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WARFARE IN THE INFORMATION ERA: THINKING DIFFERENTLY TO DEAL WITH COMPLEXITY IN MILITARY OPERATIONS

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ABSTRACT

The importance of information in contemporary societies has revolutionized the interrelations between people and generated profound social changes. It also has had a significant impact on warfare, both on its technologies and on its concepts. In fact, whether the information age approach is network-centric in for Western militaries, non-linear for the Russians or "informationized" for the Chinese, technology seems to be the main focus. However, cultural and philosophical backgrounds have also played a role in defining the way to think about warfare.

Based on the definition of complexity and especially from a systems thinking perspective, it appears that warfare in the information age can be considered as a complex adaptive system with core properties such as emergence and non-linearity. Moreover, military thinkers such as Clausewitz and Boyd have provided contemporary militaries with hindsight on the complex issues of warfare. Nonetheless, up to now technological solutions have prevailed to address these issues and one must admit that they have only had limited success.

Therefore, this study considers a different approach to thinking about warfare. First, the idea is to challenge the ancient Greek philosophical heritage of the Western society to find a different mindset inspired by Eastern philosophy. Second, a different practical approach to warfare can be defined by focusing on a "process-based" approach which gives the priority to design. This will transcend the "action-based" approach supporting the primacy of planning which is deeply rooted in Western military thinking. Third, this different approach will lay a more solid ground to deal with uncertainty in the conduct of war in the information era.

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INTRODUCTION

"Win. We have to win. We have to start winning wars again."[1] Those were President Trump's word in February 2017 to introduce an increase in defense spending for his first budget. According to him, the United States (US) are not winning wars anymore and the solution to this issue is pecuniary. In fact, the Western[2] world has had to wage very different types of war in the second half of the 20th century and the beginning of the 21st century, in what has been named the information era. The types of war extend from conventional to counter insurgency wars and, to conduct these wars, the Western military made use of a lot of technology to try to benefit from their significant advances in that domain. However, it seems that in the end, even with cutting edge and very expensive technology, some would argue that the Western countries do not win wars anymore. Therefore it seems that more spending might be necessary to increase the quality and the quantity of the means engaged in war, and hopefully, to change the outcomes.

As a matter of fact, this issue could also be seen from a different viewpoint. Indeed, one could look at the methodology used in the Western military and the philosophical concepts supporting this methodology. In fact, it appears that one's way of thinking is linked to ontological and epistemological concepts as they define one's perception of reality and knowledge. Moreover, there have been such technological breakthroughs in the second part of the 20th century that not only the Western society but most of the world has been revolutionized in a short period of time.

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[1]Donald Trump (remarks, Meeting with the National Governors Association, Washington,DC, 27 February 2017), last accessed 07 may 2017, https://www.whitehouse.gov/the-press-office/2017/02/27/remarks-president-trump-meeting-national-governors-association

[2]For this paper, "Western" will relate to European or North American origins, and "Eastern" will relate to Asian and especially Chinese origins.

Therefore, one can ask oneself how these technological breakthroughs, and especially the development of information systems within society, have changed the way to wage war. How should one shape his mind to master the evolution of warfare? Can there be a different way of thinking to a better understanding of the complexity of warfare in the information era?

In fact, warfare in the information era needs to be regarded as a complex phenomenon. Unfortunately, up to now, in the Western world it has mostly been taken into account from a technological standpoint and one has to admit that this has only had limited success. Thus, a different approach to planning and conducting military operations would seem useful. In fact, from a philosophical perspective, a better understanding of some key differences between Western and Eastern ways of thinking would induce a new way to deal with the specificities of warfare at the information age. Moreover, by being more able to cope with the inherent unpredictability of complex phenomenon it should lead to greater success in waging wars.

Before explaining how to develop such a different approach to planning and conducting operations, it is essential to understand first, the main characteristics of information age warfare (Part I) and second, the complex nature of warfare in the information age (Part II). Thus, the most noticeable features of Western warfare need to be regarded in comparison with those of Russia and China in order to perceive the importance of the Western technological bias. Then, the description of the inherent complexity of warfare will focus on the Western perspective to highlight its proficiencies but also its limits. Finally, a different approach to planning and conducting operations will be suggested (Part III). After differentiating predominant aspects of Western and

Eastern ways of thinking, it will be possible to put forward the principal facets of a different way to think about military affairs.

1. WARFARE IN THE INFORMATION ERA

To analyze how warfare has been modeled by the information era, it is necessary to start by defining the constituents of this era as it began in the 20th century with the development of technology that changed the way to use information. Moreover, it is important to analyze the existing relations between information and the technology that has supported its development, which in the end, induced major social changes.

Then, as the concepts of war can vary from a culture to another, it is interesting to look at warfare in the information age from different perspectives. On the one hand, the western world can claim to hold the lead in the evolution of warfare, especially from a technological standpoint. On the other hand, it appears that Russian and Chinese military thinkers have been able to anticipate major changes in how to wage war even if their militaries may struggle to keep the technological pace. Furthermore, by looking at the Russian "non-linear warfare" and the Chinese "informationized warfare" concepts, one will notice how they have remained influenced by their own philosophical traditions.

1.1. Defining the information era

The increasing role played by information in society over the past century has had a significant impact on how people and groups of people interact. Thus it is important to understand what information really is, how it is valued and how technology has enhanced its role in society. Then, it is possible to look at what are the social changes of information era which have an impact on how war is waged in the 21st century.

1.1.1. Information

Information has always been vital to the development of life on earth and to the evolution of mankind, as it is inherent to the DNA code of all living systems on Earth or to the transmission of knowledge between generations of human beings. Nonetheless, its

definition can vary from "facts provided or learned about something or someone" to "a mathematical quantity expressing the probability of occurrence of a particular sequence of symbols, impulses, etc…, as against that of alternative sequences" [3].

For this research paper, information will be defined as the meaning that can be issued from a set of data[4]. By essence, information can be exchanged between multiple entities through multiple ways and means.

Furthermore, it will be admitted that as depicted by Alberts et al., information constitutes a domain by itself. This domain stands between the physical domain (where life takes place) and the cognitive domain (where the physical domain is perceived and understood)[5]. This will be relevant as warfare is traditionally well apprehended in the physical domain but it also has to be appreciated in the other domains and especially in the information one.

As regards to the information domain or information environment, its three pillars are defined as: the information itself (more generally the databases), its infrastructures (hardware) and the processes associated to the treatment of information (software). Indeed, "information moves across information infrastructures in support of information processes"[6].

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[3]"Information," English Oxford living Dictionaries, last accessed 07 may 2017, https://en.oxforddictionaries.com/definition/information

[4]A similar definition can be found in Andy Jones, Gerarld L. Kovacich and Perry Luzwick, *Global Information Warfare* (Boca Raton: Auerbach Publications, 2002), 14.

[5]David S. Alberts *et al*, *Understanding Information age warfare* (Washington: Command and Control Research Program, 2004), 10-14.

[6]Andy Jones, Gerarld L. Kovacich and Perry Luzwick, *Global Information Warfare* (Boca Raton: Auerbach Publications, 2002), 15.

As for the value of information, it will be based on the two fundamental characteristics defined by Evans and Wurster: reach and richness[7]. Reach corresponds to the number of entities exchanging the information whereas richness is based on the content of the information in itself. Richness can be evaluated through first the quantity aspect to the content of information, second the customization of that content as regards to the entities exchanging the information and third, the levels of interactivity that exists between those entities.

1.1.2. Technology

It appears that in the development of mankind, technology has played a key role in defining eras. Hence, the first and second industrial revolutions gave birth to the industrial age. Similarly, significant technological advances that took place in the 20th century lead us into the informational era after the end of the Second World War. Based on technological breakthroughs, there has been a shift from mass production of goods to mass production of information associated to media enabling its distribution.

As a matter of fact, information needs energy, storage capacity and to computation in order to grow[8]. This was already true when information was only developed and stored physically, for example as it was written down in books which were kept in libraries. Nonetheless, these processes have been revolutionized by computer technology and the digitalization of data in the 20th century.

Furthermore, through the development of connectivity, "what is truly revolutionary […] is the possibility it offers to unbundle information from its physical

[7]Philip B. Evans and Thomas Wurster, "Strategy and the New Economics of Information," *Harvard Business Review* 75 no 9/10 (September-October 1997), https://hbr.org/1997/09/strategy-and-the-new-economics-of-information
[8]César Hidalgo, *Why information grows* (NewYork: Basic Books, 2015), 181.

carrier"[9]. Actually, as Evans and Wurster explain, in the old economics of information, there was a necessary trade-off between richness and reach. Now that it is possible to combine both richness and reach, what becomes determining is the quality of the interactions between the entities which share information[10].

