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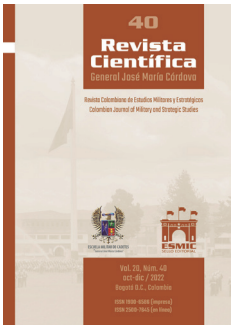

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Re-examining the center of gravity: Theoretical and structural analysis of the concept

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Re-examining the center of gravity: Theoretical and structural analysis of the concept

Reexaminando el centro de gravedad: Análisis teórico y estructural del concepto

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Abstract. The center of gravity concept is one of contemporary military science's fundamental yet highly controversial pillars. Although, over the past decades, the center of gravity has become the *modus operandi* of the planning and conduct of (major) military operations in a number of armed forces, the concept remains insufficiently understood and is often poorly applied in practice. In this light, we have sought to improve its theoretical comprehension by identifying the conceptual dimensions that the most influential authors commonly highlight. Using the structural method for the concept analysis, we have identified seven entities frequently understood as the potential centers of gravity. These are: (1) fielded military, (2) leadership, (3) industry, (4) infrastructure, (5) population, (6) public opinion, and (7) ideology.

Keywords: center of gravity; main effort; military concepts; operational art; *Schwerpunkt*; strategy

Resumen. El concepto de centro de gravedad es uno de los pilares fundamentales de la ciencia militar contemporánea, aunque muy controvertido. Aunque, en las últimas décadas, el centro de gravedad se ha convertido en el *modus operandi* del planeamiento y la conducción de operaciones militares (de envergadura) en varias fuerzas armadas, el concepto sigue sin comprenderse suficientemente y a menudo se aplica mal en la práctica. En este sentido, hemos tratado de mejorar su comprensión teórica identificando las dimensiones conceptuales que los autores más influyentes suelen destacar. Utilizando el método estructural para el análisis conceptual, hemos identificado siete entidades frecuentemente entendidas como los potenciales centros de gravedad. Estos son: (1) ejército desplegado, (2) liderazgo, (3) industria, (4) infraestructura, (5) población, (6) opinión pública e (7) ideología.

Palabras clave: arte operacional; centro de gravedad; conceptos militares; estrategia; esfuerzo principal; *Schwerpunkt*

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Introduction

Few concepts in contemporary military thought are considered as important as the center of gravity. Over the past decades, Clausewitz's idea of the center of gravity has evolved into one of contemporary military science's central yet highly controversial building blocks. The concept's importance is especially emphasized in the fields of (military) strategy and operational art. For instance, Vego (2000) describes the center of gravity as "perhaps the most critical element of operational and strategic warfare" (p. 23). Eikmeier (2004) makes a similar point, reckoning that "the center of gravity is too important a concept to guess at" (p. 2). Mattelaer (2009) places the concept among a handful of instruments that constitute the doctrinal core of the design, planning, and conduct of military operations, while Barfoed (2018) considers the center of gravity to be a central concept in military planning. Finally, Angstrom and Widen (2015, p. 63) summarize that "an assessment of different centers of gravity is of great importance to all military planning and operational activity." In this respect, the authors highlight perhaps the most appealing feature of the concept, as it addresses how to allocate and use limited resources in (armed) conflict as efficiently as possible.

Although many authors attribute unquestionable importance to the center of gravity, many theoreticians question the concept's sophistication and applicability.[1] Some point to contradictory definitions and an overstated doctrinal relevance (Melton, 2012), while others are concerned about its practical utility (Palmgren, 2006; Evans, 2012; Freedman, 2014; Mavropoulos, 2017), or are worried about the (archaic) metaphor which seems to be too mechanistic and linear (Fox & Kopsch, 2017). Further, criticisms of self-referentiality (Paparone & Davis, 2012, p. 71; Zweibelson, 2015, p. 6), terminological pollution (Meyer, 2022), metaphysicality and limited scientific relevance (VanderSteen, 2012; Angstrom & Widen, 2015) have emerged.

Despite its already longstanding inclusion in official military doctrines (FM 100-5 Operations, COPD, AJP-5, JP 5-0 Joint Planning)[2], problems regarding the concept's practical application have arisen. Indeed, military officers—especially those in higher command and staff positions—are generally familiar with the concept; however, at the same time, they are often scantily familiar with its details. This unfamiliarity is probably the result of several overlapping factors, including (1) the variety of divergent, even contradictory versions of the concept; (2) its poor incorporation into the official doctrines;

1 Although the center of gravity can be described as a tool, principle, construct, model, idea, and even doctrine, it is, by far, most commonly considered a concept. By defining the center of gravity as a concept, we emphasize that it is an empirical generalization to describe, classify, and explain reality and is the basic building block of (military) theories.

2 See, Headquarters, Department of the Army, 1986; NATO, 2013, 2021; Joint Chiefs of Staff, 2020, respectively.

and (3) the fact that the concept is not yet fully embedded in the *institutional memory* of the armed forces.

Aim and methods

Developing from the presented baselines, this article aims to contribute to an improved understanding by elucidating the theoretical dimensions of the center of gravity concept. To this end, the concepts' inner logic is addressed and illustrated in a diagram, visually representing relationships between different dimensions. Additionally, it integrates competing conceptualizations into an overarching definition, covering an array of meanings associated with the concept.

