STRATEGY RESEARCH PROJECT

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CENTER OF GRAVITY – STILL RELEVANT AFTER ALL THESE YEARS

BY

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ABSTRACT

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Clausewitz's concept of center of gravity has generated much discussion in the last twenty-five years after being "re-introduced" to doctrine in the 1986 version of the FM100-5, Operations. Requiring agreement by all services, joint doctrine with regards to center of gravity analysis is vague and contradictory. Individual service parochialism further confuses the issue. This paper initially investigates possible reasons why Clausewitz chose to label the source of enemy strength or the hub of all power with center of gravity. The evolution of center of gravity analysis in joint doctrine is discussed. Strengths and weaknesses of the joint definition and subsequent discussion are highlighted. Each individual service perspective is investigated. Agreement and disagreement with joint doctrine is highlighted. The second major weakness concerning center of gravity is addressed. In addition to confusing doctrine on center of gravity analysis, no joint or service doctrine discusses center of gravity determination. No methodology exists in doctrine to systematically examine a campaign and all associated factors to determine a candidate list and narrow that list to the choice for center of gravity. A basic analytical framework for determining center of gravity that was developed by the Center for Strategic Leadership at the U.S. Army War College is discussed. This model is updated in a cooperative research effort conducted by the Department of Defense, the Army, the Air Force, and George Mason University. Incorporating an alternate model for assessing center of gravity candidates into the previous model results in an artificial intelligent agent called Disciple-COG. This model shows potential for a robust ability to aid planners in developing a comprehensive list of center of gravity candidates. Assessment and test elements can pare the list to two to three candidates. Expert opinion, experience, and intuition can then be employed to make the final center of gravity determination.

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CENTER OF GRAVITY – STILL RELEVANT AFTER ALL THESE YEARS

Clausewitz introduced center of gravity in On War: "Aus ihnen wird sich **ein gewissen Schwerpunkt**, ein Zentrum der Kraft und Bewegung bilden, von welchem das Ganze abhangt, und auf diesen Schwerpunkt des Gegners muss der gesammelte Stoss aller Krafte gerichtet sein."[1] Der Schwerpunkt comes from the study of mechanics and translates as "center of gravity." J.J. Graham, in his 1873 translation writes, "Out of them a certain centre of gravity, a centre of power and movement, will form itself, on which everything depends; and against this centre of gravity of the enemy, the concentrated blow of all the forces must be directed."[2] Howard and Paret's more recent translation of this key passage is, "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."[3] Analysis of center of gravity at the strategic and operational level is imbedded in joint doctrine as a key step in the joint campaign planning process. Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms, dated 12 April 2001, defines centers of gravity as "those characteristics, capabilities, or localities from which a military force derives its freedom of action, physical strength, or will to fight. Also called COGs."[4] Center of gravity determination is still relevant for today's military planners. "To guide the conduct of operations, campaign planning identifies the opponent's COGs and related key areas of vulnerability."[5] In Joint Publication 3-0, Doctrine for Joint Operations, determination of the enemy strategic and operational centers of gravity are a major step in the estimate of the situation and courses of action determination and analysis. Unfortunately, a vague joint definition, coupled with parochial service attitudes towards the concept, cause confusion for today's planners. No doctrine at the joint or service level discusses how to determine center of gravity. A clear definition of center of gravity and a general methodology for determination are needed for focusing joint operations planning on the source of enemy strength.

HISTORICAL PERSPECTIVE – WHY CENTER OF GRAVITY?

Two major forces influenced Clausewitz's writing. First, his experiences in campaigns against France provided him extensive combat experience. Second, he lived at the beginning of the Industrial Revolution in Europe, a period marked with major developments in applied mathematics and the sciences. LaGrange and Laplace (Ecole Polytechnique in Paris) and Euler (Saint Petersburg and Berlin) published extensively on applied physics and mechanics. Gauss, considered the greatest scientific mind of the time, completed extensive work in applied

mathematics, mechanics, and physics in Gottingen. It is no small wonder that Clausewitz drew from the scientific studies of his time for analogies in his own writing. Another passage from On War reflects the impact of the scientific revolution on Clausewitz's writing.

> Everything in war is very simple, but the simplest thing is difficult. The difficulties accumulate and end by producing a kind of **friction** that is unconceivable unless one has experienced war...This tremendous friction, which cannot, as in mechanics, be reduced to a few points, is everywhere in contact with chance, and brings about effects that cannot be measured, just because they are largely due to chance.[6]

Clausewitz takes the concept of friction as a force of resistance from mechanics and uses it to describe the complexities and chance phenomena in war that preclude the reduction of warfare to some straight-forward mathematical analysis.

Clausewitz's use of center of gravity is also tied to another analogy he uses early in On War. "Wir wollen hier nicht erst in eine schwerfailige publizistische defintion des krieges hineinsteigen, sondern uns an das element desselben halten, an den **zweikampf**. Der Krieg is nichts als ein erweiterter **zweikampf**."[7] Graham translates this passage, "we shall keep to the element of the thing itself, to a duel. War is nothing but a duel on an extensive scale."[8] Howard and Paret translate this piece, "I shall not begin by expounding a pedantic, literary definition of war, but go straight to the heart of the matter, to the duel. War is nothing but a duel on a larger scale."[9] However, a literal translation of zweikampf is "two-struggle" or "man to man tussle."[10] Clausewitz compares war to a wrestling match, just executed on a much larger scale. In a wrestling match, two opponents grapple with each other. Each is looking for that single point by which the opponent may be toppled to the floor, the center of gravity.

