeping operations. While this group has just begun its work at this writing, it has some very important ideas.[125]

The N2C2M2 is not like the other maturity models introduced so far because it is in a single dimension. This is a reflection of the intent of its authors to avoid prescribing how to achieve different levels of maturity and to focus instead on the capabilities required at each level and how those capabilities can be recognized. In other words, it is primarily an

[125] After several NATO panels developed the NATO Code of Best Practice for C2 Assessment, SAS-026 was formed to explore the application and extension of the COBP to C2 issues in the context of Operations Other Than War (OOTW).

effort to identify meaningfully different levels of capability and to provide operational definitions for each of those levels.

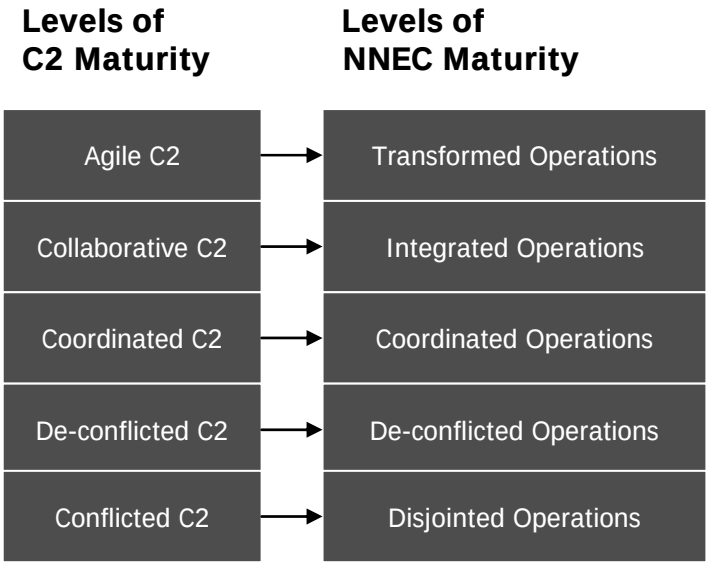

Figure 17: NATO NEC Maturity levels

As the C2 maturity level increases from conflicted to agile C2, one or more of the characteristics of the approach to command and control changes. This results in approaches to C2 that correspond to a given level of maturity being located in different parts of the C2 approach space.[126] For example, one of the dimensions of the C2 approach space is the extent and nature of the interactions among participants (in this case the contributing elements and the individuals and groups of individuals that comprise them). As the maturity of C2 increases, the frequency of the interactions among those entities increases and their focus shifts from the Information Domain (from sparse to rich exchange of information) to the Cognitive Domain (from low to high degrees of shared awareness) and to the Social Domain (from low willingness to share resources to high sharing of resources as perceptions of mutual trust and competence increase). These transitions are key "tipping points" associated with qualitatively different NNEC maturity levels. In fact, one of the results of these analyses is that it becomes clear that entities have greater capability to work together as the level of C2 maturity increases. Finally, it should be noted that each N2C2M2 maturity level incorporates the ability to operate at any one of the maturity levels below it. This offers the enterprise a choice of how best to match its capabilities to the problem at hand.

[126] Alberts and Hayes, *Understanding Command and Control*. 73-76.

NNEC Maturity Levels

The labels used for NNEC Maturity levels (right-hand side of Figure 17) were chosen to reflect the way NATO documents have defined NNEC maturity (capability) levels.[127] However, the language used here is somewhat different from that used within NATO in the following two ways: (1) NATO does not recognize Disjointed Operations and (2) NATO's highest level is termed Coherent Operations. Using the term "coherent operations" implies that lesser levels of capability are somehow incoherent, which would be inappropriate. Hence, we prefer and have used the term "Transformed Operations" indicating that this level is achieved only after the disruptive innovation needed for 21st century missions has been achieved. These language differences take on added meaning as the logic underlying them is explained below.

SAS-065's focus is not on NNEC writ large, but on the C2 inherent in (and required for) the different levels of NNEC maturity. The NNEC C2 maturity levels depicted on the left-hand side of Figure 17 are:

- Conflicted,
- De-conflicted,
- Coordinated,
- Collaborative, and
- Agile.

These levels are fractal in that they can be applied, at least in theory, to groups of individuals and organizations of any size. The discussion below applies these concepts to the coalition as a whole, not based on the manner by which contributing entities approach C2, but rather how the *collective* endeavor approaches C2.

The focus is on situations where there are two or more cooperating force elements (entities) present and where one or more of the following conditions exists: the entities have overlapping intents, the entities are operating in the same area at the same time; and the actions taken by an entity can come into conflict with those taken by one or more other entities.

The temporal dynamics of the situation and the timeliness requirements associated with a response may vary widely. Clearly, the appropriateness of a particular C2 Approach as well as the selection of an option involves considering responsiveness. The discussions that follow assume that the frequency of information sharing, the frequency of interaction, and (in selected C2 Approaches) the ability to change decision rights all match the mission requirements.

Information sharing, collaboration, and other forms of working together all require willingness on the part of the involved entities. Such willingness is assumed in all the

[127] David S. Alberts and James Moffat, "Description of Maturity Levels for NNEC C2" (SAS-065, 2006).

discussions that follow except in the Conflicted C2 level. However, as a practical matter it is possible that entities will agree to operate at a certain level of maturity but not have the willingness, or have limited willingness; to do what is necessary to make the selected C2 Approach work. For purposes of this discussion, this is considered a failure to implement.

C2 Objectives by Maturity Level

Each of the five N2C2 maturity levels differs meaningfully from the others in terms of the C2 approach. Note that each entity is expected to have its own C2 Approach, one that may or may not be fully compatible with the approach adopted (or defaulted into) for the collective. Those C2 objectives, for each level are:

- Conflicted C2: None. The only C2 that exists is that which is exercised by the individual contributors over their own forces or sub-elements.

- De-Conflicted C2: The avoidance of adverse cross-impacts between and among the participants by partitioning the problem space.

- Coordinated C2: To increase overall effectiveness or efficiency by (1) seeking mutual support for intent, (2) developing relationships and linkages between and among entity actions to reinforce or enhance effects, (3) pooling resources to accomplish things that are not otherwise possible, and (4) increasing sharing in the Information Domain in order to increase the quality of information.

- Collaborative C2: to develop significant synergies by (1) negotiating and establishing shared intent, (2) establishing or reconfiguring roles, (3) coupling actions, (4) sharing non-organic resources),[128] (5) pooling organic resources,[129] and (6) increasing interactions in the Cognitive Domain to increase shared awareness.

- Agile C2: To provide the endeavor with additional C2 approach options that involve entities working more closely together and with the ability to identify and implement the most appropriate C2 Approach given the situation (e.g. mission, operating environment, and set of coalition partners or contributing entities). This level implies requisite agility.

C2 Maturity Levels and the C2 Approach Space

As noted earlier, approaches with different levels of C2 maturity occupy different regions within the C2 Approach Space. The three interrelated dimensions of that space include:

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[128] "Non-organic resources" refers to those not "owned" by participants, such as access to roads or bridges.

[129] "Organic resources" are those "owned" by a participant such as vehicles, weapons, or supplies.

the distribution of decision rights, the patterns of interaction among the entities (individuals and organizations, which can be nested), and the distribution of information. Figure 18 provides a graphic representation of the mappings involved.

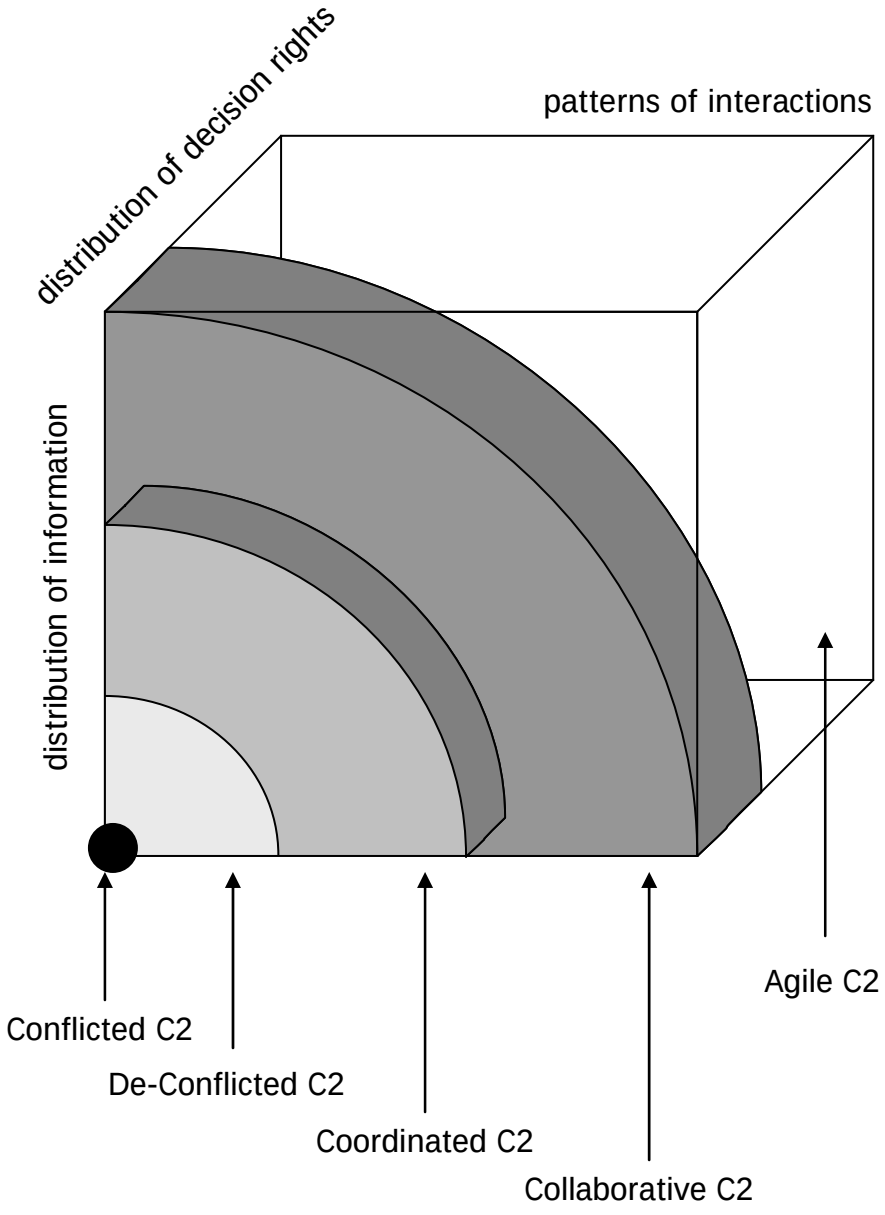

Figure 18: The Levels of C2 Maturity Mapped to the C2 Approach Space

Conflicted C2: Given that the only command and control that exists at this maturity level is the organic C2 within each of the entities, it is assumed that this level corresponds with the origin of the cube (lower, left, front). That is, all decision rights are retained within each of the entities; there are no interactions between or among the entities; and there is no meaningful exchange of information between or among those entities.