Two research methods are combined to fulfill this aim, fusing a literature review with the structural approach to the concept analysis. First, the narrative review of the literature highlights the main research traditions and identifies the key meta-narratives in the field. Narrative reviews are often seen as a pragmatic approach to making sense of diverse literature; however, their findings should be regarded as revealing rather than innovative (see Booth et al., 2016). Second, the structural analysis of the center of gravity is carried out intertwined with the literature review. In this light, a method of conceptual analysis developed by Goertz (2006) is employed. According to Goertz, the concepts' structure is essential, as most concepts are multidimensional and multilevel. Thus, concepts can be divided into several hierarchical levels (basic, secondary, and operationalization), each consisting of multiple dimensions. Therefore, a given concept can be analyzed in terms of (1) its number of levels, (2) its number of dimensions, and (3) the substantive content of each dimension on each level. Goertz also directs us to identify inner logical relationships, differentiating between classical (logical operator AND) and family resemblance (logical operator OR) structures.

To maximize validity and reliability, the research was primarily based on original publications written by the authors developing specific versions of the center of gravity concept. Both theoretical explanations and the authors' illustrative cases were taken into account. To guarantee auditability and replicability, the evidence that supports each finding has been referred to as meticulously as possible throughout the article. Nevertheless, a degree of systematic error was unavoidable, especially at the stages of (structural) analysis, interpretation, and synthesis, which required a researcher's subjective judgment.

Apart from the introduction, the article consists of four sections. The *Schwerpunkt* section summarizes the history of the concept, while the *Contemporary re-conceptualizations* section offers a detailed analysis of five contemporary versions of the concept. The *Discussion* further addresses these, where the theory is also related to a historical example. In the *Conclusion*, the findings are interpreted and related to the article's aim.

Schwerpunkt

Carl von Clausewitz introduced the center of gravity concept, discussing it in his book On War (*Vom Kriege*), posthumously published in 1832. In several places, Clausewitz addressed the dynamics of warfare with a mechanical metaphor of *Schwerpunkt* (center of gravity). Two of the frequently quoted paragraphs were translated by O.J. Matthijs Jolles in Clausewitz (2000):

> As the center of gravity is always situated where the greatest mass of matter is concentrated, and as a blow given to the center of gravity of a body is the most effective; and, further, as the strongest blow is that struck with the center of gravity of the power used, so it is also in war. The armed forces of every belligerent, whether it is a single state or an alliance of states, have a certain unity and, by means of this, cohesion; but wherever there is cohesion, analogies drawn from the center of gravity are applicable. There are, therefore, in these armed forces certain centers of gravity, the movement and direction of which decide that of the other points, and these centers of gravity are situated where the greatest bodies of troops are assembled. But just as, in the world of inanimate matter, [sic] the action against the center of gravity has its measure and limits in the cohesion of the parts, so it is in war, and here as well as there [sic] the forces exerted may easily be greater than the resistance requires, and then there is a blow in the air, a waste of force. […]
>
> All that theory can say here is that the main point is to keep the predominant conditions of both parties in view. Out of them [sic] a certain center of gravity, a center of power and movement, will form itself, upon which everything depends; and against this center of gravity of the enemy [sic] the concentrated blow of all the forces must be directed. (pp. 785, 786, 921)

In his theoretical reflection on *Schwerpunkt*, Clausewitz (2000) emphasized the concept's practical nature. He argued that the most important ways to control the enemy are (1) dispersion of his army, (2) capture of the enemy's capital, (3) an effective blow against the principal ally, (4) the unity of interests in a confederacy, and (5) chief leader and public opinion in case of an insurrection. Although Clausewitz did not define a detailed methodology for identifying the center of gravity, the metaphor proved so valuable, interesting, and influential that it has remained in use until today.

However, Clausewitz's writings on *Schwerpunkt* were relatively overlooked for several decades. It was only towards the end of the 19th century, when combat operations started to take place along continuous front lines, that *Schwerpunkt* gained importance. In this light, Alfred von Schlieffen's (Chief of the German General Staff) reconceptualization went down in history. In pursuit of a quick and decisive victory in the anticipated war with France, Schlieffen devised a plan to use concentrated forces deployed in several echelons to break through a relatively narrow section of the front. However, after Schlieffen's

death, the audacious war plan (with a force ratio as high as 7:1 in favor of the attack wing) was overly modified and unsuccessfully used at the outbreak of the First World War in 1914 (Vego, 2007, p. 102; Vego, 2009, p. VII-37).

In the post-World War I era, *Schwerpunkt* was further developed by several armed forces.[3] Nonetheless, it was the German conception that was most effectively put into practice, especially during the invasion of France in 1940 (*Fall Gelb*). *Schwerpunkt* thus became one of the basic building blocks of the German air-land battle (*Blitzkrieg*), which envisaged a concentrated breakthrough of armored and mechanized units with strong air and artillery support on the part of the front where the enemy was particularly weak. However, the innovation was not only in the effective approach to combined arms but also in the employment of forces, as the Germans began to apply the concept simultaneously at all levels of the war, thus creating *Schwerpunkts* within *Schwerpunkts* (see Schneider and Izzo, 1987, pp. 52–56; Vego, 2007, pp. 102–109; Vego, 2009, pp. VII-38–VII-48).

