CHAPTER 18

APPLYING CLAUSEWITZ AND SYSTEMS THINKING TO DESIGN

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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, they can also be disastrously misleading. Systems thinking, however, provides an alternative that compensates for the limits of linear reasoning in military design. This chapter considers the implications of systems thinking as a theory and applies the implications of systems complexity specifically to military operational design. The perspectives of Carl von Clausewitz, the Prussian military theorist, inform current doctrine on design, and the Clausewitzian concept of center of gravity provides an essential tool for commanders to employ in designing campaigns.

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 was simply equal to the sum of its parts. The logic of this linear thinking and its associated mechanical metaphors transferred outside of the natural sciences and applied to many other disciplines.

Beginning in the 1950s, pioneers of the systems paradigm questioned whether this mechanistic approach was the best method for gaining knowledge of the natural and social worlds. Some of these theorists were concerned that the expansion of knowledge was so great that it resulted in excessive specialization, which prevented scientists from communicating across disciplines, so that physicists, biologists, and sociologists were isolated from one another. The advocates of a systems approach wanted to create a general theory that could identify the existence of laws that might apply to similar structures in different fields. Underlying this 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., a system of mathematical laws."[1] Such a conception of systems theory implied a promise of greater certainty with increased ability to predict than the earlier mechanistic approach.

The dynamic behavior of closed systems is quite different from that of open systems in that the former allow greater certainty and prediction. Closed systems consist of limited variables and often impermeable boundaries between elements and so typically act in a predictable, mechanistic way. 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 social-political system, does not respond to some stimulus, say, a stock market fluctuation, in a predictable pattern. The unpredictability of open systems stems in part from the fact that many more variables are at work than in closed systems, boundaries between elements are permeable, and linkages are often both tenuous and connected in unforeseeable ways. Ironically, initial systems thinking sought greater certainty and control to facilitate prediction and enhance interdisciplinary communication. However, when the concepts were applied to more open systems like organizations or societies, the expected outcomes did not materialize and instead resulted in both unanticipated and unintended consequences.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **JUN 2012**	2. REPORT TYPE	3. DATES COVERED **00-00-2012 to 00-00-2012**

4. TITLE AND SUBTITLE **Applying Clausewitz and Systems Thinking to Design**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army War College,Department of Command, Leadership & Management,Carlisle Barracks,PA,17013**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR’S ACRONYM(S) 11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
USAWC Guide to Strategy, June, 2012

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**11**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

SYSTEMS THINKING AND ORGANIZATIONAL DESIGN

When thinking of an organization, one tends 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 to 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."

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). 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 systems 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 resulted in them doing things right (that is, following established procedures) within well-defined structures. However, as the complexity of globalization and the 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. 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. As we talk about organizations in the context of systems thinking, the terms "dynamic," "nonlinear," "second-" and "third-order effects," and "unintended consequences" are used to describe actions in organizations. There are other intangibles that defy quantification—affective factors, motivation, cohesion, organizational climate and culture, and 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 re-engineering 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 in 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 helps members understand complex problems and develops shared team understanding while suggesting ways to leverage the problems and identify and test solutions—all processes that support learning organizations.

Senge's insights apply to the Department of Defense (DoD) and its armed services, which 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 (see Figure 18-1). 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 student, after 18 or more years of service and over a decade at war, demonstrates a career characterized by four or five promotions, three or four deployments, 10 to 12 jobs at five or six different locations, four or five formal educational opportunities, and eight to 10 moves for the Soldier and family. Moreover, the personnel system is interdependent with systems for compensation, promotion, health care, 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 linkage of systems for acquiring, developing, employing, and then retiring resources is inherently complex, interconnected, and self-adapting.[8]