JOINT DOCTRINE: THE SOURCE OF CONFUSION

Center of gravity analysis first appeared in joint doctrine in the 1993 Joint Publication 3-0, Doctrine for Joint Operations. Joint Publication 3-0 defines the term as "that characteristic, capability, or location from which alliances, nations, and military forces derive their will to fight, their physical strength, or freedom of action."[11] This definition borrows from Clausewitz's principle of center of gravity and refers to a single center of gravity. The use of capability in the definition is not in agreement with Clausewitz's writings. The center of gravity is the source of the enemy's strength: the military force, the capital, the national will. The center of gravity has capabilities, but a capability is not the center of gravity. Joint force commanders should attack enemy centers of gravity directly. If direct attack is not possible, indirect means of defeating the enemy center of gravity should be executed by attacking through weak or vulnerable points.

The joint doctrine has inconsistencies, though, that confuse center of gravity analysis. Joint Publication 3-0 makes contradictory statements about a single center of gravity existing, then discussing determining and attacking multiple centers of gravity. The doctrine fails to specify whether a single center of gravity exists at each level of war, or there can be multiple centers of gravity at each level. Also, while the joint doctrine correctly differentiates between center of gravity and decisive points (a decisive point is not a center of gravity, it is a key to attacking the enemy center of gravity), Joint Publication 3-0 then returns to the capability aspect of the joint definition in that "at the strategic level, centers of gravity might include...a set of critical capabilities or functions."[12] If an invading enemy force is the center of gravity, their ability to conduct amphibious operations (a capability) is not the center of gravity. It is an aspect of the opposing force that might be vulnerable to attack to defeat the center of gravity (the force).

The 1995 Joint Publication 3-0, while emphasizing center of gravity, did not correct the deficiencies in the definition. New in this edition is the recognition of the time sensitivity of the center of gravity, an idea also espoused by Clausewitz. "Centers of gravity can change during the course of an operation, and, at any given time, centers of gravity may not be apparent or readily discernible."[13] The next update was issued in the November 2000 Joint Publication 1. A year later, a new Joint Publication 3-0 was published. Joint Publication 1 emphasizes that US military campaigns focus on enemy center of gravity. "American arms seek rapid decision in simultaneous application of all appropriate dimensions of combat power against adversary centers of gravity (COGs) and vulnerabilities."[14] The updated joint definition in Joint Publication 3-0 still includes the plural references to center of gravity but does appear to clear up any confusion about center of gravity being a physical location. "Centers of gravity are those characteristics, capabilities, or sources of power from which a military force derives its freedom of action."[15] The new definition replaces localities with sources of power. However, the joint definition still includes capabilities in the definition and capabilities in the list of possible strategic centers of gravity. While continuing to specifically differentiate between decisive points and center of gravity, chapter 4 on joint operations in war discusses joint strategic attack against a vital target or set of targets. "These targets may include but are not limited to enemy strategic COGs."[16] The same confusion is generated when force projection is discussed. "During early entry operations, US forces and ports of debarkation often will be friendly COGs."[17] So, locations or potential decisive points can be centers of gravity. The source of all these contradictions and confusion can be traced back to the development of joint doctrine. Each service must approve joint doctrine prior to publishing. Therefore, definitions and concepts are watered down to the least common factor to satisfy all the services' perspectives. Such

practices, coupled with service parochialism, can result in a lack of focus or incorrect determinations in the planning process at one of the regional commands. These problems are especially troublesome for planners since the joint doctrine includes strategic and operational center of gravity analysis as one of the primary steps in the situation analysis of the estimate process for joint campaign planning.

MUDDYING THE WATERS – SERVICE PERSPECTIVES

The "watering down" of the joint definition for center of gravity leaves each service to re-define and use the concept to best suit the needs of the individual service. An examination of each service's doctrine shows the degree of difference in interpreting center of gravity. The wide variations that occur between service doctrines only complicate discussions focused on determining the center of gravity in a joint planning environment.

THE ARMY: CLAUSEWITZ IS NEXT TO GODLINESS

In the 1986 Field Manual 100-5, Operations, the Army admitted that key operational concepts had been excluded from doctrine for some time. "In view of the increased emphasis of current doctrine on operational art, some further explanation of these concepts [center of gravity, line of operations, and culminating point] may be useful."[18] Center of gravity analysis became the cornerstone to planning at the operational level. The enemy was a complex organism, dependent on all component operations and the interactions between the various components.

