

Effects-Based Operations: A Critique

Planning close air support mission in joint terminal attack controller qualification course

99th Communications Squadron (Kevin J. Gruenewald)

By MILAN N. VEGO

Effects-based operations (EBO) are a spin-off of network-centric warfare (NCW). Hence, many of its premises are largely unproven, if not outright false. EBO and NCW proponents essentially see war as a business. They do not share the Clausewitzian view of the nature of war and have also embraced a deeply flawed systems approach for assessing situations and identifying centers of gravity.

The effects-based approach to warfare is heavily dependent on mathematical methods for predicting and measuring

effects. This increasing trend toward using various metrics to assess essentially unquantifiable aspects of warfare only reinforces the unrealistic views of many that warfare is a science rather than both an art and a science. EBO proponents also claim that their concept is based on the tenets of operational warfare. However, EBO is in fact the antithesis of operational thinking and practice. Operational terms are used as ornaments rather than in ways that articulate their true meaning. Worse, various well understood and commonly accepted terms

EFFECTS-BASED OPERATIONS (EBO)

and their associated planning constructs are controversial topics in the Armed Forces today. U.S. Joint Forces Command has been developing this concept for over 5 years, and, to the same degree as the Standing Joint Force Headquarters established in each of the regional combatant commands, integration and application vary widely. While this may be considered normal for military cultural evolution, EBO is especially thorny because of its work force demands and complexity, which even U.S. Joint Forces Command's Joint Warfighting Center admits to being "convoluted." The roots of EBO can be traced to the pre-World War II Air Corps Tactical School at Maxwell Field—and in truth, not much in the concept is new. In fact, some insist that it is merely a supplemental methodology. Accelerating technological capabilities have permitted leaps in both information management and precision applications of force, perhaps enabling new strategies and certainly facilitating faster and more accurate actions. Nevertheless, as in the interwar years, resources are scarce and devoted to many initiatives, highlighting the need to balance effectiveness with efficiency.

This said, the "concept" of EBO has remained largely just that—a conceptual construct. Joint Doctrine, bound by a paradigm that limits doctrinal treatment to extant capabilities, has introduced the idea of effects and an effects-based approach to planning and assessment in mature revision efforts to key publications (Joint Publications 3-0 and 5-0). It has addressed the construct as "small letter" variants, far short of the larger EBO construct.

The point of selecting Professor Vego's critique is to elevate debate and encourage adaptation. There are at least two sides to every story, and we hope that *JFQ* readers can benefit from the best aspects of this operational practice. Letters to the editor are encouraged as this Commentary selection is expected to catalyze thought and precipitate other views of this "emerging doctrine."

D.H. Gurney

are redefined to emphasize effects in lieu of objectives and tasks.

Objectives and Tasks

The terms *aims*, *goals*, and *objectives* are often used interchangeably. Aims and

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goals are by nature ambiguous, open-ended, and difficult or impossible to measure. Accordingly, military planning and execution cannot be based on them. Moreover, they lack elements that can be used to measure progress toward their ultimate accomplishment. Aims and goals must therefore be replaced with something much more specific: *objectives* (or *objects*).

An objective is composed of component parts—called *tasks*—that collectively lead to its accomplishment. Tasks are those measurable entities that allow the commander to determine the rate of progress. A task answers the question of *what* needs to be done, while the objective (or purpose) answers the *why*. The linkage between the objective and its constituent tasks cannot be arbitrarily severed without serious consequences to the ability to accomplish the objective. Because of their large scope and complexity, operational or strategic objectives are usually divided into groups of related *main tasks*, each of which is composed of *component* (or *partial*) *tasks*. Determining too few tasks is bound to lead to the failure to accomplish the objective. Adding new tasks without changing or modifying the objective or having larger resources leads to so-called mission creep, which, in turn, leads to a disconnect between ends and means and could have fatal consequences.

One of the most important tenets of operational warfare is having an unwavering focus on accomplishing the objective. Almost all aspects of operational warfare are related either directly or indirectly to the objective to be accomplished. Therefore, reducing its importance or arbitrarily changing its content will reduce warfare to simply firing at selected targets or target sets. It would ultimately not only eliminate operational art but also tacticize both policy and strategy. This negative trend is well under way in the U.S. military today.