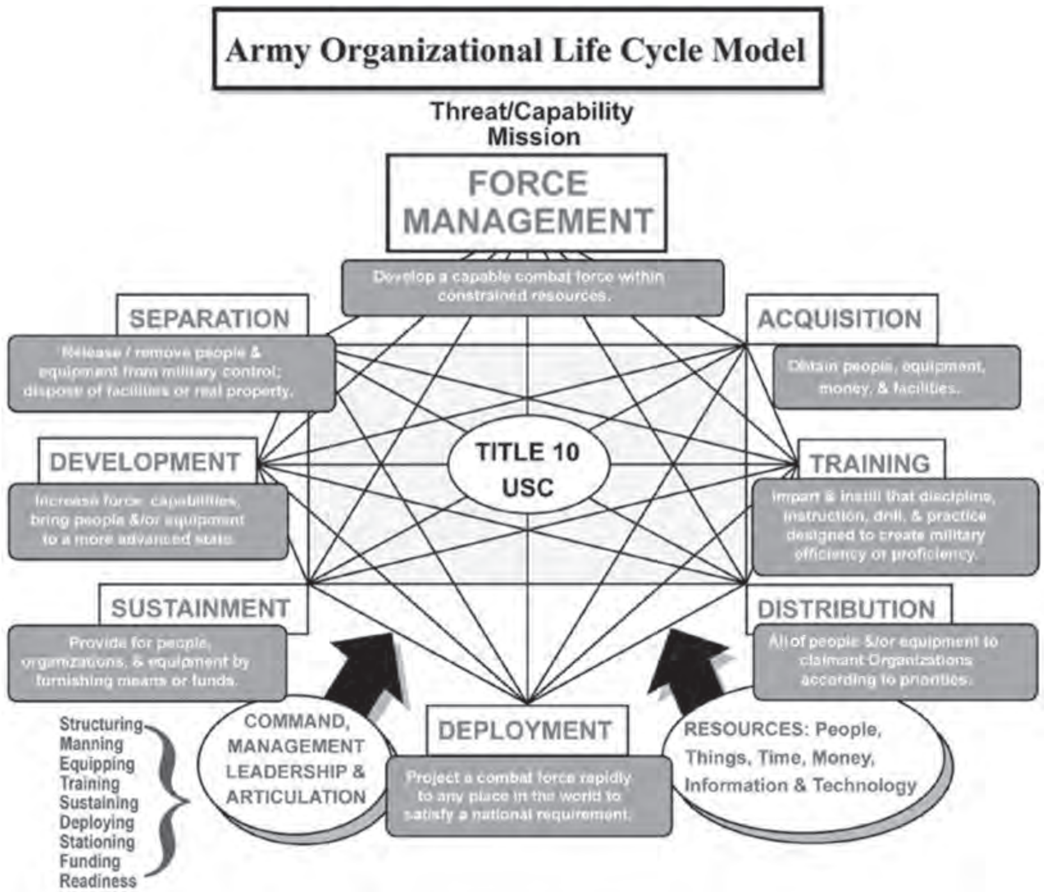

Figure 18-1. The Army Organizational Life Cycle Model.

The U.S. Army realizes that simple linear depictions do not reflect actual cause-and-effect relations; 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. This reality will become more pressing when budget reductions force a rethinking of the capabilities required of the DoD and the Services, and how they will organize, man, train, equip, and fight in an era of persistent tension. The uncertain and ambiguous future requires effective application of systems-thinking principles.

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 processes 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 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 Union of Soviet Socialist Republics (USSR) and the People's Republic of China (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 United States to triple its defense budget, conclude defense treaties around the globe, and transform the North Atlantic Treaty Organization (NATO) into a functioning military command.[9]

U.S. contemporary experiences in Afghanistan and Iraq served to reinforce the necessity to understand system complexities and dynamics. It is clear that policymakers did not appreciate the multiple components of Iraqi society nor the interrelationship between Afghanistan and Pakistan at the outset of operations. As the linkages became clearer and the underlying assumptions were invalidated, senior national security and defense policymakers were forced to reevaluate goals and eventually adjust strategies. Such was the case in 2006 for Iraq and 2009 in Afghanistan, which resulted in the surge and the refinement of military objectives. Challenges persist for military leaders to develop effective strategies in an uncertain future of persistent tension and fiscal constraints. Developing operational capabilities will require rethinking the systemic complexities associated with institutional systems and processes.