> As with any complex organism, some components are more vital than others to the smooth and reliable operation of the whole. If these are damaged or destroyed, their loss unbalances the entire structure, producing a cascading deterioration in cohesion and effectiveness which may result in complete failure, and which will invariably leave the force vulnerable to further damage.[19]

Army doctrine did not specifically identify these vital components as candidates for the center of gravity or as critical vulnerabilities, which can be used to attack the center of gravity. Doctrine then defines:

> the center of gravity of an armed force as those sources of strength or balance. It is that characteristic, capability, or locality from which the force derives its freedom of action, physical strength, or will to fight. Clausewitz defined it as the hub of all power and movement, on which everything depends. Its attack is – or should be – the focus of all operations.[20]

Army doctrine has now linked center of gravity directly to Clausewitz's definition. Doctrine, however, indicated that the center of gravity is not the force itself, but some other aspect of the force. Clausewitz would look at the force being the center of gravity, and the other aspects as

potential vulnerabilities for attacking the center of gravity. Further confusion was created with the listing of potential centers of gravity. "The center of gravity may well be a component of the field force, the boundary between two of its major combat formations, a vital command and control center, or perhaps its logistical base or line of communication."[21] This passage mixes center of gravity, critical vulnerabilities, and decisive points. The command and control center and logistics assets might be a critical vulnerability to attack the force, the center of gravity. The boundary between two forces is a decisive point, where, if held, provides an advantage over the enemy. Lawrence L. Izzo was quick to point out this confusion. Izzo sought to differentiate between strengths, weaknesses, and center of gravity. Izzo concludes that "the center of gravity represents a concentration of enemy strength... The center of gravity is not an enemy weakness."[22] Components of the enemy force can be considered critical vulnerabilities, but by themselves, do not constitute a center of gravity. The doctrine did recognize the existence of a center of gravity at each level of war.

In the updated 1993 FM 100-5, the Army doctrine contained an updated definition of center of gravity, defining the concept more in concert with Clausewitz's view. The definition now states that the "center of gravity is the hub of all power and movement, upon which everything depends."[23] Also, the writers present a list of potential examples that Clausewitz would find agreeable. "Examples of a potential center of gravity include the mass of the enemy army, the enemy's battle command structure, public opinion, national will, and an alliance or coalition structure."[24] For the first time, center of gravity analysis is referred to as a useful analytic tool as commanders and their staffs plan a campaign. The 1993 FM 100-5 also acknowledges that the center of gravity might not yet exist (the massing of enemy units) or could be abstract (national will). Distinction is made between decisive points and center of gravity. Decisive points are tied (usually) to geography and provide a commander with an advantage that could positively influence the outcome of the fight. "Decisive points are not centers of gravity; they are the keys to getting at centers of gravity."[25]

The Army replaced FM 100-5 in 2001 with FM 3-0, Operations. Confusion in center of gravity analysis occurs with contradictory statements about how many centers of gravity exist. The inclusion of the joint definition in FM 3-0 states that "centers of gravity are those characteristics...", allowing for multiple centers. The discussion then reverts to the singular form. "Destruction or neutralization of the enemy center of gravity is the most direct path to victory... Commanders examine many approaches, direct and indirect, to the enemy center of gravity."[26] FM 3-0 makes the same statement about the difference between decisive points and center of gravity as presented in the 1993 manual.

THE NAVY: NEW KID ON THE BLOCK

The United States Navy defines the center of gravity in Naval Doctrine Publication 1 (NDP 1) as "that characteristic, capability, or location from which enemy and friendly forces derive their freedom of action, physical strength, or will to fight."[27] With minor word changes, this definition follows directly from the joint definition for center of gravity from the 1993 Joint Publication 3-0, Doctrine for Joint Operations. NDP 1 is a first effort by the Navy to lay out the doctrine for employment of Naval forces for "war over the sea" or "war on the sea." A critical look on how this definition is incorporated into the doctrine is necessary to see how the Navy truly interprets the center of gravity concept.

In the "how to fight" chapter, the navy doctrine states that "modern maneuver warfare requires integration and understanding of four key concepts – center of gravity, critical vulnerability, focus of effort, and main effort."[28] Here we see an initial signal that the Navy will differentiate between center of gravity and means to attack it (critical vulnerabilities). NDP 1 then states:

> The center of gravity is something the enemy must have to continue military operations – a source of his strength, but not necessarily strong or a strength in itself. There can only be one center of gravity. Once identified, we focus all aspects of our military, economic, diplomatic, and political strengths against it. As an example, a lengthy resupply line supporting forces engaged at a distance from the home front could be an enemy's center of gravity ... Opportunities to access and destroy a center of gravity are called critical vulnerabilities.[29]

This passage has many inconsistencies that complicate discussion of center of gravity. First, the Navy doctrine appears to agree with the Clausewitzian idea that the center of gravity is singular. However, the Navy doesn't discuss center of gravity in reference to levels of war. Next, the Navy doctrine states that the center of gravity is "not necessarily strong or a strength itself." This idea is opposite of Clausewitz's notion of the center of gravity as the hub of all power. However, the doctrine then requires, as Clausewitz and the Army demand, that all elements of power focus on the defeat of the center of gravity. Unfortunately, the doctrine falls into the trap of identifying a long supply line (a critical vulnerability) as the center of gravity for a military force (the potential center of gravity). The definition then contradicts itself by separating center of gravity from critical vulnerabilities.