The *Schwerpunkt* concept is also found in modern military doctrines, usually called: *weight of (main) effort*, *point of (main) effort*, or simply *main effort*. It remains strongly linked to the spatial perception of warfare—it seeks to achieve disproportionate desired effects by concentrating combat power in a narrow geographical area, particularly to break through the front line and develop combat operations at enemy depth. As Vego (2009) explains, *Schwerpunkt* remains a useful alternative for planning land, air, sea, and joint operations. It does not require a detailed understanding of the more difficult elements to capture and is, therefore, particularly useful for planning the use of forces at tactical and operational levels. Nevertheless, as Vego adds, the concept has very limited applicability at the strategic level; it does not provide an adequate answer to the question of including non-military sources of power and seems more useful in attack than defense. In this respect, it is not surprising that in recent decades, the concept of *Schwerpunkt* has undergone a significant reconceptualization (see Table 1).[4]

3 To illustrate, in the U.S. manual FM 100-5 Operations (1939), we find the concept of *main effort*. Meanwhile, the Soviet manual Vremennyj Polevoj Ustav RKKA (PU-36) (1936) included the concepts of *glavnoe napravlenie* (main direction) and *napravlenie glavnogo udara* (direction of the main strike). For the official German definition of *Schwerpunkt*, see Truppenführung (von Hammerstein-Equord & Kurt Gebhard, 1936).

4 A renewed understanding of the concept derives from the United States, where scholars began to extensively study Clausewitz's writings during the period of intellectual catharsis following the defeat in the Vietnam War. The discourse on the center of gravity was initiated by Summers (1981) and continued in military literature by several other authors. The U.S. Army was the first to officially introduce the center of gravity concept in 1986 (see FM 100-5 Operations, 1986, pp. 179–180); other service branches of the U.S. Armed Forces and many other Western countries and NATO member states later followed suit. The discourse on the center of gravity concept has thus crossed national contexts and become international. See Gniesko (2017; 2019) for a recent Spanish language example.

Table 1. *Naming in German and English language*

	German	English
Original concept (Clausewitz)	*Schwerpunkt*	*Centre of Gravity, Center of Gravity*
Reconceptualization (19th–20th century)	*Schwerpunkt*	*weight of (main) effort, point of (main) effort, main effort*
New reconceptualization (Late 20th century)	*Zentrum der Kraftentfaltung, Center of Gravity*	*Centre of Gravity, Center of Gravity*

Source: Table created by the author.

Contemporary re-conceptualizations

While the prevalent understanding of *Schwerpunkt* (main effort) is strongly linked to the spatial perception of warfare, its latest reconceptualization focuses on the systems approach. According to the understanding of *main effort*, it is not reasonable to operate geographically dispersed, but rather to concentrate the decisive forces in a narrow area. On the other hand, the renewed conception (*center of gravity*) translates this approach to a systemic level—it still encourages concentrated actions, not in a geographical sense, but in operations against the enemy's critical (sub-)systems. In this light, the center of gravity aims to achieve disproportionate desired effects by degrading a limited but essential part of the enemy system. The concept favors an indirect approach—it promotes combat operations in which an attempt is made to evade the strongest part of the enemy system and decisively degrade it by attacking the related but vulnerable subsystem(s).

However, based on the general, abstract features of the concept, it is challenging to imagine which entities are now most commonly perceived as centers of gravity and how the concept should be applied in practice.[5] Thus, the following sections take a closer look at the ideas of the most prominent theorists and how their conceptualization could be broken down into separate categories and translated into the battlespace reality.

5 The differences between various interpretations of the center of gravity have become so great that individual definitions of the concept can be contradictory. In this light, we can speak of a background level of the concept, indicating the broadest constellation of meanings associated with the concept.

Warden and the idea of five rings

The first author to reflect in depth on the center of gravity concept was U.S. Air Force Colonel John A. Warden III. Warden studied the use of air power at the operational and strategic levels and concluded that attacking the enemy's command system (decapitation) is always the most effective and decisive. At the same time, Warden was aware that such an attack is not always feasible and that other concentrations of power are also vulnerable to attack. In this light, Warden (1992) developed the idea that in any system, we can actually speak of multiple simultaneous centers of gravity —"concentrations of strengths," but "also vulnerabilities in the same way that Samson's hair was at once his strength and his weakness" (p. 64). Warden presented a macro analytical model that reflected the conviction that some centers of gravity are more critical than others. The author illustrated this using five rings, *with the most important* center of gravity in the central circle and the lesser important in the outer rings. Warden refined the idea somewhat in the following years (1994; 1995), adding that the organization scheme is characteristic not only of political and military systems but of living systems in general:

- The first, most important ring contains the leadership (referred to in various papers as leader/leadership/command structure). If the capture or liquidation of the leader or the isolation of communication cannot directly endanger the innermost ring, Warden advises attacking it indirectly by destroying one or more of the outer rings.
- The second ring contains basic, organic, or system essentials, that is, facilities and processes without which the system cannot secure its existence. Because no system can exist without energy processing, we mainly find such (sub-)systems in the second ring. Besides the military industry, on the state level, these include civil facilities that generate power and refine oil.
- The third one is the infrastructure ring; it covers the transfer of goods, services, and information in the system. In strategic terms, this includes rail, road, air, and sea connections and facilities, as well as (non-essential) industry. Because of this increased number of elements, the third ring is usually much more resistant than the second.
- The fourth ring contains the population. The significantly large number of elements in this ring makes it difficult to attack directly; besides, such an attack would be morally controversial.
- The fifth and last ring contains the system's fighting mechanism or, from the strategic perspective, fielded military forces. Its only functions are to protect one's own and to endanger the enemy rings. With the destruction of the fifth ring, the inner four circles remain unprotected, making it very likely that the leader(s) will comply with the demands of the opposing side.

According to the theory of concept analysis, the five rings—*leadership*, *organic essentials*, *infrastructure*, *population*, and *fielded military*—could be regarded as Wardens' dimensions on the operationalization level. Warden implicitly linked those dimensions by a logical disjunction (logical operator OR), as he suggested that action against (at least) one ring already significantly affects the enemy system as a whole (see Figure 1). However, Warden also stressed that action against the second, third, or fourth ring is never taken to affect the military forces (the fifth ring), but because of the effect on the innermost, first ring—the most important of the centers of gravity (Warden, 1992, pp. 67–69).

Warden's five-ring model has attracted considerable attention among theoreticians and practitioners; nevertheless, it has remained fairly overlooked by the authors of doctrinal publications. Moreover, as Warden was a vocal promoter of air strikes, criticism arose regarding the model's applicability when the deployment of air power is obstructed for political or technological reasons.

Illustrative example:

> A hypothetical engagement with an enemy armored corps can illustrate the application of the five rings model. According to Warden's understanding, we should first and foremost strive to act against the enemy corps command (first ring). If this is not feasible, we should decisively act against the enemy's logistic capabilities (second ring), or infrastructure (third ring), or the manning of the corps (fourth ring). The enemy's combat systems (fifth ring) shall only be intentionally confronted if there is no other option.

Strange and the idea of critical factors

Whereas Warden considered strengths and vulnerabilities as both inherent and opposing features of the center of gravity, his contemporaries further elaborated on this relationship. Thus, Dr. Joe Strange articulated the link between the center of gravity, on the one hand, and (critical) vulnerabilities, on the other. To this end, he introduced two additional building blocks: critical capabilities and requirements. The refined conceptualization was recognized as innovative and has become widely echoed in various doctrinal documents.

Strange's basic premise was that depending on the context or mission, it is always relatively easy to identify one or, at most, a few entities — "primary sources of moral or physical strength, power, and resistance"— that are especially significant at a given level of command (Strange, 2005, pp. ix, 3). It is a center of gravity that provides critical capabilities in a given situation. However, as the author goes on, the full functionality of the critical capability and, hence, the center of gravity is only possible if the critical requirements are provided. If any of those critical requirements are deficient or vulnerable to attack, we speak of the critical vulnerability that can be exploited to achieve decisive results (Strange, 1996; Strange, 2005; Strange and Iron, n.d.). Strange's basic logic is, therefore, as follows:

each center of gravity has one or more critical capabilities, each critical capability has one or more critical requirements, and those critical requirements that are highly vulnerable are critical vulnerabilities. Critical vulnerabilities can be exploited to attack a center of gravity indirectly.[6]

Illustrative example:

> Strange's conception can be illustrated in an example already discussed above. If an armored corps was assessed as the most important enemy entity in a given situation, it would be the enemy's center of gravity. As the most important capability of an armored corps is the ability to maneuver — to carry out (rapid) movement in combination with fire— we can assess it as a critical capability. However, for an armored corps to be fully operative, specific critical requirements, such as logistical support, intelligence, and air defense must be met. Often, at least one of those categories is highly vulnerable to attack—it is a critical vulnerability. A critical vulnerability can be exploited to attack the center of gravity indirectly. For example, an effective attack on an enemy logistics sub-unit (logistics brigade) can degrade a critical capability of the entire armored corps, thereby indirectly degrading the functionality of the entire center of gravity, which is then exposed to a direct attack.

Strange (2005) was rather explicit about the centers of gravity's different categories (see Figure 1). Firstly, he determined that the center of gravity can be either *moral* or *physical* (disjunction; logical operator OR). Then, he further elaborated on both categories. He stated that a moral center of gravity could either be a *leader* or *public/popular/national support* (logical operator OR). Meanwhile, a physical center of gravity can be *armed forces/strength/power*, or *national industrial/economic power*, or a *large national population* (disjunction; logical operator OR).[7]

Eikmeier and the relation to ends, ways, and means

U.S. Army Colonel Dale C. Eikmeier further developed Strange's conceptualization. Eikmeier reacted to criticisms of the concept and strived to develop a version characterized by clarity, logic, precision, and testability (see Eikmeier, 2016; 2017). Eikmeier pointed out that identifying the center of gravity is actually a systems analysis, but that we can quickly get lost in a forest of nodes and links and no longer see the target. Eikmeier

6 Critical capabilities, critical requirements, and critical vulnerabilities are often referred to as critical factors in doctrinal documents and by later authors.