SYSTEMS COMPLEXITY IN MILITARY OPERATIONS

What, then, are the aspects of a systems approach that are most helpful for military leaders in strategic thinking and design? Systems thinking applied to the kinds of open systems with which commanders and staff planners deal 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) interconnected in such a way that change in some elements produce changes in other parts of the system. In addition, the changes induced in other elements will not necessarily be proportional to the initial change. The aphorism, "the straw that broke the camel's back," nicely captures this disproportion between inputs and outcomes. Initially inputs and outcomes seem at balance. One straw, or even several straws, appear to cause the camel no discomfort. However, eventually the addition of a single straw, no different from the others, causes our unfortunate beast to crumble—a seemingly disproportionate outcome, given our earlier experience with camel loading. Similarly, in the realm of economics, the "law of diminishing returns" suggests that at a particular inflection point returns will decrease despite increased input, again demonstrating an example of the disproportion between inputs and outcomes. In addition, the system as a whole exhibits properties or behaviors different from its individual parts. Following from the definition of system, interactions and interconnections within and outside the system must affect strategic thinkers contemplating military design.

Any theater of war presents a complex array of intermixed physical, geographical, psychological, social, political, and economic factors such that experts have long recognized that military operations must be approached from a systems perspective.[10] 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. Commanders must approach operations as a holistic system of subsystems—a process 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."[11] This coherence makes it difficult for a single actor, such as a commander, to compel outcomes effectively.

Historically, military operations are among the most complex of human activities. They take place in and across a range of decisive actions, yet this continuum is prone to overlap, indistinct transitions, varying magnitudes, and contemporaneous actions.[12] Across this field, threats are neither stable nor monolithic, and violence can range widely from infrequent criminal attacks during otherwise peaceful periods to the ongoing, full-scale 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 increasingly termed hybrid warfare.[13]

The electronic information age allows great advances in military affairs, because collaboration and information sharing can proceed simultaneously at multiple levels. The same electronic advances underlie precision guided munitions that increase the lethality of attack. Digital communications systems synergistically network command elements at longer ranges with greater numbers of synchronized participants, enhancing mission command. Nevertheless, the 21st-century operational environment continues to pose 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.[14] Hence, traditional requirements for effective leadership remain in effect alongside state-of-the-art technology—in particular, disciplined critical thinking, relevant experience, and insightful judgment are more important in decisionmaking and problem solving than ever. That is, the commander must add value to the process of understanding the operational environment or risk being overwhelmed by systems complexity—and be defeated by an adversary who can, despite systems complexity, design approaches to problem solving faster than the commander can.

Accordingly, 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 U.S. 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).[15]

CLAUSEWITZ AS A SYSTEMS THINKER

The great Prussian theorist of war, Carl von 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.[16] Secondly, Clausewitz postulated that a senior commander should remain adaptable and not be bound by doctrine, but guided by principles that are "intended 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 that, at the moment of action, lays down precisely the path he must take."[17]

Thus, Clausewitz focused on the central role of the commander in design—framing the strategic or operational problem to be addressed by military planning. Clausewitz's position on this matter is echoed in contemporary calls for emphasizing the role of the commander in operational design. Design highlights critical actions toward which a commander should direct personal efforts: understanding the strategic goals to be achieved, comprehending the operational context, framing the nature of the problem, and considering operational approaches to solving that problem.[18] The first two actions describe the nature of both extant factors and discover the conditions that must be altered to change those factors favorably. The third clarifies the nature of the problems to be faced, and the fourth sets the stage for the development of courses of action that will enable the achievement of the desired end states that resolve those problems.