NDP 1 tries to clarify the difference between center of gravity and critical vulnerabilities in the following passage:

> The appearance of critical vulnerabilities depends entirely upon the situation and specific objective. Some – such as electrical power generation and distribution facilities ashore or the fleet oilers supporting a task group – may be obvious. On a strategic level, examples may include a nation's dependence on a certain raw

> material imported by sea to support its warfighting industry, or its dependence on a single source of intelligence data as the primary basis for its decisions. Alternatively, a critical vulnerability might be an intangible, such as morale. In any case, we define critical vulnerabilities by the central role they play in maintaining or supporting the enemy's center of gravity, and, ultimately, his ability to resist.[30]

This list is in agreement with the Army focus on getting to the center of gravity through associated vulnerabilities. The doctrine challenges the Navy commander to "direct the focus of effort toward attacking the critical vulnerabilities so that he can ultimately collapse the enemy's center of gravity."[31] The vignette accompanying this discussion in NDP 1 provides an excellent example of a critical vulnerability. Near the end of the American Revolution, General Lord Cornwallis and his army have only a sea-based resupply capability since the Continental Army has cut off his land-based resupply lines. The discussion points out that this sea line of communication (SLOC) is a critical vulnerability. The French blockade of Chesapeake Bay cuts off all supplies, forcing the British surrender. Unfortunately, the example never defines the British army as the center of gravity and the link between the army and the critical vulnerability. This first effort at putting Navy doctrine into words attempts to get at the essence of what Clausewitz stated about center of gravity. However, the focus is centered on defining critical vulnerabilities. The doctrine for center of gravity analysis is filled with contradictions, and these contradictions leave a reader unsure about Navy interpretation of the center of gravity.

THE AIR FORCE: COGS = TARGET SETS

Early Air Force doctrine examined the application of force directed at a phenomenon similar to the center of gravity. "Early air power theorists postulated that strategic attacks were the most effective use of airpower and that *vital centers* such as warfighting infrastructure, population centers, and political leadership, presented the most lucrative and vulnerable targets."[32] Today's Air Force Doctrine Document 1 (AFDD 1) defines strategic attack as "those operations intended to directly achieve strategic effects by striking a the enemy's COGs ... which were the characteristics, capabilities, or localities from which a force derived its freedom of action, physical strength, or will to fight."[33] The problem in Air Force doctrine is how the definition of center of gravity has evolved over time.

Colonel John A. Warden, USAF, wrote in the late 1980's about the relationship between air power and center of gravity in The Air Campaign: Planning for Combat. Warden contends that "every level of warfare has a center, or centers, of gravity."[34] The first part of his statement is in general agreement with the Army's view of center of gravity: a center of gravity can be

determined at each level of war. However, his view diverges from that of the Army by allowing for multiple centers of gravity at each level. Warden states that "the enemy's air center of gravity may lie in equipment (numbers of planes or missiles); in logistics (the quantity and resilience of supply support); geography (location and number of operational and support facilities; in personnel (numbers and quality of pilots); or in command and control (importance and vulnerability)."[35] Warden equates centers of gravity with strategic targets that can be attacked. He confuses center of gravity, "the hub of all power and movement," with vulnerabilities, which can be used to attack the center of gravity. Warden later developed a conceptual model based on his thesis. His five-ring model views the enemy as a system of five concentric rings. The rings represent the key sub-systems of leadership, organic essentials, infrastructure, population, and military forces. "Within each ring is a collection of COGs for that particular ring. If the COGs are neutralized, the function of the ring (or subsystem) ceases."[36] Warden's concept of multiple centers of gravity equating to target sets for air attacks is prevalent in the current Air Force doctrine.

Air Force doctrine states that air and space power can be applied across parallel operations at all levels of war. "For parallel operations, the swift, massive, and precise application of air, space, and information power against several critical COGs may be sufficient to produce shock and may result in organizational paralysis that provides the leverage to dominate surface as well as air and space operations."[37] The 2000 AFDD 2 maintains the emphasis on multiple centers of gravity. "Destruction of the enemy's COGs can result in severe, long-lasting reduction of their combat power, as well as influencing their morale. Such targets include, but are not limited to, high-level command and control facilities and networks, industry, power generation, transportation networks, and military forces."[38] The doctrine is really describing the impact of the destruction of critical targets (vulnerabilities) on enemy forces, political will, etc. (center of gravity).

THE MARINE CORPS: CORRECTION - COG ≠ CRITICAL VULNERABILITIES!

The 1989 Fleet Marine Forces Manual 1 (FMFM 1) outlined the Marine Corps doctrine for maneuver warfare, drawing heavily from Clausewitz. FMFM 1 addresses Clausewitzian concepts such as friction and uncertainty in war, complexity, the human dimension, war as an act of policy, and centers of gravity. The Marine Corps warfighting manual states "that the most effective way to defeat our enemy is to destroy that which is most critical to him. We should focus our efforts on the one thing which, if eliminated, will do the most decisive damage to his ability to resist us."[39] This statement alludes to the concept of center of gravity and the need to

focus effort in defeating the center of gravity. Critical vulnerabilities are then introduced in doctrine. "We obviously stand a better chance of success by concentrating strength against enemy weakness rather than against strength."[40] However, FMFM 1 combines these two concepts in a new definition of center of gravity. "Sometimes known as the center of gravity... but we have since come to prefer pitting strength against weakness. Applying the term to modern warfare, we must make it clear that by the enemy's center of gravity we do not mean a source of strength, but rather a critical vulnerability."[41] Marine Corps doctrine reversed Clausewitz's concept of center of gravity. It is now a critical vulnerability, not the hub and source of all power!

