

Systems Thinking in Campaign Design

By Charles D. Allen and Glenn K. Cunningham, US Army War College

Strategic campaign planners and statesmen often begin their analyses by assuming a linear cause and effect relationship similar to a move/countermove exchange in chess. Although such linear formulations may sometimes be a useful starting point for leaders, they can also be disastrously misleading. Systems thinking, however, provides an alternative that compensates for the limits of linear reasoning in military campaign design.

For centuries, the basic approach of science relied on linear logic and a belief that the best method for understanding any phenomenon was to break that phenomenon into parts that could be studied independently. Doing so was thought to simplify a problem, thereby making it more manageable for the scientist. The approach assumed the whole to be studied was simply equal to the sum of its parts. The logic of this linear thinking and its associated mechanical metaphors was transferred outside of the natural sciences and applied to many other disciplines.

Beginning in the 1950s, this mechanistic approach began to be questioned as the best method for gaining knowledge of the natural world. Some of the scientific pioneers of the systems approach were concerned that the expansion of knowledge was so great that it resulted in excessive specialization that prevented scientists from communicating across disciplines so that, for

example, physicists and biologists were isolated from one another. Therefore, the pioneers of a systems approach aimed to create a general theory that could identify the existence of laws that might apply to similar structures in different fields. Underlying the emerging view was recognition that the whole was *not* merely the sum of its parts but rather something synergistically more. Consequently, a new approach organized around the concept of *systems* took root. Ludwig von Bertalanffy, one of systems theory's early proponents, saw the purpose of systems theory as "an important means in the process of developing new branches of knowledge into exact science, i.e. into a system of mathematical laws."¹ Such a conception of systems theory implied that it promised greater certainty with increased ability to predict than the earlier mechanistic approach.

The dynamic behavior of a closed system is quite different from open systems in that the former allows greater certainty and prediction. For example, a person knows what the response of a thermostat will be when one adjusts the temperature up or down. In contrast, a more open system, like a political system, cannot be expected to respond to some stimulus, say a stock market collapse, in a predictable pattern. The unpredictability of open systems stems in part from the fact that many more variables are at work than closed systems. Ironically, initial systems theorizing and thinking sought greater certainty and control to facilitate prediction and enhance interdisciplinary communication. However, when the

¹ Ludwig von Bertalanffy, "An Outline of General System Theory," *British Journal for the Philosophy of Science* 1 (1950):134-165.

concepts were applied to more open systems like organizations or societies, the expected outcomes did not materialize and resulted in both unanticipated and unintended consequences.

What then are the aspects of a systems approach that are most helpful for strategic thinking and campaign design? Systems thinking, applied to the kinds of open systems that commanders and staff planners deal with, provides a caution against the hazards of simple linear cause and effect reasoning. A starting point for appreciating differences between systems thinking and linear thinking lies with the definition of *system*. A system is a set of units (or elements) that are interconnected in such a way that changes in some elements produce changes in other parts of the system. Moreover, the changes induced in other elements will not necessarily be proportional to the initial change. This disproportion between input and output is captured nicely in the aphorism, “the straw that broke the camel’s back.” In the realm of economics, the disproportion between input and output is also captured in the law of diminishing returns where, at a particular inflection point, returns will decline despite increased input. In addition, the system as a whole exhibits properties or behaviors that are different from its individual parts. Following from the definition of system, interactions and interconnections within and outside the system must affect strategic thinkers contemplating organizational design.

Systems Thinking and Organizational Design

As we think of an organization, we tend to look at its structure as a wiring

diagram that depicts departments and functions in the form of a bureaucracy—hierarchical and well defined. Military organizations in particular, have long been considered illustrative of such structure and processes. Gareth Morgan conceptualized organizations as functioning like a machine.² The machine metaphor views organizations as closed systems with inputs, internal processes, and outcomes. Each part of the organization fits together by design so the smoother and more standardized the operation, the more efficient is its production. The scientific management concepts of Frederick Taylor supported the view of organizations as closed systems.³ Taylor sought to reduce all production into component processes, define key activities, minimize variations, and then manage the performance of workers with precision. This scientific approach assumed direct cause and effect relationships in what happened on factory shop floors. The role of leaders in general, and strategic leaders in particular, was to remove any fluctuation in the external environment to allow for the predictability of both inputs and outputs. As such, strategic leaders designed internal systems that demanded maximum efficiency from workers, acquired resources for production, and either captured or developed demand for the product in the market. In other words, strategic leaders were the only “thinkers” in the organization—most other direct-level roles in such a system were intended to only be “doers.”

