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(Unintended) Effects Based Operations: Dealing with Secondary Effects

Topics:
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ABSTRACT

This paper proposes an approach and methodology for the utilization of the fundamentals of systems theory as an aid to dealing with the secondary consequences of actions in effects based operations. At its core is an examination of the elements of nations' or non-state actor's power resources. The product of the analysis is the compilation of a set of nodes, and the relationships between these, upon which actions may be taken to achieve desired effects. Since the boundaries between the subsystems of power resources are flexible and permeable, and there will be interactions between elements in different subsystems, a *system of systems* approach is essential so that the functioning of the system may be better understood and the secondary consequences of actions considered. The premise is that changes cannot occur in isolation, and that alterations in one component will result in modifications (intended or unintended) to related elements. The goal of the approach is not precise prediction of the effects of actions, but rather to provide for understanding of the relationships between elements of national power that will lead to expectations of the consequences of those actions. The advantages of utilization of the principles of the system of systems construct and some of the requirements for its implementation are provided.

Introduction

The calling notice for this symposium states that effects-based operations (EBO) and *transitioning into EBO-centric mindsets and planning* is an appropriate area for consideration by the event participants. Hence, EBO will provide the foundation of this paper. EBO has been an element of United States (US) defense transformation for several years.[1] More recently, North Atlantic Treaty Organization (NATO) has considered adoption of some of its facets, under the designation of an effects based approach to operations (EBAO).

However, EBO and EBAO are far too expansive concepts for consideration in a short monograph. Therefore, concentration is on a single element of EBO, specifically the phenomenon of the secondary effects, or the consequences that actions will inevitably produce. While the *law of unintended effects* is a near universally recognized and accepted occurrence, means of dealing with it are not abundant, and it is often relegated to the "too hard" category. This is due primarily to one universal certainty: "We can never do merely one thing."[2] This simple observation by Robert Jervis provides the basis for this discussion. An action taken to create an effect will result in more than one consequence. Since these secondary outcomes may not be part of the initial planning process, this examination describes these as *unintended* effects. Any utilization of effects as the basis for operations planning or execution must consider this phenomenon.

This paper does not proclaim the discovery of a means for accurately predicting the secondary effects of actions—a task that has frustrated military planners since ancient times. Rather, based on a sound intellectual foundation, it proposes a systematic approach, which has been subject of experimentation by the US and NATO. The narrow claim is that a system of systems approach may have the potential to provide some ability to anticipate secondary effects. This approach provides the necessary basis for the assessment that is a prerequisite for anticipation of secondary effects. This is in keeping with the theme of this event, particularly exploration and adoption of Command and Control to meet the challenges of the 21st Century.

In a complex international environment, where the elements of capabilities are multifaceted and interrelated, the task of accurate assessment becomes exceptionally difficult, and the tools available for analysis are more limited. Determination of the relationship between cause and effect remains problematic. This is particularly true in the anticipation and comprehension of the secondary effects of actions that are designed to achieve national or coalition objectives. Consequently, a process or methodology that can assist decision-makers in the formulation and execution of coercive actions is a worthwhile aspiration. The justification for this study and proposed methodology is the need for a rudimentary tool for decision-makers to contend with the consequences of actions when dealing with complex systems.

This investigation into the potential for benefits of such an analysis will consider three key questions:

1. Can nations, and some non-state actors, be described as complex adaptive systems?
2. Can the interaction between elements within a system be determined using a system of systems model?

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1. Edward Smith provides two excellent examinations of EBO. See Edward A Smith, *Complexity, Networking, & Effects-Based Approaches to Operations* (Washington, DC: DoD Command and Control Research Program, 2006) and Edward A. Smith, *Effects Based Operations: Applying Network Centric Warfare in Peace, Crisis and War* (Washington, DC: DoD Command and Control Research Program, 2002).

