OPERATIONAL SCIENCE AND ART: A PERSPECTIVE ON DESIGN

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ABSTRACT

This article presents the relation between Operational Art and Science, which has been questioned in War Studies for centuries. It examines that relation through a methodology that employs the research based on a literature review, explored with mixed methods of enquiry in the search for answers. Thus, the article concludes that the Operational Art provides the Operational Commander with a margin of creativity and personal influence in the planning process of a Campaign or Military Operation. It permeates all the Operational Science of this planning, where it shows its aspect of rationality. This Science can also be expressed in Operational Planning through Operational Design, which has in its concepts the vital link between Operational Art and Science. However, the British Operational Design still has a broader scope than the Brazilian Operational Design, which is only a graphic representation of the Course of Action synthesis chosen by the Operational Commander.

Keywords: War. Science. Operational Art. Design Approach. Operational Design. Joint Planning.

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INTRODUCTION

> *Thus, War becomes Art - Art, of course, which is served by various sciences. In War, as in Art, we find no universal forms, nor can a rule take the place of talent.* Helmuth Von Moltke (Moltke, the "Old")

Archaeological evidence suggests that the human species (Homo sapiens) stopped living in nomadic groups around the Neolithic Period (10000 – 3000 BC), when it began to effectively modify its environment according to its needs and interests. This behavioral change was fundamental for the development of new skills or techniques, as well as tools, enabling the survival of the species under these conditions and boosting the continuous improvement of its knowledge (JUDGE; LANGDON, 2011). The systematic form established to organize such knowledge, obtained through observation and experience, is commonly called Science (FERREIRA, 2010, p.164).

Humans are made up of a genetic combination that makes each individual unique. This condition allows so that each person may offer their own unique contribution, based on their own experiences and on the influences of the environment or group to which they belong (UNITED KINGDOM, 2010). Therefore, each individual has a unique ability to create, used to achieve a certain result, obtained by different means. This form of expression, which is essentially human, can be understood as Art (FERREIRA, 2010, p.68).

In the military field and in War itself, the acquired knowledge was consolidated over time through the organization of its means and methods, resulting in a complex and multidisciplinary social science. In this context, Waltz emphasizes that "men are led not by the precepts of pure reason, but by their passions. Men, driven by their passions, are drawn into the conflicts" (WALTZ, 2010, p.24). This statement demonstrates the imminent human contribution that emerges in this field. Therefore, the expression in War of its component "Art" cannot be overlooked either.

Niccolo Machiavelli (1469 – 1527) presents a persistent dichotomy in his thoughts, simultaneously focusing on human aspects and the classical Roman values of organization. In his book "The Prince", from 1512, he discusses the values of the "Prince" as a ruler and the importance of the organization of "Principality" and its army, as well as its way of combating external threats (BRAZIL, 2007a; MAQUIAVEL, 2009).

On the other hand, Prussian general Carl Von Clausewitz (1780-1831) tried to present the War fundamentally as science, seeking to systematize his study, based on his observations on the Napoleonic Wars (1805-1815). He established a methodology that is both robust and sometimes difficult to understand, while seeking to distinguish Science from the Art of War. Nevertheless, in his work "On War", Clausewitz still devotes an exclusive chapter to what he called "Military Genius", which would represent a combination of essential attributes to the complexity of War and the way it is lead, exposing its Art aspect. Among these attributes, such as courage and determination, this "genius" should also possess high intellect as an equally indispensable quality found only in civilized people. This characteristic becomes evident when he describes War as the "province of uncertainty", and that an average intellect of its commanders always leads to mediocre results, resulted from the poor understanding of a particular problem (CLAUSEWITZ, 1984).

Similarly, British thinker Julian Corbett (1854 - 1922) also questioned in his book Some Principles of Maritime Strategy, 1911, the relevance of Military Science, in relation to the traditional Art, which would often depend on the judgment of individuals (CORBETT , 2009).

Thus, within this perspective of Science and Art, this work will evaluate the importance of the Operational Level for War planning, due to a complexity that is superior to that found in the Tactical Level and its relevance in the translation of the demands from the Strategic to the Tactical Level. Such complexity is due to the influence of intangible factors on the military problem, in addition to the presence of natural tangible factors, being also aggravated by the involvement of state and non-state actors. For this, data collection made from a bibliographic search will provide a theoretical basis for the article. The analysis of the subject will be carried out through a mixed method of approach of qualitative character, underpinning its investigation.

In the initial chapter, definitions and difficulties will be presented at the operational level, regarding the methodology used for Planning and its relationship with the so-called "Operational Art", based on the comparison between the Brazilian and British Operational Planning Doctrines.

The second chapter will address the forms of thinking employed by Operational Art in the search for a solution to complex military problems and its relevance to Operational Planning.