7 In one of the articles, Strange (see Strange & Iron, 2004, p. 26) additionally distinguished "ruling elites" among the moral centers of gravity as "closed groups in which real power resides in their members." However, this category could be regarded as a somehow expanded leader(ship) dimension.

(2007; 2012) combined the center of gravity with Arthur F. Lykke Jr's concept of ends, ways, and means to guide, simplify, and objectify the analysis. According to Eikmeier, Lykke offers three simple but crucial questions for identifying the center of gravity: (1) what are we trying to achieve (ends)? (2) how are we trying to achieve it (ways)? (3) what are the required resources (means)? A somewhat more subtle but significant change from Strange's model should also be mentioned. For Eikmeier (2015), identifying the critical capability(ies) is essential, as he believes that the center of gravity can only be identified on their basis (and not *vice versa*).

Illustrative example:

> Based on our previously discussed case, we should first ask what the enemy wants to achieve (e.g., seize an area) and what the critical capabilities contributing to achieving the desired ends (attack, maneuver, seize) are in order to assess the enemy's primary entity (armored corps). We must then identify the critical requirements and vulnerabilities, as discussed above.

Eikmeier's definition of the center of gravity—"the primary entity that inherently possesses the critical capabilities to achieve the objective"—implies a logical conjunction, as the *entity* has to manifest *critical capabilities* (logical operator AND). However, further analysis of Eikemeier's conception is somehow restricted, as he does not systematically distinguish between different categories of centers of gravity. Eikmeier (2004; 2007; 2012; 2017) states that at the operational level of war, centers of gravity are usually *key military forces*, further discussing entities such as *economic/industrial capabilities*, *government*, or *population* at the strategic level (logical operator OR) (see Figure 1). Moreover, according to Eikmeier (2012; 2016), only physical centers of gravity exist; these can by no means be intangible elements like "moral strength, public opinion, or a righteous cause." By omitting the moral factor, the author strived to improve the clarity and reduce the concept's abstractness, limiting it to tangible targets against which it is easier to act. At the same time, Eikmeier allows critical capabilities, critical requirements, and critical vulnerabilities to be intangible.

Vego's version of critical factors

The U.S. professor Dr. Milan Vego, a former Yugoslav Navy officer, took up the idea of critical factors. Vego based his model on the analysis of a military situation consisting of a variety of physical (tangible) and abstract (intangible) factors. Given the military action's objective, Vego regards some of these factors as more important than others; these critical factors include critical strengths and weaknesses. Those exploitable critical weaknesses (or, more rarely, critical strengths) are critical vulnerabilities (Vego, 2000; 2009; 2017).

The basic logic is that critical strengths are used to achieve the objective, the most important of which is the center of gravity. However, because it is impossible to be strong in all areas simultaneously, there are also critical weaknesses in every situation. If critical weaknesses (or, more rarely, critical strengths) are open to attack, we speak of critical vulnerabilities that can be exploited for an indirect attack on a center of gravity.

Illustrative example:

> Let us illustrate Vego's conception using an example of an armored corps. Like Eikmeier, Vego recommends initially determining one's objective and the (supposed) objective of the enemy. Then, based on an analysis of the situation, we should reflect on the critical factors and identify critical strengths and weaknesses for each side. For example, if the enemy intends to seize an area, and its critical strengths are identified as maneuver, high cohesiveness, and reconnaissance, then, the center of gravity's entity should be found in this set (in this case, we defined it as an armored corps, as it provides maneuver). However, the enemy is also likely to have weaknesses in some areas of operation, such as logistics, air defense, or command and control. If any of these categories is deemed highly vulnerable to attack (e.g. the enemy's command post), we have identified a critical vulnerability through which the entire center of gravity (the armored corps) can be degraded.

Vego (2009) defined the center of gravity as "a source of massed strength—physical or moral—or a source of leverage" (pp. VII-13 and GL-6), using logical disjunction to establish the inner logic of the concept (logical operator OR). However, like Strange, Vego also recognizes the importance of both physical and abstract elements. As Vego (2000) argues, the higher the level of war, the greater the influence of the latter. In this way, he suggests that centers of gravity are elements such as *leadership*, *ideology*, *legitimacy*, *will to fight*, *key military forces*, *computer (cyber) networks*, *public opinion*, or even *hostages* (logical operator OR) (see Figure 1).

Strange, Eikmeier, and Vego agree that a continuous process of analysis of both the enemy's and friendly's centers of gravity is required. While there are some differences in definitions, the biggest dissimilarity between the authors is that Strange and Vego recognize both tangible and non-tangible elements as potential centers of gravity, while Eikmeier only allows for the existence of tangible ones.[8]

8 The contrasting views on the center of gravity's tangibility raise fundamental ontological questions. However, to date, they have been insufficiently addressed in the literature and are worthy of further investigation. For an introduction to ontology, epistemology, and methodology of the center of gravity concept, see Zweibelson (2015).