2. Robert Jervis, *System Effects* (Princeton, NJ: Princeton University Press, 1997), 10.

3. Can knowledge of these interactions provide insight into the consequences of actions, including the secondary effects?

The methodology proposed is a system of systems analysis (SoSA). *Enhanced understanding* is the product of the process described in the text that follows. While seemingly modest, this goal is of great potential value to the decision-maker whose arsenal of analysis tools is currently limited. The inability to provide *precise predictions* of secondary effects does not connote that the effort is not potentially important. "Some problems are just too complicated for rational, logical solutions. They admit *insights*, not *answers*."[3] The objective of this methodology is the development of the former, as a tool to provide the latter. However, before embarking upon further examination, the desire for clarity warrants a look at the appropriateness of *systems* in the context of this paper.

The need of an improved approach to assessments

Assessments that consider the elements of political, economic, military, and social power as separate and distinct entities do not adequately present the holistic view. This results in a less than optimum level of analysis. This shortfall produces, at minimum, inefficient applications of power and increased potential for failure to achieve the stated objectives.

A segmented and linear view of the adversary can lead to an inability to anticipate secondary effects that occur beyond system boundaries. Incomplete assessments can produce unnecessary levels of violence, increased destruction of human life and the means to support it, and a worsening of the situation that the operation was intended to alleviate. If a government increases the level of efforts of its actions, e.g., tightens an economic embargo against another regime, there is not a precise means of determining if the resultant impact will increase proportionately, or even if there will be a variation at all. Additionally, the secondary or unintended effects of the action may work counter to the embargoing nation's objectives, such as strengthening, rather than weakening domestic support for the regime in the targeted nation. Prediction is confounded by conditions of nonlinearity. Hence, the methods of analysis that utilize a linear Newtonian approach in subjects such as mathematics and physics, have limited application to prediction of secondary effects in a complex environment.

While the recognition of nonlinearity is centuries old, and the scientific community has made continuous attempts to understand and deal with this phenomenon, it is the recent advances in information systems and computer technology that are largely responsible for this increased ability to recognize nonlinear relationships. Consequently, new approaches and advances in the physical sciences may provide insights for other disciplines.

The deleterious effects of the lack of an adequate level of understanding are evident; tools to assist the decision-maker in dealing with them are less abundant. In an attempt to reduce that shortfall, this paper proposes a methodology that approaches assessments of national power from a systems perspective.

"Systems" is used in a myriad of contexts and is subject to wide interpretation. This justifies some scoping of the term. Kenneth Waltz supplies a simple yet practical characterization of a system as "a set of interacting units."[4] However, more importantly, he observes that the system also includes structure, which makes it more than simply a collection of units and the interaction between these units. Most of the essential components of modern and technologically

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3. A. B. Cambel, *Applied Chaos Theory* (Washington: Academic Press, Inc, 1993), vi. Emphasis added. Attributed to President Emeritus of MIT, Jerome B. Weisner.

[4] Kenneth Waltz, Theory of International Politics (Reading, MA: Addisson-Wesley Publishing Company,1979), 40.

advanced societies may be depicted as systems, and these often have been developed as the result of systems analysis. Sophisticated communications, transportation infrastructure, information management, manufacturing, distribution of resources, and health systems are but a few examples. Despite the relative lack of contentiousness of these suppositions, acceptance has not provided significant practical advantages to those who desire to influence those complex adaptive systems.

A calculus that considers the political, economic, military, and social systems as interrelated elements of an overall system of power, which (importantly) is different from the sum of the parts, is critical to the assessment. Therefore, a construct that can provide enhanced understanding of the functioning of that system can contribute to more effective and efficient attainment of objectives. However, an effective utilization of such an approach requires an understanding of the systems to be acted upon, especially in the interrelationships between elements within and across the systems.

Robert Jervis presents the key challenge to the selection of the optimum alternatives when confronting a complex system. “To alter the state of a system, it is necessary to understand the interaction of the elements that make up the system. It is impossible to change one element of the system without affecting the remaining elements.”[5] This condition presents to decision-makers a virtually universal problem that lacks satisfactory solutions.