Design as a creative thinking methodology is not new, but rather reemphasizes an approach to systems thinking that postulates that the commander must appreciate the operational environment facing him/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 about how to effectively bring about change.[19] 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.[20]

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 design, 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 staff inputs and estimates. Field Marshall Sir William Slim described this unalterable responsibility:

> 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 operations, you take up your pen yourself and write the object in your own words so that object goes down to everybody.[21]

The commander's responsibility to understand strategic guidance, visualize a design concept, and communicate it succinctly and thoroughly to his/her subordinate planners and commanders cannot be delegated, but are, in fact, fundamental elements of strategic senior leadership. The commander's personal role in design is perhaps his/her most essential contribution to campaign success.[22] As Clausewitz pointed out:

> If we pursue the demands that war makes upon those who practice it, we come to a region dominated by the powers of intellect. 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.[23]

That discrimination and judgment, that skilled intelligence, is something only a seasoned, discerning commander can provide.

CENTER OF GRAVITY DETERMINATIONS IN SYSTEMS THINKING AND DESIGN

In the joint doctrinal context, design is directly applicable to operational art. Design involves the formation and use of a conceptual and contextual framework as the foundation for understanding the situation and the problem relative to implementing strategic direction. Design reduces system complexity and ambiguity to enable campaign planning, joint operations order development, and subsequent execution of the campaign.[24] Thus, design inherently requires a systems perspective at its forefront.

However, it is the nature of complicated systems to defy rational analysis and linear thought. As Clausewitz pointed out, there is no quick and easy process that will eliminate friction and dissipate the fog, enabling the commander to crystallize an appropriate course of action in an operational environment comprised of numerous interrelated subsystems. The resultant systems interaction of complexity, indistinctness, internal dynamics, and human cognitive limitations place heavy demands on planners and make the commander's decisionmaking imprecise and risk-prone.[25] Hence, a common tendency is to pursue imprecise and vague objectives that are often in actuality multiple objectives. This poses problems for 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.[26] Hence, one of the most important determinations facing a commander and his/her staff in design is the identification of the centers of gravity.

The Clausewitzian concept of center of gravity is a useful construct in 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 constantly seeking out the center of his power, by daring all to win all, will one really defeat the enemy.[27]

Clausewitz's concept of center of gravity has generated much discussion, but for the purposes of this treatment, it is sufficient to clarify its importance and relevance to systems thinking and 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, its constituent elements, and where and how operations should be executed. It is key to the design elements of framing the operational environment, framing the nature of the problem, and considering