Indeed, Castells considers that the "features that constitute the heart of the information technology paradigm"[11] are technologies using information as a raw material, the pervasiveness of their effects on society, the networking logic in the integration of technology, the flexibility of information technology and its ability to reconfigure, and eventually its convergence into integrated information systems.

1.1.3. Social changes

Brzezinski speaks of a "technetronic" age, as technology and especially electronics are "increasingly becoming the principal determinants of social change, altering the mores, the social structure, the values, and the global outlook of society"[12].

Actually, what is most significant about the information era is the changes observed in society, and especially in the ways identities are being redefined and power is redistributed. Indeed, these social changes have then a major impact on how to think about warfare.

Society in the information era is based on networks which link people one to another. As Castells defines it, "the new social structure of the Information Age […] the

[9]Philip B. Evans and Thomas Wurster, "Strategy and the New Economics of Information," *Harvard Business Review* 75 no 9/10 (September-October 1997), https://hbr.org/1997/09/strategy-and-the-new-economics-of-information
[10]Ibid.
[11]Manuel Castells, *The Rise of the Network Society* (Malden: Blackwell Publishing, 2000), 70.
[12]Zbigniew Brzezinski, Between Two Ages: America's Role in the Technetronic Era (New York: Viking Press, 1970), 5.

network society […] is made up of networks of production, power, and experience, which construct a culture of virtuality in the global flows that transcend time and space."[13]

Social media are very tangible examples of how networks diffuse information within the society. Indeed they enable groups of people to swiftly organize themselves into communities of interest. For example, the use of social media played a key role during the Arab Spring in 2011 and more recently, Daesh has had a very efficient recruiting process within the youth of Western countries by using social media. Hence, he networks of social media give the ability to anyone to produce valuable information in the sense that it inherently combines richness and reach.

Thus, in the information age "a much larger part of the population both within and among countries has access to the power that comes from information." [14] This speaks to Nye's concept of diffusion of power within society enhanced by the "enormous reduction in the cost of transmitting information."[15] Inevitably, this profoundly changes the social context in which war in waged. Non-state actors become much more capable and can truly challenge a military force, especially in a long term perspective.

1.2. A Western perspective: from the RMA to EBO/RDO and NCW

As technology developed in the information era, the Western world played a leading role in redefining warfare. The concept of Revolution in Military Affairs (RMA) was a significant step as its proponents argued that information technology was fundamentally changing the way war was to be waged. Then, concepts such as Effects-Based Operations (EBO), Rapid Decisive Operations (RDO) and Network-Centric

[13]Manuel Castells, *End of Millenium* (Malden: Blackwell Publishing, 1998), 370.
[14]Joseph Nye, *The Future of Power* (New-York: PublicAffairs, 2011), 114.
[15] *Ibid*, 115.

Warfare were built on the basis of the RMA to eventually define new forms of organization.

1.2.1. A Revolution in Military Affairs

With the end of the Cold War and the success in Operation Desert Storm in 1991, the idea that a RMA was taking place became predominant in how the Western world was considering information age warfare. The highly developed technology of the US armed forces had reached such a tangible level of dominance that it was to lead to a new way of warfare for the unfolding information era.

The idea of an ongoing RMA in the early 1990s came from Andrew Marshall[16], the director of the US Department of Defense's Office of Net Assessment, who thought that it was the "beginning of the real revolution in military affairs. The Gulf War need[ed] to be seen as [a] first trial of new technology and new ways of operating were undertaken."[17] He believed that long range precision strikes were becoming the "dominant operational approach" and that the information domain "may become increasingly central in the outcome of battles and engagements"[18].

In fact, with stealth technology, GPS positioning, precise-guided munitions (PGM), the Western world appeared to be mastering the technology needed for warfare in the information age. Indeed, at the heart of the concept of an RMA is the idea that technology and organization would alleviate the uncertainty of war. Thus, by developing cutting edge technology which was based on the ability to compute information, the Western world would benefit from a decisive advantage for the future of warfare.

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[16]Christophe Wasinski, "Créer une Révolution dans les affaires militaires : mode d'emploi," *Cultures & Conflits*, no. 64 (hiver 2006): 149

[17]Andrew W. Marshall, *Some thoughts on Military Revolution – Second Version* (Office of the Secretary of Defense Washington, DC: 23 August 93).

[18]Ibid.

Furthermore, the Western world and especially the US were to adapt their organization in order to properly use these new technologies. The new concepts of operations would be supported by new forms of organization for the operating forces. Indeed, the RMA was leading to further integration of joint forces as it was enabled by the development of network-based forms of organization.

1.2.2. Effects-Based Operations and Rapid Decisive Operations

Amongst of the most significant offspring of the RMA of the 1990s is the concept of EBO and its sibling, RDO. These concepts were initially closely linked to how air power had been used during Operation Enduring Freedom in perfect contrast to its use during the Vietnam War.

As one of the main supporters of EBO and RDO, Deptula explains that "well beyond the activity of destroying an opposing force lies the ultimate purpose of war—to compel a positive political outcome. The use of force to control rather than destroy an opponent's ability to act lends a different perspective to the most effective use of force."[19] Therefore the main idea supporting EBO is that a war of attrition or annihilation is not necessarily the way to reach the desired outcome of war. This idea is not new to the information era. Nonetheless, information age technology and especially as regards to air power, has given the Western world the ability to put it into practice at a greater scale.

Furthermore, as it is linked to EBO, Deptula's concept of RDO emphasizes the idea that with information age technology (especially stealth bombers and PGM), operations can now transcend a traditional sequential approach to adopt parallel modes of

[19]David Deptula, *Effects-Based Operations: Changes in the Nature of Warfare* (Arlington: Aerospace Education Foundation, 2001), 5.

action, thus achieving simultaneous effects. Indeed, "parallel war exploits three dimensions—time, space, and levels of war—to achieve rapid dominance."[20]

During the first decade of the 21st Century, the EBO concept has been developed beyond its original concept and led to "effects-based thinking" and effects-based approach (EBA) to operations. In fact, in facing irregular warfare, the "failing of EBO gave rise to the second version of EBO development, which is intended to broaden the application of EBO into areas other than armed conflicts between nations."[21] Hence, Smith now defines EBO as "coordinated sets of actions directed at shaping the behavior of friend, foe, and neutral in peace, crisis, and war."

The use of a broader EBO concept had to face strong criticism in the wake of the 2006 Israel-Hezbollah war. In analyzing the lessons learned by the Israeli Defense Forces (IDF), on the one hand, Mattis, then commander of the US Joint Force Command, considered that EBO concepts where too complicated to be completely understood and mastered by most of the planners. On the other hand, he argues that if they can easily apply to closed systems such as power grids, road networks or railway infrastructure, EBO are much less suited for open systems[22].

1.2.3. Network-Centric Warfare

The concept of network-centric warfare (NCW) was developed by the US Navy at the end of the 1990s as an avatar of the RMA. Cebrowski and Garstka defined NCW by adapting the evolution of economic and business paradigms to a concept for warfare.

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[20]Ibid, 5.
[21]J. F. Cottingham, "Effects-Based Operations: An Evolving Revolution", in *Effects-Based Approaches to Operations: Canadian Perspectives* (Ottawa: Canadian Forces Aerospace Warfare Center, 2008), 51.
[22]James N. Mattis, "USJFCOM Commander's Guidance for Effects-based Operations", *Parameters 38*, no. 3 (Autumn 2008): 18-25, last accessed 07 May 2017 http://ssi.armywarcollege.edu/pubs/parameters/Articles/08autumn/mattis.pdf

Based on the evolution of information technology, they described NCW as "a shift in focus from the platform to the network" thus enabling "the new concepts of speed of command and self-synchronization" to outrun the enemy forces[23].

Alberts, Garstka and Stein focused their definition of NCW on its organizational implications. Indeed, according to them NCW is "about human and organizational behavior" and is "based on adopting a new way of thinking."[24] Therefore, the key concepts that support NCW are "dispersed forces", "shared knowledge" and "effective linking".

Furthermore, Alberts et al. integrated the concept of information superiority, which is defined as the "ability to get the right information to the right people at the right time in the right form while denying an adversary the ability to do the same", into NCW by developing the "NCW value chain."[25] Information superiority enables a network-centric force and its command and control structure to ensure its own decision and knowledge superiority. The result is a full spectrum dominance of the joint force over its adversary[26].

As matter of fact, by combining the broader concept of EBO with NCW, Smith argues that network-enabled effect-based approach to operations will allow to "supplement the capabilities of individual decision makers with all the knowledge, information, data, analytical tools, and cognitive, social, or cultural anthropological

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[23]Arthur K. Cebrowski and John J. Garstka, "Network-Centric Warfare: Its Origin and Future," *Proceedings* 124, no.1 (January 1998):140.
[24]David S. Alberts, John J. Garstka and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington, DC: Command and Control Research Program, 1999), 88.
[25]David S. Alberts *et al*, *Understanding Information age warfare* (Washington, DC: Command and Control Research Program, 2004), 53.
[26]*Ibid*, 77.

models that networking might bring to bear."[27] The goal here is definitely to have better tools to address complexity and to improve decision making in warfare.