In determining a military objective, the enemy's factors of space, time, and force must be fully taken into account. Once the objective is chosen, it must be properly balanced with one's own factors of space, time, and force, collectively called *operational factors* in planning a campaign or major operation. The objective to be accomplished—not the level of command, as is often assumed—determines whether the war is fought at the tactical, operational,

or strategic level. The objective is the principal factor in determining the method of combat force employment (tactical actions, major operations, and campaigns). Operational and strategic objectives are normally accomplished through major operations and campaigns, respectively. The objective also determines the content of, and mutual relationships among, individual elements of operational warfare, such as concentration, critical factors and centers of gravity, maneuver, fires, point of culmination, deception, sequencing, synchronization, branches and sequels, and reserves.

Effects versus Objectives

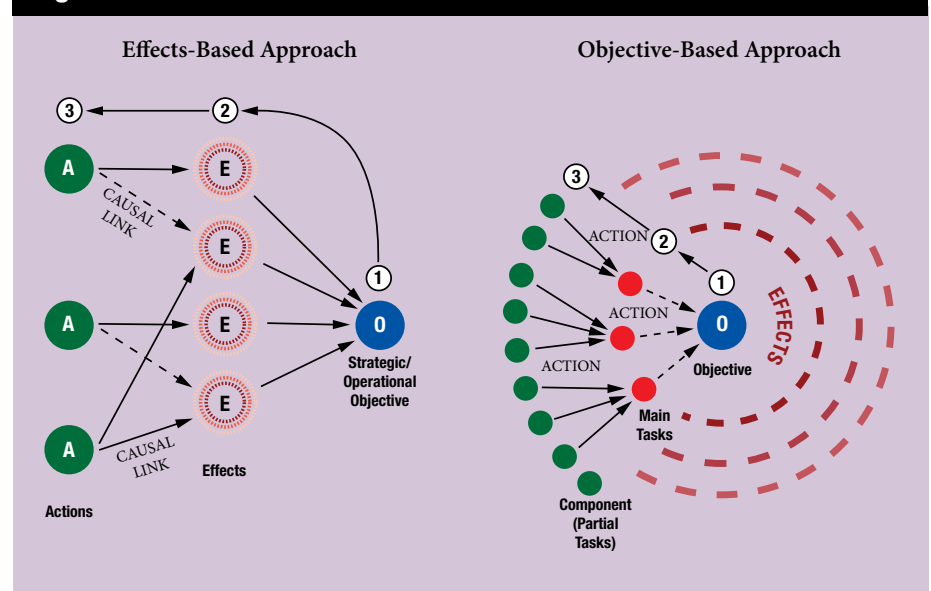
In contrast to the objective and tasks, *effects* are far less specific; thus, like aims and goals, they cannot serve as the basis for military planning and execution. For instance, effects to be attained cannot be used as the basis for planning when one intends to seize a geographic location such as a capital, island, or territory. Nor do effects have attributes that are associated with objectives, such as destroying, neutralizing, annihilating, defending, controlling, seizing, capturing, or maintaining. These attributes in combination with tasks are reliable indicators of whether actions are unfolding as planned and the objective is being accomplished. EBO proponents also ignore the fact that any military objective, once accomplished, would generate certain effects, in terms of space and time, on enemy, friendly, and neutral sides.

Proponents differentiate between direct and indirect effects. *Direct effects* can be physical, functional, collateral, and physiological. *Indirect effects* can be functional, collateral, cascading, systemic, cumulative, and physiological; they can also be second-, third-, or fourth-order effects. Predicting direct first-order effects is difficult enough; going several steps farther to try to predict second-, third-, or fourth-order effects, as EBO proponents do, is a practical impossibility. There are simply too many variables. A slight change in the conditions of a single entity can generate unpredictable effects, desired and undesired.

Advocates explain that the first step in effects-based operations is to determine objectives, and the next is to designate the effects necessary to accomplish the objectives. The last step is to determine tasks, variously defined as actions that generate effects or as directing friendly actions.¹ To make room for effects, EBO advocates have arbitrarily changed what is commonly understood as the task. Another problem is the insertion of effects between the objective and what they call actions. The logical thing is to predict effects *after*—not before—the accomplishment of the objective (see figure 1).