The third chapter will present the consequent types of approach of Operational Art to a military problem, assessing its advantages and disadvantages, and discussing in depth the relationship between the Operational Commander and his General Staff, and its importance to the success of the Planning of a Campaign or Major Operation.

The last chapter will discuss the relevance of Operational Science and Operational Design in the analysis of a military problem, from a British perspective, and its comparison with the so-called "Operational Design", employed in Brazilian Operational Planning.

Finally, the work will present the conclusions on the distinction observed between Art and Science at the operational level, as well as its influence on Operational Design, primarily resulting from the confrontation between the use of the Operational-Level Planning Process (OLPP) by the British and its Brazilian counterpart , the Joint Planning Process (JPP), with their respective challenges.

ART AT THE OPERATIONAL LEVEL

This chapter will seek to establish a definition for Operational Art, from its genesis, demonstrating its relevance and challenges for the Operational Level, based on the Brazilian and British joint doctrines.

The importance of Military Art dates back more than two millennia, when Sun Tzu's "The Art of War" (544 – 496 BC) presented philosophical influences on reflections on military issues, exploring the human characteristic of the War phenomenon. In spite of this, it is not yet possible to say exactly which philosophical school he favored the most. But even with his constant insistence on rules, which would represent a more prominent face of science in his work, he comes up with strong Taoist concepts, especially as he underscores the importance of the choice of leaders for their "Path" (or Tao ◎, in Chinese), which would be vital to the survival of the nation. This "Path" sets a precedent for individuality in War planning, providing it with an "Art" character, as already mentioned above. In addition, Sun Tzu already emphasized the relevant contribution of the "military genius" in the pursuit of victory (TZU, 2011).

Nowadays, the continuous evolution of the means and methods of War associated with the instability of the International System, especially after the collapse of the former Soviet Union in 1991 and the end of the Cold War (1945 – 1991), has exerted a relative impact on the traditional inter-state

conflicts (FRIEDMAN, 2009). These conflicts, which result in the so-called "War of Attrition", have given way to intra-state conflicts (HEWITT et al, 2013). In these conflicts, where there is a proliferation of non-state actors, between which there is a strong imbalance of the "means" involved and the will to fight, the asymmetry of the actors involved becomes more evident. Likewise, "Effects-based Wars", which focus on coordinated actions aimed at the opponent's behavior, are increasingly gaining ground in conflicts (SMITH, 2003). In this scope, the old paradigm of an operation controlled by the achievement of goals shifts to another, focused on obtaining the desired effects (BRAZIL, 2011a). Already in the early twentieth century, the Russians asserted that "modern war had destroyed the symmetry of the Napoleonic paradigm in which tactics were the management of forces on the field of battle and strategy the maneuver of forces to the field of battle." (SVECHIN, 2004, p.26)

Therefore, the uncertainty and complexity resulting from the relationship of state and non-state actors involved, as well as their repercussions in a military campaign, permeate the reality of modern conflicts (KELLY; BRENNAN, 2009). This condition tends to require more from the Operational Level of War planning, which is responsible for connecting the Strategic to the Tactical Level, in order to fully achieve its objectives.

The category of military art between Strategy and Tactics was first called Operational Art (OA) by the Russian General Aleksander Andreevich Svechin (1878-1938). However, it was widespread when the American General Norman Schwartzkopf used the term in a post-campaign briefing in the Gulf War of 1991 (SVECHIN, 2004).

Despite this, Science is more evident in the Operational than in the Strategic Level, where the aims are more intangible. However, its "Art" component is still significantly present, especially in the planning of a military campaign.

The British Allied Joint Doctrine for Operational-Level Planning of the Ministry of Defence defines Operational Art (OA) as "(...) the orchestration of an operation, in concert with other agencies, to convert strategic objectives into tactical activity in order to achieve a desired outcome" (UNITED KINGDOM, 2013, pp. 1-20).

On the other hand, the Doctrine of Joint Planning of the Brazilian Ministry of Defense (MD) establishes OA as "the set of concepts that will contribute to a better conception of the use of military and non-military

means in a theater or area of operations, for the realization of a campaign or, simply, a military operation" (BRAZIL, 2011a, 19).

In addition, this same Doctrine highlights that "Operational Art occupies an indispensable position between strategy, on the one hand, and tactics, on the other, constituting, therefore, an interface between these two areas" (BRAZIL, 2011a, p. 74). In the same vein, Milan Vego states that "in the same way as Strategy and Tactics, OA is simultaneously art and science" (VEGO, 2009, page I-3). But, he still defines Operational Art as

> The component of military art concerned with the theory and practice of planning, preparing, conducting, and sustaining campaigns and major operations aimed at accomplishing strategic or operational objectives in a given theatre of operations (VEGO, 2009, p. I-4)

Svechin, in turn, defines it as "the totality of maneuvers and battles in a given part of the theater with military actions directed towards attaining a common goal, established as an end in a given period of the campaign" (SVECHIN, 2009, p. 38).