1.3. A Russian perspective: from MTR to non-linear warfare

Despite the fact that the Russians did not play a leading role in developing the technology of information age warfare, they still closely followed how the Western world was evolving. Russian military thinkers clearly understood what was at stake in how they defined their Military-Technical Revolution (MTR). Furthermore, the Russians are now moving a step forward with a non-linear approach to warfare and with their conception of the informational sphere.

1.3.1. The Military-Technical Revolution

During the 1970s and 1980s the Soviets had been following the evolution of information age technology very closely as it was empowering the Western countries and thus increasing the capabilities of their main threat. Indeed, the Soviets analyzed what they were the first to call a MTR and which would eventually be defined as a RMA by the Americans.

The Soviets were "watching a more technologically advanced United States develop new technologies, and move to incorporate them into new military systems."[28] They analyzed it as a revolution "where quality [was] becoming far more important than quantity."[29] The Soviets foresaw that the levels of war (strategic, operational and tactical) would be more intermingled due to the simultaneity of actions enhanced by information

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[27]Edward A. Smith, *Complexity, Networking, and Effects-Based Approaches to Operations* (Washington: Command and Control Research Program, 2006), 298.
[28]Andrew F. Krepinevich, Jr., The Military-Technical Revolution: A Preliminary Assessment (Washington, DC: Center for Strategic and Budgetary Assessments, 2002), 5.
[29]*Ibid*, 6.

age technology. Furthermore, they perceived that the interaction between the different environments (land, sea and air) would increase as joint operations would prevail.

As the Soviet Chief of General Staff in the early 1980s, Marshal of the Soviet Union Ogarkov believed that technology was determining in how war was waged. Furthermore, he thought that the use of conventional weapons would be transformed by advances in the technology supporting guidance systems and command, control, communications and intelligence capabilities[30].

Ogarkov's analysis was immersed in the Marxist-Leninist philosophical concept of dialectical materialism. In his interpretation of the Marxist-Leninist rule of thought, Stalin insisted on the importance of the holistic approach to phenomena, the dynamic nature of phenomena, the evolution from quantity to quality and the inherent contradictions within phenomena[31].

Therefore, Ogarkov emphasized three aspects of dialectical materialism to introduce the military-technical revolution[32]. First, the unity of opposites and especially the interrelationship between offense and defense defines modern warfare. Second, there will be transition from quantitative to qualitative change as the greater amount of new assets in warfare would eventually lead to new means and ways to wage war. Third, there will be a negation of the negation as the new ways of waging war negate the old ones which in consequence lead to the negation of the old organization. In the end, the latter will fundamentally change the structure of the organization.

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[30]Brian A. Davenport, "The Ogarkov Ouster: The Development of Soviet Military Doctrine and Civil/Military Relations in the 1980s," *Journal of Strategic Studies* 14, (1991): 129-147.
[31]Joseph V. Stalin, *Dialectical and Historical Materialism* (London: Communist Party of Great Britain, 2012), 7-15.
[32]Dale R. Herspring, "Nikolay Ogarkov and the Scientific-Technical Revolution in the Soviet Military Affairs," *Comparative Strategy* 6, (1987): 29-59.

As a matter of fact, Ogarkov was ousted as it appears that he went too far in trying to "expend military influence in areas such as the economy and national-security decision making."[33] Nonetheless, the military-technical revolution was conducted within the Russian armed forces despite their limited resources in the early 1990s, "focus[ing] above all on the development of the new deep-strike weapons, information weapons (advanced C31 systems), and electronic warfare (EW) assets."[34]

Indeed, Ogarkov's analysis constitutes the genesis of Marshall's RMA even though the Soviet philosophy of dialectic materialism was left aside by the Western world. Moreover, his ideas are still inspiring Russian militaries, including the current chief of the General Staff of Russian armed forces, Valery Gerasimov[35].

1.3.2. Russia's non-linear approach

A novel published in March 2014 under the name of Natan Dubovitsky (allegedly Vladislav Surkov, Putin's current presidential aide) depicts the idea of "non-linear war" where multiple sides collide "all against all," and consider "war to be part of a process. Not necessarily its most important part."[36]

This actually appears to be very much in accordance with what Gerasimov describes, in a now famous article published in 2013, as the new character of warfare. Indeed, a significant evolution in Russian military thinking came to light in the aftermath

[33]Brian A. Davenport, "The Ogarkov Ouster: The Development of Soviet Military Doctrine and Civil/Military Relations in the 1980s," *Journal of Strategic Studies* 14, (1991): 129-147.
[34]Mary C.Fitzgerald, "The Russian Military's Strategy for 'Sixth Generation' Warfare," *Orbis* 38, no. 3 (Summer 1994): 457-476.
[35]Julian Lindley-French, "The Gerasimov Doctrine: History Teaches Vigilance," *Speaking Truth to Power* (blog), 13 August 2015, http://lindleyfrench.blogspot.ca/2015/08/the-gerasimov-doctrine-history-teaches.html
[36]Natan Dubovitsky, *Without Sky*, quoted in Peter Pomerantsev, "Non-linear war", *London Review of Books* (blog), 28 March 2014, https://www.lrb.co.uk/blog/2014/03/28/peter-pomerantsev/non-linear-war/

of the "color revolutions" and the Arab Spring. As the chief of the General Staff of Russian armed forces, Gerasimov details how he foresees warfare in the information age.

As Ogarkov had foreseen in the 1990s, Gerasimov acknowledges that "new information technologies have enabled significant reductions in the spatial, temporal, and informational gaps between forces and control organs," and that "the application of high-precision weaponry is taking on a mass character." [37] Moreover, he assesses that "the differences between strategic, operational, and tactical levels, as well as between offensive and defensive operations, are being erased."[38]

Nonetheless, beyond the Soviet heritage of the concepts underpinning the Military-Technical Revolution, what is new in Russian military thinking is the idea that the "role of nonmilitary means of achieving political and strategic goals has grown, and, in many cases, they have exceeded the power of force of weapons in their effectiveness."[39] As a matter of fact, alike Ogarkov, Gerasimov's analysis is based on his perception of the Western's way to wage war in the 21st century.

From a Russian perspective, the "color revolutions" and the Arab spring have all been triggered and conducted in the same way. Gerasimov analyses them as a Western "adaptive approach for use of military force" where a concealed use of force to destabilize a regime will eventually lead to the creation of a pretext for military intervention as the ultimate goal is a US-led regime change. [40]

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[37]Valery Gerasimov, "The Value of Science is in the Foresight New Challenges Demand Rethinking the Forms and Methods of Carrying out Combat Operations," *Military Review* 96, no. 1 (January-February 2016): 23-30.
[38]Ibid.
[39]Ibid.
[40]Charles K.Bartles, "Getting Gerasimov Right," *Military Review* 96, no. 1 (January-February 2016): 30-38.

In fact, as it has been observed in Crimea and in Eastern Ukraine in 2014, the Russians have significantly improved the concept. Indeed, using a combination different mechanism and levers such as information operations, cyber tools, proxies, economic influence, clandestine measures and political influence, Russia has been able to further its influence[41]. Apart from the cyber tools, these mechanism and levers are not new to the information age. What has changed is the extent to which they have been used and how Russia has been able to thoroughly coordinate their implementation in an increasingly interconnected world.

1.3.3. The Russian concept of information sphere

Beyond their non-linear approach to warfare, the Russians have a broad definition of the information sphere that has developed with the advent of the information age. With a traditional and cultural dialectical mindset, Russians consider that there are two aspects to the information sphere[42]. First is the "information-technical" aspect which comprises of the infrastructure, the hardware and the software that enable actions in the informational sphere. Second is the "information-psychological" aspect which includes the people's ideas and perception of reality.

Furthermore, the new Russian Information Security Doctrine, published in December 2016, emphasizes "the role of the information sphere in technological development but, most importantly, regards it as a tool to change the fabric of society."[43]

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[41]Christopher S. Chivvis, "Understanding Russian Hybrid Warfare," Testimony presented before the House Armed Services Committee on 22 March 2017, RAND Corporation (2017)
[42]Timothy L. Thomas, "Russian Information Warfare Theory: The Consequences of August 2008," in *The Russian Military Today and Tomorrow: Essays in Memory of Mary Fitzgerald*, ed. Stephen J. Blank and Richard Weitz (Strategic Studies Institute, 2010), 266.
[43]Katri Pynnöniemi and Martti J. Kari, "Russia's New Information Security Doctrine: Guarding a besieged cyber fortress," *Finnish Institute of International Affairs Comments* 26 (December 2016), http://www.fiia.fi/en/publication/646/russia_s_new_information_security_doctrine/

Therefore, from a Russian standpoint, warfare in the information age must take into account both aspects of the information sphere, especially when considering the threats to its national interests.