Echevarria and the return to Clausewitz

Perhaps the U.S. Lieutenant Colonel and Professor Dr. Antulio J. Echevarria II formulated the most controversial conception of the center of gravity. Echevarria argued that modern versions of the concept deviate too much from Clausewitz's original idea. In order to bring the concept "back under control" (Echevarria, 2004, p. 12), he undertook a detailed study of the writings of *On War*. He concluded that the center of gravity is not about strength, source of strength or weakness, but "a *focal point* where physical (and psychological) forces come together" (Echevarria, 2002, p. v). As the definition reveals, Echevarria's conception is based on conjunction, combining the *physical* and *psychological* categories (logical operator AND).[9]

According to Echevarria (2002, pp. 5–16), Clausewitz's *Schwerpunkt* is not a loose metaphor but a much closer analogy to the physical idea of the center of gravity. Echevarria illustrated that if we move with enough force against the center of gravity of a body, we make it fall—thus, the center of gravity is not strength, a source of strength or weakness, but a factor of balance. The author went on to say that Clausewitz's theoretical writings, and the examples he gives, show that even in war, a "centripetal or centralizing function that holds power systems together" is essential. It is thus a "focal point that draws and organizes power from a variety of sources" (ibid., p. 12) or gives it "purpose and direction" (2004, p. 12), which is only found when there is sufficient connectivity between the various parts of the enemy structure to form an overarching system. Connectivity can be *political*, *ideological*, *geographical*, *electronic*, or *other* (Echevarria, 2012, pp. 6–7). These categories can also be regarded as dimensions on the operationalization level of the concept (disjunction; logical operator OR).

Echevarria (2002; 2004) points out that Clausewitz did not distinguish between tactical, operational, and strategic *Schwerpunkt* but defined it for the entire enemy system. Therefore, the author suggests that the concept should not be applied at individual levels (tactical/operational/strategic) but rather holistically. As the author explains, the separation at the operational, tactical, and strategic levels (over-)stretches the center of gravity concept so that it means everything but, at the same time, nothing.

Illustrative example:

> Returning to the example of an armored corps, as Echevarria is not applying the concept to lower levels of warfare, he would have probably considered the concept as irrelevant in such a situation.

9 Although Echevarria clearly defined the center of gravity concept using the logical operation of conjunction, his illustrative examples are not necessarily consistent with the definition. For example, when discussing a campaign against Al Queda, Echevarria (2002) assessed that terrorist cells do not have a strong physical link; they are united ideologically, yet he still found the concept of the center of gravity to be applicable. In this respect, the author neglected one of the dimensions, which—according to his definition—constitute both necessary and sufficient conditions of a concept.

Echevarria (2002; 2004) proposes three steps to apply the concept:

1. Determining whether identifying and attacking a center of gravity is appropriate for the type of war we will wage.
2. Determining whether the enemy's structure or system is sufficiently connected to be considered a single body.
3. Determining which element has the necessary centripetal force to hold the entire system together.

Echevarria's understanding of the center of gravity has been rejected by several theorists, arguing that the conception is too mechanistic, full of reservations, and (too) narrowly focused on a type of war that does not reflect the current spectrum of modern military operations (see Eikmeier, 2012, p. 163; 2016, p. 111; Vego, 2009, pp. VII-32–VII-33). In this light, it is not surprising that writers of official military publications have not embraced the concept.

Discussion

As can be seen in Figure 1,[10] fielded military and leadership are the most universally perceived categories of the center of gravity. The first category is explicitly supported by four out of five analyzed authors, with Warden speaking of the fielded military, Strange of the armed forces, and Eikmeier and Vego of the military forces. Echevarria is the only author addressing the category rather ambiguously.[11] Furthermore, most authors apply somewhat greater importance to fielded forces understanding of the center of gravity at operational rather than the strategic level of warfare.

In the case of the leader(ship), the most notable difference between the authors is whether they perceive the center of gravity to be the leader alone or whether they also include the leader's closest associates (such as military staff). Three authors (Warden, Strange, and Vego) name the leadership category rather explicitly, while Echevarria's notion is somehow less apparent and might be most closely correlated to the dimension of

10 It is worth pointing out that the selected authors studied the center of gravity concept with varying degrees of rigor. In this respect, their lists of (potential) centers of gravity may be non-exhaustive or only apparent from the illustrative cases provided by the authors.

11 On the one hand, Echevarria (2007) stated that the center of gravity "refers less to the concentrated forces than to the actual element that causes them to concentrate and gives them purpose and direction," further illustrating that they "enable leaders to hold the system together" (pp. 181–182). On the other, Echevarria (2002) recognized armed force as a potential "focal point that draws and organizes power from a variety of sources" (p. 12).