The most difficult prediction is what physical actions must be accomplished to generate desired behavioral effects over a period of time. This is especially complicated at the operational and strategic levels of war because of the dynamic mix of tangible

Figure 1



and intangible elements. The effect of one's actions on the enemy's political leadership or operational commander cannot be predicted accurately. Neither can one precisely anticipate the psychological effect on the enemy's will to fight or the attitude of the populace, particularly when the enemy's political and military culture is different from one's own,

in Operation *Rolling Thunder*, there was a disconnect between predicted and actual effects, indicators, measures, analysis, and feedback

as seen in Afghanistan and in the postcombat phase of the war in Iraq. Intelligence simply cannot predict key aspects of the enemy's strategic behavior.

The duration and intensity of the effects cannot be easily determined, much less measured. Like operational and strategic surprises, the duration of effect is relatively short. But unlike most surprises, planners will most often be unaware of the effect of a certain action at the time when quick and decisive action is needed to take advantage of the newly created situation. Even when the objective is used as the basis for operational planning, the effects of actions on the adversary are highly unpredictable and can be detrimental to one's strategic purpose, as with the German invasion of Poland in September 1939 and the Japanese surprise attack on Pearl Harbor in December 1941.

The effect of the physical destruction of the enemy's infrastructure or military power is hard to anticipate and even harder to measure. In the American air bombing of North Vietnam from February 1965 to October 1968 (Operation *Rolling Thunder*), there was a disconnect between predicted and actual effects, indicators, measures,

analysis, and feedback. The desired effect was to compel the North, under the pressure of aerial bombardment and hindering the flow of men and materiel through attacks against the transportation system, to cease its support to the Vietcong insurgency. Some 90 percent of the effort was against transportation-related and interdiction targets. Yet despite all the efforts, in January 1968 an estimated 70,000 North Vietnamese and Vietcong launched the Tet offensive. Operation *Rolling Thunder* had failed to effectively reduce the flow of men and supplies the enemy needed to support operations in the south or to compel the North Vietnamese leadership to cease its support of insurgents there. The operation damaged the North's small industrial base and rudimentary transportation system, but it did not achieve its stated objective. Both the civilian and military leadership miscalculated the effect of

Rolling Thunder. They believed the threat of industrial devastation would compel Hanoi to end the war.²

The biggest problem with effects at the operational and strategic levels is that they are the levels where intangible elements are the most critical for success. Tangible elements of the situation are normally (although not always) possible to quantify. Intangibles are hard or impossible to quantify with certainty. Nowhere is that more true than at the operational and strategic levels, where intangibles encompassing not only military but also nonmilitary sources of power abound. At the strategic level, the degree and robustness of public support for the war, the leadership's will to persevere, and alliance or coalition cohesion cannot be satisfactorily quantified.