In 1997, Marine Corps Doctrinal Publication 1-2 (MCDP 1-2), Campaigning, was updated. In this manual, the Marine Corps sought to get doctrinal concepts in congruence with the other services and with Clausewitz's writings. "We must understand both the sources of the enemy's strength and the key points at which he is vulnerable. We call a key source of strength a center of gravity. It represents something without which the enemy cannot function."[42] Marine Corps doctrine also recognized the center of gravity at both strategic and operational levels of war. Marine Corps doctrine still stresses the desire to avoid direct attack into an enemy's strength, but to seek weakness. "Therefore, we seek a critical vulnerability. A critical vulnerability is related to, but not the same as, a center of gravity; the concepts are complementary. A vulnerability cannot be critical unless it undermines a key strength."[43] A clear differentiation was made between center of gravity and critical vulnerabilities.

In 2001, the Marine Corps replaced FMFM 1 with Marine Corps Doctrinal Publication 1 (MCDP 1), Warfighting. Centers of gravity and critical vulnerabilities are again addressed as separate but complimentary concepts. The Marine Corps recognizes the various sources of strength involved in a war that might be considered as a center of gravity. "We ask ourselves: Which factors are critical to the enemy? Which can the enemy not do without? Which, if eliminated, will bend him most quickly to our will? These are centers of gravity. Depending on the situation, centers of gravity may be intangible characteristics such as resolve or morale."[44] Referencing warfighting doctrine that seeks to find weaknesses to exploit and attack, MCDP 1 asks where is the enemy most vulnerable, in order to effect an attack against centers of gravity.

> Therefore, we should focus our efforts against a critical vulnerability, a vulnerability that, if exploited, will do the most significant damage to the enemy's ability to resist us... However, we should recognize that most enemy systems will not have a single center of gravity on which everything else depends ... It will often be necessary to attack several lesser centers of gravity or critical vulnerabilities simultaneously.[45]

While now differentiating between center of gravity and critical vulnerabilities, the Marine Corps still advocates the existence of multiple centers of gravity. The doctrine confuses the issue by allowing for attacks on lesser centers of gravity and critical vulnerabilities simultaneously. The idea of a lesser center of gravity is contradictory to the Clausewitzian notion for the concept.

USEFULNESS OF CENTER OF GRAVITY TODAY

Center of gravity analysis is a critical step in campaign planning as outlined in the 25 January 2002 Joint Publication 5-00.1, Joint Doctrine for Campaign Planning. The outline for the theater campaign plan contains specific references to the center of gravity. In paragraph 1, Situation, adversary and friendly centers of gravity are specified at the strategic and operational level. In paragraph 3, Execution, "the plan should incorporate the following operational concepts, orientation on adversary's strategic and operational centers of gravity and protection of friendly strategic and operational centers of gravity."[46] While the joint definition of center of gravity does not change with this publication, the discussion and focus on center of gravity analysis clearly represents a new emphasis. Doctrine now states that the most important aspect of the planning for a campaign is the proper determination of the enemy strategic centers of gravity.

Another aspect of center of gravity analysis in the new 5.00-1 is the clear distinction between center of gravity and capabilities, despite the faulty up-front definition. Joint Publication 5.00-1 incorporates the CG-CC-CR-CV concept developed by Dr. Joe Strange of the Marine Corps War College to explain center of gravity (CG) analysis differences between Marine Corps doctrine and joint doctrine. Joint Publication 5.00-1 specifically separates center of gravity from critical factors. These critical factors are critical capabilities (CC), critical requirements (CR), and critical vulnerabilities (CV), all pieces of Dr. Strange's conceptual model. Critical capabilities are "those adversary capabilities that are considered crucial for the adversary's COG to function."[47] Critical requirements are those essential conditions for a CV to be fully operational. "Critical vulnerabilities, on the other hand, are those aspects or components of the adversary's critical capabilities, which are deficient, or vulnerable to neutralization, interdiction, or attack."[48] A critical vulnerability is some aspect of the enemy that, if attacked, can lead to the defeat or destruction of the enemy center of gravity. The focus of friendly effort should be exerted against the opponent center of gravity, either directly or indirectly. If friendly strength is superior to the strength of the opponent center of gravity, then a direct effort against the center of gravity might be the quickest path to victory. If the enemy

center of gravity is too strong, or cannot be directly attacked, indirect means are required. For example, in military operations other than war (MOOTW),

> the adversary's COG(s) are usually difficult to identify and attack directly. Because the adversary's COG will most likely be heavily defended, the indirect approach may offer the most viable method to exploit adversary vulnerabilities and weaknesses by attacking them along decisive points. While decisive points are not COGs, they are essential in attacking COGs.[49]

In either case, to attack the enemy center of gravity, the commander must find those critical vulnerabilities that lead to defeat of the center of gravity. Unfortunately, Joint Publication 5.00-1 fails to address the issue of how to determine the center of gravity. "From a procedural perspective, the analysis of the adversary's COGs is a key step in the joint intelligence preparation of the battlespace (JIPB) process. In the third of four steps in the JIPB process, joint force intelligence analysts identify adversary COGs,"[50] and refers the reader to Joint Publication 2-01.3, Joint Tactics, Techniques and Procedures for Joint Intelligence Preparation of the Battlespace. An examination of this publication reveals that center of gravity determination is addressed in the JIPB process, but no specific methodology is offered for actually analyzing the situation, specifying a candidate list, or determining which candidate is the center of gravity.