A fundamental assumption for the utilization of a system of systems analysis in this context is that the domains of national power are interrelated, i.e., an action upon a node (nexus, junction, leverage point) in one system is likely to have an impact on other nodes in other systems. Awareness of these interactions represents the critical output of the system of systems process. The proposition is that improved comprehension of the elements of national power, and the interactions within and between these, can provide a broader knowledge of the whole system, which may contribute to more informed decisions regarding actions designed to influence those systems.

Consideration of the secondary effects of actions has been an element of military operations throughout recorded history. There is a need for this approach now due to the dramatically changed environment in which nations will employ coercive power. The evolving nature of conflict and the perceived decreased likelihood of symmetrical force-on-force confrontations give this study an increased relevance. Historically, wars have involved direct conflict between military forces. Hence, assessments that focused on primarily military aspects were adequate. However, the wars of the second half of the twentieth century involved more than exclusively military engagements.[6] That phenomenon is likely to continue into the twenty-first. Therefore, assessments must consider all aspects of national power.

Historically, the focus has been on military capabilities, with other areas considered only for their contributions to military operations. However, the nature of conflict in the twenty-first century suggests that this approach is no longer appropriate. As a former senior US military commander observes, “Future military operations will be overlaid with political, humanitarian and economic considerations.”[7]

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5. Robert Jervis, "Complexity and the Analysis of Political and Social Life," *Political Science Quarterly* 112, no. 4 (Winter 1997-1998): 582.

6. Certainly, there are multiple exceptions to this trend. Korea, Falklands/Malvinas, and the 1991 Gulf War were primarily military conflicts. The Israeli military victories of 1967 and 1973 have not yet produced their primary objectives of peace and stability in the region.

7. Anthony Zinni, "A Commander's Reflections," *Proceedings* 126/91/17, no. 171 (September 2000): 34.

The economic, political, and social structures have become as important as the military correlation of forces. Ongoing conflicts have reinforced this need to consider all elements of national power. However, some assessments still focus on the military, and examinations treat the other components of power as separate entities. There is no adequate means of developing an understanding of the system as a whole, and as a result, the ability to anticipate the effects of actions is limited. Hence, decision-makers need better models and processes.[8] An objective of this paper is to contribute to: (1) an understanding of intellectual and logical foundations of a systems based approach; and, (2) recognition of the importance of secondary effects to successful utilization of EBO.

Premise 1. Nations, and some non-state actors, can be described as complex adaptive systems

This paper uses the *complex adaptive systems* (CASs) as a paradigm for power. Systems have been described as "instances of *organized complexity*."[9] Hence, the linkage of systems to complexity does not represent a radically new pairing. However, further development requires a firmer theoretical underpinning.

First, agreement on basic definitions is required. As discussed earlier, a system may be described as a "regularly interacting or interdependent group of items forming a unified whole…under the influence of related forces."[10] Depiction of the essential components of modern societies as *systems* is appropriate. Sophisticated communications, transportation infrastructure, information management, manufacturing, distribution of resources, and health systems are but a few examples. While even a cursory investigation of the concept of systems will reveal an abundance of characterizations, the terms that appear most consistently in definitions of systems, and those most important to this analysis are *structure* and *function.*

A basic premise of a systems approach is the presence of a set of characteristics and properties that are common to all systems regardless of the specific domain. Additionally, the existence of some level of organization in the world, with patterns concepts and principles, must be accepted if the approach is to be applied to political and social processes.