² Gareth Morgan, *Images of Organizations* (Thousand Oaks, California, Sage Publishing, 2006)

³ Frederick. W. Taylor, *The Principles of Scientific Management* (New York, New York: Enna, 2008). (Original work published 1911)

As one would expect, this machine metaphor, while potentially effective in a stable, predictable environment, had some drawbacks. The emergence of larger and more complex organizations led to the discipline of systems analysis and the rise of Operations Research and Systems Analysis (ORSA). The ORSA practitioners sought to identify all key parameters of closed production systems by observation, measurement, and analysis. Analysts then developed mathematical models and simulations to determine the optimal design of systems and processes. This ORSA approach attained prominence in military circles with the "whiz kids" of Secretary of Defense Robert McNamara in the 1960s. In the 1980s, the emphasis on system analysis led to systems engineering with the focus on design and control.⁴ Army officers will remember the emergence of Battlefield Operating Systems (BOS) and System of Systems Analysis (SOSA) as the Army tried to quantify combat operations in the era of Air-Land Battle. The methodology for systems analysis was to observe potentially critical events, collect data to reveal trends, establish causal relationships, and then seek to design systems with control mechanisms to attain optimal performance. Attempts to quantify large-scale combat operations to reduce the fog and friction of war through BOS and SOSA led to a false sense of certainty challenged by contemporary 21st century experience in operations in Iraq and Afghanistan.

The focus on the scientific reductionism of processes by managers

⁴ The U.S. Army emphasized the ORSA approach in the 1980's with a separate MOS identifier (49A) for officers and the United States Military Academy established Systems Engineering as an academic major in 1988.

resulted in them doing things right (that is, following established procedures) within well-defined structures. However, as the complexity of globalization and interconnectivity of near-instantaneous communications and data processing increased, this approach proved less and less efficacious. Organization theorist and systems thinking pioneer, Russell Ackoff, presented another perspective of organizations as human enterprises with people as integral components and organizations as part of open systems.⁵ His approach to systems thinking challenged the purely scientific approach by examining social, cultural, and psychological aspects of people in organizations. Ackoff offered that systems thinking was required by leaders to determine what were the “right” things to do for organizations. This holistic view of organizations coincided with the acceptance that an organization was more than the sum of its parts. As part of an open system, there are organizational interactions with the external environment that are beyond the control of management as well as internal feedback mechanisms that indirectly influence operations in unforeseen ways. As we talk about systems thinking, the terms dynamic, nonlinear, second- and third-order effects, and unintended consequences are used to describe actions within organizations. The desire to have an organization that acts like a well-oiled machine with clock-like precision does not mirror the reality of most organizations. There are other intangibles that defy quantification— affective factors, motivation, cohesion, organizational climate and culture, and

⁵ Russell L. Ackoff, "Towards a *System of Systems* Concepts, *Management Science* 17, no. 11 (July 1971): 661-671, in *Business Source Complete*, EBSCOhost (accessed January 26, 2010).

leadership—that either support or detract from organizational performance.

Peter Senge introduced and captured in his book, *The Fifth Discipline*, the treatment of an organization as an entity that actually “learns.”⁶ He noted that something was missing in our understanding of organizations as systems when:

- Over 75 percent of reengineering efforts fail to achieve targeted improvements in performance.
- Many initiatives to reduce cost in one part of a system result in increased cost elsewhere.
- The vast majority of restructuring efforts fail to achieve intended synergies and generate unintended consequences.
- Large-scale projects tend to overrun schedule, budget or both.
- Metrics result in more reports and administrative burdens but shed little light on the levers that can be pulled to meet targets.