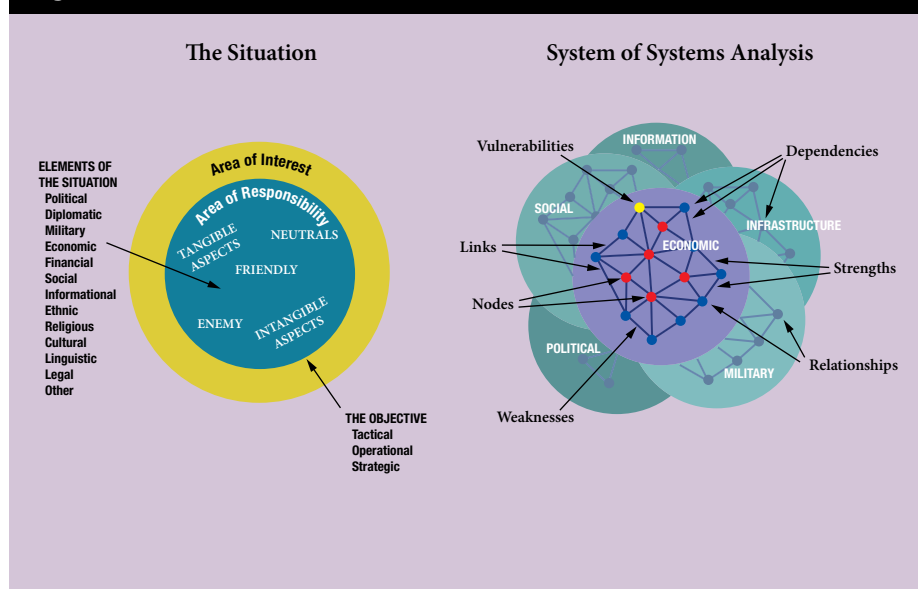
Traditional versus Systems Approach

The tactical, operational, and strategic military situations are differentiated based on the scale of the objective. Any military scenario consists of three overlapping and inter-related situations: the enemy's, one's own, and the neutrals'. The larger the objective, the larger and more complex the situation. Furthermore, the military situation is composed of tangible and intangible elements. Nonmilitary aspects of the situation are always present, especially at the operational and strategic levels (see figure 2).

In contrast to the traditional approach, EBO advocates insist that the best way of evaluating the military situation is what they call a *systems approach*.³ They do not distinguish situations based on the objectives to be accomplished. Instead, they use the term *operational environment*, as defined in Joint Publication 5-0, *Joint Operation Planning (OE)*: "the air, land, sea, space, and associated adversary, friendly, and neutral systems (political, military, economic, social, information, infrastructure, legal, and others), which are relevant for specific joint operation."

Currently, an operational environment is composed of political, military, economic, social, infrastructure, and information (PMESII) systems. Each system, in turn, is broken into two primary elements, nodes and links. Nodes are defined as tangible elements (people, materiel, facilities) within a system that can be targeted. Links are the behavioral and functional relationships between nodes, establishing interconnectivity between them,

Figure 2





Bust of Saddam is removed from presidential palace converted to Coalition Provisional Authority headquarters

1st Combat Camera Squadron (Reynaldo Ramon)

of system. Humans are not machines. The enemy has his own will and may not behave as one wishes. He is bound to respond to one's actions. He is not devoid of emotions. He can react unpredictably and irrationally. Thus, in fact, EBO proponents are trying to take the art out of warfare and substitute it with science. This is the best proof that the entire EBO approach to warfare rests on faulty foundations.

Operational Decisionmaking

EBO proponents are also drastically changing the methods traditionally used to reach a sound decision. Many advocates rarely consider the proven process of the commander's estimate of the situation. By inserting and then highlighting effects, the content of several steps of the estimate has been

significantly changed. To make matters more complicated, proponents have added what they call *system-of-systems analysis* (SoSA) to the joint intelligence preparation of the battlefield (JIPB) process as part of the commander's estimate of the situation.

Proponents claim that JIPB and SoSA have identical purposes: to give joint force commanders sufficient situational awareness of the operational environment to accomplish their missions. The differences

encompasses a detailed analysis of both military and nonmilitary elements of the situation. Adding SoSA while at the same time retaining the JIPB process will make decisionmaking processes not simpler and more effective, but just the opposite.

Supposedly, depicting node-link relationships graphically helps planners discover decisive points against which the joint force can act. Actually, the nodes are these decisive points, a fact that apparently escapes the EBO proponents. By depicting a system's capabilities as a combination of interconnected nodes and links, analysis can enhance joint force commanders' understanding of which capabilities are most critical to system performance or behavior and, in turn, which are most vulnerable to friendly influence. However, the nodes might be wrongly determined; such a mistake might affect the use of one's power against other nodes, or it might not generate a ripple effect. In addition, the strength of the links could be improperly assessed initially, or links and nodes might undergo changes during combat that are not noticed by the planners in timely fashion.

In the effects-based approach, a major part of the mission analysis seems to center on determination of effects. This step is made unnecessarily complex and difficult. Moreover, many elements of the mission analysis have nothing to do with it. For instance, the mission analysis, as the title implies, should not include determination of the friendly and enemy's (or "adversary") centers of gravity. Proponents highlight the need to use language that clearly distinguishes effects from objectives and tasks. Yet they define objectives for "prescribing goals" while tasks "direct friendly action." However, both definitions differ from those traditionally accepted and commonly known. They also

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which allows functioning as a system to achieve specific behavior. Analysts link nodes with sufficient detail to inform the joint force commander of potential key nodes—those nodes that, when acted on, are likely to produce systemic effects in the operational environment. Key nodes will probably be linked to, or reside in, multiple systems. EBO advocates believed that every system can be analyzed by using node-link analysis.