Besides the lack of consensus among the theorists of the subject on the definition of OA, we can also identify a partial dissonance between those set forth in the presented doctrines. This dissonance is represented, on the one hand, by the British, which approaches the main purpose of the operational level, which is responsible for the interface between the strategic and the tactical level. On the other hand, the Brazilian one is based on the "set of concepts" that form it.

This "set of concepts" previously cited in the Brazilian doctrine of OA is also referred to as "elements of operational design" by the MD (BRAZIL, 2011a), which are presented by the British Doctrine as Operational Design Concepts (ODC). For the MD, Operational Design (OD) is only the "graphical representation of the synthesis of the Lines of Action (LA) that the Commander at the operational level developed with his General Staff (GS)" (BRAZIL, 2011, p.).

These elements are used to effectively build a framework in which the operations take place and can be seen as a "bridge" between the OA and Operational Design, which will be discussed later in more detail. The main elements are established by the MD as the Desired End State

(DES), Center of Gravity (CG), Operational Objectives (OpObj), Decisive Point (DP), Culminating Point (CP), Line of Operation (LOp), Variant and Operational Pause (OP) (BRAZIL, 2011a).

However, it is emphasized that the Operational Strategy is synthetically defined by the MD as the "art of dislocating, deploying, preparing and employing the Armed Forces, aiming to meet, in the best conditions, objectives that are assigned to them" (BRAZIL, 2007b). 1-3). Thus, given the similarity of this definition to Vego's (2009) proposal for the OA, the Brazilian Doctrine understands the term "Operational Strategy" as its synonym.

Nevertheless, for the British, the Strategy at the Operational level or simply Strategy is responsible for guiding the OA, determining the "ends" and allocating the "means" needed to do so. This concept of Strategy adheres particularly to that of the British thinker Basil Henry Liddell Hart (1895 – 1970), which is the one used by the MD for Strategy itself (UNITED KINGDOM, 2013, HART, 1991; BRAZIL, 2007b).

However, according to the British doctrine, the OA integrates the "means" available (sources of military or non-military resources), the "ways" of employment of a campaign or major military operation ("type of approach" to a problem) and their associated "risks", to achieve the desired results or "ends". It can be observed that this idea is more connected to the primordial function of the operational level, integrating the strategic to the tactical.

These elements of the OA can be briefly illustrated by Operation Barbarossa of 1941, when there was a clear imbalance of them in the German forces. The German troops invaded the Soviet Union, with the strategic objective of achieving the collapse of that nation (ends), though in a short but decisive campaign (ways). However, excessive self-confidence and weak intelligence (risks) led to evil-sized resources (means) for such purposes.

Thus, OA's visionary and intuitive portion is ultimately the work of the OPCom, its main propeller being creative thinking, an innovative element that may be called "Operational Ideals" (UNITED KINGDOM, 2013).

Nevertheless, based on the British definition, it is observed that OA still demands rational processes to convert the strategic objectives into tactical activity, in an intelligible way so that it can be executed, aiming to achieve the desired result.

THE FORMS OF THINKING IN OPERATIONAL ART

Here, we presented the forms of thinking used by the OA in the search for solutions to a military problem and its relevance to Operational Planning.

Although there is no consensus on its definition, it is clear that OA has a strong subjective component. This subjectivity, which emerged from the "Art of War", which predominated in the Studies of Strategy between the Middle Ages (5th–15th century) and the Modern Age (15th–18th century), began to give way to the idea in the Western world that reason would bring benefits to War, as an influence of the optimism of Enlightenment from the late eighteenth century (FREEDMAN, 2013). Clausewitz (1984) is an emblematic example of this period, where his "trinity" puts the "reason" offered by political ends to balance the "luck" (field of probabilities) that revolves around battles and "armies", making a counterpoint to the "passion" that ignites the people. Thus, this reason emerges in opposition to the subjectivity imposed by the "Art" employed by the Operational Commanders until then. However, the limited rationality, inherent in planning, also creates barriers in the process of understanding problems (Morgan, 2006). In this way, some devices, using different forms of thinking, are being used more often in decision making, seeking this balance between subjectivity and rationality in solving military problems.