A basic methodology is required for center of gravity determination. First, the joint definition should be updated and focus on center of gravity as a singular entity at each level of war. The following definition is a proposal to eliminate confusion. *The center of gravity is the source of power from which a military force derives its freedom of action, physical strength, or will to fight. A center of gravity exists at the strategic and at the theater strategic level. At the operational level of war, a distinct center of gravity can exist in each phase of the operation. Planners must be cognizant that the center of gravity at any level can change, as the strategic or theater situation changes.* The arguments for multiple centers of gravity refer to On War for justification. A careful examination of On War, however, reveals that in the twenty-eight separate references to center of gravity, all but two refer to the concept as a single entity. In the other cases, Clausewitz discusses narrowing down center of gravity candidates to find one source of power. "The first principle is that the ultimate substance of enemy strength must be traced back to the fewest possible sources, ideally to one alone."[51] Clausewitz then goes on to discuss the conditions and some examples of reducing multiple sources of strength to a single center of gravity. Clausewitz then addresses the other possibility of not being able to reduce the multiple strengths to one. "There are very few cases where this conception is not applicable – where it would not be realistic to reduce several centers of gravity to one. Where this is not so,

there is admittedly no alternative but to act as if there were two wars or even more, each with its own object."[52] In the study of physics and mechanics, center of gravity is defined as the single point at which the entire mass of an object is located or the point where the total weight of a material body is thought to be concentrated. Putting his writings in context with the emphasis on science in his era, a strong argument can be made that Clausewitz intended for center of gravity to be a single entity.

Given this definition, a general methodology is proposed to determine the center of gravity. Arguments erupt at this point over whether center of gravity determination is science or art. As Joint Publication 5-00.1 clearly states, "identifying COGs is an analytical process that involves both art and science."[53] On a macro scale, a basic analytical model is used to provide inputs to the decision maker or commander in chief (CINC), blending science with art.

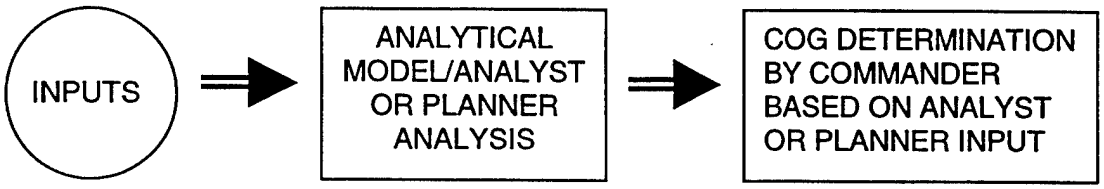

FIGURE 1. BASIC ANALYTICAL MODEL

The "science" is applied in the analysis step which takes information and methodically examines all aspects of the adversary and friendly sides, establishes a list of potential center of gravity candidates, reduces the list via some elimination process, and presents the candidate list to the CINC. The "art" is applied by the CINC in using his knowledge, experience, and intuition to choose the center of gravity. Clausewitz, in personal correspondence, stated that he was writing On War for the practitioner of the art of war. Campaign planners must always keep in mind that "the purpose of identifying centers of gravity ... is to force us to think through the essential elements of a particular enemy's power and thus to help us focus on what makes him dangerous and what we need to do to defeat him."[54]

One analytical model that can be used by campaign planners from all services was developed by the Center for Strategic Leadership (CSL) at the U.S. Army War College. This CSL model is based on three phases: situation, determination and analysis, and application. In phase 1, a complete examination of the situation for the campaign is completed. This step initially examines the following factors (the model "inputs"):

- Demographic Factors
- Economic Factors

- Geographic Factors
- Historic Factors
- International Factors
- Military Factors
- Political Factors
- Psychological Factors
- Interests and Political Goals

With this information, the planner identifies all of the distinct enemy forces involved such as a single force, a coalition, an alliance, or a set of independent or non-allied groups.[55] This phase of the center of gravity determination ends with the specification of both friendly and enemy strategic goals and aims. Phase 2 of the CSL model, determination and analysis, identifies all reasonable center of gravity candidates, then tests each candidate, and reduces the candidate set. Center of gravity candidates can be found in each of the category factors discussed in the first phase. Assessments are conducted iteratively on the list to reduce the number of candidates. The Assessments focus on composition of force (single, equal or dominant partners), primary controlling element (governing or ruling body), type of government (democratic, totalitarian, feudal), level of civilization (pre-industrial, industrial, informational), and other factors (special strategic capabilities, key independent figures). At the conclusion of this analysis, the following test is applied to each candidate to determine validity. "Can imposing your will (destroy, defeat, delay) on the potential center of gravity candidate create the deteriorating effect that prevents your foe from achieving his aims and allows the achievement of ours...and will it be decisive?"[56] Phase 3 of the CSL model, application, incorporates considerations for new elements entering the conflict, changes or shifts in campaign plans, and changes in capabilities or aims.