1.4. A Chinese perspective: from ancient China concepts to "informationized" warfare

Chinese concepts of warfare have inherited from a very philosophical way of approaching military thinking that comes from ancient China. Then, with the establishment of the People's Republic of China, Mao has had a significant influence in how Chinese military thinkers conceived war when facing technologically superior enemies. However, now that China has been able to modernize its society and to develop information age technology, Chinese military thinker have progressively been set free from the Great Helmsman's concepts, though they still refer to ancient Chinese philosophy.

1.4.1. Concepts underpinning Chinese military culture

Even if Chinese military thinking and strategic culture has evolved since the Spring and Autumn period, it is still deeply rooted in ancient China's philosophy. With a Taoist perspective, China's military culture can be analyzed through the concepts of *Tao*, *Shih*, and *Li*.

Tao is a fundamental concept in Chinese philosophy. It is generally translated as the "Universal Way". Taking into consideration its multiple interpretations, it can be described as a dynamic equilibrium from which the order nature is derived. Moreover, as

regards to warfare and according to Sun Tzu, it is the first of the five fundamental factors to be used to appraise war, along with weather, terrain, command and doctrine[44].

Shih and *Li* are two opposing concepts. *Shih* can be understood as latent energy, the "dynamic power that emerged in the combination of men's heart, military weapons, and natural conditions."[45] *Shih* is intangible whereas *Li* refers to the power of "tangible things of nature that people [can] accumulate"[46].

Furthermore, Sun Tzu defined two other key principles in Chinese military thinking which are linked to *Tao* and *Shih*. First is the idea that "all warfare is based on deception."[47] Second is the idea that "to subdue the enemy without fighting is the acme of skill."[48] This eventually leads Chinese military to favor indirect strategies empowered by *Shih*. Nonetheless, direct strategies are not despised. Commanders may achieve their goal through direct strategies and consequently reinforce future indirect strategies. In a sense, commanders are taught "to use Li within *Shih*-strategy not as an objective to achieve on the path to victory but only as a means to the end of gaining national *Shih*."[49]

As a matter of fact, in the 20th century *Tao* and *Shih* underpinned the Maoist doctrine of warfare. Indeed, Mao's military doctrine was "based on the assumption that the 'human element' was more important than weapons because by employing a

[44]Sun Tzu, *The Art of War*, trans. Samuel B. Griffith (New York: Oxford University Press, 1971), 63.
[45]Willian H. Mott IV, and Jae Chang Kim, *The Philosophy of Chinese Military Culture* (New York: Palgrave MacMillan, 2006), 11.
[46]*Ibid*, 30.
[47]Sun Tzu, *The Art of War*, trans. Samuel B. Griffith (New York: Oxford University Press, 1971), 66.
[48]Ibid, 76.
[49]Willian H. Mott IV, and Jae Chang Kim, *The Philosophy of Chinese Military Culture* (New York: Palgrave MacMillan, 2006), 30.

'people's war' strategy, the superior quality and quantity of the Chinese troops would outweigh their technological inferiority"[50].

Therefore, Chinese military culture is based on a strong philosophical foundation which puts forward the intangible aspects of warfare. Indeed, "*Shih*-strategists continue to focus on planners or commanders – not on weapons – in designing strategic options."[51] Nonetheless and especially in the post-Mao era, Chinese military leaders did not disregard the tangible aspects of warfare as the nascent technology of the information age appeared to be able to change the rules of war.

1.4.2. The evolution from Mao's concepts of warfare

When Mao shaped the People's Liberation Army (PLA), his core principle was the idea of being able to defeat a superior enemy force. He intended to do so with his main concepts of warfare which were "protracted war" and "active defense". Indeed, Mao's concepts were based on ancient China philosophy and his experience of revolutionary wars with a Marxist-Leninist dialectical perspective. His idea of defense was in fact "for the sake of counter-attack and advance."[52] Mao's concepts are "pre-information age" concepts but they constitute the cultural background of today's Chinese military thinking.

The first step in the evolution of Chinese military thinking was taken by Deng Xiaoping. To stay in line with Mao's original concepts, Deng named his doctrine "people's war under modern conditions". Actually, Deng foresaw that with the advances in military technology, "the era of war based on 'millet and rifles' (*xiaomi jia buqiang*)

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[50]Ellis Joffre, "'People's War under Modern Conditions': A Doctrine for Modern War," *The China Quarterly* 112 (December 1987):555-571.
[51]Willian H. Mott IV, and Jae Chang Kim, *The Philosophy of Chinese Military Culture* (New York: Palgrave MacMillan, 2006), 230.
[52]Mao Tse-Tung, *Selected works Volume 1 1926-1936* (New-York: International Publishers, 1954), 205.

[had] passed"[53]. Moreover, Deng laid the groundwork for the evolution of Chinese military thinking in the information age. The PLA would now replace Mao's concepts of "'luring the enemy deep' and 'preparing to fight a total war' with 'extended depth of defense' and 'local war in China's periphery,' respectively."

The second step would come with the analysis of the First Gulf War in 1991, which set forward the American concept of RMA, and the 1995-1996 Taiwan Strait Crisis. During these two major events, the PLA assessed the superiority of the US armed forces and their use of cutting edge technology. The conclusions drawn from the PLA's analysis of the superiority of the US armed forces highlighted the joint integration of forces in the battle space "assisted by information technology allowing their C3I systems to coordinate the time, place, and purpose of service capabilities in conducting their individual missions."[54]

Furthermore, in anticipating the continuing inferiority of the PLA facing the US armed forces, the main focus of the analysis was on how to defeat the American advanced-technology military capabilities. China's military analyst identified different ways to do it. The first way was to seize and retain the initiative. The idea was to restrain the use of advanced-technology weapons. Indeed, the PLA should have sought the inherent weaknesses of these weapons and exploited them. The second way was by developing weapons that would "offset the advantage held by superior adversary" such as

[53]Alexander Chieh-Cheng Huang, "Transformation and Refinement of Chinese Military Doctrine: Reflection and Critique on the PLA's View*",* in *Seeking Truth from Facts*, ed. James C. Mulvenon, Andrew N. D. Yang (Arlington: RAND, 2001), 132.
[54]Paul H. B Godwin, "The PLA Faces the Twenty-First Century: Reflections on Technology, Doctrine, Strategy, and Operations," in *China's Military Faces the Future*, ed. by James R. Lilley and David Shambaugh (Washington: American Enterprise Institute, 1999), 56.

cruise and ballistic missiles. The third way was to explore information warfare technologies."[55]

As a matter of fact, two colonels from the PLA Air Force, Qiao Liang and Wang Xiangsui, published a book in 1999 where they went further in the analysis of the evolution of warfare in the information age. They argued that warfare was not anymore limited to the traditional battle space, hence the name of their book, "Unrestricted Warfare"[56]. From their perspective, warfare had now to be conceived in all domains, military and non-military, violent and non-violent. They analyze the American RMA as just a step and describe a much deeper revolution in how to think about warfare. In fact, it appears that Qiao and Wang have had a significant influence in the development of China's strategy under Jiang Zemin's presidency and the development of the "three warfares" doctrine[57].

1.4.3. China's "informationized warfare" and "three warfares" doctrine

Under the Jiang's presidency, Chinese military thinking evolved from Deng's "people's war under modern conditions" to the concept of "winning local wars under high-tech conditions" as it appeared in the 1993 Military Strategic Guidelines for the New Era. Jiang emphasized the need for the PLA to transform itself from a large but backwards army to a smaller, more competent, and technologically sophisticated one."[58]

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[55]Paul H. B Godwin, "Change and continuity in Chinese Military Doctrine, 1949-1999," in *Chinese Warfighting: the PLA Experience Since 1949*, ed. Mark A. Ryan, David M. Finkelstein and Michael A. McDevitt (New York: M.E. Sharpe, 2003);
[56]Qiao Liang and Wang Xiangsui, *La Guerre Hors Limite*s (Paris: Bibliothèque Rivages, 2003).
[57]Tony Corn, "Peaceful Rise through Unrestricted Warfare: Grand Strategy with Chinese Characteristics," Small Wars Journal, 2010, http://smallwarsjournal.com/blog/journal/docs-temp/449-corn.pdf
[58]Alexander Chieh-Cheng Huang, "Transformation and Refinement of Chinese Military Doctrine: Reflection and Critique on the PLA's View*",* in *Seeking Truth from Facts*, ed. James C. Mulvenon, Andrew N. D. Yang (Arlington: RAND, 2001),140.

In the late 1990s, the "high-tech conditions" was adjusted to "modern informationalized conditions" as Jiang understood that advanced technology relied on the information domain.[59] The strategic guidance has recently been updated in the 2015 Defense White Paper. The PLA will now focus the preparation of the forces on "winning informationized local wars"[60].