Senge offered a view of organizations as social activities that perform best when all members are able to contribute to achieving their goals. While some have called this empowerment, systems thinking is the critical competency within an organization that develops the synergy of the other four disciplines.⁷ Systems thinking provides a framework for understanding and explaining organizational processes and how they perform over time. The use of system thinking models

⁶ Peter Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization* (New York, Doubleday/Currency, 1990)

⁷ The four other disciplines are shared vision, mental models, personal mastery, and team learning. See Senge, pp. 12-13.

helps members understand complex problems, develops shared team understanding while suggesting ways to leverage complex problems, and identify and test solutions—all processes that support learning organizations.

Senge's insights apply to the Department of Defense and its armed services that are undeniably large, stratified organizations composed of systems within systems. A review of any DOD organizational chart will illustrate the functions and assignment of responsibilities to provide a product or service in the pursuit of national defense. The Army Organizational Life Cycle Model (AOLCM) depicts the linkage of systems for acquiring, developing, employing and then retiring resources (Figure 1). A vivid example of the AOLCM in action is personnel—the Army recruits, trains, and educates people, then assigns them to perform missions until they are eventually released from service. Some may naively believe that such a personnel system is a simple linear process, but in truth, it is inherently convoluted and complex. A typical U.S. Army War College Army student, after 18 or more years of service, demonstrates a career characterized by 4-5 promotions, 2-3 deployments, 10-12 jobs at 5-6 different locations, 4-5 formal educational opportunities, and 8-9 moves for the Soldier and family. Moreover, the

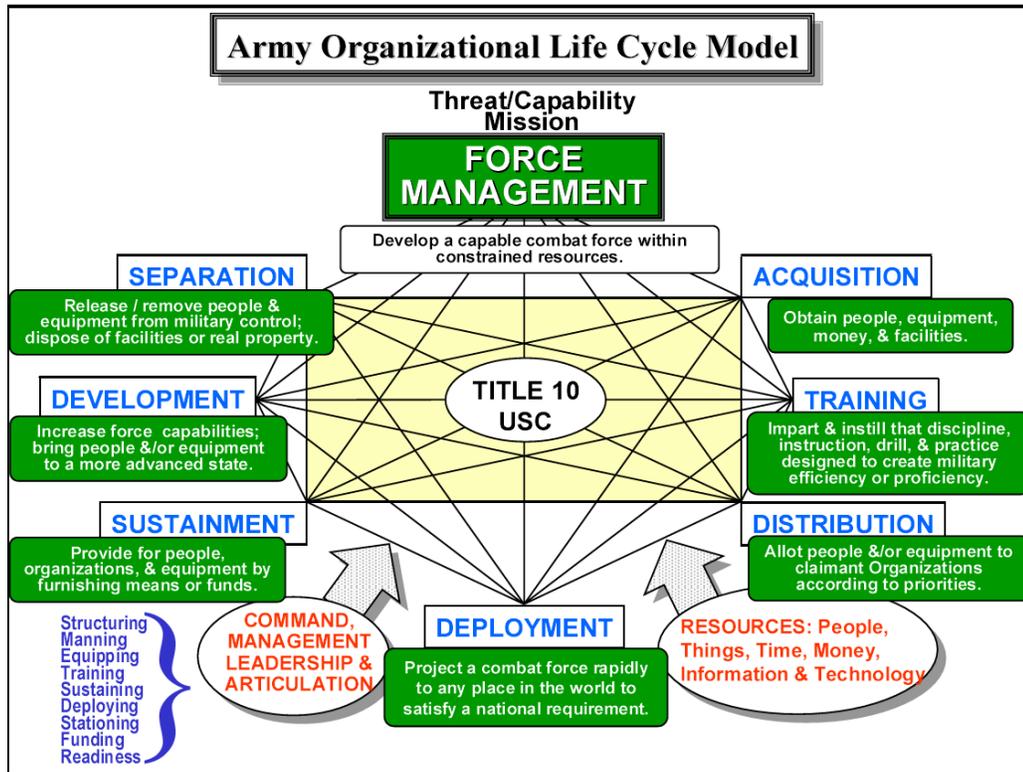


Figure 1. The Army Organizational Life Cycle Model. The linkage of systems for acquiring, developing, employing and then retiring resources is inherently complex, interconnected, and self-adapting