Sanders describes CASs as "Open nonlinear systems that are constantly processing and incorporating information."[11] This means that CASs change and evolve in reaction to external stimuli, as well as to feedback within the system. Gell-Mann offers that a CAS "acquires information about its environment and its own interaction with that environment."[12]

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8. The National Military Strategy of the United States declares, "Our experiences in Afghanistan and Iraq highlight the need for a comprehensive strategy to achieve longer-term national goals and objectives. It also provides, "commanders must expect and plan for the possibility that their operations will produce unintended 2nd- and 3rd-order effects." U.S. Department of Defense, "National Military Strategy of the United States 2004," (http://www/oft.osd.mil/library/library_files/document_377.pdf).

9. John W. Sutherland, *Systems Analysis, Administration and Architecture* (New York: Van Nostrand Reinhold Company, 1975), 7. Italics in original.

10. *Webster's New Collegiate Dictionary*, 8th ed., s.v."system."

11. T. Irene Sanders, *Strategic Thinking and the New Science* (New York: The Free Press, 1998)., 69. These systems "exist at the boundary between chaos and order." M. Mitchell Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos* (New York: Simon and Schuster, 1992), 330, observes that in a CAS "agents are constantly adapting to each other and things are always in flux."

12. Murrary Gell-Mann, "The Simple and the Complex," in *Complexity, Global Politics, and National Security*, ed. David S. Alberts and Thomas J. Czerwinski (Washington, DC: National Defense University, 1997), 17. The result is the determination of regularities in that information that condensed into a "schema" or model that

CASs change and evolve in reaction to external stimuli. In capitalist economic systems, the law of supply and demand predominates; securities prices reflect this condition. The environment provides the primary stimulus to the system. In order to preclude the system from descending into chaos, control mechanisms have been incorporated to suspend trading in specific circumstances.

Unlike many physical structures, national and international systems are nonlinear, complex, and at times, chaotic. There is no calculus, and there are no universal laws that can precisely equate cause to effect. Further complicating the analysis, these systems are dynamic and reactive. Hence, even in the least technologically advanced nations may reasonably be described as *complex.*

When non-state actors, such as al Qaeda are thrown into the equation, the complexity becomes undisputed. Due to multiple interacting components of national power, viewing nations as a system is readily accepted. Additionally, there is little debate that nations are *adaptive*, that is, they react to external as well as internal stimuli. Hence, a portrayal of nations as CAS is not a radical departure from mainstream concepts.

Perceived by some as little more than stating the obvious, moving beyond agreement presents the important question, "so what?" The important issue remains whether or not this recognition of nations as complex adaptive systems presents any practical applications. Even if the models are accurate, an important question emerges. Can utilization of the components of these theories provide any realistic assistance to those who must make foreign policy decisions in such an environment? If so, are examples extant that can provide additional insights into the potential value of the consideration of these theories? Satisfactory answers to these questions are far less evident.

Premise 2. An action taken to influence a complex adaptive system will also produce secondary effects

Any attempt to alter one element of a system will result in changes in the other components with which it interacts. Consequently, it is extremely difficult to distinguish between "causes" and "effects," since initial behaviors influence subsequent ones. Therefore, outcomes do not always conform to intentions.[13] The resultant quandary is that even if we can predict with an exceptionally high degree of certainty that action A, will result in effect B, the problem of what other events will occur remains unaddressed. As affirmed earlier, *we can never do only one thing.*

In the physical world, if the force applied to an object is changed, the laws of motion lead us to expect a commensurate alteration in the resultant velocity of the object. The effect of a standard cue ball, traveling at a certain velocity, impacting a grouping of solid and striped balls of known mass, at a specific angle of incidence, may be determined with some degree of accuracy if the environmental factors, e.g., wind velocity, temperature, humidity, etc., are known. And, importantly, the effects of the secondary collisions are calculable. However, there is no equivalent equation to predict with much confidence the consequences of state actions.

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influences actions. CAS's are not static, or limited to a specific purpose. "Complex adaptive systems …have a general tendency to generate other such systems" (ibid., 19).

13. Jervis, "Complexity and the Analysis of Political and Social Life." 582. He notes, "in a system, actions have unintended effects on the actor, others, and the system as a whole, which means that one cannot infer results from desires and expectations, and vice versa" (ibid., 578).