De-Conflicted C2: In order for the entities to de-conflict their intents, plans, and actions, they need to be able to recognize potential conflicts and attempt to resolve them. This involves limited information sharing and limited interactions. It does not require any changes in decision rights, although once a decision has been taken to de-conflict, that decision becomes a constraint on each of the entities. Thus, a decision to de-conflict is not a redistribution of decision rights, but the taking of a decision by previously authorized entities. Given the limited nature of the information exchanges and the interactions required, a de-conflicted C2 Approach occupies a small, two-dimensional region near the origin of the approach space. It moves away form the origin only on the dimensions of interactions and information distribution.

Coordinated C2: Coordination involves more than an agreement to modify intent, plans, and actions to avoid potential conflicts. It involves the development of a degree of shared intent and an agreement to link actions in the separate plans being developed by the individual contributors (elements or entities). This, in turn, requires a significant amount of information sharing (broader dissemination) and a richer set of interactions, both formal and informal (relative to those required for de-confliction) among those in the various elements involved in establishing intent and developing plans. However, it is unlikely that the interactions between the entities are continuous. While this approach does not require major changes in the allocation of decision rights, it does require that decisions with respect to intent and plans be constrained by shared intent and linked plans. Hence, the region of the C2 Approach Space that corresponds to this level of C2 maturity occupies a three-dimensional space that extends meaningfully along the interactions and information distribution dimensions and a small distance along the distribution of decision rights dimension.

Collaborative C2: This maturity level involves a substantial amount of shared intent and it involves the collaborative development of a single, shared plan. The intents of the entities or elements of the endeavor are subordinated to shared intent unless they do not conflict with or detract from that shared intent. Similarly, entity plans need to be supportive of the single, integrated plan. Entities operating at this level of C2 maturity accept symbiotic relationships and are interdependent. Continuous interactions between and among identified individuals and the organizations they represent will involve richer and more extensive exchanges in both the Information and Cognitive Domains. These interactions are required to establish and maintain shared understanding and the development of a single broad plan. This maturity level corresponds to an area in the C2 Approach Space that extends across almost the full range of the interaction and information dissemination dimensions and over a substantial portion of the of the allocation of decision rights dimension. Once shared intent has been negotiated and established and an agreement has been reached on an integrated plan, participating entities are delegated the rights to develop supporting plans and to dynamically adjust those plans collaboratively. The real delegation that occurs here takes place when this approach to C2 is selected/accepted by the participants. This decision delegates the power to develop (often in a negotiated fashion) the single integrated plan to the collective.

Agile C2: This level of C2 maturity is distinguished from the previous level by (1) the addition of the option to self-synchronize, as well as (2) the ability to recognize which approach to C2 is appropriate for the situation and adopt that approach in a dynamic manner. The ability to self- synchronize requires a rich, shared understanding across the contributing elements. This, in turn, requires a robustly networked set of entities, each with easy access to information, that extensively share information, with rich and continuous interactions, and with the broadest distribution of decision rights. Agile C2 allows the collection of entities to operate virtually anywhere in the C2 Approach Space, including reaching into the corner furthest from the origin, a space associated with Edge organizations and requisite agility.

Discussion of C2 Maturity Levels

For each C2 maturity level, this section identifies the objective, describes what the C2 function seeks to achieve, discusses some of the implications for the collective and for the contributing entities, and locates the maturity level in a region of the C2 Approach Space.

Conflicted C2: It should be kept in mind that, at this level, no C2 is being exercised at the endeavor or collective level. Each entity is pursuing its individual intent and taking independent actions. Entities are operating in the same physical or geographic space without communicating with, sharing information with, or engaging in any C2-related interaction. This means that there is no way to avoid some 'negative cross-impact' between or among force elements. This also means that some actions will, in all likelihood, lead to adverse interactions, actions that interfere negatively with others. In other words, some of the actions of the independent entities are in conflict and increase costs, degrade effectiveness, or both. At times, the actions of one entity may preclude the intended actions of other entities. The net result is that the option space for mission accomplishment is less than the sum of the option spaces of the individual entities. The sum is less than the sum of its parts and, to the degree it is less, there are opportunity costs. There may be some situations where the probability of adverse impacts is low, the consequences few, and the costs of moving to a higher C2 maturity level are high, or it is not possible (e.g., due to politics or time) to make the move to a more mature level of C2. Only in such limited circumstances would this (non) approach to C2 be suitable. For example, in the very early stages of disaster relief (e.g., post-Tsunami) operating at this C2 maturity level may be unavoidable. However, to succeed in any reasonably complex endeavor, the C2 approach will need to evolve over time to a higher maturity level.

De-Conflicted C2: Entities that wish to de-conflict must be willing, at a minimum, to accept some constraints on their plans or actions. In return, they hope to avoid or remove adverse cross-impacts. Limited peer to peer interaction in the Information Domain must be sufficient to dynamically resolve potential cross-impacts. Total effectiveness approaches 'the sum of the parts' in the limit at this level of C2 maturity. The main emphasis is still on vertical interaction along 'stove-piped' chains of command within each entity. This approach to C2 allows partners with different C2 levels of maturity to work together, co-existing in the same operational space. The nature of the constraints

imposed will vary, but may include the creation of boundaries (exclusive areas assigned to a given entity) along time, space, function, and/or echelon lines. This serves to constrain each entity's' option space. Planning is required to establish the initial conditions (the decompositions or boundaries). This may be a lengthy process. Should these boundaries need to be changed, re-planning is generally cumbersome and slow. The boundaries become fault lines and are themselves targets; vulnerabilities to be protected. This C2 level of maturity is most appropriate when the situation, goals and the response are stable and decomposable in terms of objectives, space, time, and function (no cross impacts). Hence, the situations that can be effectively handled by de-confliction are complicated, but not complex.

Coordinated C2: The previous C2 maturity level does not require any linking of plans or actions. This level of maturity involves seeking opportunities to generate synergies by linking the plans and action(s) of one entity with those of another. In this manner, actions may reinforce each other in the action or effects spaces or they may, in effect, combine resources to achieve a necessary threshold for effective action or significant effects. Total effectiveness is more than the sum of individual actions. The option space expands for participating entities. However, planning time may increase as a function of the number and nature of the links between and among plans. This level of maturity begins to make it possible to form "task organized' forces with contributions from different entities to simplify interactions across the air, land and maritime domains, and other non-military actors. This level of maturity is appropriate for decomposable problems in terms of objectives, space, time, and function as long as they have limited cross impacts.

Collaborative C2: This level of maturity involves sharing of resources in addition to a requirement for more information sharing and richer interactions between and among the entities. It envisions going beyond specific and explicit links between and among plans to the collaborative development of a shared single plan that establishes symbiotic relationships. Total effectiveness is significantly more than the sum of individual actions due to the synergies that are created. The option space is significantly expanded. Entities plan in parallel, basing their individual plans on the shared plan. Because of this, planning times can be reduced. This level of maturity may involve the use of 'positive control'[130] to allow richer peer to peer inter-working. To a far greater extent than is present in lower levels of C2 maturity, entities become interdependent. This is possible if and only if trust has been developed a priori or has been achieved as a product of developing the necessary shared understanding required to create the single plan. As a consequence, risk is pooled (as it would be through insurance). This level allows the full implementation of task organized forces across the endeavor. This C2 maturity level is appropriate for problems that are not fully decomposable in terms of objectives, space, time, and function and thus for which, a holistic approach is desirable.

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[130] Positive control allows the superior commander (military or civilian) to be informed of such interchange, and to intervene only when he/she can see that such an interchange would not match with higher level, more strategic requirements.

Agile C2: Reaching this level of C2 maturity is predicated upon achieving a high degree of shared understanding of a common (collective) intent. It also requires a rich and continuous set of interactions between and among participants, involving widespread information exchanges to allow the build up of trust, shared understanding, and the willingness and ability (where appropriate) to self-synchronize The increased effectiveness that can be achieved can be accompanied by a potential reduction in the total resources required. Furthermore, as its name implies, this level of C2 maturity is inherently agile, making it relevant for situations characterized by high dynamics, uncertainty, and complexity.

The ability to achieve a given level of C2 maturity, that is to move from any level to the next higher level requires the addition of one or more key capabilities that in turn require improvement in the "info-structure" and changes in C2 concepts and processes. This section identifies some of these transition requirements.

- From Conflicted to De-conflicted: The following C2-related tasks must be accomplished: identification of potential conflicts, resolution of conflicts by establishing constraints and/or boundaries. In order to accomplish this, limited communications involving some individuals and limited information exchanges are required.

- From De-conflicted to Coordinated: The following two C2-related tasks must be accomplished: development of limited shared intent and the development of links between and among individual plans and actions. In order to accomplish this, a coordination process needs to be established, that is, supported by sufficient communications and information-related capabilities involving appropriate individuals as well as necessary information exchanges.

- From Coordinated to Collaborative: The following C2-related tasks must be accomplished: development of shared intent, shared understanding and trust, development of a single integrated plan, and parallel development of entities' plans that are synchronized with the overall plan. In order to accomplish this, a set of collaborative processes needs to be established supported by a sufficiently robust and extensive distributed collaborative environment available to all appropriate individuals and organizations.