personnel system is interdependent with systems for compensation, promotion, healthcare, and family support. The personnel system is also influenced by operational concepts that seek to determine the types of people needed to man weapons systems and equipment to fight according to Army doctrine. There are series of interactions that have second and third order effects as well as unintended consequences. Hence, any decision on military personnel should consider its relation to other functions.

The U.S. Army realizes that simple linear depictions do not reflect actual cause and effect relations and thus the Army looks for intervening variables and

interactions between the variables. Interconnectedness and unintended consequences abound in the most mundane decisions in large and complex organizations, and the U.S. Army and operational commands are not immune from this reality.

The machine metaphor used to characterize organizational design is more troublesome when applied to open political and social systems. Thus, the impact of interactions, associated negative feedback and unintended consequences is central to the security dilemma underlying dynamic process in international relations. The dilemma stems from the fact that states often seek to maximize their power by increasing the resources devoted to their security. By doing so, states are able to threaten others who are likely to respond with efforts to neutralize or counterbalance the effort of the first state. The end result is that no state is more secure than when the process began, and the first state was unable to maximize its power as intended. Similarly, the balance of power illustrates the negative feedback found in international politics. States may respond to threats by balancing against any state that might threaten their security so that any move that could bring a state great competitive advantage can be expected to generate opposition from others. For example, one can look at the North Korean attack on South Korea in 1950 as reflecting such a response. That attack was sanctioned by both the USSR and the PRC on the assumption that the North Korean advance would strengthen their position in Northeast Asia against the United States and Japan. However, the attack had the opposite effect because it led the US to triple its defense budget, conclude defense treaties around the globe and

transform NATO into a functioning military organization.⁸

Systems Complexity in Military Operations

Any theater of war presents a complex array of intermixed physical, geographical, psychological, social, political, and economic factors so that it has long been recognized that military operations must be approached from a systems perspective.⁹ That said, the 21st century, with the globalized and digitally enhanced nature of human enterprises of all sorts, presents particularly compounding structural and interactive complexities, so that commanders must approach operations as a holistic system of subsystems, complicated even more by adaptive interventions on the part of the many actors who are involved, whether supportive, neutral, or adversarial. Such complex adaptive systems “exhibit coherence under change, via conditional action and anticipation, and they do so without central direction.”¹⁰

The electronic information age allows great advances in military affairs, because collaboration and information sharing can proceed simultaneously at multiple levels. Similarly, the same electronic advances underlie precision guided munitions that increase the lethality of attack. Command and control is enhanced and can be synergistically networked at longer ranges with greater numbers of

⁸ Janeen Klinger, in Charles D. Allen, G. K. Cunningham, and Janeen Klinger, "Strategic Thinking for Strategic Leaders" [Unpublished manuscript] (Carlisle, Pennsylvania: U.S. Army War College, 2009)

⁹ U.S. Joint Chiefs of Staff, *Joint Operation Planning*, Joint Publication 5-0 (Washington, DC: U.S. Joint Chiefs of Staff, December 26, 2006), III-7.

¹⁰ John J. Holland, *Hidden Order: How Adaptation Builds Complexity* (Reading: Addison-Wesley, 1995), 55.

participants. Still, the 21st century operational environment poses problems that can be variously well-structured, medium-structured, or ill-structured, thus defying easy discernment and presenting no uniform, definitive way of formulating solutions.¹¹ Hence, the traditional requirements for leadership remain in effect alongside state-of-the-art technology. Disciplined critical thinking, relevant experience, and insightful judgment are more important than ever. The commander must add value to the process of understanding the operational environment or risk being overwhelmed and defeated by systems complexity.