EBO proponents assume that so-called nodes and links can be determined with certainty and that the effect of one's actions on enemy nodes is more or less linear. They believe these actions can be precisely calibrated to produce desired effects. The effects-based approach to warfare is not much different from the failed "geometrical" or "mathematical" school that dominated European military thinking in the late 18th century. A system-of-systems view of the situation resembles an architectural design rather than a description of the real world, which is highly complex and dynamic. Yet the military situation cannot be viewed, much less properly analyzed, as some kind

are primarily a matter of scope, emphasis, and form; JIPB supposedly focuses more on enemy military capabilities and geography, while SoSA expands its assessment to nongeographic dimensions and can extend beyond the battlespace to the political, economic, informational, and other domains. SoSA devotes more analysis to subjects of interest to the entire interagency community, especially with regard to human behavior.⁴ However, JIPB, when properly conducted,

confuse the purpose and objective as two different things, when they are in fact identical.

Another major problem with adopting the effects-based approach is that the traditional content of the mission statement is fundamentally changed. Normally, any well-written mission statement is composed of two parts: the tasks, followed by the purpose (objective). By redefining tasks as actions and inserting effects, EBO advocates make the mission statement far more dif-

difficult to articulate concisely and clearly. The mission will be composed of a mix of a specific purpose with far fewer specific elements—effects. In short, advocates would fundamentally change the principal product of the mission analysis—the restated mission, as well as the commander's intent, which is based on the restated mission. Articulating a sound mission statement and commander's

a center of gravity cannot be considered in isolation from the objective

intent is often poorly done. The effects-based approach will not make it easier. This problem is compounded by the apparent confusion on the part of many EBO proponents on which elements are tasks, effects, and objectives; they are often understood and expressed almost identically.

In the effects-based approach, course of action development encompasses not only the development of friendly courses of action, but also the analysis (wargaming of friendly and enemy courses of action), comparison, and selection of the most optimal course of action. Clearly, too many steps of the estimate of the situation are crammed into a single step, complicating the process significantly.

Systems Approach and Center of Gravity

EBO advocates apparently believe in the great value of the concept of center

of gravity for sound planning. The third draft of Joint Publication 5-0 correctly defines *center of gravity* as comprising “the characteristics, capabilities, and/or sources of power from which a system derives its freedom of action, physical strength, and will to fight.” Despite this sound definition, EBO proponents' understanding of what constitutes center of gravity is deeply

flawed. They have essentially adopted the systems approach of Colonel John Warden, USAF (Ret.), and his “five-ring model.” Like Warden, EBO proponents, with their PMESII construct, believe that there are multiple centers of gravity in any system. The purpose of SoSA is to identify what they call *adversary* and *friendly* centers of gravity, to include key systems, nodes, and links and their relationships to each other. In the view of EBO proponents, centers of gravity in a given system may consist of what they call a key node, but typically they will encompass a subsystem within a system. The EBO proponents assert that key nodes are related to “a strategic or operational effect or center of gravity.” To make the situation more confusing, they claim that key nodes “may become decisive points for military operations”⁵ (see figure 3). In short, they imply that effects, centers of gravity, and decisive points have

the same meaning. Proponents also explain that a center of gravity would typically encompass a number of key nodes and links that comprise a subsystem within a system. The number and strength of links to a node or set of nodes can be indicators of a potential center of gravity. They also clearly imply that there are numerous centers of gravity.