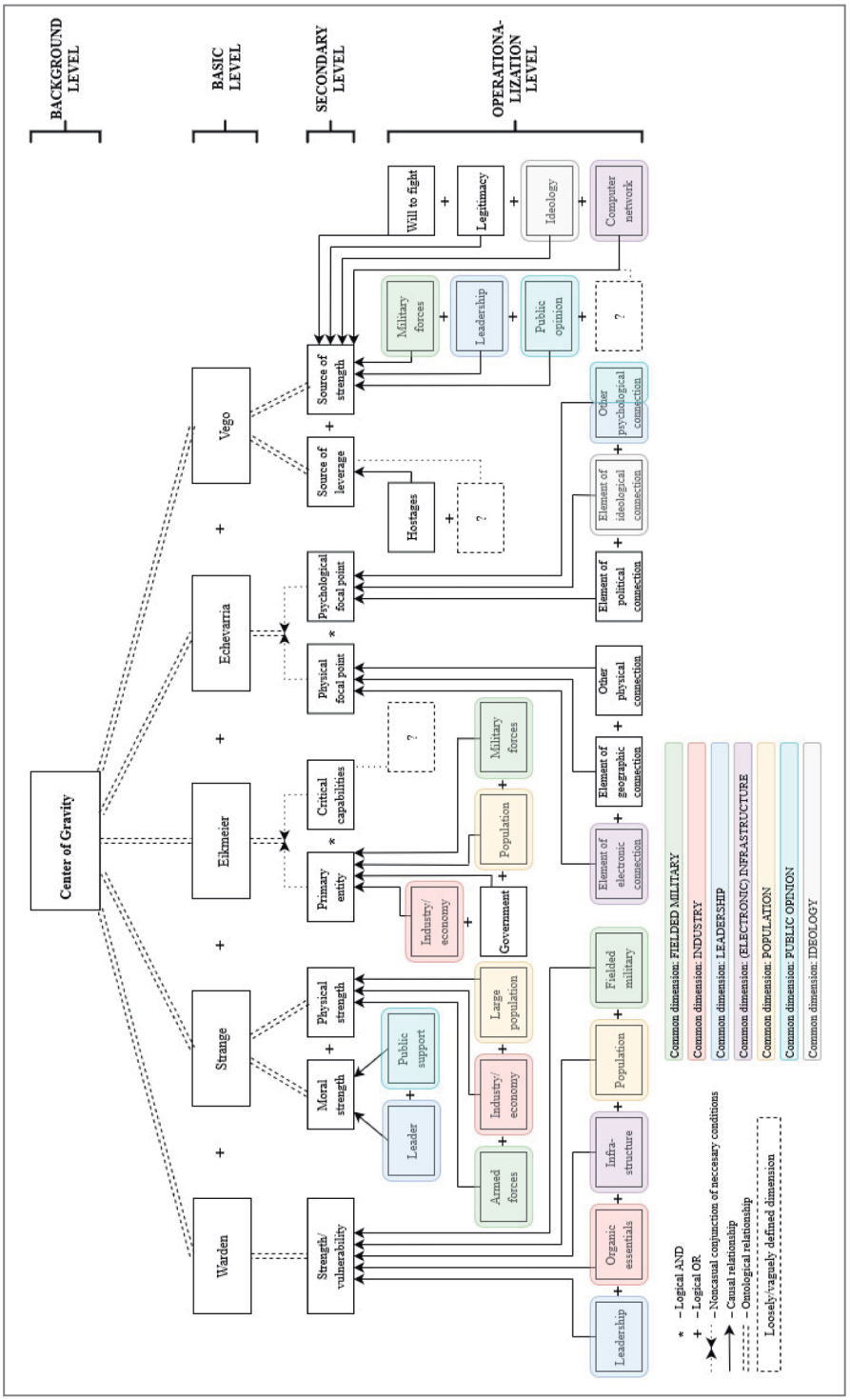

Figure 1. *Structural outline of the center of gravity concept*
Source: Figure created by the author.

psychological connection.[12] Eikmeier is the only author who explicitly objects to leadership being put on the list.[13]

Industry, (electronic) infrastructure, population, and public opinion are the next categories that stand out; they are supported by three out of five analyzed authors. Warden named the industry category as organic or system essential, leaving no doubt that—at the strategic level—the center of gravity consists of the military and civil industry. Electronic infrastructure is defined somewhat more vaguely, with Warden speaking of infrastructure in general, Echevarria of the focal point of electronic connection, and Vego of computer networks, while the population is referred to rather straightforwardly by Warden, Strange, and Eikmeier. In the case of public opinion, Strange listed the category under the name of public support but later on interchangeably used the terms as synonyms. Meanwhile, Echevarria's notion of public opinion might be attributed to the category of psychological connection.[14] The remaining category recognized by at least a pair of authors is ideology.

Different perceptions of the center of gravity are not significant only on the theoretical level; they can also lead to contrasting views regarding the practical application of the concept. A disagreement during Operation Allied Force, a NATO air campaign against Yugoslavia in 1999, is a notable example. As it turned out, two of the most prominent commanders, General Wesley Clark (Supreme Allied Commander Europe) and General Michael C. Short (commander of Allied Air Forces Southern Europe), disagreed on the centers of gravity against which NATO should direct attacks.[15] Short argued that Yugoslav strategic electricity, transport, communications, and industrial facilities should be destroyed as soon as possible, making his approach at the strategic level largely in line with Warden. Short was metaphorical with journalists:

> I'd have gone for the head of the snake on the first night. […] I'd have turned the lights out. I'd have dropped the bridges across the Danube. I'd have hit five or six political-military headquarters in downtown Belgrade. Milosevic and his cronies would have woken up the first morning asking what the hell was going on. […] If you hit that man hard -- slapped him up side [sic] the head -- he'd pay attention. (Short, 1999, as cited in Kozaryn, 1999)

12 However, Echevarria (2007) leaves no doubt that leaders can be centers of gravity, stating that "something relatively small, such as a political or military leader, […] can bring down an entire state or coalition" (p. 184).