Such forms of thinking can be summarized basically into two, according to recent research in the field of Psychology. The first, through the intuitive method, also called implicit or "System or Type 1", has an unconscious characteristic and is based on an associative or experimental process. This process that uses choice and judgment in decision making can use heuristics, which are practical rules of simplification of problems used by the human brain in the search for their solutions. The second is the analytical method, also described as explicit or "System or Type 2". This process is based on reason and rules in a conscious and deliberate way for decision making, but it can be influenced by bias, which is a tendency or inclination to a certain vision or way of thinking. According to neurologists, both forms act in the prefrontal region of the human brain, which is associated with intelligence and plays a fundamental role in the decision-making process and the search for solutions to problems (KAHNEMAN, 2011).

However, more complex activities may require more of "System

2", causing an overload that can generate failures in the perception of additional information, especially under time pressure, just the typical work environment of a GS. This effect on perception is called by psychology experts "perception blindness" (or inattentional blindness), which has for some time been known in the field of aviation as "tunnel vision". A very widespread experiment, conducted by psychologists Chabris and Simons (2011) and entitled "The Invisible Gorilla", has shown that about 50% of people are affected by this effect in activities that require some concentration.

Therefore, perceptual failures in approaching a military problem can be caused by the heuristics and biases that influence the critical thinking of the individuals involved in the planning, causing "distortion" of the facts, as in an effect of "refraction" of reality that alters the perception of this reality. In addition, individuals may also have their perception reduced under time pressure in intense periods of mental work, as in the case of work in GS, generating a sort of "blindness" to certain facts, where this perception is focused only on certain points of reality ("tunnel vision"). These analogies with optical phenomena of human vision have been used here only to illustrate such perceptual failures.

Additionally, the understanding of a problem can be divided into three types: individual, with all its associated peculiarities discussed previously; collective, which is based on the shared perspective between individuals of the same group; and common, which is perceived by different groups. In this way, the approaches may also present different perspectives, either by the individual himself, or by the group to which he belongs or by the relationship with other groups, as when forming an alliance, for example. This understanding in groups can also result in a perception of failure caused by groupthink, which is the tendency to adopt the decision of a majority of members in a group with similar training and sharing common values (UNITED KINGDOM, 2016).

For Milan Vego (2009), subordinate Commanders need to have a broad understanding of the situation to act in accordance with the intent of the Operational Commander (OpCom) and achieve full success. Furthermore, starting from the premise of Bloom's Taxonomy presented in 1956, understanding follows the attainment of knowledge in the escalation of the cognitive domain (FERRAZ; BELHOT, 2010).

Consequently, despite the importance of the weighted participation of reason that overlays the Science used in Operational

Planning ("System 2"), it will nevertheless be subject to failures in the perception of nuances in the complex analysis that a military problem demands. However, the participation of the OpCom, with his experience and individual characteristics, can provide more balance to this process in a more creative and innovative way through the OA.

THE TYPES OF APPROACH TO A MILITARY PROBLEM

In this part of the paper, the types of Operational Art approaches in a military problem will be exposed, where the relationship between the OpCom and his GS is deepened and the balance between the subjectivity and objectivity provided by both is established, essential for the success of Operational Planning.

Therefore, in order to bring more rationality to the OA, an analytical approach is necessary, which can be divided into subtypes of approaches identified in Military Planning.

First, the traditional approach, which has its origins in the Renaissance (14th century – 16th century) and divides a complex phenomenon into as many parts as possible to better solve it (UNITED KINGDOM, 2013), followed by a synthesis and a verification of the solution, which is based on evidence (Cartesian Method). This methodology, also called reductive analysis, works with a "cause and effect" chain, expressing a deterministic thinking that can also be conceived by linear mathematical models (Newtonian influence) (CHIAVENATO, 2011).

In this way, this approach becomes more efficient in relatively simpler phenomena such as the movement of forces, the logistics, the effects in the combat to the systems of arms, the units or military groupings, making its use difficult in more complex environments (UNITED KINGDOM, 2013).

Then comes the systemic approach, which allows to conduct a broader analysis of a complex environment, as in a large system. It has its origins in an unfolding of Human Relations Theory, known as Behavioral Theory, or Behaviorism, of the mid-twentieth century. Behaviorists study, more descriptively, perception and cognition with an emphasis on people as part of a system of decisions. Thus, these theories gained strength in reaction to the Classical Theory, which approached the problems in a mechanistic or prescriptive way, as if they existed in a closed system, without external influences. Such a change has also resulted in significant

impact on organizations, especially in the division of tasks, the system of authority and training.

The Systems Theory, which develops most significantly from the analogy of living beings as an open system, seeks to establish a dynamic equilibrium condition or "homeostasis" as an objective or result, through a self-regulation mechanism of constant interaction with the environment (CHIAVENATO, 2011).

The systems approach provides a framework where mental models can be constructed, relationships between component systems are discovered and patterns of behavior can be determined (UNITED KINGDOM, 2013).