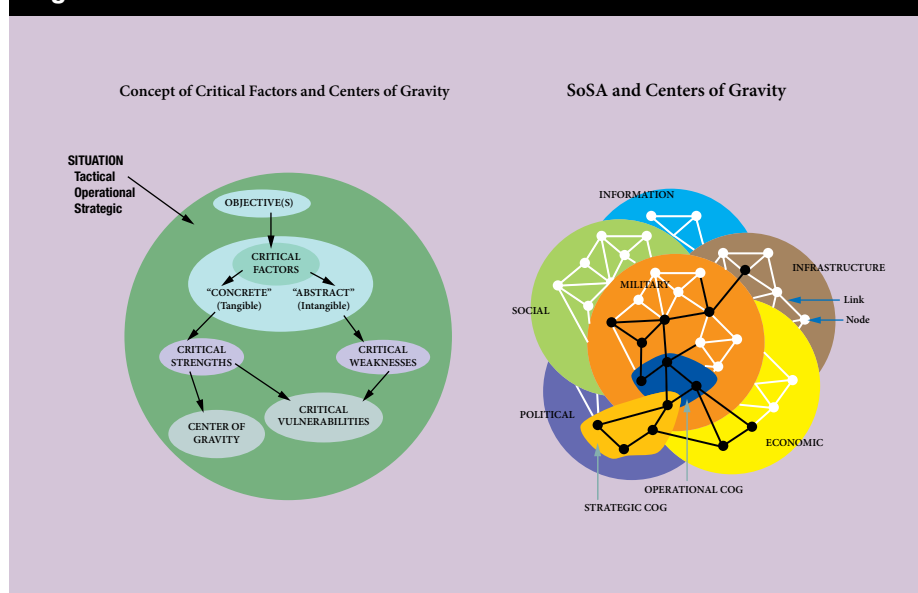
Nowhere do EBO proponents link the objective to be accomplished with the corresponding center of gravity. Yet a center of gravity cannot be considered in isolation from the objective. It is the objective that determines the situation and subsequently the level and scope of the analysis of enemy and friendly critical strengths and weaknesses. A center of gravity is invariably found among enemy or friendly critical strengths, not critical weaknesses or critical vulnerabilities. Hence, a center of gravity is not location/place, some critical weakness/vulnerability, or decisive point. Nor is it found among those critical strengths that lack the ability to physically or otherwise endanger the enemy's center of gravity, such as logistics; command, control, communications, computers; and intelligence; and nodes.

If center of gravity is disconnected from the objective to be accomplished, as in SoSA, there is no larger purpose to which everything must be subordinate. In fact, objectives serve to limit the number of centers of gravity against which major parts of one's efforts must be directed. The higher the level of war, the fewer are the objectives to be accomplished and the fewer the centers of gravity. In a campaign, there is a single theater (or military) strategic center of gravity because there is a single ultimate strategic objective. For each intermediate-operational objective in a campaign, there is a single operational center of gravity. The entire concept of center of gravity loses its meaning when a major part of one's effort is not focused against specific centers of gravity. The proper application of this concept also ensures the application of the principle of *economy of effort*.

Operational Planning and Execution

EBO advocates propound a different approach to campaign planning. The *regressive* (or inverse) method used for planning campaigns and major operations based on the objectives to be accomplished is, for all practical purposes, abandoned. The focus is given almost exclusively to effects, not to

Figure 3



intermediate (operational or major tactical) and ultimate (strategic or operational) objectives and other elements of operational design, such as balancing operational factors and identifying enemy and friendly critical factors and centers of gravity. Normally, for a campaign or major operation intended to end hostilities, the highest political leadership issuing a strategic guidance should also include the desired strategic endstate. The latter is defined as a set of diplomatic, informational, military, and economic aspects of the strategic situation that the Nation's or alliance/coalition's leadership wants to see after the end of hostilities. Expressed in EBO terms, the desired (strategic) endstate is in fact the *strategic effect* that should be achieved to bring political victory in a conflict (see figure 4). The desired endstate, in turn, serves as a starting point to determine strategic objectives, which are also part of strategic guidance. The combatant commander normally determines theater-strategic objectives based on the military strategic objectives determined by the national leadership. However, experience shows that the politico-military leadership in issuing its strategic guidance rarely if ever provided the theater commander what can be understood as the desired (strategic) endstate.

In contrast, EBO proponents intend to use a different logic in the planning process. They say that in designing a campaign, a combatant or component commander provides objectives that describe the desired effects. Once these effects are defined, plan-

ners devise a framework consisting of the elements comprising each effect. After the quantifiable measures have been applied to the effects, tasks are assigned to subordinates. Campaign phasing will be based on the effects achieved not dependent on the accomplishment of the intermediate-operational objectives. Effects identified for enemies, friendlies, and neutrals would supposedly be

social structure, and information and infrastructure networks. ONA relies on a comprehensive system-of-systems understanding of the operational environment's PMESII analysis.⁶ ONA uses various quantitative and qualitative measurements to assess whether predicted effects are actually achieved and one's actions are progressing as intended. Quantitative measurements are actually

a serious deficiency of the assessment concept is its almost total lack of sound intellectual framework

used as criteria for entering the next phase of a campaign. Normally, accomplishing intermediate objectives in a campaign determines phasing. Why the effects on neutrals should be a major factor in phasing one's campaign is difficult to explain or understand.