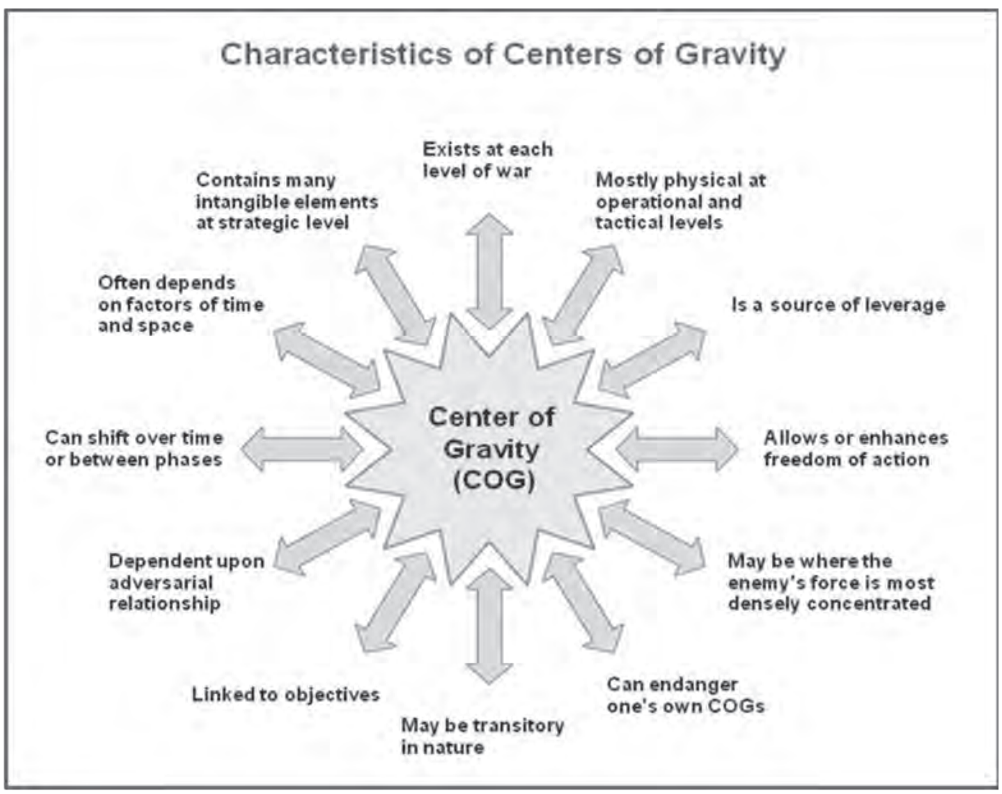

Figure 18-2. Characteristics of Centers of Gravity.

operational approaches. A center of gravity is "a source of power that provides moral or physical strength, freedom of action, and will to act."[28] JP 5-0 suggests characteristics of centers of gravity (see Figure 18-2), emphasizing that centers of gravity may 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 design and planning purposes it would be wise to limit proliferation, since that dilutes both focus in design and concentration of effort in both planning and operations. Thus, the determination of a center of gravity is a key output of design in terms of understanding the operational environment. In theory, as operational art attempts to generate the right conditions to neutralize or destroy a center of gravity, it links lines of operations and effort to a center of gravity producing the most direct path to mission accomplishment. However, as with most attempts to influence or alter elements in a system, this is not an empirical, mathematically precise process. Design, as a general methodology for framing the situation and the nature of the problem confronting a commander, facilitates such operational art.[29] 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. Thus, for a variety of reasons, center of gravity determinations may change over the course of a campaign.[30]

Under such a methodology, a center of gravity constitutes that part of the operational environment against which planning and operations will be pressed. It may not be a specific node or a particular relational link, but rather may consist of a judiciously identified and deliberately selected limited set of nodes and related links (see Figure 18-3). Hence, the uncovering of a center of gravity is applicable to framing both the environment and the problem and in delineating an operational approach. Note that strategic and operational centers of gravity may differ and that a center of gravity may include more than one specific key node or link. It also may cross boundaries between conceptual domains of analysis.[31]

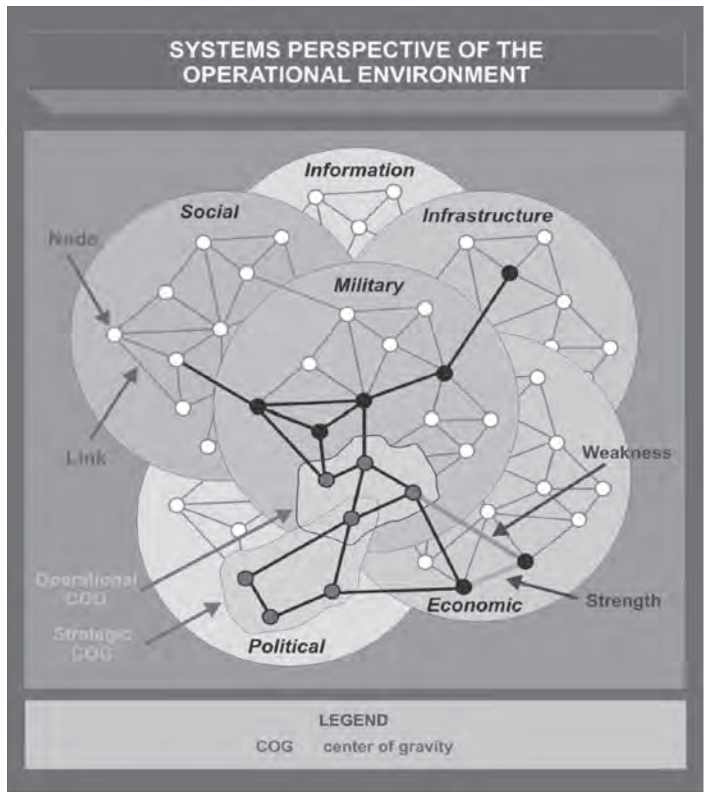

Figure 18-3. Determining Center of Gravity in a Systems Perspective of the Operational Environment.