Unlike the traditional analytical emphasis, this type of approach has its focus on synthetic thinking, that is, it is more interested in joining the parts than separating them. In addition, it is also based on teleology, which is the study of behavior to achieve goals. In the teleological conception, behavior is explained by what it produces or by what its purpose is or a goal to produce. In this sense, the relation of "cause and effect" is not a deterministic, but a probabilistic one. Therefore, the dynamics of forces acting on a system produce a systemic emergence for each of its parts (or subsystems), which cannot be clearly determined (Chiavenato, 2011). Fuller's (1926) view well illustrates this approach to a military problem, which does not only demand to know that a certain "B" effect followed an "A" cause, but rather why it followed it. This becomes extremely pertinent if we view conflicts or crises as systems, where each has independent parts that interact continuously.

Some tools are used in this systemic approach, such as SWOT analysis, which results in an analytical matrix of the internal environment (Strengths and Weaknesses) and external environment (Opportunities and Threats). Another common tool is PMESII (Political, Military, Economic, Social, Infrastructure and Information) analysis, forming a tabular matrix with ASCOPE (Areas, Structures, Capacities, Organization, People and Events) analysis.

However, this approach has been subject to criticisms, stating that it attempts to implement rationality and certainty in the understanding of problems, whereas conflicts are actually permeated by the opposite characteristics, where we find not only objective but also subjective probabilities (UNITED KINGDOM, 2013).

In response to these criticisms, the design approach arises, which

offers a systemic holistic view of a particular crisis or conflict by replacing the mechanical application of the typical systemic approach with a more balanced one that stands between critical and creative thinking. This allows the OpCom to better understand the peculiarities of the situation, and to better describe and visualize the change of its status quo.

The design approach has its genesis in the complexity and uncertainty found in the environment and represents an advance beyond the one offered by the Systems Theory through a so-called contingency view, trying to analyze not only the relations between the subsystems or a particular system with its environment, but also by establishing patterns in these relationships or the configuration of variables (CHIAVENATO, 2011).

Understanding a problem by design is a mental construct, an abstraction performed by the human mind so that several different parts of knowledge make sense and result in an ample construct of it (constructivist thinking) (WIGGINS; MCTIGHE, 2005). In this line of thought, knowledge is not something finished and results from the individual's interaction with his physical and social environment (BECKER, 1994).

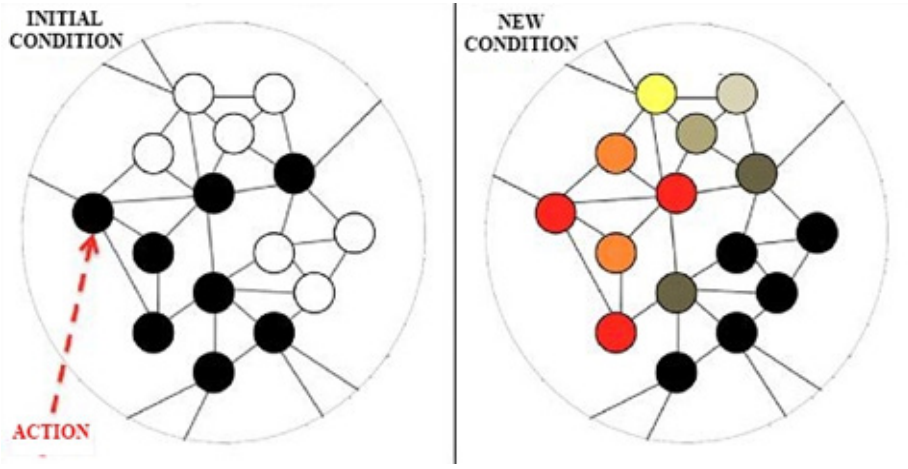
To do this, groups can be formed by members of various specialties to attack a complex problem, establishing an alternative system of organization, parallel to the formal hierarchy, to perform specific tasks. These multidisciplinary project teams work best in unstable and complex environments. This form of matrix organization was also known as Adhocracy, which brings more flexibility and adaptability to the execution of "projects" or "task-forces" (MORGAN, 2006).

Obviously, this type of organization is not new and had great participation of the Prussian general Herbert Scharnhorst in the early nineteenth century, when he began to reform his army and created a General Staff (GS), responsible for organizational planning of major military operations (HOLBORN, 2010). However, in the second half of the 20th century, the studies of Paul Lawrence and Jay Lorsch (1967) have made a significant contribution to the so-called Contingency Theory, giving greater precision and refinement to the solution of complex problems. According to their research, the design of a problem must be established from two main aspects: differentiation and integration.