13 Eikmeier (2004, pp. 4–5) explicitly classified leadership/key personality among critical requirements and not centers of gravity. However, in one of his illustrative cases, Eikmeier (2007, p. 66) identified the government as the potential center of gravity.

14 In Echevarria's (2007) words, "An army versus public opinion, for example, pits a physical mass against an attitude, which might easily generate disproportionate results" (p. 184).

15 The differences in perceptions of the center of gravity were largely a result of different doctrinal approaches to warfare, as U.S. Army commanders primarily sought to achieve effects at the land theatre level, while the U.S. Air Force sought systemic effects at the strategic level. Because Clark came from the Army and Short from the Air Force, the differences in perception of the center of gravity are unsurprising. Clark (2001, p. 449) also mentioned the difference at the political level between the American and European wings of NATO, as European allies are said to favor attacking military forces, unlike the United States.

While Short believed that Yugoslav land forces were not the center of gravity, his superior, General Clark, was convinced of the opposite, that decisive action should be taken against military units deployed in and around Kosovo (against the 3rd Yugoslav Army). As Clark (2001) wrote:

> The military mission […] is to attack Yugoslav military and security forces and associated facilities with sufficient effect to degrade its capacity to continue repression of the civilian population and to deter further military actions against its own people. We are going to systematically attack, disrupt, degrade, devastate, and ultimately destroy these forces and their facilities and support, [sic] unless President Milosevic complies with the demands of the international community. (p. 203)

Clark (2001), later acknowledged that there were, in fact, two centers of gravity: land forces in Kosovo at the operational level and elements that were critical to the support and command of the forces, such as "TV stations, key bridges, and electric power stations" (p. 242), at the strategic level. However, the disagreement between Short and Clark was so great on one point, that the latter even considered resigning (Pirjevec, 2003, p. 151). Even though we might never know what decisively persuaded the Yugoslav authorities to surrender in June 1999, a presented case clearly indicates what an influence the center of gravity concept has on the military planning and command process in general and how significantly the differences in understanding can alter the conduct of a military operation. Hence, the center of gravity concept should always be applied judiciously and not as a silver bullet for solving all and every problem of military planning.

Conclusion

The center of gravity concept originates from a revived interest in Clausewitz's book, *On War*, which in the second half of the 1970s, (re-)attracted the attention of military theorists, first in the United States and later elsewhere in the world. Because Clausewitz's in-depth treatment of war paved the way for the institutionalization of military science and the modern understanding of warfare, it is not surprising that his writings remain relevant and are used by many theorists as a baseline for an abstract and generalized understanding of armed conflicts.

The use of various metaphors permeated Clausewitz's perception of war, many of which remain employed today. One is the concept of the center of gravity (*Schwerpunkt*), which has inspired many modern reinterpretations. One of these was introduced into official doctrine by the U.S. Army in 1986, followed by other service branches of the U.S. Armed Forces, and many other Western countries and NATO members, including Slovenia (the country of origin of the author of this article). Thus, in many armed forces, the center of gravity became the *modus operandi* of planning and conducting (major) military operations. The doctrinal introduction of the concept was followed by a turbulent

expert discourse, in the course of which several refined versions of the concept emerged. These were not only important from a theoretical point of view; they have also significantly influenced the further development of military doctrines.

At the highest level, the concept of a center of gravity can be referred to as a background concept, which encompasses such a wide range of definitions that, in some cases, even contradict each other. At the lower level of the basic concept, we can distinguish between definitions of individual authors. Warden, Strange, Eikmeier, Vego, and Echevarria have written the most influential definitions to date. Using the structural method for the concept analysis in this research, it is concluded that the mentioned authors quite commonly (but not universally) perceive seven entities as the potential centers of gravity. These are (in order of frequency): (1) fielded military, (2) leadership, (3) industry, (4) infrastructure, (5) population, (6) public opinion, and (7) ideology. The authors also use similar terms concerning action towards the centers of gravity, such as destruction, neutralization, weakening, dislocation, denial, breakage, disruption, isolation, capture, and liquidation. In this way, centers of gravity may be best understood as subsystems whose reduction in functionality is most often decisive for the favorable outcome of a military operation.

How can we understand a center of gravity concept in its most generic sense? It is a warfighting concept that aims to achieve disproportionate desired effects by degrading a limited but essential part of the enemy system. The concept favors an indirect approach and is used at all levels of warfare; however, it has special importance for strategy and may even be more pivotal in the operational art. As we have seen, the center of gravity concept, in fact, combines two functions. On the one hand, it serves as a central tool for planning military operations (normative function); on the other, it can also be interpreted as a variable, explaining quick and decisive military victories (analytical/explanatory function). However, degradation of the center of gravity is, at best, a necessary yet insufficient condition to achieve a decisive military victory.

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