In this systems context, it becomes less imperative that a center of gravity be 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. This lack of certainty is no impediment to resolute action; rather, it is simply the nature of warfighting as a systems activity requiring insightfulness, strength, and adaptability on the part of commanders and planners alike. As Clausewitz suggested, "Four elements make up the climate of war: danger, exertion, uncertainty, and chance. If we consider them together, it becomes evident how much fortitude of mind and character are needed to make progress in these impeding elements with safety and success."[32] Center of gravity selection is no more certain. That said, without the identification of a reasonable center of gravity as the foundation of 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 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. Design 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 unruly and ever-changing operational environments. As Clausewitz recognized, a systems approach to design can enhance a commander's appreciation for the operational environment in which he or she must attain objectives and accomplish missions, and so achieve political and military end states that truly matter in national security and international affairs.

ENDNOTES - CHAPTER 18

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

2. Gareth Morgan, *Images of Organizations*, Thousand Oaks, CA: Sage Publishing, 2006.

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

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

5. Russell L. Ackoff, "Towards a *System* of *Systems* Concepts," *Management Science,* Vol. 17, No. 11, July 1971, pp. 661-671, *Business Source Complete*, EBSCO*host*.

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.

8. Harold W. Lord, ed., *How the Army Runs: A Senior Leader Reference Handbook 2011-2012*, Carlisle, PA: Department of Command, Leadership, and Management, U.S. Army War College, 2011, p. 7.

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

10. *Joint Publication (JP) 5-0, Joint Operation Planning,* Washington, DC: U.S. Joint Chiefs of Staff, August 11, 2011, pp. III-9-III-10.

11. John J. Holland, *Hidden Order: How Adaptation Builds Complexity*, Reading, MA: Addison-Wesley, 1995, p. 55.

12. *Army Doctrinal Publication (ADP) 3-0*, *Unified Land Operations,* Washington, DC: U.S. Department of the Army, October, 2011, pp. 2-4.

13. James N. Mattis and Frank Hoffman, "Future Warfare: The Rise of Hybrid Wars," *United States Naval Institute Proceedings,* Vol. 131, No. 11, November 1, 2005, pp. 18–19.

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

15. JP 5-0, pp. IV-4-IV-5.

16. Carl von Clausewitz, *On War*, Michael Howard and Peter Paret, eds. and trans., Princeton, NJ: Princeton University Press, 1976, p. 140.

17. *Ibid.,* p. 141.

18. *Field Manual (FM) 5-0, The Operations Process,* Washington, DC: U.S. Department of the Army, March, 2010, pp. 3-7-3-8; JP 5-0, p. III-7.

19. FM 5-0, p. 3-12.

20. JP 5-0.

21. Sir William Slim, "Higher Command in War," *Military Review,* Vol. 70, No. 5, May 1990, pp. 10–21. (His remarks to the U.S. Army Command and General Staff College, Fort Leavenworth, KS, April 1952.)

22. FM 5-0, p. 3-6.

23. Clausewitz, p. 101.

24. JP 5-0.

25. Dietrich Dörner, *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*, Reading, MA: Addison-Wesley, 1996, p. 37; Herbert A. Simon, *Administrative Behavior: A Study of Decision Making Processes in Administrative Organizations*, 4th Ed., New York: Free Press, 1997, p. 92, originally published in 1945.

26. Simon, p. 51.

27. Clausewitz, pp. 595–596.

28. JP 5-0, p. III-22.

29. *Ibid*., p. II-5.

30. *Ibid*., p. III-23.

31. *Joint Publication (JP) 2-01.3, Joint Intelligence Preparation of the Battlefield*, Washington, DC: U.S. Joint Chiefs of Staff, June 161, 2009, p. II-66.

32. Clausewitz, p. 104.