The first emerges from the actual differentiation of the task environment, which results in distinct structures for approaching a problem. In the Operational Level, these "tasks" can be observed in

"Operation lines (OpL)". The second aspect refers to the opposite of differentiation, where integration seeks to achieve unity of efforts and coordination between these "tasks" or "actions", whereby the design approach seeks a continuous summation of "effects" to achieve their "operational objectives (OpO)" (Galbraith, 1973). (FIG 1)

Figure 1 - Effects of actions on the system



Source: Prepared by the Author

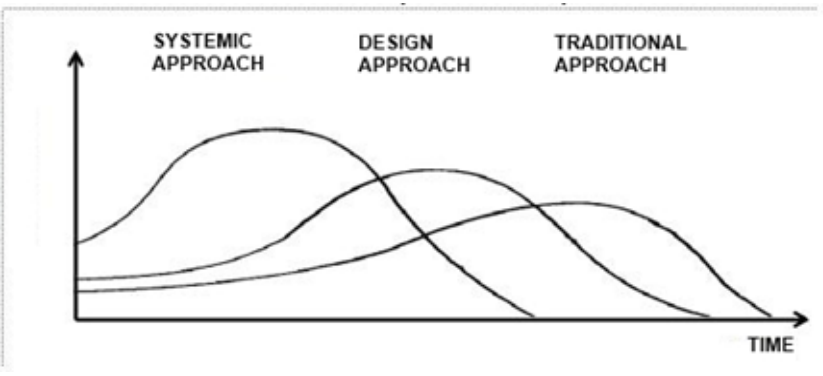
In Design, the "effects" play a key role, where their understanding is decisive to establish the "actions" that act in the Operational Environment. Morgan (2006) reinforces this argument, noting that "there is no better way to get organized" and that "the appropriate way depends on the type of task or environment in which one is acting" (Morgan, 2006, p. 53). Thus, this integration can be seen, even in the early stages of planning, more clearly in a graphic of effects and their sequencing, combining the operating factors of power, space and time. The key to the implementation of the OA lies in the ability of this visualization (BRAZIL, 2011a).

According to the Project Management Institute (PMI), a project can be defined as a temporary endeavor to create a particular product or result. But despite having a defined beginning, it only ends when its goals are met or as one concludes that they cannot be achieved (PROJECT MANAGEMENT INSTITUTE, 2012, 2009). Consequently, this approach can also be seen as a large project (WIGGINS; MCTIGHE, 2005), which

brings flexibility and adaptability to the campaign or military operation, either during planning, implementation or in the evaluation of the full spectrum of operations performed, and may generate the need for its re-designing.

Thus, given the complexity of a crisis, a type of uniform analytical approach throughout the Process of Planning at the Operational Level becomes a challenge for the OpCom, which should strike a balance between subjectivity and objectivity, given the time available and the always limited resources. This balance is achieved through the so-called balanced approach, composed of a combination of approaches and applied during the steps of the Operational Plan, seeking to obtain the expected solution in the scope and depth of a certain problem (UK, 2013). (FIG. 2)

Figure 2 - Hypothetical example of a balanced approach to Operational Planning



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The doctrine employed by the United Kingdom describes OA products as "Operational Ideas", which feature ample solutions envisioned to the military problem. To this end, the OA requires creative and innovative thinking, as well as a deep understanding of the Operational Design Concepts and their tools in achieving these "ideas" (NORTH ATLANTIC TREATY ORGANIZATION, 2010).

In this sense, these "ideas" are abstractions and the challenge of design is just to bring a practical application for them (WIGGINS; MCTIGHE, 2005), where those elements that are fundamental to the Operational Planning itself are identified, in the so-called Operational Design. (Table 1)

Table 1 - Facts Analysis

Fact	Deduction	Conclusion
A significant factual statement of information recognized as true and that has **operational implication**. What is the current state of relations or trends?	The implications, problems or considerations derived from one or more facts that have **operational relevance**. So what is the relevance of that fact?	The result that **requires action in planning** or posterior analysis. (Examples: Actions, Vulnerabilities Criticisms, Critical Requirements, Decisive Points, Intelligence Needs, Essential Intelligence Elements) So what can or should be done?

Source: Prepared by the Author

SCIENCE AT THE OPERATIONAL LEVEL AND OPERATIONAL DESIGN

In this section, the main components of Operational Science are presented, focusing on Operational Design, which has in its elements the vital link with Operational Art.

Corbett (2009) points out that for centuries the "Art of War" showed an unscientific feature. The classic strategists gave preference to the term "art" instead of "Science", for it did not use laws or rules, which are unpredictable for the human factors. Perhaps this rejection is also linked to the fact that officials highly engaged in "Science" failed as military leaders.