These changes greatly expand the range of issues facing that commander. An operational or strategic commander cannot focus on purely military matters in his operational environment and ignore other subsystem or related system elements. Certainly potential adversaries realize this, as it is clear that US military power is overwhelming. If an enemy cannot hope to prevail militarily, that foe is likely to choose other battlespace. Instead of a military-to-military confrontation, modern warfare is likely to require the application of all elements of national power (diplomatic, informational, military, and economic) against adversary systems (political, military, economic, social, informational, and infrastructure).¹²

Moreover, military operations take place in and across a spectrum of conflict, yet this continuum is so prone to overlap, indistinct transitions, varying

¹¹ U.S. Department of the Army, *Commander's Appreciation and Campaign Design*, TRADOC Pamphlet 525-5-500 (Fort Monroe: U.S. Army Training and Doctrine Command, January 28, 2008), 5–11.

¹² U.S. Joint Chiefs of Staff, *Joint Operation Planning*, Joint Publication 5-0, III-16–III-19.

magnitudes, and contemporaneous actions that it is perhaps best described as “a spectrum of conflict and operational themes.”¹³ Along this spectrum, violence can range widely from the occasional criminal attacks of a stable peace to the ongoing full-nation hostilities of general war. Operational themes include, but are probably not limited to, peacetime military engagement, limited interventions, peace operations, irregular warfare, and major combat operations. These thematic descriptions may not occur in sequence or in isolation, but may well surface simultaneously as a mixture of activities sometimes termed hybrid warfare.¹⁴

Clausewitz as Military Theorist—and Systems Thinker

Clausewitz posited two ways out of systems-generated conundrums. The first was to recognize that just as all things in war are complex and cause friction, not all things are of equal importance or equal difficulty. Tactical tasks are relatively self-contained and logistical concerns are restricted along certain channels of action by the limitations of time and space. However, as the functions to be performed become increasingly intellectual, the more the commander’s cognition and experience becomes of paramount importance. Secondly, Clausewitz postulated that a senior commander should remain adaptable and not be bound by doctrine, but guided by theory, which is “intended

¹³ U.S. Department of the Army, *Operations*, Field Manual 3-0 (Washington, D.C.: U.S. Department of the Army, February, 2008), 2-3-2-5.

¹⁴ James N. Mattis and Frank Hoffman, "Future Warfare: The Rise of Hybrid Wars," *United States Naval Institute Proceedings* 131, no. 11 (November 1, 2005): 18–19 in ProQuest Research Library (accessed April 27, 2009).

to provide a thinking man with a frame of reference for the movements he has been trained to carry out, rather than to serve as a guide which at the moment of action lays down precisely the he must take.”¹⁵

Thus, Clausewitz focuses on the central role of the commander in framing the strategic or operational problem to be addressed by military planning. His position on this matter is echoed in contemporary calls for emphasizing the role of the commander in operational campaign design. Design highlights two critical actions toward which a commander should direct personal efforts: framing the operational environment and framing the nature of the problem.¹⁶ The first describes the nature of both extant, existing factors and projects desired conditions that must be undertaken to change those factors favorably. The second clarifies the nature of the problems to be faced and determines courses of action that will enable desired end states.

Campaign design is not new, but rather reemphasizes an approach to systems thinking that postulates that the commander must appreciate the operational environment facing him or her and must further be able to assess the relative qualities and values of systemic operational factors. Only by thus framing the nature of the problems confronting the organization can a commander visualize a concept of operations and describe to others a mission narrative on

¹⁵ Clausewitz, *On War*, 141.

¹⁶ U.S. Department of the Army, *Commander's Appreciation and Campaign Design*, TRADOC Pamphlet 525-5-500,

how to effectively bring about change.¹⁷ The primary tools used to initiate and guide this process, which perforce must be undertaken in some detail by the commander's staff, are the initial commander's intent, the commander's planning guidance, and the commander's critical information requirements.¹⁸

On the modern battlefield, the commander cannot be a passive approval authority for the insights, initiative, and industry of others. The commander must be an integral and additive part of the process and make a personal, positive contribution to mission success through all aspects of planning and execution. Indeed, the commander may well be the only person with the requisite experience, long-range time horizon, judgment, and intuition who is in a position to make those additive contributions to initial staff inputs and estimates.