While there may be valid justification for an action against an infrastructure node, e.g., bridge, power plant, or fuel storage facility, its destruction could result in secondary effects that are counter to overall objectives. Recent applications of military power in Afghanistan and Iraq provide examples where actions designed to achieve desired effects in support of objectives, also resulted in secondary (unintended, unanticipated, or undesired) effects that may or may not have supported these overall coalition objectives.

A key challenge to the selection of alternatives when confronting a complex system is "To alter the state of a system, it is necessary to understand the interaction of the elements that make up the system. It is impossible to change one element of the system without affecting the remaining elements."[14] This condition presents to decision-makers a virtually universal problem that lacks satisfactory solutions. This is a dilemma that adoption of a system of systems analysis within an effects based approach seeks to address.

Premise 3. A system of systems analysis provides a means for anticipation of secondary effects.

NATO's Strategic Commanders declared, "Effective decision making requires a net assessment capability that harnesses the current political, military, economic, civil, information and infrastructure factors that affect all actors."[15] While categorization is useful for descriptive purposes; such systems do not operate independently. Due to their size and complexity, the total structure and processes of a nation's capabilities may be better understood as a *system of systems*. The inherent complexity and interactions make this holistic system of systems different than merely an arithmetic sum of the subsystems. Hence, the challenge facing those who would utilize a systems approach becomes more problematic. Nevertheless, some intellectual energy has been expended in this arena, the most visible manifestations being the Operational Net Assessment (ONA) and System of Systems Analysis (SoSA) efforts contained within the Multinational Experiment series.

Since an ability to predict system behavior requires near perfect knowledge, and that level of information is not likely to be available, then attainment of a total understanding of system operation and behavior is not a realistically achievable goal. While the potential for the secondary effects of actions is not contentious, workable methods to contend with this phenomenon have not yet been provided. Therefore, some means to overcome the predicament generated by the existence of complexity is required. The linkages between entities (actors) with the systems that comprise a nation's overall system of power surfaced as a likely foundation upon which to base a methodology.

In conditions of linearity, if an action is taken against a component in the system, the effect of that action could be understood and possible secondary effects predicted. Because systems of national power are complex adaptive systems, and relationships between elements are nonlinear, we can recognize only that one element is related to another, that interactions are likely, and that secondary effects may emerge; even if their nature is not determinable.[16] Hence,

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14. Jervis, "Complexity and the Analysis of Political and Social Life," 582.

15. North Atlantic Treaty Organization, Supreme Allied Commander Operations/ Supreme Allied Commander Transformation, "Strategic Vision: The Military Challenge." 23 August 2004. The document "is not a directive, but is intended to inform, educate and stimulate debate within the Alliance and nations." 2.

16. Robert Axelrod, *The Complexity of Cooperation* (Princeton, NJ: Princeton University Press, 1997), 3. Complexity theory involves the interactions of multiple actors. Acknowledging that managing the interactions

prediction of every effect that may result from an action is not possible. That condition is accepted. However, the premise that recognition of this situation must lead to the conclusion that there is no feasible way to generate insight into secondary effects is not.

The stratagem is to attack this condition of complexity with simplicity, i.e., to present the dilemma and a possible contribution to resolution in an uncomplicated manner, using a readily understandable and generally applicable technique. This is not an unprecedented approach. Decomposition of the complex into smaller and more reasonably understood segments is central to scientific methods. However, the danger of regressing into a merely reductionist approach is apparent.

Nodes are fundamental to the process. Nodes are tangible, and represent persons, places, or things upon which actions may be taken in order to influence system behavior. Examples include government officials, religious leaders, transportation infrastructure, financial institutions, and military command and control facilities. A point that is important to the proposed methodology is that not all elements, actors, and entities are nodes. Consequently, determination of when an entity is to be designated as a node is vital to the process. The following illustrations provide a simplified view of the problem facing the development of an understanding of secondary effects of actions.