- From Collaborative to Agile: The following C2-related tasks must be accomplished: development of shared intent, awareness and understanding. In order to accomplish this, power to the edge principles and associated doctrine must be adopted supported by a robust, secure, ubiquitous, interoperable, infostructure that extends to all participating entities.

A conceptual model of planning would not been complete unless it contained a maturity model for planning that provided links to a C2 maturity model.

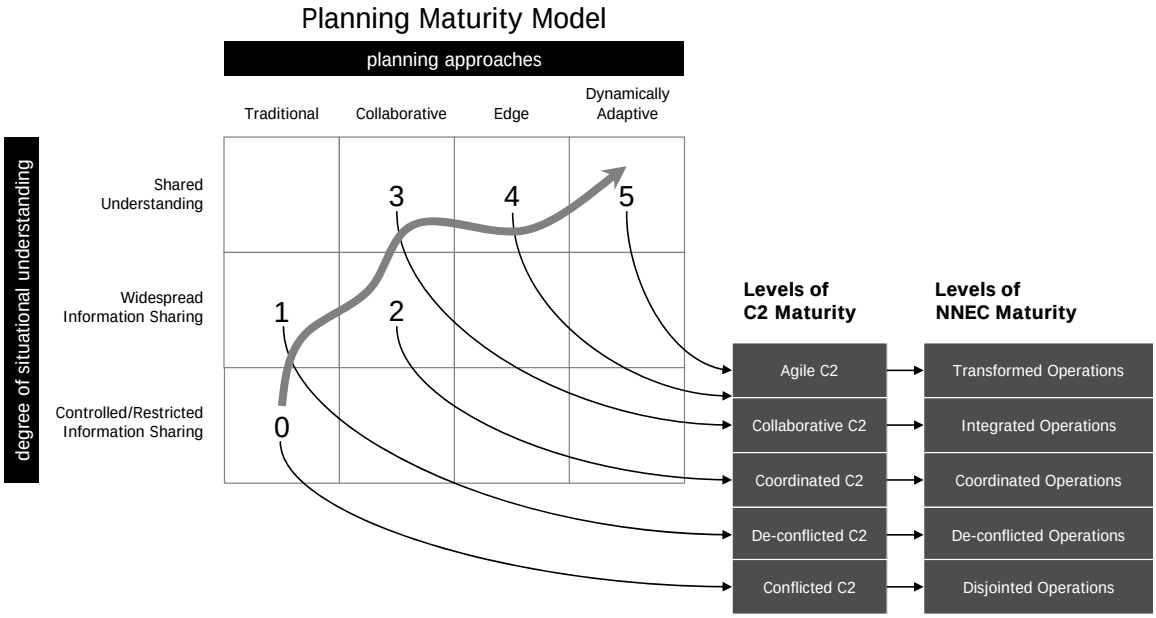

Figure 19: Linked NEC, C2, and Planning Maturity Models

The Maturity Models for NNEC, NNEC C2 and Planning are brought together in Figure 19, which maps (1) planning maturity to C2 maturity and (2) planning maturity to NEC maturity.

Note that Conflicted C2 will, by definition, be associated with controlled or heavily restricted information sharing (information will not be shared across organizational boundaries) and traditional planning (meaning independent planning by each element of the force). This represents Position 0 in the Planning Maturity Model.

As information sharing becomes more widespread, a more mature type of planning becomes possible (Position 1) because the planning within each element is now performed within the context of considerable knowledge about the boundaries between functions and organizational areas of responsibility. Hence, while still independent, the resulting plans should not create negative cross-impacts. This corresponds to De-Conflicted C2.

As collaborative planning becomes possible, Position 2 becomes available because selected activities become synchronized (purposefully organized in time and space) in order to achieve synergies in some specific efforts. This is intended to generate synergistic effects. Position 2 is the first level of planning maturity at which such synergies are consciously sought during the planning process and corresponds to Coordinated C2.

Moving to Position 3 becomes possible as the level of information sharing and collaboration allow the different elements of the endeavor to achieve shared

understandings, which means that they see the problem in the same way and can agree on the classes of activities in which they expect to have positive effects. If this is accompanied by a change to collaborative planning processes, all the requirements for Position 3 are fulfilled. However, to achieve this level the interactions (information exchanges, collaborative planning processes) will need to be, for all intents and purposes, continuous. That is, the frequency is matched to the dynamics of the situation. This level of planning maturity maps to Collaborative C2.

Achieving Position 4 implies more than collaborative planning processes and shared understanding. The requirement becomes one in which every element of the force is willing to depend on the other elements for crucial support and resources. Hence, the level of planning moves beyond collaboration – each element accepts an overall, negotiated set of intents and approaches to mission success and subordinates its own planning efforts to that construct. Hence, each force element sees itself as both the "main effort" and also a crucial "supporting effort" upon which others must depend. Agile C2 also requires self-synchronization, the ability to dynamically adapt. This represents the capability to identify and execute at the requisite level of agility.

Chapter 9. Campaigns of Experimentation

The Industrial Age approach of centralized planning and decentralized execution is in the process of being replaced by Information Age, network-centric approaches designed to move seamlessly to integrate planning and execution. While new patterns of information sharing and altered distributions of roles and responsibilities will be required, there are many questions that need to be answered and a wide variety of approaches that need to be explored and assessed before it is understood when and under what circumstances these new approaches should be employed. To generate the information necessary to answer the questions (and ask the right questions) and to sort out the more promising approaches from the less promising approaches, a campaign of experimentation, accompanied by focused research, needs to be undertaken.

As in science generally, theories (in this case, new approaches to planning) are falsified by experimentation. Thus, experiments are essentially checks on the validity of scientific hypotheses. In our case, models and hypotheses are our theories and the role of experimentation is exactly the same as in good science.

A Campaign of Experimentation is not just a collection of experiments but involves a series of steps in moving from concepts to capabilities and serves as "a process that (1) combines and structures experimental results much in the way that individual bricks are fashioned into a structure for a purpose, and (2) steers future experimentation activities."[131]

Nature of a Campaign of Experimentation

A campaign of experimentation is a journey from the general to the specific. In this case, it involves moving from concepts to capabilities and from hypotheses to understandings. A campaign of experimentation is a balancing act involving tradeoffs between variety and replication. Unlike the natural progress of science where experiments are, at the very best, loosely coupled and depend on the abilities and desires of a set of independent actors, a campaign of experimentation is a focused activity where the selection and sequencing of experiments and research activities are a reflection of coherent decisionmaking. If properly conceived, designed, and executed, campaigns of experimentation can be far more efficient and achieve results in a shorter period of time.

Risks and Remedies

To the extent that they are orchestrated and hence reduce choice, campaigns of experimentation are subject to a number of risks.

Joint Forces Command (JFCOM), the COCOMs, each of the Services, and DoD Agencies are, to different degrees, experimenting with new ways to accomplish their

[131] David S. Alberts and Richard E. Hayes, *Campaigns of Experimentation* (Washington: CCRP, 2005), 2.

assigned missions and responsibilities. These activities have, for a variety of reasons, not been as productive as they could be. Five reasons have been identified for the observed shortcomings:[132]

1. Moving ahead without sufficient evidence and understanding;
2. Prematurely settling on an approach;
3. Confining explorations to the Industrial Age–Information Age border;
4. Progressing by trial and error as opposed to be guided by theory; and
5. Failing to capitalize on the creativity present in the force.

The campaign of experimentation and accompanying research program outlined here is designed to avoid these known pitfalls. How this is accomplished is discussed later.

Focus and Objectives

Campaigns of Experimentation are all managed to some degree. The nature of the management structure and approach can vary, just as there are different approaches to command and control. The articulation of a campaign's focus is analogous to the articulation of command intent. In this case, the focus is on exploring and assessing network-centric approaches to the effects based planning suitable for complex endeavors.

Phases of a Campaign of Experimentation

The journey from the general to the specific, moving from concepts to hypotheses to understanding and ultimately to, in this case, a network-centric planning capability, needs to proceed in an orderly fashion, paced not according to a predetermined schedule but rather by actual progress, by the achievement of specific milestones. Campaigns begin, according to the Code of Best Practice,[133] with a Formulation Phase, followed by a Concept Definition Phase and a Refinement Phase, and conclude with a Demonstration Phase.

Formulation Phase

All campaigns begin with an idea, in this case the idea of network-centric planning as an integral part of a network-centric approach to command and control in complex endeavors. The first phase of a campaign, Formulation, takes the idea for the campaign, one that is usually expressed only in general terms, and develops a statement of goals and objectives. It sketches out the landscape to be explored and understood and the capability to be developed. The Formulation Phase also involves decisions regarding an initial allocation of resources, the participants in the campaign, and their respective roles and

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[132] Alberts and Hayes, *Campaigns of Experimentation*, 21-28.

[133] For a discussion of the phasing of a campaign of experimentation see: Alberts and Hayes, *Campaigns of Experimentation*, 117-124.

contributions. The products of this phase include a statement of goals and objectives expressed in the context of an initial version of a conceptual model.

Concept Definition Phase

With the general statement of goals and objectives as a point of departure, the Concept Definition Phase is focused on, as its name implies, developing more precise definitions, the construction of a working conceptual model, the construction of the treatment space, and the development of metrics that define key attributes and instruments used to take measurements of those attributes. In other words, the Concept Definition Phase makes the idea or concept operational and begins to explore the landscape.

This phase includes undertaking of discovery experiments and the conduct of exploratory analyses. The products of this phase are (1) an enriched conceptual model, (2) a set of testable hypotheses organized by priority and sequenced, and (3) measurement tools and instruments.

Refinement Phase

The Refinement Phase is where in-depth undertakings are developed and capabilities built. Guided by the state of the conceptual model developed during the Concept Definition Phase, the activities undertaken during this phase test hypotheses and refine and assess capabilities. While during the Concept Definition Phase there is a need to make sure that all of the possibilities are considered, in the Refinement Phase there is a need to make sure that these early successes are adequately retested and that the conditions needed to obtain success are well understood. This involves pushing ideas and capabilities to their breaking point, developing a solid understanding of the relationships among key variables and developing an understanding of why various approaches or concepts (treatments in the language of experimentation) work, and do not work, under specific sets of circumstances.