The latest evolution in center of gravity determination is a result of a combined research effort sponsored by the Defense Advanced Research Projects Agency (DARPA), the Air Force Research Laboratory, the Air Force Office of Scientific Research (AFOSR), and the U.S. Army War College. Conducted by the George Mason University Learning Agents Laboratory and the U.S. Army War College, the objective of the research is "to clarify and formalize the process of the identification of centers of gravity for enemy and friendly forces at the strategic and operationally levels of war, and to enable the development of an intelligent assistant for solving this complex problem."[57] The computer-based learning agent is called Disciple-COG (Disciple). Disciple can learn how to conduct a more intuitive center of gravity determination as it learns

from multiple campaign analyses and interaction with a center of gravity expert. The center of gravity determination methodology in the agent is based on the CSL model.

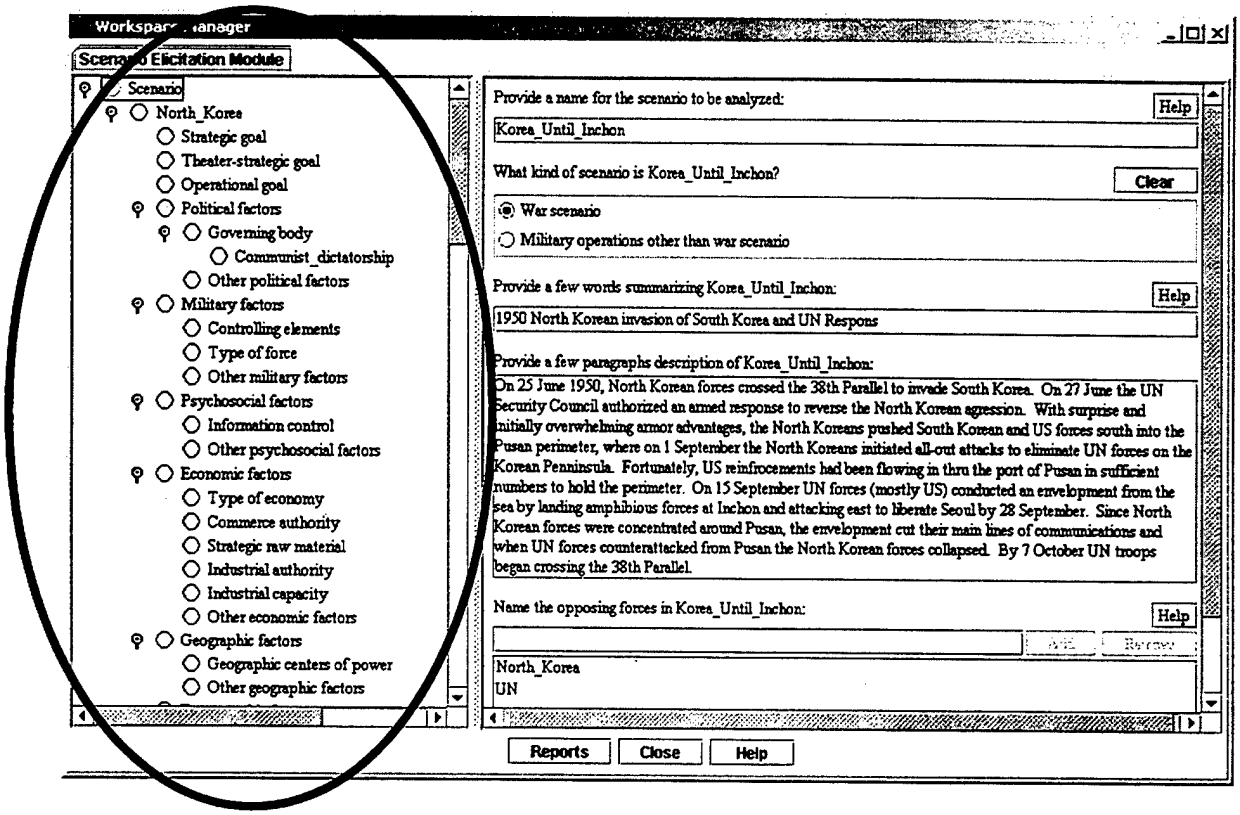

FIGURE 2. DISCIPLE-COG SCENARIO ELICITATION WINDOW[58]

Phase 1 inputs occur in the scenario elicitation window of Disciple. In the left-hand frame of figure 2, the different factors (military, demographic, economic, geographic, etc.) are listed. The analyst or planner enters all requested information regarding these factors and answers a set of questions posed by Disciple. Based on answers to specific queries such as type of scenario (war or MOOTW) or type of force on force engagement (single nations, coalitions, etc.), the planner is led through differing branches of questions. The CSL model's strength lies in the phase 1 analysis of the campaign, resulting in a list of center of gravity candidates. The phase 2 testing and selection is strengthened in Disciple by incorporating Dr. Joe Strange's CG-CC-CR-CV model.