This unalterable responsibility was described by Field Marshall Sir William Slim:

I suppose I have published dozens of operations instructions and orders, and I have never written one myself because I have always had excellent staff officers who could do it. But, there is one part of an order that I have always made a point of writing myself. That is the object [that is, the commander's intent]. I do recommend it to you, gentlemen, that when long orders are being written for complicated

¹⁷ U.S. Department of the Army, *Operations*, Field Manual 3-0, 5-2-5-9.

¹⁸ *Ibid.*

operations, you take up your pen yourself and write the object in your own words so that object goes down to everybody.¹⁹

The commander's responsibility to understand strategic guidance, visualize campaign design, and communicate it succinctly and thoroughly to his subordinate planners and commanders cannot be delegated, but are in fact the fundamental elements of command and constitute essential contributions to mission success.

Systems Thinking and Campaign Design

In the joint doctrinal context, operational art is directly applicable to campaign design. It involves the formation and use of a conceptual and contextual framework as the foundation for campaign planning, joint operations order development, and subsequent execution of the campaign.²⁰ Thus, a systems perspective is at the forefront of campaign design.

However, it is the nature of complicated systems to defy rational analysis and linear thought. There is no quick and easy process that will eliminate friction, dissipate the fog, and crystallize an appropriate course of action in an operational environment that is comprised of numerous interrelated subsystems. The resultant interaction of complexity, indistinctness, internal dynamics, and human cognitive limitations place heavy demands on planners and make decision

¹⁹ Sir William Slim, "Higher Command in War," *Military Review* 70, no. 5 (May 1990): 10–21. [His remarks to the US Army Command and General Staff College, Fort Leavenworth, KS, April 1952.]

²⁰ U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington, DC: U.S. Joint Chiefs of Staff, September 17, 2006), IV-3.

making, in systems, imprecise and risk-prone.^{21, 22} Hence, a common tendency is to pursue imprecise and vague objectives that are in actuality often multiple objectives. This poses potential problems for campaign design and planning because the pursuit of such multiple ends with limited means and restricted ways implies that many factors must be simultaneously counterbalanced and many criteria satisfied at once, thus increasing risk.²³ Hence, one of the most important determinations facing a commander and his or her staff in campaign design is the identification of centers of gravity.

The Clausewitzian concept of center of gravity is a useful construct in campaign design. It provides a means by which commanders and planners can frame the complicated, interlocking systems making up the operational environment, set priorities, and coordinate and synchronize efforts across the range of warfighting functions. Clausewitz described this concept thusly:

One must keep the dominant characteristics of both belligerents in mind. Out of these characteristics a certain center of gravity develops, the hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed. Small things always depend on great ones, unimportant on important, accidentals on essentials. This must guide our approach. . . . [Only] by

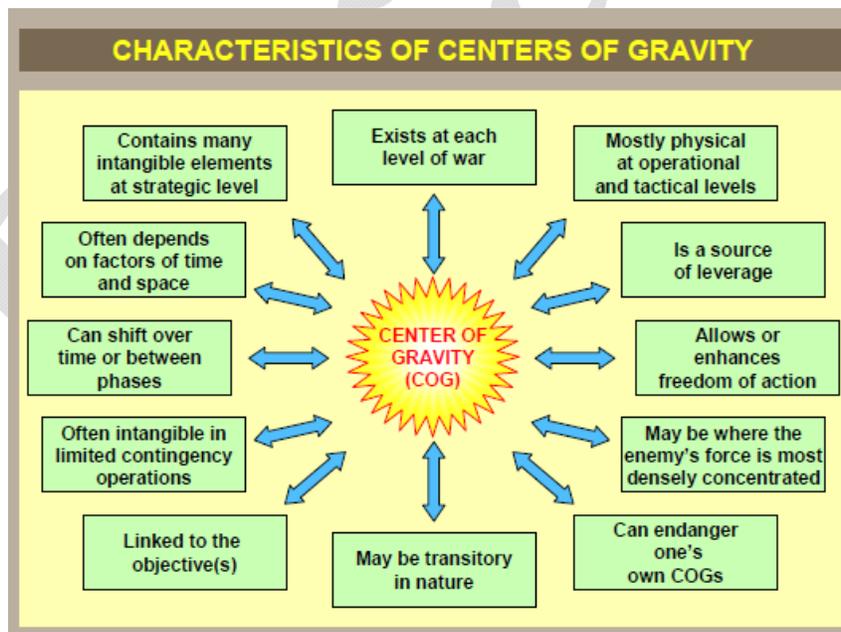
²¹ Dietrich Dörner, *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations* (Reading: Addison-Wesley, 1996), 37.