This phase usually takes the longest and requires the most resources. It is also the phase that, if properly conceived, will have its share of both unexpected setbacks and pleasant surprises. The products of this phase include a refined and enriched conceptual model and capabilities that are ready to be demonstrated.

Demonstration Phase

Demonstration experiments and confirmatory analyses form the core of the Demonstration Phase. The purpose of this phase is to provide an opportunity for a variety of individuals and organizations to better understand the new concepts and experience the new capabilities. This phase presents the evidence for adoption of the new concepts and capabilities. It is important that this phase does not begin until the concepts are adequately explored and the capabilities are adequately tested in the previous phases. Prematurely moving into demonstrations is a common, avoidable mistake.

Conducting a Sound Campaign

Conducting a successful campaign of experimentation is not easy. In addition to the obvious, that it requires considerable knowledge, expertise, and experience, it also requires a great deal of patience and a willingness to accept ideas that run counter to conventional wisdom. It also requires sound management and fiscal flexibility.

Among the most critical items that are needed to avoid problems and fully leverage the opportunities that present themselves are:

- Conducting peer reviews;
- Employing objective measures of effectiveness or value;
- Documenting experiments and analyses;
- Keeping the conceptual model current;
- Conducting analysis beyond individual experiments;
- Avoiding a premature narrowing of the focus; and
- Maintaining continuity of personnel.

These are discussed in the applicable codes of best practices (COBP) and elsewhere, specifically the *NATO COBP for C2 Assessment*, the *COBP for Experimentation*, the *COBP for Campaigns of Experimentation*, and *the Logic of Warfighting Experiments*. All can be found at www.dodccrp.org.

Expectations must also be realistic so as to avoid creating situations that will compromise individual experiments and analyses, or worse, the campaign itself. Unrealistic expectations compounded by inadequate resources and an inflexible schedule have frequently resulted in flawed experiments and analyses and a lack of opportunity to collect useful data or to leverage what useful data is collected.

Perhaps the most important thing to realize is that one experiment or analysis cannot be expected to do too much. Collecting a number of small experiments (known as Limited Objective Experiments or LOEs) as part of creating a large event (major experimental environment such as Millennium Challenge) adversely affects the quality of these experiments because priorities become confused. In addition, there are usually conflicting objectives. Conducting experiments as a number of smaller events is preferable.

Experimenters and their leadership need to understand that campaign progress will be nonlinear and that "failure," as defined by a concept that does not work as expected, is not failure but a success as long as the experiment or analysis was done properly and is well documented. In other words, experiments are successful if knowledge is increased even if that knowledge is related to what not to do. Hence, resourcing must be flexible to allow for additional experiments and/or analyses as required.

Each of the Codes of Best Practice has a lessons learned section.[134] Prior to undertaking this campaign of experimentation, each participant should review this material to help ensure that these avoidable problems are not repeated. Prior to the conduct of each individual experiment and analysis, the team should once again review the applicable lessons learned.

Conceptual Model

The *Code of Best Practice for Campaigns of Experimentation*[135] identifies two pre-conditions for success: (1) building a strong team and (2) creating an explicit *conceptual model*. A conceptual model is the heart of any experimentation campaign. A conceptual model is an explicit construct that organizes and synthesizes existing knowledge and guides the course of the experimentation campaign. Specifically, a conceptual model identifies the (1) set of relevant variables, (2) set of relationships among them, and (3) relevant measures of merit (MoM). The conceptual model will evolve over the course of any campaign of experimentation as experimental and/or analytical findings become available or known, whether from activities that are part of the campaign or the efforts of others. Thus, keeping abreast of related activities and reflecting relevant findings in the conceptual model is important.

When experimenters select a subset of the variables and/or relationships from the conceptual model, this is called a "view." Two specific views are central to a campaign of experimentation. The first is a "value view" that focuses on variables that are a reflection of quality or value and the relationships among these variables. The value view provides a value chain that can be explored, tested, and used during the campaign to design experiments or analyses.

The second view of interest is the "process view." A process view looks at a set of variables that describe various processes including inputs and outputs. A process view is used to provide data that informs a value view. For example, the process view provides the transfer function between inputs (e.g., information) and outputs (e.g., awareness). The characteristics of both the inputs and the outputs are reflected in measures of quality (e.g., information quality and quality of awareness). Thus, the process view, when instantiated for a particular case, provides one set of data points for the relationship between two measures of value. When process-related experiments or analyses are repeated over a range of conditions (the variables that moderate this relationship), an estimate of the nature of the relationship between the value variables can be developed.

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[134] Alberts et al., *COBP for Experimentation*, Chapter 13.
Alberts and Hayes, *Campaigns of Experimentation*, Chapter 7.

[135] Alberts and Hayes, *Campaigns of Experimentation*, 100-101.

Mission Capability Packages and Coevolution

The concept of a coevolved mission capability package (MCP) dates back about a decade.[136] Coevolved MCPs are a response to the problems that can arise when new technology, other capabilities, or new concepts are introduced but are not accompanied by changes in other areas, such as training or doctrine. For years, many people (some very knowledgeable) subscribed to the popular view that computer technology was not cost-effective because there was a lack of empirical evidence to show improvements in productivity. In fact, there was more than a grain of truth in this view. However, it is more appropriate to conclude that a lack of coevolution was the culprit, not a lack of the potential power of computers. To make matters even worse, a lack of coevolution or co-adaptation not only can prevent value from being created, but a lack of coevolution can also have significant adverse impacts. Thus, the introduction of computers or new ideas that have enormous potential can actually degrade performance unless they are accompanied by appropriate changes in organization, work processes, training, or other enabling factors.[137]

With respect to changing the current planning approach to one that is better suited for Network Centric Operations, the new network-centric mission capability packages need to include new approaches to command and control that specify the nature of the planning process, the type of the plan it produces, the systems that are needed to support the approach to C2 (specifically planning), the organization including roles and responsibilities, the interactions among participants, the distribution of information, recruitment objectives, education and training programs, and personnel practices and incentives. The approach to execution would also need to be considered. A coevolved MCP is one with elements that have all been adapted to be mutually supportive of the concept of operations.

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[136] David S. Alberts, *Mission Capability Packages* in INSS Strategic Forum 14 (Washington: NDU Press, 1995).
David S. Alberts, *The Unintended Consequences of Information Age Technologies* (Washington: CCRP, 1996), 47-52.

[137] Alberts, *The Unintended Consequences*, 13-14.

Chapter 10. A Campaign to Explore Planning for Complex Endeavors

The goals of the campaign outlined here are to understand the nature of the planning approach(es) that are appropriate for complex endeavors. We assume that it is reasonable to start with the exploration of effects based, network-centric approaches, and assess the relative merits of these approaches to planning in contrast to more traditional approaches. Thus, current planning concepts, processes, and products should be used as a baseline.

This campaign focuses on complex civil-military missions undertaken by a broad coalition including nation states, international organizations, non-governmental and private voluntary organizations (NGOs and PVOs), as well as private industry.

This campaign consists of four phases: a Formulation Phase, a Concept Phase, a Refinement Phase, and a Demonstration Phase. It also involves interrelated research, analysis, and experimentation activities. These activities will be centered about a conceptual model that places planning in the context of Network Centric Operations and assesses the quality of a plan in the context of the network-centric value chain.

Formulation Phase

Although this book provides a vision for a campaign of experimentation focused on exploring network-centric planning in the context of SSTR and provides an initial formulation of a conceptual model that can be used to guide the campaign and design individual experiments and analyses, the formulation of this campaign cannot be completed until a decision is made to resource and embark on this effort. Once such a decision is made, several steps need to be immediately taken. These include selecting the set of participants, establishing their roles and responsibilities, and allocating available resources.

In anticipation of a decision to proceed, this chapter provides the outline of a plan of research, analysis, and experimentation activities needed to achieve the objectives of this campaign.

Concept Phase

A properly conceived and executed Concept Phase helps ensure the success of the campaign. The following tasks need to be undertaken during the Concept Phase:

- Developing a conceptual model
- Establishing the baseline
- Identifying and characterizing promising approaches to planning
- Developing approaches and instruments for key variables

Of these, the first two should be given top priority. Their completion, prior to the conclusion of the Concept Phase, is essential.

Developing a Conceptual Model

Key components of a suitable conceptual model have been presented earlier in this document, but these components need to be integrated and fleshed out before the model is suitable to form the intellectual core of this campaign of experimentation. The objective is to construct a conceptual model that contains all of the variables that are expected to have a first order effect on the effectiveness of an approach to planning. The model also needs to incorporate a value chain capable of distinguishing between network-centric and traditional approaches to planning. In addition, care must be taken to ensure that the model contains the variables necessary to characterize the range of missions and operations of interest. Finally, the planning approach space needs to be mapped to specific ranges of values for a set of variables that capture the dimensionality of the planning space and specific approaches starting with the baseline, traditional planning processes, and an edge approach to anchor the opposite corners of the space.

A NATO research group has developed a conceptual model[138] that can be used to explore and assess new approaches to command and control. This group identified over 300 variables and the significant relationships among these variables. They have also created a value view that identifies the links in a value chain. This value traces the capabilities and characteristics of a force to measure effectiveness and agility. The purpose of this reference model is to serve as a checklist for those constructing a conceptual model such as the one required for this campaign of experimentation. Clearly, not all of the over 300 variables and associated relationships will be directly applicable. However, to a high degree of probability, virtually all of the variables that are relevant to this effort can be found in this reference model. The task at hand is to select a subset of these variables and relationships for an initial conceptual model for this campaign.