This historical imbalance between the two is described by J.F.C. Fuller:

> To deny a Science of War and then to theorize on war as an Art is pure military alchemy, a process of reasoning that for thousands of years has blinded the soldier for the realities of War and will continue to blind him until he creates a science of war upon which to have his art. (FULLER, 1926, p. 21)

Fuller (1926) also questioned the military obsession with traditions, often with the absence of rules for war planning, leading the thinking of theorists of the prevailing War to its art component and resulting in the denial of its science.

The synergistic capability of the relationship between the Science and the Art of War, given their respective characteristics, is emphasized by Clausewitz (1984), stating that while the object of science is knowledge, the object of art is creative ability.

Thus, at the Operational Level, that Art component or Operational Art is materialized by combining the skills of the OpCom and the processes conducted by his GS. These processes are called Design and Operational Management, which correspond to the Science component at this level of War planning or Operational Science.

Operational Science can be understood as the expression of reasoning applied to planning at the operational level, even for its control, in the pursuit of a set of positive and accurate conclusions (CLAUSEWITZ, 1984).

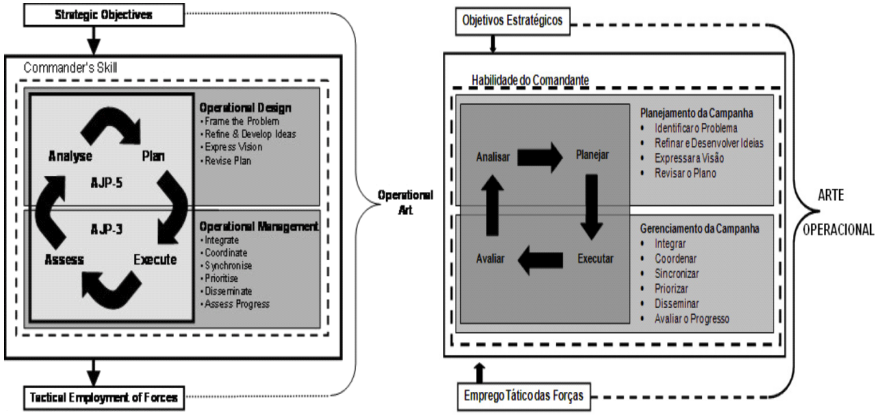
According to the doctrine employed by the British, Operational Design structures the problem, as well as refines and develops the "Operational Ideas" to provide a detailed Plan. The review and improvement of critical aspects of the continuous Operational Re-Design occurs according to the dynamics of the situation, and the understanding of the problem or the environment by the OpCom changes in response to the actions and reactions of other actors (NATO, 2010).

Bazermann (2004) states that by asking questions during a decision-making process, this can be continuously refined. Wiggins and McTighe (2005) also claim that, in understanding a problem by design, the most practical way of thinking is through a set of interrelated questions, called "key issues".

The Socratic Method particularly adheres to this view, which seeks to identify these key issues, refining that process continuously (HARTIG, 2014). For Svechin, by using the dialectic, this approach has an impact on Military Science that is proportional to the one Einstein had on Newtonian physics, putting a "principle of relativity" in the place of the certainty of "universal laws' (Svechin, 2004). In this sense, the British doctrine proposes a series of questions that the OpCom should answer through the stages of planning to employ his approach by design (UK, 2013).

Therefore, it can be concluded that the approach by design in OA provides a feature of more flexibility and adaptability to Operational Planning, through its subjective aspect. The combination of processes of Design and Operational Management underscores its continuous and cyclical nature, using respectively the analysis of the operational environment and the evaluation of the actions employed. (FIG.3)

Figure 3 - Cyclic and Continuous characteristics of the Operational Planning of NATO (2010) (left) and BRAZIL (2011a) (right)



Source: Prepared by Author

Operational Design, as part of Operational Science, consists of Operational Estimate, Operational Design Concepts and Operational Plan (NATO, 2010).

The Operational Estimate is based on two pillars, Understanding the Problem and the Environment and the establishment of the "Art of the Possible" (UK, 2013), also understood respectively as Conceptual and Detailed Component of Operational Planning by the MD (BRAZIL, 2016).