²² Herbert A. Simon, *Administrative behavior: A study of decision making processes in administrative organizations*, 4th ed. (New York: Free Press, 1997), 92. [Original work published 1945.]

²³ Dörner, *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*, 51.

constantly seeking out the center of his power, by daring all to win all,
will one really defeat the enemy.²⁴

Much has been written about this concept, but for the purposes of this treatment it is sufficient to clarify its importance and relevance to systems thinking and campaign design. The selection of a center of gravity serves to solidify the commander’s understanding of the operational environment and provides insights about the system and where and how operations should be executed. Centers of gravity are those “characteristics, capabilities, or sources of power from which a system derives its moral or physical strength, freedom of action, and will to act.”²⁵ Joint Publication 5-0 suggests characteristics of centers of gravity (Figure 2), emphasizing that centers of gravity may



²⁴ Clausewitz, *On War*, 595–596.

²⁵ U.S. Joint Chiefs of Staff, *Joint Operation Planning*, Joint Publication 5-0, IV-8.

Figure 2. Characteristics of centers of gravity.²⁶

be transitory, shift over time or between operational phases, and may be largely intangible at the strategic level. That is, a center of gravity is a design tool, not a magic talisman. There may be more than one, but for campaign design and planning purposes it would be wise to limit proliferation, as that dilutes both planning focus and operational concentration of effort. Thus, “the essence of operational art lies in being able to produce the right combination of effects in time, space, and purpose relative to a [center of gravity] to neutralize, weaken, defeat, or destroy it. In theory, this is the most direct path to mission accomplishment.”²⁷ However, as with most attempts to influence or alter elements in a system, this is not an empirical, mathematically precise process. Design can be facilitated, however, by adherence to a consistent methodology of campaign analysis.²⁸

Under such a methodology, the center of gravity constitutes that part of the operational environment against which planning and operations will be pressed.²⁹ It may not be a specific node or a particular relational link, but rather will consist of a judiciously identified and deliberately selected limited set of

²⁶ Ibid, IV-9. Note the repeated references to inconstancy and mutability intimated by the characteristics presented, indicative of this concept as part of a systems approach to campaign design. That is, for a variety of reasons, a center of gravity may change over the course of a campaign. Failure to recognize such changes may produce severe consequences.

²⁷ Ibid, IV-9.

²⁸ Joe Strange, *Centers of Gravity & Critical Vulnerabilities: Building on the Clausewitzian Foundation So That We Can All Speak the Same Language*, in *Perspectives on Warfighting* No. 4, 2nd ed. (Quantico: U.S. Marine Corps University, 1996).

²⁹ U.S. Joint Chiefs of Staff, *Joint Operation Planning*, Joint Publication 5-0, IV-8.

nodes and related links (Figure 3). In this context, it becomes less imperative that a center of gravity be