Another NATO research group, SAS-065, has recently been formed. This group is, as previously mentioned, working on an NEC C2 maturity model that maps various levels of NEC maturity to a corresponding level of C2 maturity. As their work continues, case studies will be developed and the C2 maturity model presented in this book will be refined. This campaign of experimentation needs to keep abreast of these developments as it employs the linked set of maturity models depicted in Figure 17, to develop hypotheses related to the nature of the planning approach(es) that would be appropriate for various levels of C2 maturity (and hence corresponding levels of NNEC maturity).

Establishing the Baseline

The second critical task that needs to be completed during the conceptual phase is the establishment of a quantitative baseline. Starting with the subset of the planning space that reflects current planning approaches, the values of the variables that comprise the value chain need to be estimated and the nature of key relationships (e.g., how current

[138] "The Conceptual Model of Command and Control." Prepared by NATO's Research and Technology Organization's Studies Analyses and Simulation Panel (RTO SAS-050). June 2003 to November 2005.

planning processes are affected by the quality of information or the need to respond to a dynamic situation, that is, produce or change a plan to some specific degree of quality in x hours). This involves reviewing, analyzing, and most likely gathering empirical evidence and/or modifying and running available simulation models.[139] This baselining activity is in addition to having an explicit baseline to anchor both the individual analyses and experiments that will be undertaken.

Because appropriate data and/or models may not be readily available, to the development of a baseline involves both the development of new simulation models and a set of specifically designed experiments and analyses. It should be noted here that objective quantitative data is critical to the success of the campaign. Developing and moving to a network-centric approach to planning should not be undertaken because selected subject matter experts (SMEs) feel good. There are no true SMEs for Network Centric Operations simply because we do not yet have enough experience with these approaches.

Identifying Promising Approaches to Planning

It is not reasonable to expect that all of the promising approaches to planning will be identified during this phase. However, at least one planning approach should be identified in four distinct regions of the planning space:

- The region immediately adjacent to the baseline or current approach;
- The region that contains edge approaches to planning that have the characteristics of Level 4 of the network-centric maturity model;
- A region that represents a capability that corresponds to Level 2 of the maturity model; and
- A region that corresponds to Level 3.

The first two approaches bound the problem, while the latter two provide at least an initial idea of the shape of the fitness curve.

It should be expected that some of the approaches identified will, in all likelihood, be discarded or modified, or replaced by others that incorporate what seems to work and changed by what does not seem to work. Such changes to the approaches under consideration are, in fact, signs of progress, not signs of failure.

Developing Measurement Approaches and Instruments

Prior to the conduct of experiments, it is necessary to have developed the approaches and instruments necessary to collect data about the variables of interest. These are required in order to establish the values of those variables under certain conditions. Objective data regarding key concepts and variables associated with the network-centric value chain

[139] It is far more likely that a simulation that reflects existing processes and approaches will be available rather than one that is able to reflect new approaches, or can easily be modified to accomplish this.

have only recently been collected, and thus mature and validated approaches and instruments do not yet exist. Measuring the right variables and understanding the characteristics of these measures is a critical component of any successful experiment. The difficulty of this task should not be underestimated. It should be expected that multiple attempts will be needed to arrive at a satisfactory approach to a particular variable or set of variables.

Quality metrics for awareness, shared awareness, planning, a plan, and synchronization each present a somewhat different challenge. Trying to measure awareness involves taking a measure in the cognitive domain, a domain that is not directly accessible. Thus, instruments used to measure awareness are designed to elicit responses from subjects and/or observe their behavior. This means that the measurements will be indirect ones from which awareness is inferred. Shared awareness has all of the challenges associated with measuring awareness as well as the problem of operationally defining what is meant by *shared*. Prior work on the NCO Conceptual Framework and NATO NCO Conceptual Model may help in identifying specific metrics.[140]

Planning is an activity or process. The quality of the process can be measured by the degree to which the process is carried out as it is specified. But this process-oriented measure is, in and of itself, not a sufficient measure of quality. This is a measure of the quality of the execution of a specific planning process, not the quality of the planning process itself. The latter measure is needed in order to be able to compare different approaches to planning. The quality of a plan (the expression of the result of a planning process) requires both types of measures, that is, a measure of how good a "type x" plan it is, as well as how good a plan it is, given the situation.

Synchronization is a concept that can be applied to decisions, actions, or effects. While it may be relatively easy to define the endpoints of a scale for synchronization,[141] the difficulty lies in defining how far from the endpoint a given instance is located. In the case of synchronization, the scale to be used should range from a large negative (corresponding to conflicts among, for example, the decisions made) to a large positive (corresponding to synergies achieved). The midpoint is a zero, a point that represents de-confliction (where there are no conflicts, but also where there are no synergies). Most of the interesting space is, therefore, located in the positive range.

Refinement Phase

This phase of the campaign of experimentation tests, assesses, and refines the planning concepts under consideration. In the associated program of research, efforts are focused on increasing the understanding of key relationships (e.g., the set of circumstances, the

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[140] SAS050, "Exploring new Command and Control concepts and capabilities: Final Report" (Washington: NATO, 2006).

[141] Alberts et al., *Understanding Information Age Warfare*, 205-237.

quality of planning, and the quality of the plan produced for different approaches to planning).

The object of this phase is to develop a solid empirical basis for proceeding with the implementation of a set of planning approaches[142] and their integration into existing organizations. Establishing a solid empirical basis for moving ahead with a particular approach involves (1) exploring the various options over a wide set of circumstances that reflect the range of missions that DoD can be expected to undertake, (2) replicating experiments to develop sufficient experience and data, and (3) maturing the various approaches so that they reflect their potential. As stated previously, this involves pushing ideas and capabilities to their breaking point and developing an understanding of why various approaches or concepts (treatments in the language of experimentation) either work or do not work under specified conditions. Establishing a solid empirical basis also requires that experimentation activities be conducted in accordance with the applicable Codes of Best Practice.

The products of this phase include (1) a refined and enriched conceptual model and (2) capabilities that are ready to be demonstrated. Care must be taken to update the conceptual model as individual experiments are completed, integrative analyses are completed, and knowledge improves.

Demonstration Phase

This phase provides the opportunity to involve a variety of individuals and organizations, either as observers or participants, to make them aware of and to understand the new concepts and approaches that merit implementation. While there will be opportunities to have selected individuals and organizations observe and even participate in the earlier phases, this is the time to expose what has been developed and learned during the course of the campaign. It may seem obvious, but demonstrations have little value if the new approach to be demonstrated has not been adequately tested, if the supporting systems are not stable, or if the participants (those involved in the demonstration) have not been adequately trained. Demonstrations also have little or no value if the problem or situation is insufficiently complex or interesting and if it cannot be objectively shown that the new approach is better. In this case, it would be preferable to run side-by-side demonstrations of how groups of individuals could, for the same situation, plan for and execute a variety of missions. Alternatively, a well-documented baseline using traditional or rejected alternative approaches should be available to demonstrate the gain from the innovative approach.

[142] This refers to a set of planning approaches because it is not envisioned that one approach will be best suited for all circumstances.

Priorities for a Program of Research

Given that there are many things about network-centric approaches to planning that are not well understood, a program of focused research must necessarily accompany this campaign of experimentation. While the campaign of experimentation will provide empirical evidence regarding the desirability of alternative approaches to planning for NCO, the associated program of research needs to explore basic relationships among key variables, how best to measure them, and incorporate what is learned into the campaign's conceptual model.

Chapter 11. Plan of Work: Concept Phase

This section identifies and discusses the tasks that need to be accomplished during the Concept Phase and their relationship to one another (see Figure 20). It assumes that the campaign has been formulated, that the team has been assembled, and that peer review and advisory groups have also been identified and organized.

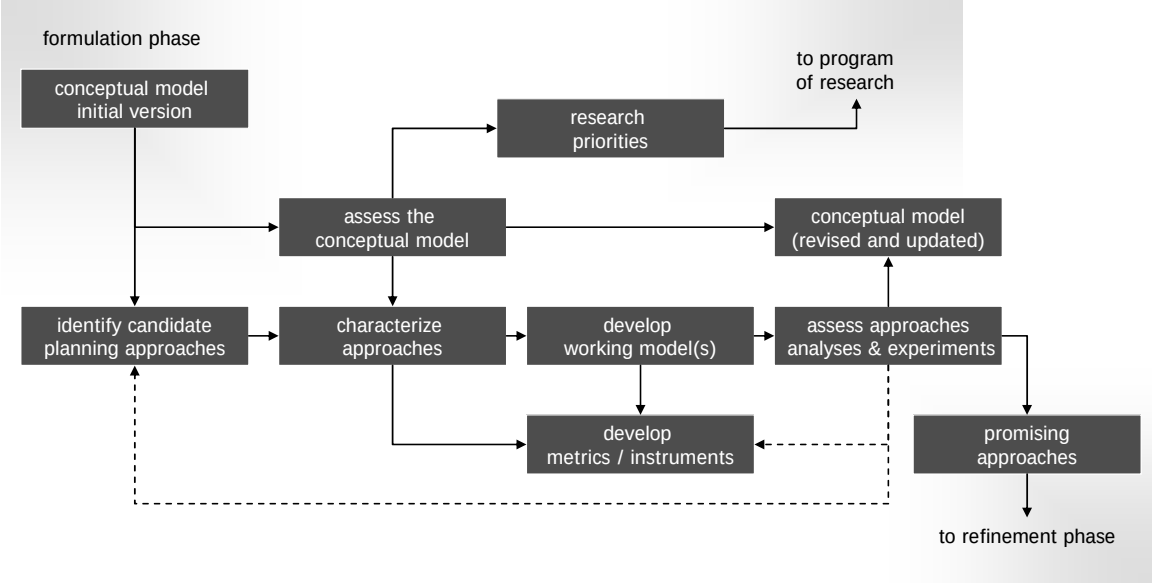

Figure 20: Plan of Work: Concept Phase
(note: dotted lines indicate feedback loops)

Assessing the Conceptual Model

The campaign's conceptual model plays a central role. Its state[143] at the beginning of the campaign provides the point of departure. In large part, it determines what the priorities are for analysis, experimentation, and the program of research. As the model improves, it becomes ever more useful in analyses that extend specific empirical results and provide the basis for sensitivity analyses of the assumptions made in the experiments.