Moreover, informationized warfare is described in Chinese military thinking as an "asymmetric way to weaken an adversary's ability to acquire, transmit, process, and use information during war and to force an adversary to capitulate before the onset of conflict." [61] As a matter of fact, this evolution within the strategy of "active defense" still relies on the principles defined by ancient Chinese philosophy.

While Chinese military thinkers began to focus on the "informatization" of warfare, they also developed the "three warfares" concept which was approved by the Central Military Commission in 2003. This concept relies on the combination of "legal warfare", "psychological warfare" and "media warfare" to wage war by other means in order to "acquire resources, influence and territory, and to project national will"[62]. Indeed, the Chinese have been effectively using the "three warfares" for its claims in the South China Sea[63]. Thus, in their understanding of the context of the information age, the Chinese take a "significant shift away from current understandings of war as defined

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[59]Taylor Fravel, "China's New Military Strategy: 'Winning Informationized Local Wars,'", *China Brief* XV, no13 (02 July 2015),3..
[60]The State Council Information Office of the People's Republic of China, *China's Military Strategy* (Beijing, May 2015), http://china.org.cn/china/2015-05/26/content_35661433.htm
[61]Office of the Secretary of Defense. *2016 Annual Report to Congress: Military and Security Developments Involving the People's Republic of China* (Washington, DC: U.S. Government Printing Office, 2016).
[62]Stefan Halper, *China: The Three Warfares*, prepared for Andy Marshall, Director Office of Net Assessment (May 2013), 31, http://images.smh.com.au/file/2014/04/11/5343124/China_%2520The%2520three%2520warfares.pdf
[63]Geoffrey Till, "China, the 'Three Warfares' and the South and East China Sea, in *China: The Three Warfares,* ,prepared for Andy Marshall, Director Office of Net Assessment (May 2013),381.

primarily by the kinetic and tangible, and towards one focused more on thought processes, mental impressions, and the will to act"[64].

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This first part has explained how information age warfare has been shaped by significant progress in the evolution of technology, especially in how information is produced and grows. Thus, the western world has developed concepts based on these technological breakthroughs. Technology has also had a significant impact in Russia and China though these military cultures are still influenced by their philosophical traditions.

Actually, information age warfare is highly influenced by the social changes induced by information technology. There has been a considerable increase of the number of actors in warfare due to the reduction in cost of information technology and the fact that there is no need to trade-off richness and reach when dealing with information. This has eventually led to the diffusion of power at every level of society, especially between state and non-state actors and, in consequence, to a complexification of warfare that now needs to be studied.

[64]Laura Jackson, "Revisions of Reality: The Three Warfares – China's New Way of War," in *Information at War: From China's Three Warfares to NATO's Narratives*, The Legatum Institute, Transition Forum (September 2015), https://lif.blob.core.windows.net/lif/docs/default-source/publications/information-at-war-from-china-s-three-warfares-to-nato-s-narratives-pdf.pdf?sfvrsn=2

2. COMPLEXITY AND INFORMATION AGE WARFARE

There are many different ways to define complexity and to make sense of how warfare in the information age is to be considered as a complex phenomenon. Thus, it seems important to use different perspectives to approach the concept of complexity.

As it was initially developed in the 20th century to study complex phenomenon, system thinking provides a way to understand how complexity is related to other concepts such as feedback, emergence and non-linearity. Then, with different western philosophical and epistemological viewpoints, other approaches can be followed to come to grasp the concept of complexity. These can be analytical, phenomenological or constructivist.

Eventually, it becomes possible to analyze warfare as a complex phenomenon and to look at how two western military strategist, Carl von Clausewitz and John Boyd contribute to thinking about warfare in the information era.

2.1. Defining complexity

To define complexity, it is necessary to start by understanding the difference between the adjectives complex and complicated. Then, with the perspective of system thinking, it appears that complexity is underpinned by core ideas and reveals its essence in complex adaptive systems (CAS). Eventually, complexity can also be approached with different philosophical and epistemological viewpoints.

2.1.1. Complex compared to complicated

In defining the adjective "complex" as "consisting of many different and connected parts" or as "not easy to analyze or understand; complicated or intricate,"[65] the common sense does not take into account the importance of complexity as a phenomenon and its importance in describing systems. Furthermore, it appears to consider "complex" and "complicated" as synonyms.

From a philosophical perspective, Morin defines complexity as something that is "impossible to simplify"[66] whereas what is defined as "complicated" can be reduced to a number of simple principles. A complicated system is just hard to analyze as it is an intricate sum of its parts. This leads to the necessity of a holistic approach to study complex phenomena. In fact, these phenomena need to be analyzed in their integrality, not just through its different parts.

The holistic approach to complexity analyses the combination of all the interactions that are internal to the phenomenon as a whole. It is essential to understand that a complex system is not necessarily equal to the sum of all its parts. Paradoxically, as Morin explains, it is at the same time, "more, less, other than the sum of its parts."[67]

2.1.2. Systems thinking

The idea of defining systems and more specifically "open systems" to study phenomena, thus named "system thinking", appeared in the mid-20th century and was introduced from the perspective of a biologist, Ludwig von Bertalanffy. In his General System Theory, Bertalanffy considered that "in one way or another, we are forced to deal

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[65]"Complex," English Oxford living Dictionaries, last accessed 07 may 2017, https://en.oxforddictionaries.com/definition/complex
[66]Edgar Morin, *La Méthode, Tome I*,(Paris: Éditions du Seuil, 2008), 509.
[67]*Ibid*, 166.

with complexities, with 'whole' or 'systems', in all fields of knowledge."[68] Hence, he defines systems as "complexes of elements standing in interaction," [69] which emphasizes the importance of the whole as a set of interrelated parts. Moreover, "open systems" as opposed to "closed systems" also interact with their environment. Bertalanffy argues that system thinking is to transcend the different fields of science and to focus on organized complexity for which classical science has had little answers.

Furthermore, Bertalanffy applied the two essential notions of information and feedback, based on the development of Communication Theory, to systems thinking. He understood how systems relied on information to operate. He considered information to be "negative entropy […] a measure of order or of organization"[70]. Also, with the development of Cybernetics, Norbert Wiener had defined the regulative function of systems with the concept of feedback which can be negative or positive. The self-regulating property of negative feedback can be observed in living systems as for example the homeostasis properties of the human body. In fact, negative feedback will have a stabilizing effect on the system, whereas positive feedback will amplify the deviance and lead to an instable system and eventually chaos. Certain systems can have both negative and positive feedback loops which can interact like in the climate system.

Nonetheless, beyond the critical importance of information and feedback, in analyzing the development of system thinking, which is at the origin of what should be

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[68]Ludwig von Bertanlanffy, *General System Theory: Foundation, Development, Aplication* (New York: George Braziller, 1969), 5.
[69]Ludwig von Bertanlanffy, "General System Theory," in *Systems Thinking, Volume1*, ed. Gerald Midgley (London: SAGE Publications, 2003) 37.
[70]*Ibid*, 41.

considered as a "system movement", Checkland argues that its "core concerns are the two pairs of idea: *emergence* and *hierarchy*, *communication* and *control*."[71]

Emergence is defined as a property, a quality produced by the organized whole that does not exist within its isolated parts[72]. In other words, emergence only happens when the parts of a system are interrelated in its organized complexity. Moreover, the idea of emergence leads to the definition of *hierarchy*, as it can be observed within complex systems. Indeed, "there exists a hierarchy of levels of organization, each more complex than the one below, a level being characterized by emergent properties which do not exist at the lower level."[73] Therefore, emergence is what characterizes complex systems as a whole of interrelated parts observed in hierarchical levels of organization.

Furthermore, the core concepts of *communication* and *control* are critical for systems to operate. As there is a hierarchy in the organization of the system, "maintenance of the hierarchy will entail a set of processes in which there is communication of information for purposes of regulation or control."[74] Information needs to circulate within the system to make it work, hence the importance of communication which supports this circulation. Moreover, control entails constraints from one level of hierarchy to another and these constraints are embodied by information[75].

Therefore, complexity can be defined from a systems approach as a phenomenon underpinned by core ideas such as information, feedback, emergence, hierarchy, communication and control. Nonetheless, as information circulates within systems and

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[71]Peter Checkland, *Systems Thinking, Systems Practice* (Chichester: John Wiley & Sons, 1999), 14.
[72]Edgar Morin, *Penser global* (Paris: Robert Laffont, 2015), 116.
[73]Peter Checkland, *Systems Thinking, Systems Practice* (Chichester: John Wiley & Sons, 1999), 78.
[74]*Ibid*, 83.
[75]*Ibid*, 85.

allows the interrelationship between its parts, emergence is the expression of a complex but still organized whole.