In a simple linear relationship, an action taken against a node can be expected to produce an effect. As with all linear relationships, the effect is projected to be directly proportional to the intensity of the action. However, this type of simple linear relationship is rarely exhibited in systems of power. This is because it is exceptionally difficult to identify an element of a system that is not is some way connected to another. Attempts to segregate any individual actor within the political system, for example, would meet with frustration, and most likely with failure. Similarly, a completely isolated economic, military, or social node defies unearthing. For example, a military action that is designed to degrade an electrical power production facility may be successful in that aim, but if that facility also is related to a hospital, as the only electricity to it, then there will be a deleterious effect on that medical facility.

Adding additional complications to the analysis, if a third node-to-node relationship exists, the effects produced by the original action may influence the interrelated nodes, which in turn produces effects that may further influence the interrelated nodes in other ways. The result is a set of effects that is beyond determination or prediction. Although the use of computers may permit an enhanced ability to display the relationships, even as few of three objects makes the number of permutations unmanageable.

A Proposed Process

As previously argued, an understanding of structure and functioning is critical to the system of systems construct. However, this is not the part of the analysis in the greatest need of improvement. Rather, the ability to respond to the second challenge, i.e., determination of the linkages between components is lacking. Consequently, the interconnections between elements, and how these may have potential for exploitation, will be the principal focus of this section.

For organizational purposes, the proposed process divides the sources of national power into the four categories Political, Economic, Military, and Social (PEMS).[17] However, this

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between numerous actors and interactions is too difficult for mathematical solutions, he advocates use of computer simulation as a primary research tool.

17. The concept development and experimentation efforts of the U.S. Joint Forces Command (USJFCOM) and NATO's Allied Command Transformation use these four, but add *Infrastructure* and *Information*. Most

sorting is conducted primarily for organizational purposes; the objective is to structure the analysis, take advantage of specialist skills and experience, and ensure that all elements of power are considered.

The boundaries between the PEMS areas are flexible and permeable. A basic assumption is that very few components must reside exclusively within one grouping. For example, a governmental agency may be primarily political, but its responsibilities are likely also to have economic and social implications. For that reason, the segregation of elements into categories is relatively arbitrary; the essence of the task is determination of relationships between elements, not the placement of the components themselves. These are critical aspects that are essential to avoiding a purely reductionist approach.

Establishment of the relationship between elements, within and across political, economic, military, and social (PEMS) areas is the key task of those conducting a system of systems analysis. Figure 1 illustrates node within the PEMS domains.

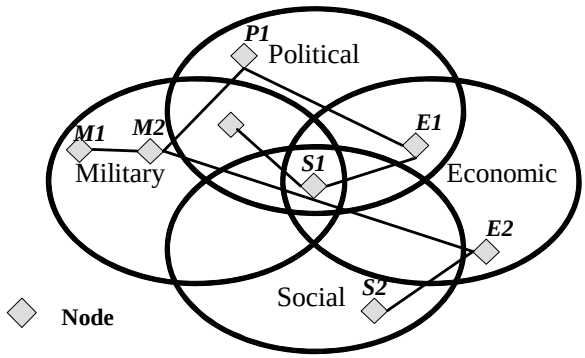

Figure 1. Nodes within System Domains

The principal function of the system of systems analysis is first to establish the key elements of the systems, then to determine the key components within those elements, and finally to identify nodes and the connections between them. While the process is continuous and seamless, for simplicity description is a series of steps.

Step 1. Identification of the essential elements within each system. With the broad categories that comprise the system of system domains (PEMS) already identified, the next step in the process is to determine the critical components of each of these.

Step 2. Determination of the essential sub-elements of each of these. Since the essential elements are too broad for a comprehensive analysis, further decomposition is required.