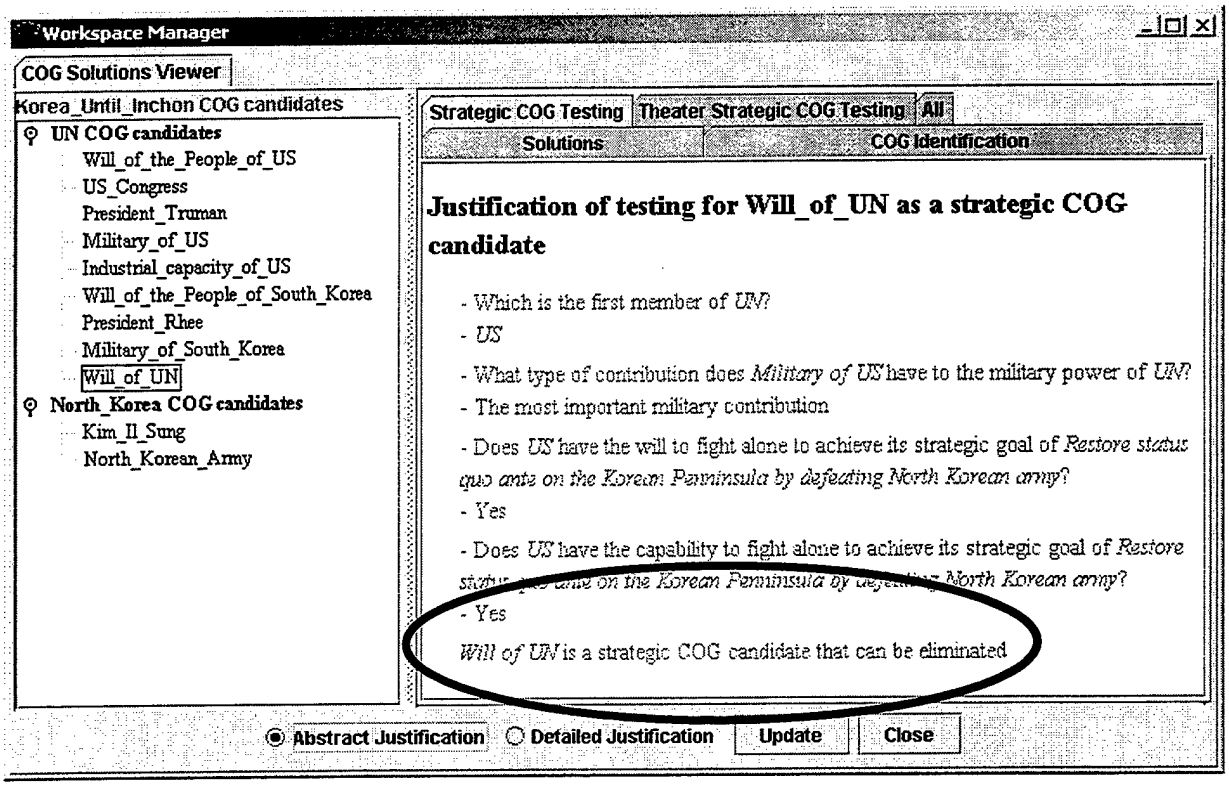

FIGURE 3. CENTER OF GRAVITY JUSTIFICATION[59]

In the example shown in figure 3, Disciple is examining the "will of the United Nations (UN)" as a strategic center of gravity candidate for the UN coalition in the Korean War. Based on a comparison of this candidate to the others and an examination of critical capabilities and requirements, Disciple eliminates will of the UN as a strategic center of gravity candidate. In a recent exercise conducted at the U.S. Army War College, seven different historical campaigns were investigated using Disciple. The use of this agent resulted in a fifty percent reduction in the size of the strategic center of gravity candidate pool. Feedback from the officers conducting the work also emphasized the reduction in time to analyze the campaigns. Also, participants appreciated a methodical process to focus information gathering on all possible factor areas for candidates for the center of gravity. In each case, Disciple reduced the list of candidates to two or three. Then, the experience and intuition of the military officer was the critical addition for actual determination of the center of gravity. While Disciple currently can only focus on the strategic center of gravity for both sides, research is continuing to include the theater-strategic and operational levels of war in the next year.

Center of gravity analysis has been the subject of many articles since the concept was re-introduced into doctrine by the Army in FM100-5. Differing service perspectives, confusing definitions and language in joint doctrine, and multiple interpretations of Clausewitz's writings

have contributed to "muddying the waters" when it comes to the usefulness of center of gravity. As Commander Jeff Huber wrote in 2000, "The center of gravity theory won't wash if it takes a Zen master decades of rumination from atop the highest peak in Tibet to apply it."[60] A common language and understanding of the concept is required. The inclusion of Dr. Joe Strange's model into joint doctrine provides new clarity to the meaning of center of gravity. An unambiguous definition for center of gravity is available if plural references to center of gravity are removed from the language of the new Joint Publication 5.00-1. Joint doctrine should incorporate a basic methodology for center of gravity determination. A blending of science and art can be achieved using the CSL model and subsequent modification currently being worked. Center of gravity is not dead, it is an integral part of U.S. military doctrine and planning. After more than 160 years, it is still a relevant and useful concept for focusing planning on the defeat of the enemy. As Clausewitz said himself, "Far from believing we have discovered a new technique, we are merely providing a rationale for the actions of every general in history, which serves to explain their connection with the nature of the problem."[61]

WORD COUNT = 6492

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