2.1.3. Complex adaptive systems

Amongst complex systems, the Santa Fe Institute in New Mexico defined in the 1980s the concept of CAS in order to study how complex systems can survive to changing environmental conditions. In fact, beyond their survival, CAS co-evolve with their environment.

According to Gell-Mann, CAS exchange information with their environment and use schemata to "supply descriptions of certain aspects of the real world, predictions of events that are to happen in the real world, and prescriptions for behavior of the complex adaptive system in the real world."[76] Then, in a dynamic process based of feedback, the selection of the best schemata can occur. In fact, Gell-Mann admitted that "the term schema is taken from psychology where it refers to a pattern used by the mind to grasp an aspect of reality"[77]. Hence, with such a learning process, CAS can adapt to both negative and positive feedback.

Furthermore, in formulating a theory for CAS based on the extraction of common characteristics, Holland defines four fundamental properties: "aggregation", "non-linearity", "flows" and "diversity"[78]. "Aggregation" helps modelling the systems but most importantly it is defined by the emergent property of the aggregated agents that, as it has been explained previously, does not exist within each agents taken separately. "Non-linearity" is due to the fact that the emergent properties of the whole are not proportional to the sum of its parts. Thus, it is difficult to analyze the system based on the

[76] Murray Gell-Mann, "The Simple and the Complex," in *Complexity, Global Politics, and National Security*, ed. David S. Alberts and Thomas J.Czerwinski (Washington, DC: National Defense University, 1997), 4.
[77] *Ibid*, 5.
[78] John Holland, *Hidden order* (New York: Perseus Books, 1995), 10.

sole analysis of its parts. Then, the concept of "flows" refers to the "resources that flow over the network of nodes and connections"[79] as CAS are dynamic systems. Finally, "diversity" concerns the different functions of the agents within CAS, as regards to their interrelation with other agents.

In fact, even if CAS are based on simple principles, their complexity is based on the emergent properties that come out of the multitude of parts and their multiple interactions as they adapt to their environment. Thus, CAS are informationally rich systems sitting in-between completely ordered and chaotic systems which are both informationally poor. Indeed, the former can be described through simple models while no models can define the randomness of the latter. Moreover, Langton defines the space between order and chaos as a phase transition where complexity reaches its maximum[80]. Thus CAS sit at the "edge of chaos."

2.1.4. Philosophical perspectives

Philosophy, and more specifically epistemology, gives another perspective in understanding complexity. Indeed, the fundamental principle underpinning knowledge are determining in studying complexity as a phenomenon. First, starting with the initial division in modern philosophy between rationalism and empiricism, it is possible to grasp some of the difficulties in analyzing and synthetizing complex phenomenon. Second, based on the contemporary division between analytical philosophy which is dominant in the Anglo-Saxon world, and continental philosophy which developed in mainland Europe from Husserl's phenomenology, the study of complexity can be very different as regards to the epistemology used as a reference. Third, the constructivism standpoint, which by

[79] *Ibid*, 23.
[80] Christopher G. Langton, "Computation at the Edge of Chaos: Phase Transition and Emergent Computation" (Dissertation, Degree of Doctor of Philosophy, University of Michigan, 1991), 140.

definition focuses on interrelation, gives another viewpoint in how to acquire knowledge of complex systems.

In modern philosophy, on the one hand and from a rationalist point of view, it is through reason that one can attain knowledge. Hence, understanding comes *a priori*. This approach to knowledge has been developed by Descartes and is illustrated by his statement: "*cogito ergo sum*" (I think therefore I am), in Discourse on the Method. Thus, based on rationalist ideas, complex phenomena would be only analyzed through reason. On the other hand, from an empiricist standpoint, knowledge is first and foremost sensed through experience. Eventually reason contributes to an *a posteriori* abstraction. An empiricist approach to complexity would then require experiencing the complex phenomena to be able to analyze them. Today, it appears that both methods taken separately would rather be incomplete in facing the non-linearity and emergence inherent to complex phenomena. Indeed, human reason has yet not proven successful in understanding *a priori* complex phenomena and senses have not proven sufficient for an *a posteriori* analysis.

However, Kant's "critical philosophy" addressed the issue of rationalism and empiricism by synthetizing both epistemologies[81]. In Critique of Pure Reason, Kant argued that "the sensible world, or the world of appearances, is constructed by the human mind from a combination of sensory matter that we receive passively and *a priori* forms that are supplied by our cognitive faculties."[82] Thus, knowledge is conceived as a synthesis based on reason and sensibility. Hence, what has been referred to as Kant's Copernican revolution in philosophy should be considered as the starting point in the

[81]Michael Rohlf, "Immanuel Kant," Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/entries/kant/#KanCopRev
[82]*Ibid*

development of the ability to understand complex phenomena. Indeed, reason and sensibility are complementary as they interact in studying holistically complex phenomena and its emergent properties.

Today, the current division between analytical and continental philosophy gives another perspective to how complex phenomena can be studied. Contemporary analytical philosophy was developed during the 20th century and is characterized by the "role played by logical analysis, which depended on the development of modern logic"[83]. Though there have been multiple developments in analytical philosophy, Russell defined the epistemology of analytical philosophy with the idea that "each questionable entity may be reduced to, or defined in terms of, another entity (or entities) whose existence is more certain."[84] This induces a reductionist approach to understanding complex phenomena when it is based on analytical philosophy. Eventually this approach describes thoroughly the causal links within the system by using logic. The issue is that "by its very focus on analyzing problems into their logical components, [it] is inimical to the holism, uncertainty and subjectivity entailed by complexity."[85]

Continental philosophy, as it was developed from Husserl's phenomenology, focuses on the subjectivity of experienced phenomena. Moreover, "phenomena must be reconceived as objective intentional contents (sometimes called intentional objects) of subjective acts of consciousness. Phenomenology would then study this complex of

[83] Michael Beaney, "Analysis," in Stanford Encyclopedia of Philosophy https://plato.stanford.edu/entries/analysis/#6
[84] Andrew David Irvine , "Bertrand Russell," in Stanford Encyclopedia of Philosophy https://plato.stanford.edu/entries/russell/#RWAP
[85]Francis Heylighen, Paul Cilliers and Carlos Gershenson, "Philosophy and complexity," in *Complexity, Science and Society*, ed. by Jan Bogg and Robert Geyer (Oxford: Radcliff, 2007), 127

consciousness and correlated phenomena."[86] What is important here, are the interrelations between the observer and the observed phenomena. Furthermore, as Ricoeur combined phenomenology to hermeneutic, the phenomenologist epistemology evolved towards a theory of interpretation.[87] Such an epistemology leads to the concept of narratives as tools to understand and model complex systems. Indeed, based on Ricoeur's hermeneutical epistemology, Collender suggests that "a narrative approach would be more helpful to those disciplines where non-mathematical would be more useful for work that requires quick human decisions."[88] Indeed, using Ricoeur's "model of the text" he shows that "through a hermeneutic phenomenological approach [there is] a way of approaching parts and wholes that preserves both the detail of the parts and the operation of wholes so that neither category is reduced to the other, nor are they separated."[89]

Furthermore, from a constructivist standpoint, the understanding of complexity is underpinned by how knowledge comes from a constructed perception. Indeed, "as Piaget stressed, knowing is an adaptive activity"[90]. Knowledge is then considered to be built on subjective experience as far as it allows finding solutions to problems. Therefore knowledge is conceived as "a mapping of actions and conceptual operations that had proven viable in the knowing subject's experience.[91]

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[86] David Woodruff Smith, "Phenomenology," in Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/entries/phenomenology/

[87] David Pellauer and Bernard Dauenhauer, "Paul Ricoeur," in Stanford Encyclopedia of Philosophy https://plato.stanford.edu/entries/ricoeur/#InteFullLang

[88]Michael Collender, "Complexity and Hermeneutic Phenomenology," (Dissertation, Degree of Doctor of Philosophy, University of Stellenbosch, 2008), 170.

[89]I*bid*, 305.

[90]Ernst von Glaserfeld, "A constructivist approach to teaching," in *Constructivism in education*, ed. L. P. Steffe and J. Gale (Erlbaum: Hillsdale, 1995): 6 3–15, http://www.vonglasersfeld.com/172

[91]Ernst Von Glaserfeld, "Introduction: Aspects of constructivism," in *Constructivism: Theory perspectives, and practice*,ed. C. T. Fosnot (Teacher College Press, 1995): 5, http://www.vonglasersfeld.com/180

In fact, with a constructivist perspective and to emphasize on how interactions between entities are critical in a complex system, Morin defines the concepts of dialogic, holographic principles and organizational recursion. The concept of dialogic, which stems from Hegelian dialectics, considers that two opposing but complementary logics can form and be part of a single unity. Though, in Hegel dialectics one eventually comes to a "concrete" solution to the initial contradictions, in a dialogic these contradictions remain as the constituent of their united and constructed entity. Then, holographic principles illustrate the fact that a part of a system can contain nearly all the information needed to represent the whole. For example, all the genetic information of a human body is contained in its cells. Finally, organizational recursion describes a process where entities are producers and products of themselves. [92]

2.2. How complex is information age warfare

Complexity in information age warfare can be analyzed from two different standpoints. First, from a systems perspective, information age warfare proves to have the attributes of CAS and second, from command and control perspective, the challenge is then to manage complexity.