Step 3. Determination of junctions, intersections, and leverage points (Nodes). An entity is considered to be a node when a change in it is expected to significantly affect the system. Hence, the analyst is faced with somewhat imprecise criteria. An effective determination of status as a node requires extensive knowledge of the system as well as of the component under consideration.

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infrastructure elements could also be categorized as military or economic; and information is a broad area that can be included in social or political. This paper will limit the numbers to four in order to simplify the illustration. The number of categories is relatively unimportant, as long as a provision is made for inclusion of all possible nodes.

Step 4. Examination of nodes both within and across PEMS areas for determination of node-to-node linkages. This step requires adoption of the system of systems construct. For as already established, nodes may interact with other nodes within and across PEMS system domain boundaries. Due to the flexibility and permeability of the edges of the PEMS systems, interactions may occur anywhere within the overall system of power.
Step 5. Assigning linkages between nodes when a significant relationship exists. These node-to-node linkages provide the basis for determination of possible secondary effects of actions. This in turn will provide insights for further understanding of the system as a whole. Figure 2 provides a depiction of the process.

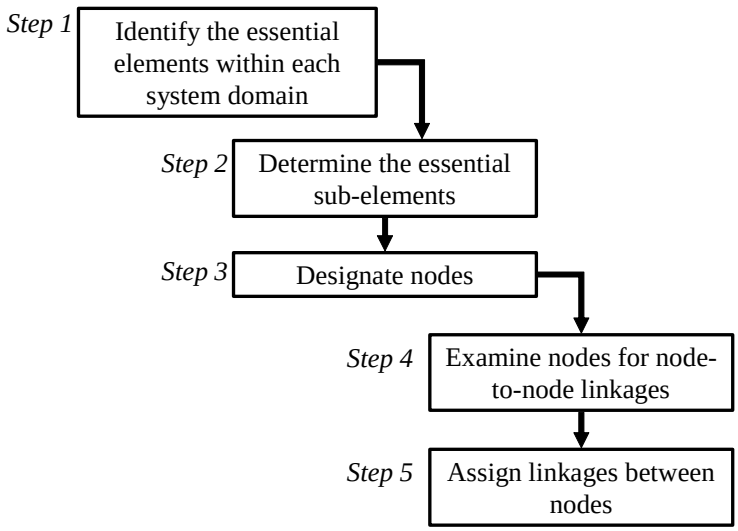

Figure 2. The Analysis Process

Once these relationships are captured in a database, analysts can use the overall understanding of the system and the existence of these nodal relationships to support the planning effort. Recognition of this capability provides a number of possible advantages. Of these, three are offered as the most valuable to the decision-maker.
1. Amplification of the effects of actions. An action designed to influence a specific node also is likely to have an effect on any nodes connected to it. This can result in extension of the effects of actions. Continuing the illustration with the use of military nodes, if a particular air defense radar is determined to be connected to a specific air interceptor command and control facility, that facility may be degraded by destruction of the radar site. Furthermore, if that same radar site is connected to additional command and control facilities, then the action to influence it may have cascading effects on those facilities. Hence, a single action may produce multiple desired effects. However, in aCAS, the equation is rarely so simple. The final analysis and decision also must consider factors such as redundancies in the overall system, e.g., back-up radars or other detection capabilities. Nevertheless, the potential for expanding the impact of the action due to knowledge of the connections is readily apparent.
2. Indication of possible undesired effects. It is conceivable that an action taken against a node in one PEMS system will have an undesired effect on another. This is the phenomenon of *surprise* and *rogue outcomes*. Using another military example, the destruction of a bridge that is being used by insurgents to transit to and from a specific geographic area also may be on the primary

route for the provision of humanitarian supplies to refugees within and beyond that area. If that bridge is destroyed, the intended military effect may be achieved. However, the unintended reduction in the ability to sustain the refugees could have a deleterious influence on the social, economic, and political systems, and run counter to the overall objectives of the mission. The recognition of this possible outcome does not rule out the destruction of the bridge, but it does provide the decision-maker with additional information upon which to select or reject that action.