The first step in the research program is the determination of research priorities. These priorities are a product of an assessment of the "as is" conceptual model. The primary focus of the program of research needs to be on the relationships that are not well understood, particularly those that involve the variables that define the characteristics that distinguish one approach to planning from another, and those related to the value chain. Seeking to focus on those variables or relationships expected to have the greatest immediate payoff, while a common practice, is actually a poor strategy because (a)

[143] The state of the model tells us the nature o the relationships among the variables that are known and the relationships about which there remains uncertainty.

knowledge is generally inadequate to determine the relative potential of different focuses and (b) in any reasonably complex problem area, no single variable or relationship has value or leverage independent of the others.

Identifying and Characterizing Candidate Planning Approaches

The planning space depicted in Figure 5 should be used to identify and characterize approaches to planning that will initially be considered during the Concept Phase. While the planning space serves to provide information about the three key dimensions of a planning approach (the nature of the planning process, nature of the plan, and information dissemination and sharing), fully specifying a planning approach involves actually developing the details of the process and the plan produced. It also involves describing those elements of a mission capability package that are directly related to planning (e.g., command approach: how intent is developed and communicated) as well as those that use the products of the planning process. The latter are needed in order to understand and assess the relationships between planning and execution.

As discussed earlier, it is best practice to consider, at least initially, approaches from all regions of the planning space to ensure that the choices are not overly constrained by current views.

Discovery experiments[144] are often used to instantiate workable versions of planning approaches, particularly those that have never been used before or have never been tried in the problem space. Discovery experiments informed by lessons learned can be used to improve upon existing approaches or modify them so that they evolve into a part of the planning space in the vicinity of traditional approaches, but are a step toward a network-centric approach.

Developing a Working Model

The conceptual model components provided here and the conceptual models that were developed by NATO RTO and OSD identify key variables that are required to understand and test a variety of approaches to command and control. They were each developed with the objective of being able to compare traditional and network-centric or edge approaches. They provide a checklist of variables and relationships to be considered and might best be understood as reference models. As such, these conceptual models are not in a form that is suitable for direct application in specific analyses and experiments. First, for many efforts they contain a great many variables that are either of little or no interest. Second, these are not executable models, that is, they are not in a form that allows one to set the values of certain variables and see what effect they have on other variables. For these reasons, working models based on these conceptual models need to be developed for analyses and experiments.

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[144] Alberts and Hayes, *Campaigns of Experimentation*, 73.

A working model contains, as indicated above, a subset of variables and is in a form that facilitates manipulation. Different types of models (simulations, agent-based, spreadsheets, system dynamics) have different purposes. Most often, several are employed in the same effort.

Developing Metrics and Measurement Instruments

Concepts such as information quality have been an integral part of analyses and experiments for a considerable time. Despite this, a number of advances in our understanding of what constitutes information quality have taken place recently. For example, it has been recognized that terms like *currency* and *timeliness* were being used rather loosely and interchangeably, despite the fact that they have different meanings. The difference between these two terms is that one (currency) is an objective measure of the passage of time, while the other (timeliness) makes sense only in the context of a specific situation, and thus, is a fitness for use measure. This distinction is not confined to these two measures. A re-examination of how one thinks about various quality metrics has led to the separation of objective and fitness measures. As subject matter experts became more sensitized to the issue of information assurance, there was a growing recognition of the need to add IA-related attributes. Figure 21 provides a current view of the attributes of information quality.

Objective	Information Assurance	Fitness for Use
• correctness • completeness • precision or accuracy • currency • consistency	• privacy • integrity • authenticity • availability • non-repudiation	• relevance • timeliness

Figure 21: Attributes of Information Quality

The task here is to review the definitions of all of the variables selected for the working models and, if any are not deemed satisfactory, pursue a research effort to improve upon the existing definitions. If they are satisfactory, review available measurement instruments and modify or improve upon these as required. At a minimum, the variables that should receive priority attention comprise those included in the figures in the initial conceptual model for network-centric planning presented here.

Assessing Candidate Approaches

At this point in the campaign, there will be a fairly large number of candidate approaches. It is better to err on the side of too many rather than too few. The approach to assessment that makes sense in this situation is to use a variety of methods and tools designed to quickly explore the potential value of the alternatives. These include a variety of model-based analyses and well-instrumented discovery experiments. The current practice of

using poorly instrumented and poorly structured games with subject matter experts is problematical. One major danger is that "familiar and comfortable" will substitute for potential value as the operable selection criteria. Another is that the lack of rigorous measures that will generate results that are impossible to replicate.

It is important when conducting these initial assessments that the candidate approaches have an opportunity to mature; the bugs need to be worked out. Not allowing ample time or allocating sufficient resources for maturation will bias the results. Similarly, time is needed for subjects to familiarize themselves with each of the new approaches.

It is also important to use, for each candidate approach, a variety of mission challenges. This should "sample the interesting space."[145] This is necessary to make sure that an approach has promise over a reasonable portion of the mission space.

The cost of these assessments is a function of the number of individuals involved and the number or runs. The more analysts, experimenters, and subjects involved, the greater the costs will be. With increased costs comes a reluctance to replicate the activity. This is why model-based analyses should both precede experiments that involve many subjects and also follow them in order to replicate and extend the results of these experiments.

[145] Alberts et al., *NATO Code of Best Practice for C2 Assessment* (Washington: CCRP, 2002).

Chapter 12. Plan of Work: Refinement Phase

As a result of efforts in the Concept Phase, a number of promising candidates will have been identified. In this phase, each of these approaches will receive a more in-depth look. This involves the conduct of a series of coordinated model-experiment/exercise-model efforts,[146] one for each of the promising approaches. In addition to the efforts focused on specific approaches, a concurrent analysis effort is needed to synthesize the results obtained and to ensure that valid and interesting comparisons can be made between and among the most promising of the approaches. As a result of these efforts, it can be anticipated that areas and issues that require research will be identified. This synthesis effort, as well as the in-depth looks at promising approaches, should be informed by the results of research. Figure 22 depicts the activities of the Refinement Phase.

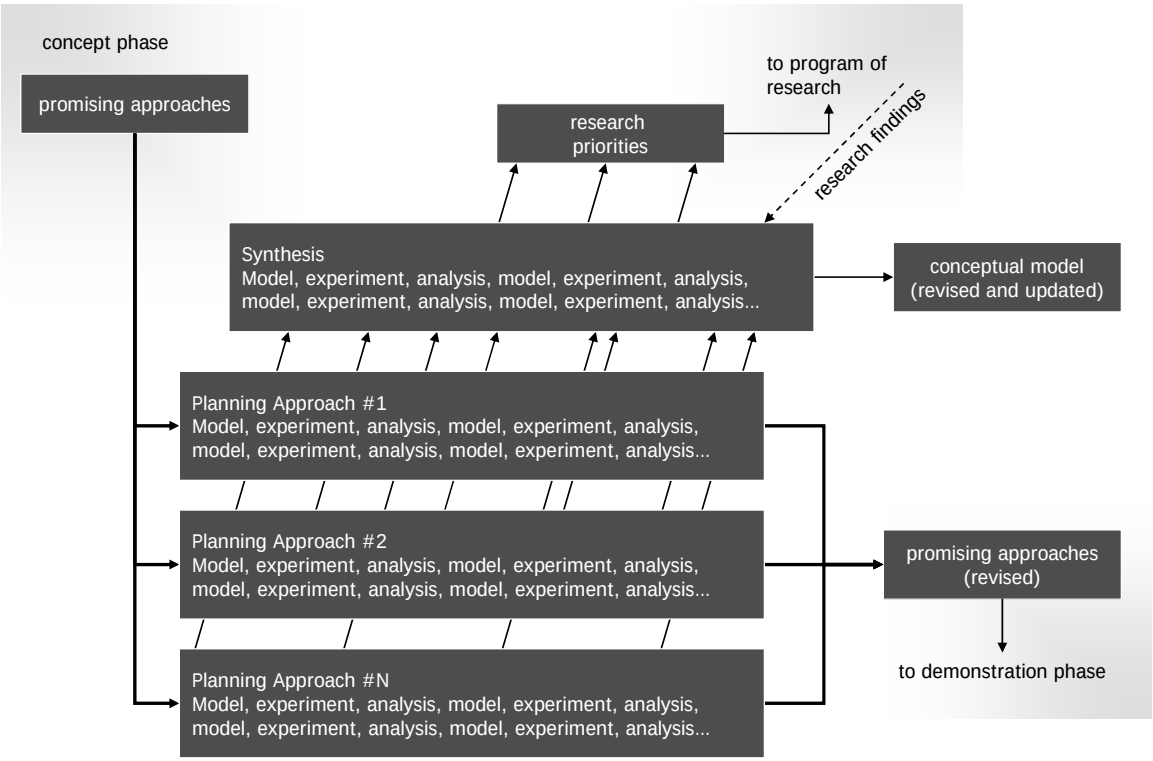

Figure 22: Promising Approaches

In-depth Investigations

Successful in-depth investigations (analysis-model-experiment-model-analysis) are not only those that find a promising approach to be truly promising, but also include those that result in learning why an approach may not work, or work only under specific circumstances. In fact, an in-depth investigation that simply confirms the promise of an

[146] Richard A. Kass, *The Logic Of Warfighting Experiments* (Washington: CCRP, 2006), 154-156.

approach and does not result in an understanding of why it works and under what circumstances it does not work (the boundary conditions) is *not* a full success, despite the fact that the approach continues to show promise.

The "model" referred to above is a working model derived from the conceptual model. The analyses conducted as part of the in-depth investigation include those that (1) explore the approach and conditions space to identify areas that should be the subject of experiments and (2) are devoted to extending the results of the experiments by performing sensitivity analyses.

Synthesis

The synthesis activity is important for four reasons:

- First, to help ensure that the lessons learned are communicated across approach investigations;
- Second, to be able to systematically capture the results and findings of these investigations and incorporate them into the analysis of planning;
- Third, to serve as a basis for assessing the progress being made and guidance regarding directions to these investigation; and
- Fourth, to incorporate the data collected and the results of analyses into an updated conceptual model and associated knowledge base.