2.2.1. Informational age warfare is a CAS

As it has been defined, it appears that warfare in the information era deals with complexity. Indeed, warfare takes place in a complex environment and in the same time, it is a complex phenomenon in itself. Moreover, from a systems perspective, warfare and its environment are open systems themselves, where input and output are situations, circumstances. These systems co-evolve and adapt to changing conditions as do CAS.

[92]Edgar Morin, *La Méthode, Tome II* (Paris: Éditions du Seuil, 2008), 2429.

The different properties of CAS (cf. paragraph 2.1.3) can be identified when analyzing warfare from a systems perspective. Indeed, the agents of the warfare system (militaries, combatants, civilian contractors, non-governmental organization – NGO – employees…) follow schemata, whether it they are sets of laws, rules or cultural and traditional beliefs. It is also possible to aggregate these agents in different groups (armies, groups, companies, NGO….) from which new properties will emerge such as a critical action at a certain point of time and space. This emerging property might be positive or negative relatively to the desired outcome. Furthermore, the non-linearity of the system is measured by the considerable impact that the actions of few, nearly random, agents can have on the whole of the system. For example, the torture and human rights abuse that took place in Abu Ghraib in 2003 had a dramatic and critical impact on the whole of the campaign of Operation Iraqi Freedom. Then, as a resource, information constantly flows within the system. Interestingly, in the information age, information is both a resource enabling the system to function and in the same time it is itself subject to conflict as regards to information warfare. Finally, the great diversity of agents involved in warfare all interact within the system which then evolves.

What is characteristic of the information era is that the complexity of warfare significantly increased as more agents take part in conflict. This results from the technological and social changes (cf. paragraph 1.1.3) of the information era. Indeed, "social movements emerging from communal resistance to globalization, capitalist restructuring, organizational networking, uncontrolled informationalism, and patriarchalism […] are the potential subjects of the information age."[93] Actually, Castells includes religious fanatics or nationalists in these social movements, amongst others, as

[93]Manuel Castells, *The Power of identity* (Malden: Wiley-Blackwell, 2010), 426.

they constitute communities and thus build up power. This also relates to Nye's concept of diffusion of power as "states will remain the dominant actor on the world stage, but they will find the stage far more crowded and difficult to control."[94] In fact, in the information age, the agents involved in warfare tend to be more numerous and to constitute greater diversity.

Furthermore, these agents have now greater interrelations through networks made available by information technology (cf. paragraph 1.1.2). In fact, "networks are open structures, able to expand without limits, integrating new nodes as long as they share the same communication codes."[95] Thus they have become critical elements of warfare. Today, the Western world, Russia and China share the idea that in the information age, networks are central to warfare as much as warfare is a matter of networks. Indeed, NCW is key to the Western world's concepts of warfare in the information age (cf. paragraph 1.2.3), alike "non-linear" warfare in Russia (cf. paragraph 1.3.2) and "informationized" warfare in China (cf. paragraph 1.4.3). Moreover, from a CAS perspective, empowered networks enable feedback loops which now have the ability to rapidly change the issue of warfare as the system is not linear.

As matter of fact, from a systems perspective, warfare in the information age enhances the emergence of "surprising" events. Taleb uses the metaphor of a country named "Extremistan" to describe how the world has evolved into a "scalable" environment where unpredictable "Black Swans" have huge effects on the systems in

[94]Joseph Nye, *The Future of Power* (New-York: PublicAffairs, 2011), 114.
[95]Manuel Castells, *The Rise of the Network Society* (Malden: Blackwell Publishing, 2000),5 01.

which they suddenly emerge.[96]Interestingly, even if these "Black Swans" are not predictable, they can still be expected by knowledgeable observers.

2.2.2. Command and control in the information age

According to Beninger a "Control Revolution" had preceded the "Information Society". He argued that this "Control Revolution" was a response to the "crisis of control" consequent to the Industrial Revolutions of the 19th century. Indeed, the speed of the "society's entire material processing system"[97] had increased dramatically and the control mechanisms had initially not been able to keep pace. Consequently, "the technological and economic response to the crisis – the Control Revolution – had begun to remake societies throughout the world by the beginning of [the 20th] century."

A similar ongoing process can be observed in warfare in the information era. Today, the challenges for effective control are not only the speed of the processes within the system but also their complexity. Up to today, the quest has headed towards technological solutions. The Western development of NCW, the Russian concepts inherited from the MTR and the Chinese analysis of the RMA materialize that quest for technology to support control.

From a component standpoint, the US air force (USAF) has shown since World War II high concern for the control of air operations. Indeed, the USAF developed the concept of centralized control (CC) and decentralized execution (DE) to meet the challenges faced by air warfare in the information age. Thus, the concept of CC states that "because of airpower's unique potential to directly affect the strategic and operational levels of war, it should be controlled by a single Airman who maintains the

[96]Nassim N. Taleb, *Le Cygne Noir: La Puissance de l'Imprévisible* (Paris: Les Belles Lettres, 2008), 67.
[97]James R. Beniger, *The Control Revolution* (Cambridge: Harvard University press, 1986), 427.

broad, strategic perspective necessary to balance and prioritize the use of a powerful, highly desired yet limited force."[98] In the meantime, DE "allows subordinates, all the way down to the tactical level, to exploit situational responsiveness and fleeting opportunities in rapidly changing, fluid situations."[99]

For the USAF, CC and DE are key tenets of air warfare as they are adapted to air power and the speed and reach of its assets. Moreover, its proponents emphasize that, in a complex environment, it develops the situational awareness of the air component, maximizes the interactions between its agents and gives flexibility in the employment of air power[100]. Nonetheless, it remains an "air centric" control concept and it appears not applicable to a joint force as "decentralized execution" needs to encompass more than weapon delivery. Indeed, its detractors argue that "from a joint perspective, centralized control and decentralized execution is illogical and cannot exist together because control is about execution and is inherent in command"[101] As a matter of fact, they argue that planning and directions are meant to be centralized not control.

In fact, as technology enhances network organization and self-synchronization within the network, Alberts and Hayes argue in favor of an "emergent leadership" because with a proper "set of initial conditions […] control is not achieved by imposing a parallel process, but rather emerges from influencing the behaviors of independent agents"[102] Therefore, Alberts considers that "focus and convergence" should replace

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[98]United States Air Force Doctrine Document (AFDD 1), "Air Force Basic Doctrine," https://doctrine.af.mil/dnv1vol1.htm
[99]*Ibid.*
[100]Alan Docauer, "Peeling the Onion Why Centralized Control/Decentralized Execution Works," *Air & Space Power Journal* 28, no. 2 (March-April 2014), 24-44.
[101]Mark G Davis, "Centralized Control/Decentralized Execution in the Era of Forward Reach," *Joint Force Quarterly* 35 (October 2004), 95-99.
[102]David S. Alberts and Richard E. Hayes, *Power to the Edge* (Washington, DC: Command and Control Research project, 2003), 208.

"command and control".[103] Focus speaks to shared understanding of the situation while convergence is underpinned by a high level of interactions, a similar response from independent agents and operational coherence. Thus, by changing their traditional hierarchical paradigm, military organization would become sufficiently agile to cope with the complexity of warfare in the information age. Nonetheless, these original concepts have not yet come to reality.

2.3. How Western strategist take complexity into account

To deal with warfare as a complex phenomenon, military thinkers hold a critical role in giving food for thought on how to make the best out of it. To start, Clausewitz is still one of the most influential within the Western military and can provide some hindsight on complexity. Then, as a thinker of the information age, Boyd has indeed provided contemporary militaries with concepts that can are used to cope with the complexity of warfare in the 21st century.