3. Recognition of alternative actions. In the application of coercive power there are likely to be situations where the analysis indicates that an action taken to influence a specific node has a high probability of generating the desired effect. However, that action may not be possible for a variety of reasons, e.g., proximity to critical civilian infrastructure, political considerations, lack of resources, etc. In these cases, knowledge of the connections between nodes may allow a node to be influenced indirectly, i.e., through exploitation of a secondary effect. These illustrations describe three potential benefits of the methodology: (1) identification of opportunities for extension of the effects of actions; (2) indications of likely undesired effects; and, (3) recognition of secondary effects to mitigate targeting dilemmas. Even if partially available, such insights can be of immense value to those who must consider options in the application of coercive power. However, the limits on application of the process must be recognized so that expectations are managed and to preclude its inappropriate use.

Limitations

The ability to perform these tasks and to produce the desired outputs is directly related to the degree of comprehension of the system and its nodal linkages. The depth and breadth of this knowledge is the principal limitation of the methodology since "Knowing all the possible outcomes of a dynamic system is theoretically impossible, and thus there remains a final subset of unknowns that are simply unknowable."[18]

Some argue that attainment of even a rudimentary knowledge of the behavior of a complex system is a daunting task. Other relevant observations include that causality is holistically relational, and that there are "no clear cut dependent and independent variables as such."[19] By extension, this implies that precise determination of cause and effect, and an ability to discriminate between primary and secondary effects, is not attainable.

While these views should be considered, acceptance of their arguments does not preclude utilization of the proposed methodology. Instead, their impact is to limit the applications of this model and construct. While not providing a panacea for understanding or predicting effects within complex adaptive systems, if used appropriately, the insights attained can be of considerable value when decisions regarding application of power are undertaken.

Conclusion

Utilization of a system of system analysis can provide better understanding of the secondary consequences of actions which leads to enhanced Effects Based Operations. Appreciation that nations operate as CASs, and that the elements that comprise these systems are interrelated, is an important realization. This understanding will allow for improved comprehension of the linkages between units of the system and could contribute to better

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18. Diana Richards, *Political Complexity: Nonlinear Models of Politics* (Ann Arbor: The University of Michigan Press, 2000), 16. She adds: "The challenge is to think about how one moves from merely presenting an example to actual scientific inference," 26. She contends that every system has a set of "unknowable unknowns."

19. Ian T. King, *Social Science and Complexity* (Huntington, NY: Nova Science Publishers, Inc., 2000), 90.

awareness of secondary effects of actions. However, exploitation will require enhanced capabilities, and adaptations in existing organizational structures and policies.

When implementation of the process is considered, several practical problems emerge. Chief among these is how to manage the immense trove of required information. That is, how can analysts determine the important interrelationships, and once they do, how can the potentially thousands of linkages be captured and handled to present some practical knowledge to the decision maker? The problem is more than an ability to collect information. Rather it is the ability to manage the data and to transform it into actionable knowledge.

Effective utilization of the approach will require sophisticated tools. Many of these may already exist, and could be readily adapted for the specific analysis tasks. The rapid pace of software development makes identification of the optimum knowledge management and analysis tools itself a formidable task that will require dedicated and organized effort.

Advances in information technology make the knowledge management dilemma less daunting, but the inherent complications are immense and the difficulty in developing the adequate tools should not be underestimated. Likewise, maintenance and keeping current such a knowledge system is an enormous task. Decision support aids such as modeling and simulation, and structured argumentation tools will be required. The potential for exploitation is worthy of further concept development and experimentation.

Can military planners deal with the phenomenon of secondary effects? This paper argues that we cannot afford not to deal with secondary effects, and provides one approach. It is relatively untested, and its implementation clearly presents myriad difficult challenges. If the potential of an effects based approach is to be realized, then methods for dealing with the inevitable unintended effects of actions must be developed.

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