Chapter 13. Program of Research

There is always a tension between a desire to produce immediate results, that is, improve current capabilities in near-real-time and mid- to longer-term objectives. It should be remembered that we need disruptive innovation to meet the challenges of the 21st century; the more disruptive a new approach is, the more time will be required to mature the approach, and then assess and field it. Thus, the approaches we can spin off early on are most likely to be incremental improvements. However, if too much time and too many resources are devoted to satisfying these short-term demands, it will adversely affect our ability to deliver the disruptive innovation we require. The program of research is necessary to lay the foundation for disruptive innovation and enable us, as time goes by, to be able to generate approaches to planning more rapidly, at higher quality, with less risk. As such, this program of research should begin as soon as possible, focusing on the gaps in our understanding that we currently have.

Determining Research Priorities

In due time, the campaign-specific priorities for the program of research will emerge from an assessment of the conceptual model, the experience associated with developing working models, and their capability to inform efforts to assess specific approaches to planning.

However, Network Centric Operations has been under consideration for several years now and we have a reasonable appreciation of the major issues and uncertainties that we face. The OSD and NATO efforts to build conceptual models that facilitate the exploration of network-centric concepts and capabilities and comparisons with traditional approaches to command and control have resulted in a solid foundation upon which to build. These models identify key variables and relationships needed to understand the role that planning, as an element of sensemaking, and plans, as products of command and control, play in NCO.

Clearly, anything that would contribute to a more complete, useful, and believable conceptual model is potentially of considerable value because it would (1) help focus initial experiments and analyses, and (2) allow model-based analysis to play a larger role and lessen the need to rely on costly experiments.

High Priority Research Topics

It is important that we do not confuse our current notions of planning and plans that have coevolved with current organizations, processes, and products with what is possible and what may be best suited for NCO. Therefore, some basic research is in order to identify and systematically explore the possibilities.

Research topics that should be given high priority include:

- Taxonomy for Planning and Plans;
- Quality Metrics for Planning and Plans;

- Factors that Influence Planning Quality;
- Factors the Influence Plan Quality;
- Impact of Planning and Plan Quality on Operations;
- Methods and Tools for Planning; and
- Plan Visualization.

Taxonomy for Planning and Plans

Some work has been done on characterizing various approaches to command and control and mapping specific approaches taken by different countries at different times to a C2 approach. Although centralized planning is identified as a feature of Industrial Age approaches to command and control[147] and coupled with decentralized execution, there has not been any comprehensive treatment of planning as a function of C2 approach.

To facilitate the exploration of planning and plans in operations, specifically Network Centric Operations, these taxonomies (one for planning and one for plans) are required. These taxonomies need to focus on what makes various approaches to planning and different kinds of plans different. Once these two taxonomies are completed, it is important to test them by seeing if they are able to map past, current, and proposed approaches to specific classes of planning and plans defined by the taxonomies.

Quality Metrics for Planning and Plans

It is hard to overestimate the importance of having appropriate metrics. The quality of information is, for example, not an adequate substitute for the quality of awareness. Expert opinion, particularly when the expertise may not be on point, is not, in and of itself, an adequate substitute for performance or value. Attention to metrics early in the campaign will greatly enhance the value of the analyses and experiments that are undertaken.

While it is important to define metrics that measure what needs to be measured, there will be cases when these metrics are either difficult or costly or both to measure. The correct response is find indicants that can serve as an approximation and study the relationships between these indicants and the metric of interest. The incorrect response is to ignore those metrics that present measurement problems. It is far better to get an approximation for the correct metric than to get a precise measure of the wrong metric. Often sets of indicants, each reflecting some aspect of the phenomenon of interest, will prove useful. The most common example in C2 work is the recognition that "quality of information" is reflected in completeness, correctness, currency, consistency, and level of precision—each an independent dimension.

[147] Alberts and Hayes, *Power to the Edge*, 46-47.

Factors that Influence Planning Quality

There are, of course, many factors that influence the quality of planning. The objective of this research is to identify those that have a first order effect. The DoD Network Centric Conceptual Framework and the NATO SAS050 Conceptual Reference Model provide points of departure, presenting lists of candidate variables and relationships. In looking at these, it should be noted that these models are focused on decisionmaking and decisions rather than planning and plans. Thus, an interesting topic for investigation might be the differences, if any, between the subset of decisions that are related to planning and expressed in plans and decisions that are not directly related to planning.

It is important to remember that planning is a cognitive and social process and, thus, it is the interactions among people and organizations that are of utmost importance. Analyses that focus on information quality and flows are unlikely to result in an adequate understanding of planning processes, although these factors clearly need to be included.

Factors that Influence Plan Quality

Although the quality of the planning process can expected to be a major factor, if not *the* major factor, in determining plan quality, other factors need to be considered. Although, in theory, the approach to command and control and command arrangements includes the approach to planning and the nature of any plans that are produced, in practice, inconsistencies can occur, particularly in coalition and civil-military operations. Thus, attention also needs to be paid to the compatibility between the nature of the plan (e.g., level of detail), command arrangements, and the approach being taken to command and control.

Impact of Planning and Plan Quality on Operations

The relationship among the quality of planning, plan quality, and operations is complicated by exogenous variables that have a direct impact on operations. Thus, the investigation into the impact of the quality of planning and the quality of plans needs to focus on determining the conditions under which the quality of planning and plans has a dominant influence over operations and those where the influence of planning and plan quality is muted.

It is likely that the relationship between planning and plan quality and operations differs as a function of the approach to command and control, particularly under differing circumstances. Therefore, the approach to command and control needs to be a controllable variable in these investigations.

Methods and Tools for Planning

The complexity of operations has and will continue to increase while, at the same time, windows for effective responses have and will continue to shrink. This has put enormous pressure on planning processes to produce plans that adequately deal with situations of increasing complexity in less and less time. Methods and tools have the potential to help

planners deal with both these increases in complexity and the requirement for more timely plans.

One of the sources of increased complexity is the set of differences that exists between planning processes and the information systems and flows that support planning. Agile methods and tools designed to bridge these differences and minimize their adverse effects should be one of the focuses of this research.

Given the consequences of a failure to de-conflict plans or actions, it is not surprising that a lot of attention has been focused on processes and methods that are designed to ensure that conflicts and mistakes do not occur. However, we cannot be satisfied with a planning process that does not move beyond de-confliction to realizing synergies, particularly in a resource-constrained world. Research on new methods and tools is needed to see if we can improve synergies while providing adequate protection against conflicts and mistakes, while at the same time reducing the time it takes to develop plans.

Particular methods and tools may be more suitable for some approaches to planning and/or types of plans than others. Therefore, as part of this research, it is important that we understand when specific methods and tools are useful and when they are not.

Plan Visualization

A key factor determining the success of a plan is likely to be the ability of participants in the operation to understand the plan and to develop shared awareness. Hence, anything that helps people to visualize a plan, and fully understand its implications and what it means for them, should be of value.

It should be noted that one size does not fit all when it comes to visualization approaches or visualizations. Thus, an important part of this research will be which techniques are useful as a function of different situations, roles and responsibilities and individual characteristics (including experience). The appropriate visualizations may be very different when the participants are drawn from differing professional and national cultures.

Chapter 14. The Way Ahead: Critical Path

Overview

Developing a better understanding of the class of command and control arrangements and planning processes that work well with network-centric and coalition operations is on the critical path to DoD Transformation. To improve our current understanding, we must improve (1) our models, (2) our ability to measure key variables, and (3) our ability to conduct analyses and experiments. In addition, we also need to simultaneously push both the state of the art and the state of the practice of command and control itself. The state of the art is generally understood to be on the critical path, but the connection between understanding C2 and improving the practice of C2 is not as widely recognized. The campaign of experimentation and associated program of research discussed in this book have been designed to contribute to all of these objectives.

Synergies: Key to Accelerating Progress

The experimentation campaign and associated program of research should not be undertaken in isolation from the practice of planning or from practitioners. Figure 23 depicts the synergies that result from an effort that involves researchers, experimenters, and practitioners.