Effect Assessment

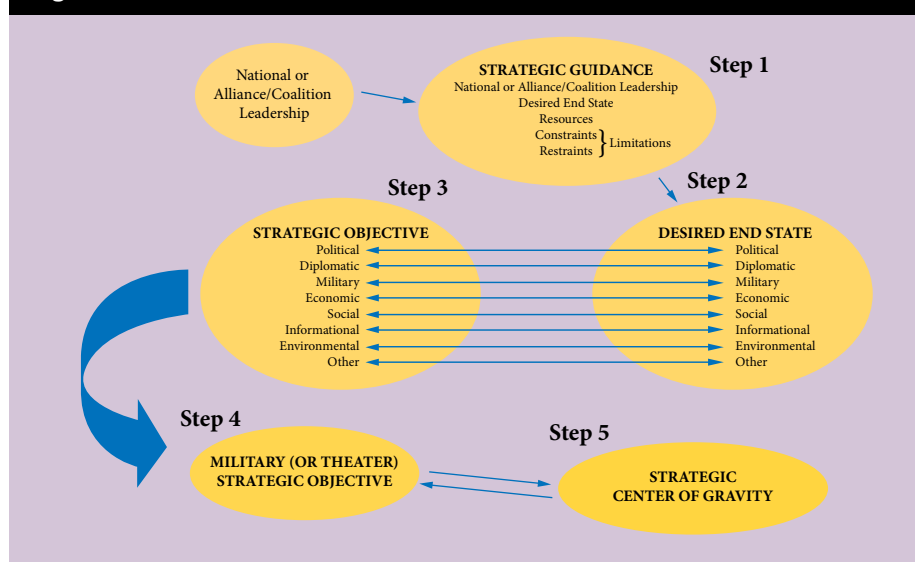
The principal methods used for the analysis of PMESII systems is the so-called operational net assessment (ONA)—a process and product that integrates people, processes, and tools by using multiple information sources and collaborative analysts to build a shared holistic knowledge based on the operational environment. ONA supposedly provides a more comprehensive view of the commander's area of responsibility; it allows the commander to gain better insight into complex relationships, interdependencies, strengths, and vulnerabilities within and throughout the adversary's political structure, military capabilities, economic system,

preferred because they are supposedly far less susceptible to subjective judgment. Yet the fact is that both quantitative and qualitative measurements are equally subject to political manipulation, mirror-imaging, and biases. A more serious deficiency of the assessment concept is its almost total lack of sound intellectual framework. EBO proponents assume that the effects of one's actions could be precisely measured and almost instantaneously known to decisionmakers. This is highly unlikely. This heavy reliance on various quantifying measurements and fast feedback raises the issue of the utility of the effects-based approach, especially at the operational and strategic levels of war.

An effects-based approach to warfare in its essence represents application of the targeteering approach to warfare across all levels. It has proven highly successful in attacking various components of the enemy's infrastructure, such as the land transportation network, maritime trade, and the electricity grid. It makes perfect sense to attack not all potential tangible elements of a certain network, but only those nodes that, if destroyed or neutralized, would cause a ripple or cascading effect throughout the network. The effects-based approach can also be highly effective in attacking enemy information systems, and computer networks in particular.

However, things are significantly more complex when using the effects-based approach at the operational and strategic levels of war. The mix of tangible and intangible elements, combined with ever-present uncertainties, friction, and the unpredictability of the human element, makes the effects-based approach largely irrelevant. Tactical methods and procedures cannot be successfully applied at the operational and strategic levels. The accomplishment of a

Figure 4



strategic or operational objective requires different methods of combat force employment and, therefore, different methods of planning and execution.