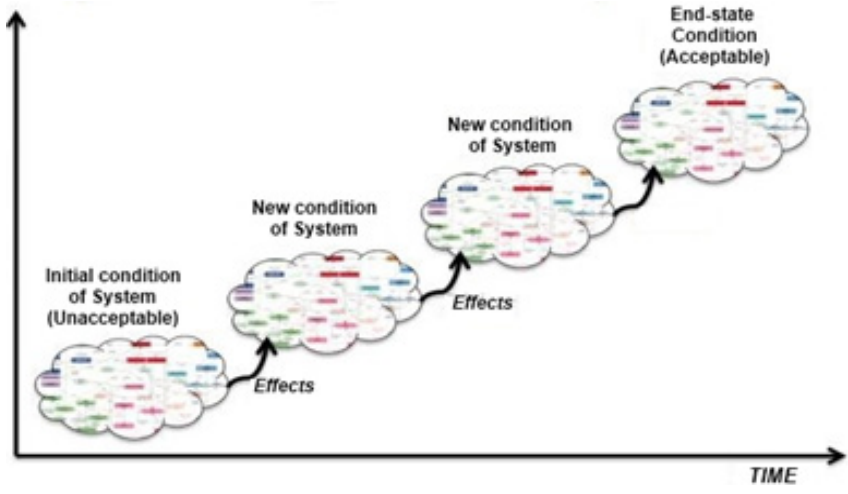
Operational estimate is essentially a practical and flexible tool designed to enable the development of a coherent and intelligible Operational Plan but which does not conclude Planning. Its result is the visualization of a "guideline" for the Military Campaign containing a decision on "what to use" (means), "how" to do it (ways) and "what for" (ends) (UK, 2013).

Thus, understanding the Operational Design Concepts is crucial

to identify and analyze them in the approach by Design. In addition, the use of the Operational Design tools also becomes crucial. Such tools, like the CG analysis Matrix, LA decision matrices, Risk Analysis Matrix or Synchronization Matrix, will provide the foundation for the Operational Management (UK, 2013). This part of science is called by the MD as Campaign Management, consisting primarily of the stage of "Control of Planned Operation" of the final stage of the PPC with the same name and held during its execution (BRAZIL, 2011b).

After all, the operational effects (OE), or simply Effects, still have a key role in the approach by design . They are responsible for a change in behavior or physical state of a system or its elements (subsystems), as a result of one or more actions or other causes, being able to format it for a DES. Thus, the combination of certain OE results in a "Decisive Condition" (UK, 2013). The "crucial conditions" are simply intermediate conditions that the system reaches before reaching the desired condition or DES. (FIG. 4)

Figure 4 - Changes in Operating Environment



Source: Prepared by the author.

To do this, tools for following these effects provide resources for the Operational Management, making use of effectiveness and performance indicators for them, to check the status of these "conditions" (BRAZIL, 2011a).

Given the importance of these effects in the Operational Planning, an efficient use of the Approach by Design in Operational Art, as well as its development in Operational Science through Operational Design, will seek to shape the Operational Environment in accordance with national interests to a more favorable condition in which they prevail the same. This view is evident in the Brazilian doctrine, when it points out that "the essence of Operational Art is first to identify what will be decisive, shape the necessary operations for success and, in its simplest expression, determine 'when', 'where' and 'for what purpose' the forces will conduct the operations" (BRAZIL, 2011a, p. 73).

In this sense, the use of Design aims to establish a broad understanding of a crisis or conflict, where the expression of military power can act more proactively and the OpCom can take the initiative of actions and greater freedom of maneuver. This view can be summarized in the final words of the Member of British Parliament George Osborne in a debate in the House of Commons on the UK position on the Syrian crisis in 2016: "If you don't shape the world, you will be shaped by it." (... ALEPPO, 2016).

CONCLUSION

Despite the controversy that orbits around its definition, Operational Art plays a key role at the Operational Level. Its genesis from a complex and turbulent environment demonstrates the importance of this subjective aspect in Operational Planning, which provides flexibility in this condition of uncertainty. Such a feature may be noted in the Operational Commander's personal influence, achieved through his creativity and talent.

The approach by design enhances this characteristic of adaptability in planning, the operational environment being visualized as an open system over which actions employed result in a set of effects that are able to shape it and turn it into an acceptable or stable condition in a given conflict, targeting the desired result.

Thus, Operational Science, merged with Operational Art in a "symbiotic" relationship, employs the Operational Design to allow so that executors may have a rational and intelligible vision of the Operational Plan.

Despite everything, Scientific and Operational Art make individually significant contributions to Operational Planning. However,

art is continually related to science, with which it is synergistically combined as it is created. This strong connection is expressed in the elements of Operational Design, demonstrating the relevance of knowledge and of the identification of these concepts throughout the planning process.

Thus, the distinction between art and science applies in the continuous observance of the extent to which a certain rationality must be established in the Planning Process and of where the subjectivity that is part of it begins, which must be clear to the OpCom.

Finally, the existence of gaps in the development of Operational Design found in the Brazilian doctrine, which has limitations in that topic in comparison to the British one, can be better exploited as an opportunity for its improvement. If the operational design is seen as a product of an Operational "project" or "architecture" in a more comprehensive usage, such as the process of Operational Design , and not merely as a graphical representation of a synthesis of the LA, it will be an effective tool for the development of actions that are able to shape the operational environment and achieve the success of a Campaign or major Military Operation.

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