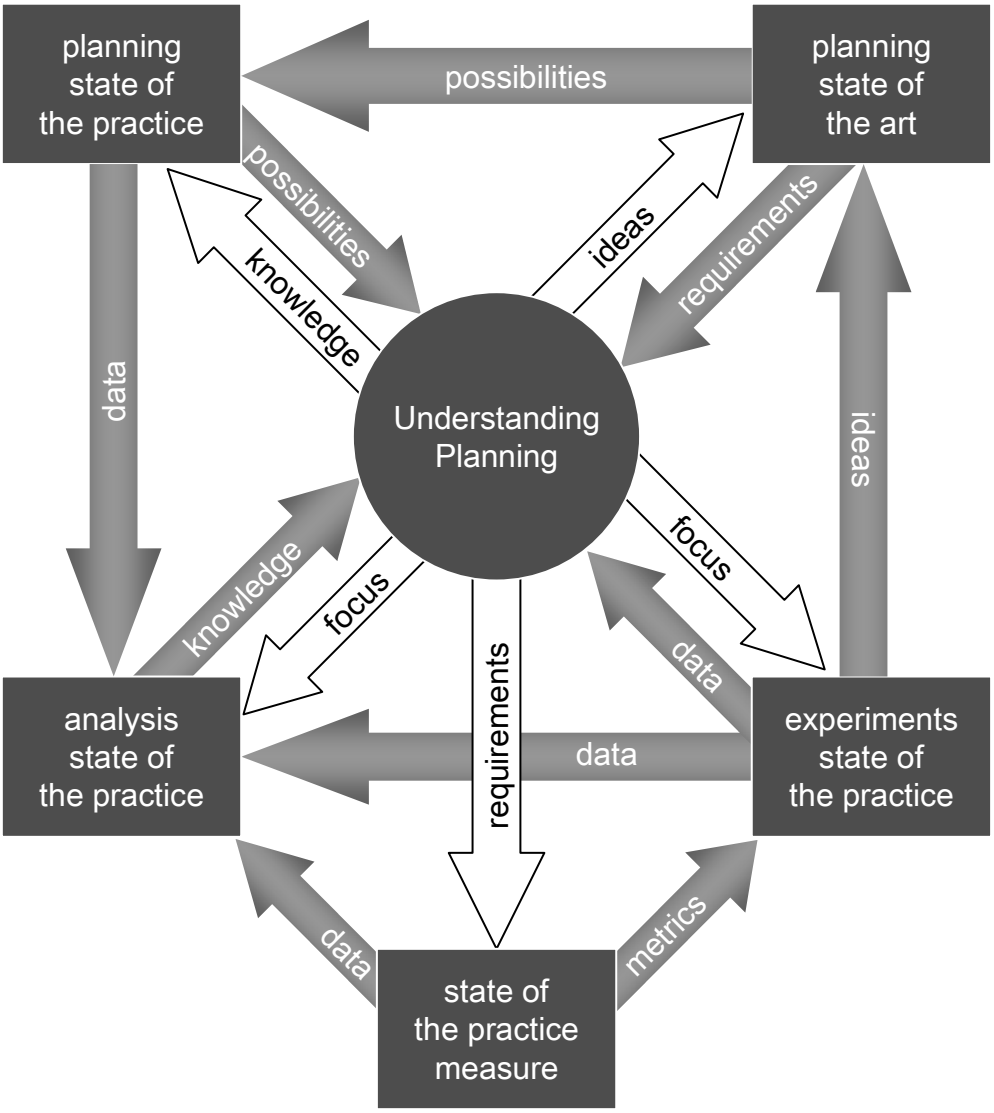

Figure 23: Synergies in a Multi-Pronged Effort

This figure depicts the complicated set of interactions and relationships between and among the State of the Art and Practice of planning and the states of the practice of analysis, experimentation and measurement that contribute to the level of understanding of planning. The relationships between and among these states depicted in Figure 23 include:

- Improving the state of the art of planning (the theory) serves as a source of possibilities for practitioners (applications of theory).
- At the same time, developments in the field that improve practice also inform theory and improve our understanding of network-centric planning.
- Improving the practice not only can generate a set of possibilities that theory needs to address, but also provides opportunities to collect data that can

inform our models and give us opportunities to test instrumentation and measurement approaches.

- Improvements in understanding provide knowledge to practitioners, ideas that can improve the state of the art, a focus for experiments and analyses, as well as variables and relationships that need to be measured.
- Improvements in the analyses we undertake can provide knowledge that enables us to improve our understanding while improved experimentation provides valuable data that can enhance our understanding.
- Finally, improving our ability to measure key variables and relationships can help experimenters by giving them the tools they need and help analysts by providing better data.

A failure to invest and harvest the advances made in any one of these areas diminishes our ability to undertake these activities, makes them less productive, and retards overall progress. Thus, the way ahead involves investments in each of the areas depicted in Figure 23 and the creation of a mechanism for sharing possibilities, data, ideas, knowledge, metrics, measurement techniques and tools, and, most significantly, understanding.

Establishing a partnership between those who design and conduct campaigns of experimentation, those who undertake focused programs of research, and practitioners is necessary if these synergies are, in fact, to be realized. Thus, when crafting a plan for a campaign of experimentation and an accompanying program of research, there must be a section of the plan devoted to engaging and involving practitioners at the beginning of the process, rather than waiting, as is too often is the case, until the phase of the campaign when demonstrations are conducted. Practitioners need to be offered an opportunity to contribute to the exploration of various approaches to planning (the planning approach space) and not just shown the "solution." This also helps generate "buy in."

The Critical Path

In recent years, interest in the practice of C2, developing a theoretical understanding of C2, and exploring new approaches to C2 have increased significantly. This is due, in large part, to a growing appreciation that DoD Transformation is, in fact, an Information Age transformation and that the adage that new ways of doing business are required means that new approaches to C2 are required. New approaches are required to adapt existing mindsets and practices to the security challenges of the 21st century as well as to fully support emerging concepts of operations (e.g., network-centric and effects based).

As a result, individuals and organizations around the world are engaged in a wide variety of research and analysis activities. They are producing useful data and creating bits of knowledge. It is vitally important that these C2-related research and analysis activities not only be supported but expanded as well. Equally, if not more important, is the urgent attention that needs to be paid to creating the conditions necessary to get the most out of the C2-related research and analyses that are undertaken. By making the most of these investments, we can hope to accelerate progress.

Research, analysis, and experimentation efforts are both more efficient and more effective if they can build upon data that has already been collected and knowledge that has already been created. Clearly, taking full advantage of available data, research and analysis findings, and the existing body of knowledge requires that individuals and organizations become aware of what is available. Progress depends then on the level of shared awareness in the C2 community.

However, simply knowing that some data was collected or that some analysis or experiment was done, does not, in and of itself, make these data and findings useful. The utility of the data collected depends upon the following:

- the existence of metadata;
- the relevance of the metrics used;
- the appropriateness of the instruments; and
- the conditions under which the data was collected.

The value of analyses and experiments depend upon the quality of their formulation and the extent to which the efforts adhered to the Code of Best Practice for C2 Assessment. Similarly, the value of the experiments that have been done depends on how well they were designed and conducted. Both of these, in turn, are a function of the degree of adherence to the codes of best practice related to experimentation and to campaigns of experimentation. The value of both the analyses and experiments that are conducted also depend on the quality of the conceptual and working models that are employed. These in turn depend on the quality of an evolving NATO C2 Conceptual Reference Model, which is, in the final analysis, a community effort. Thus, the prevailing state of the practice of analysis and experimentation determines the rate of progress as much as the degree to which the community has shared awareness of what research has been done and the data that exists, what research and analysis is ongoing, and what efforts are planned.

Priorities

Understanding network-centric planning requires a community effort. It requires increased collaboration and cooperation between and among individuals and organizations that are interested in defense transformation in general and specifically, those interested in new approaches to planning (as part of a C2 approach) that anchor coevolved network-centric mission capability packages. Three areas warrant immediate, priority, and sustained attention:

- The initial conceptual model;
- Adopting the Codes of Best Practice; and
- Establishing a portal for data, findings, and instrumentation.

Initial Conceptual Model

There have been two major efforts to develop a conceptual model that can be used to organize existing knowledge, focus research and experimentation, and support analyses

related to an Information Age transformation. The first, sponsored by OSD (a collaboration of the Office of Force Transformation and the Command and Control Research Program in the Office of the Assistant Secretary of Defense for Networks and Information Integration) used the tenets of Network Centric Warfare as a point of departure for constructing a conceptual framework that could be used to structure case studies and convey observations and findings in a systematic manner that facilitates comparisons between traditional and network-centric approaches to operations.

The second effort, under the sponsorship of the NATO Research and Technology Organization's Studies, Analysis, and Simulation Panel (research group SAS-050), independently[148] developed a C2 conceptual model designed to facilitate the exploration of new, network-centric approaches to C2. This initial version of the NATO C2 Reference Model was then validated by (1) applying the NATO COBP for C2 Assessment model to a case study to assess its utility (ability to support problem formulation), (2) an extensive literature search conducted to identify variables that were found to be relevant to C2 and its relationship to operations, and (3) comparing the NATO model to the OSD Conceptual Framework. As a result, the current version of the NATO C2 Reference Model represents the best thinking of a set of international experts[149] and provides the community with a conceptual model to employ in research, analyses, and experiments and a firm foundation upon which to build.

The NATO C2 Conceptual Reference Model is accessible on the CCRP Web site (www.dodccrp.org). This Conceptual Reference Model should be used as a source of ideas and a checklist to help ensure that a campaign of experimentation and its associated program of research consider all of the variables and relationships that are relevant to their efforts.

Adopt Codes of Best Practice

Many years of effort have been devoted to the development of the Codes of Best Practices currently available (*COBP for C2 Assessment*, *Experimentation*, and *Campaigns of Experimentation*, as well as *The Logic of Warfighting Experiments*). Their value is clearly a function of the extent to which individuals and organizations are committed to adopting and adhering to them. These codes should be distributed to all participants and classes formed to familiarize individuals and organizations with their content and application (SAS-050 members have conducted such courses and arrangements can be made through the CCRP for customized versions of these courses).

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[148] These efforts were largely independent, although key members of the NATO group including its chairman participated in both efforts. However, the Chairman insisted that the NATO group start with a clean sheet of paper and build their model from the experience of the participating analysts who came from both NATO and non-NATO countries.

[149] Experts from the United States, Canada, Sweden, France, Germany, Denmark, the Netherlands, Norway, Spain, Turkey, the United Kingdom, and Austria.

Establish Portal for Data, Findings, and Instrumentation

Power to the Edge principles[150] that are now embodied in DoD Policy and Directives,[151] include the concept and practice of moving from smart push to smart pull. This shift in the approach to information dissemination is designed to promote widespread information sharing and collaboration, a necessary condition for attaining shared awareness. A cornerstone of this shift in responsibilities is the requirement for individuals and organizations, in this case, the researchers, analysts, and experimenters engaged in this effort, to post in parallel. Of course, this is insufficient to achieve the objective of providing users with the opportunity to shape their own information positions. This is because the information not only has to be available for users to access, but users also need to know what information is available and where and how to get it.[152] One way to accomplish this is the creation of a portal with an accompanying effort to make its existence widely known. This portal should provide access and links to data, findings, and instruments of interest to researchers, analysts, and experimenters.

Final Thoughts

The undertaking of a campaign of experimentation as well as a related program of research is a significant effort. For this to be successful, adequate resources must be provided and the effort must be allowed to proceed, paced by the results and findings it develops and not by some arbitrary schedule. Learning how to plan in the context of Network Centric Operations (particularly coalition operations) is decidedly not about how planning has been accomplished in the past. Rather it is about what functions planning needs to accomplish, the potentially useful approaches to planning, and the value propositions that trace improvements in planning to improvements in C2 to measures of operational effectiveness, particularly agility.

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[150] Alberts and Hayes, *Power to the Edge*, 82.

[151] Such as DoD Directive 3000.05, "Military Support for SSTR Operations."

[152] And of course, the information is not of value unless metadata is also provided.