By inserting effects along with procedures for their prediction and measurement between the objective and the tasks, EBO advocates have in effect weakened the importance of objectives in the decisionmaking and planning process. Yet unless the link between objectives and subordinate tasks is maintained at all times, there is no proper way to measure progress toward mission accomplishment. Hence, it is simply wrong to sever that link by inserting effects and redefining the task as an action. Based on logic and common sense alone, it is hard to see the value of placing inherently ambiguous effects between far more specific and measurable objectives and tasks.

The highly complex situations found at the operational and strategic levels of war cannot be arbitrarily and artificially reduced to six or more systems, with these systems further reduced to what EBO enthusiasts call nodes, links, vulnerabilities, and interdependencies. As with any machine, any errors in determining nodes or links (and errors are inevitable) would cause ripples and largely undesired effects throughout the so-called system. An attack against a specific node carried out at the wrong time or in an inappropriate way could also generate unwanted consequences. Moreover, the enemy has a will of his own and could react indepen-

dently, unpredictably, and even irrationally. EBO proponents apparently ignore these well-known facts.

Properly applied, traditional decision-making and planning processes incorporate all the supposed advantages of the effects-based approach. EBO proponent claims that operational planning as currently applied cannot ensure the synchronized employment of both military and nonmilitary sources of power are only partially true. Current planning procedures are designed to ensure that all instruments of national power are properly sequenced and synchronized in a campaign. Because these procedures may not be followed or may be poorly applied does not mean they need to be abandoned.

The increasing emphasis on metrics and indicators is a trend in the wrong direction. Even at the tactical level, it is difficult to predict, much less precisely measure, effects because of the mix of tangible and intangible elements in the situation and human actions and reactions. The progress of a major operation or campaign cannot be precisely measured by using various quantifiable methods, no matter how advanced the methods might be. Apparently, advocates of effects-based operations learned little from the pitiful experiences of the United States in using various mathematical methods to assess the progress of the war in Vietnam. To be sure, there is value in applying mathematical analysis in many areas, but that is primarily true in the design of weapons and sensors,

and, to some degree, at the tactical level. The higher the level of war, the more difficult it is to apply these methods as a guide for the commander's decisions and subsequent planning. **JFQ**

NOTES

¹ Joint Warfighting Center, USJFCCOM, *Commander's Handbook on an Effects-Based Approach to Joint Operations*, draft version (Norfolk, VA: Joint Concept Development and Experimentation Directorate, forthcoming), III-5.

² Donna Lucchese, *The Relationship of Center of Gravity Analysis, Targeting for Effect, and Measuring Success* (Carlisle Barracks, PA: U.S. Army War College, 1998), 7-8.

³ Proponents define a *system* as a network of nodes and links within a battlespace that represents any combination of people, material, facilities, and information and their relationships to one another. A system is also understood as any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions. A *system of systems* is defined as grouping assemblies of resources, methods, and procedures regulated by interaction or interdependence to accomplish a set of specific functions. *Vulnerability* is described as the characteristics of a system that cause it to suffer a definite degradation or inability to perform the designated mission because of being subjected to a certain level of effects in a manmade hostile environment. A *model* is described as the intellectual construct, composed of sets of categories, assumptions, and postulates, that helps one to sort and examine the relationship between elements of data and predict the course of events. However, if a model does not somehow correspond to what it claims to represent, it will have limited utility because it fails to mirror reality faithfully. Lewis Ware, "Some Observations of the Enemy as a System," *Airpower Journal* (Winter 1995), 87-93, available at <<http://www.airpower.maxwell.af.mil/airchronicles/apj/ware.html>>, 2. A system is a functionally, physically, and/or behaviorally related group of elements that interact as a whole; Joint Warfighting Center, Joint Doctrine Series, Pamphlet 7, *Operational Implications of Effects-based Operations (EBO)* (Norfolk, VA: U.S. Joint Forces Command, November 17, 2004), 2.

⁴ Joint Warfighting Center, *Commander's Handbook*, II-3.

⁵ Joint Publication 5-0, *Joint Operation Planning (OE)*, IV-11; Joint Warfighting Center, *Commander's Handbook*, III-3 and III-4.

⁶ Joint Warfighting Center, *Operational Implications*, 9.



86th Fighter Weapons Squadron

2,000-pound GBU-10 laser-guided bomb being dropped from F-16