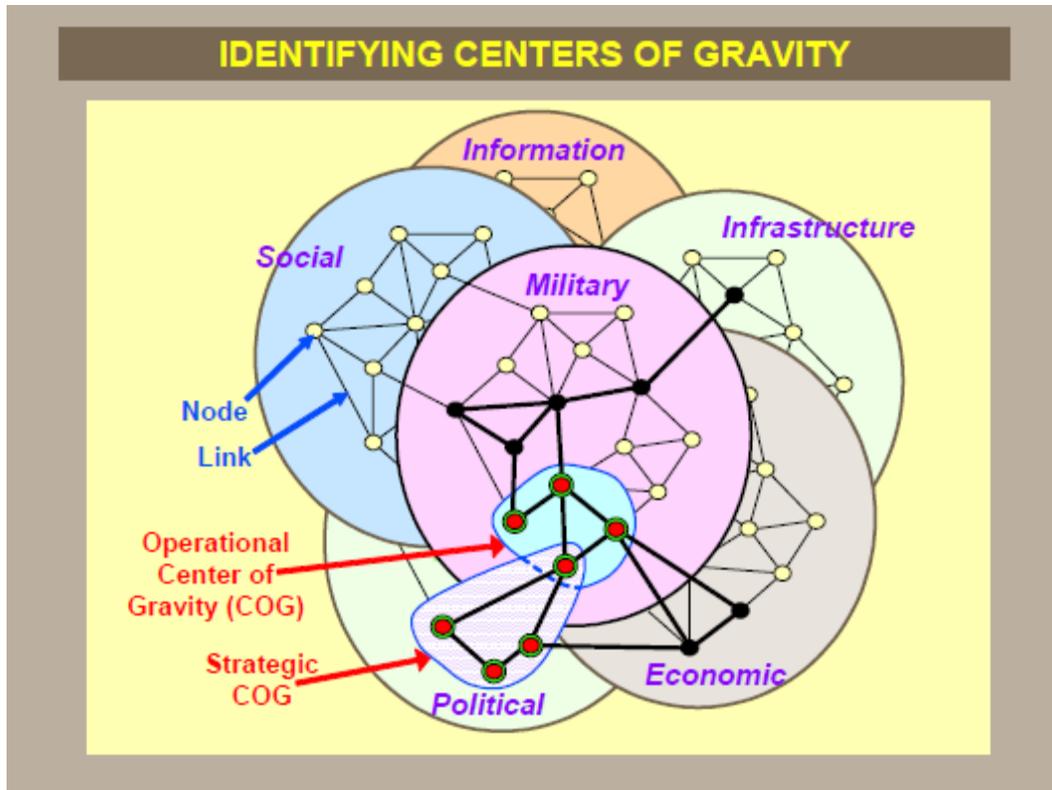


Figure 3. Identifying centers of gravity as a systems component, that is, as a judiciously selected set of nodes and links.

precisely, absolutely, and irrevocably correct. While assuredly it cannot be arbitrarily or capriciously determined, it is far more important that it be reasonable and credible than that it be exactly, immutably right. A center of gravity is a construct, a mental model on which to predicate analysis and planning. Continued situational awareness and the unfolding of events as a campaign progresses will allow reframing of the appropriateness of the center of gravity selected. This lack of certainty is no impediment to resolute action; rather, it is

simply the nature of warfighting as a systems activity, requiring perspicacity and adaptability on the part of commanders and planners alike. As Clausewitz suggested, “War is the realm of uncertainty; three quarters of the factors on which action in war is based are wrapped in a fog of greater or lesser uncertainty. A sensitive and discriminating judgment is called for; a skilled intelligence to scent out the truth.”³⁰ Center of gravity selection is no more certain. That said, without the identification of a reasonable center of gravity as the foundation of campaign design, there is no place to enter the system and begin credible planning.

Understanding the operational environment as a complex, interrelated system is central to operational art. The campaign design process set forth in current doctrine accepts the systemic nature of warfighting and seeks to impose a consistent, rational model on the system to mitigate uncertainty and facilitate further analysis and planning on the part of commanders and staffs. Campaign design and planning cannot eradicate friction and the fog of war, but it can enable resolute and insightful commanders to frame the nature of the campaign and impose their will in the context of an unruly and ever-changing operational environment. A systems approach to campaign design can enhance a commander’s appreciation for the operational environment in which he or she must attain objectives, accomplish missions, and truly reach political and military end states that matter in national security and international affairs.

³⁰ Clausewitz, *On War*, 101.

Draft