2.3.1. Clausewitz' dialectical approach and unpredictability in warfare

Even if Clausewitz is a "pre-information era" military thinker, his work still "appears able to withstand every kind of political, social, economic, and technological change since it was published."[104] Indeed, his writings show that he "was not only a practical soldier. He was that, but he was also a philosopher who asked not merely how war ought to be made, but what its real nature is and what purpose it serves."[105]

In the early 19th century, science had made great progress in the past few centuries. On the one hand simple models had great results in predicting what seemed to

[103]David S. Alberts, "The Future of C2", *The International C2 Journal* 1, no.1, 21.
[104]Martin Van Creveld, "The Eternal Clausewitz", *Clausewitz and Modern Strategy, Journal of Strategic Studies* 9 no.2-3 (February1986), 35.
[105]*Ibid*

be linear behaviors and on the other hand, probabilistic science and thermodynamics were now helping to understand phenomenon of great complexity. In fact, in On War, Clausewitz used many metaphors referring to science to support his theory, whether from classical Newtonian mechanics or to probabilistic mathematics. Nonetheless, he also showed he understood that "mathematical certainties do not occur in the real world in which wars were conducted."[106] Moreover, Clausewitz was able to combine "the tradition of the Enlightenment, which emphasized rational objective analysis and the search for clarity, with the German romantic tradition […], which focused on the on the psychological, emotional, intuitive, and subjective dimensions in the interpretation of the surrounding world."[107]

Therefore, even if warfare in the early 19th century was not as complex as in the Information era, Clausewitz has highlighted some aspects of warfare that should guide contemporary thinking. Indeed, at the very beginning of his definition of war he explains that "here more than elsewhere the part and the whole must be thought together."[108] This argument is in line with how warfare can today be considered as a complex system.

Furthermore, Clausewitz' primary definition of warfare, "nothing but a duel on a larger scale"[109] unveils his dialectical approach. In fact, he focuses on the importance of interactions in warfare as "military action […] must expect positive reaction, and the process of interaction that results."[110] Thus, through his concept of warfare, "by contrasting theory and practice *(praxis)*, means and ends, the attack and defense, action

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[106]Alan Beyerchen, "Clausewitz and the Non-Linear Nature of Warfare: Systems of Organized Complexity," in *Clausewitz in the Twenty-First Century*, ed. Hew Strachan and Andreas Herberg-Rothe (New York:Oxford University Press, 2007), 53.
[107]Michael I. Handel, "Introduction", *Journal of Strategic Studies* 9, no. 2-3 (February 1986), 6.
[108]Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1976), 75.
[109]*Ibid*, 75.
[110]*Ibid*, 139.

and inaction, tension and rest, reason and uncontrolled emotions, the physical and moral, he forces the reader to develop his own ideas on the meaning and interrelationship of each of these subjects."[111]

Then, beyond the dialectical approach, Clausewitz focused on dealing with the unpredictability of war. In his conception of the nature of warfare, "Clausewitz' greatness stems from his willingness to accept ambiguity and uncertainty as the essence of war while resisting the temptation to impose a false sense of clarity."[112] In fact, Beyerchen argues that Clausewitz' unpredictability comes from his concepts of interactions, friction and chance, thus "unpredictability is a key manifestation of the role that nonlinearity plays in his work."[113]

It also appears to Beyerchen that On War has too often been analyzed with a linear approach whereas "Clausewitz perceives war as a profoundly nonlinear phenomenon that manifests itself in ways consistent with our current understanding of nonlinear dynamics."[114] Indeed, Clausewitz stresses the importance of the context of warfare as one "move[s] from the abstract to the real world, and the whole thing looks quite different."[115] Moreover, he refines his definition of war to include the idea of feedback as "war moves on its goal with varying speeds; but it always lasts long enough for the influence to be exerted on the goal and for its own course to be changed in one way or another."[116] Thus, On War gives us the ability to understand the complex nature

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[111]Michael I. Handel, "Introduction", *Journal of Strategic Studies* 9, no. 2-3 (February 1986), 5.
[112]*Ibid*, 11.
[113]Alan Beyerchen, "Clausewitz, Non-linearity and the Unpredictability of War," *International Security* 17 (winter 1992–3): 59-90, http://www.clausewitz.com/item/Beyerchen-ClausewitzNonlinearityAndTheUnpredictabilityOfWar.htm#na4
[114]*Ibid.*
[115]Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1976), 78.
[116]*Ibid*, 87.

of warfare which is not necessarily a consequence to the information age and its technology.

Therefore, as a "pre-Information age" military thinker and considering that he foresaw the concept of non-linearity in military affairs, Clausewitz gives us hindsight on the nature of warfare and its inherent complexity. Nonetheless, Clausewitz said it himself, "every age had its own kind of war, its own limiting conditions, and its own peculiar preconceptions. Each period, therefore would have held to its own theory of war, even if the urge had always and universally existed to work things out on scientific principles."[117] Thus even if Clausewitz' definition of the nature of war addresses its complexity, it does not take into account the processes underpinning information age warfare.

2.3.2. Boyd and the OODA loop

Boyd's Observation – Orientation – Decision – Action (OODA) loop is usually defined as a cognitive process underpinning the C2 function of a force. Considering Boyd's records as a fighter pilot in the USAF, the OODA loop could also be seen as a model of a tactical aerial combat decision cycle scaled to higher levels of decision making. Thus, to defeat an enemy one would need to outrun its OODA loop as a fighter pilot needs to set his flight path inside the one of his enemy in order to gain critical advantage to be able to shoot him. Nonetheless, "this view is also too limited. The 'rapid-OODA loop' idea too is too narrow an interpretation of the general OODA loop construct as Boyd employed it."[118]

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[117] *Ibid*, 593.
[118] Frans Osinga, *John Boyd and strategic theory in the postmodern era*, 1 http://www.au.af.mil/au/awc/awcgate/boyd/osinga_boyd_postmod_copyright2007.pdf

Actually, one must also consider the fact that Boyd was familiar with system thinking and it appears that "the similarities between the OODA 'loop' and Murray Gell-Mann's theory of schemata in CAS are striking"[119] (cf. paragraph 2.1.3). Indeed, Boyd's model focuses on "complexities, unpredictability, uncertainties, non-linearity, and intangibles."[120]

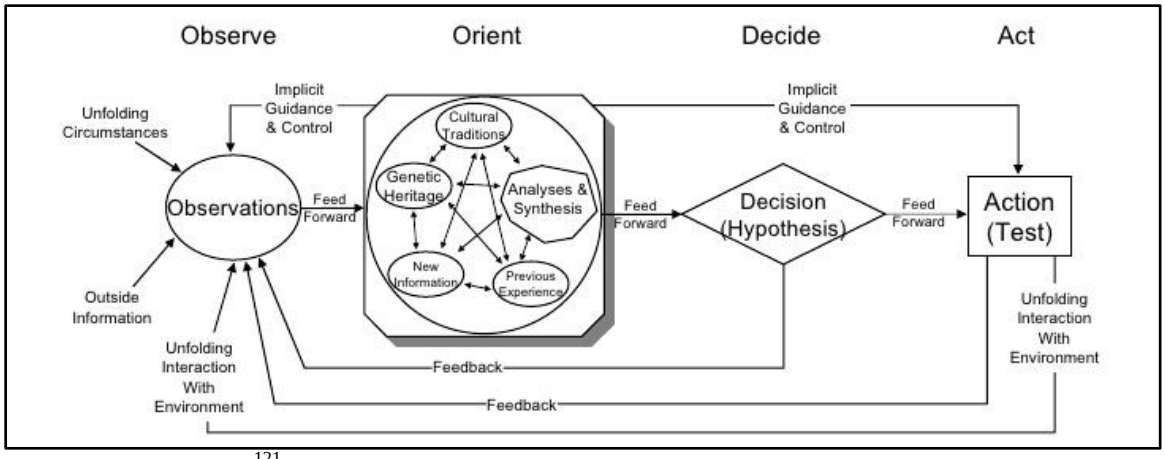

Fig 1 The OODA loop[121]

As for the process itself, the orientation phase is considered as the essential part of the OODA loop since it "shapes" both the observation and the action.[122] For this critical phase, Boyd conceived a "framework of analysis which creates meaning, discerns existing opportunities and threats, and provides a range of response to initiate."[123] Moreover, orientation is based on the dialectic of analyses and synthesis as Boyd thought that "the basic goal of individuals and societies seem to work in dialectic harmony driving and regulating the destructive/creative, or deductive/inductive, action"[124].

[119]Antoine Bousquet, *The Scientific Way of Warfare* (New York: Columbia University Press, 2009), 191.
[120]John A. Olsen, "Boyd Revisited: A Great Mind with a Touch of Madness," *Air Power History* 63, no.4 (Winter 2016), 9.
[121]John R. Boyd, *The Essence of Winning and Losing* (1996).
[122]John R. Boyd, *Organic Design for Command and Control* (1987).
[123]Antoine Bousquet, *The Scientific Way of Warfare* (New York: Columbia University Press, 2009), 188.
[124]John R. Boyd, *Destruction and Creation* (1976).

Nonetheless, this works in a dynamic process based on interactions in order to co-evolve with the environment.

Beyond the dialectical approach to how situational awareness is constructed, Boyd's OODA loop can also be perceived as a "hermeneutical circle that behaves like [the] circle Ricoeur describes. Boyd analyzed the warfighting process and discovered that the opposing forces in a war go through a four-part hermeneutical circle"[125] Collender explains that the OODA loop, as an iterative process, which echoes Ricoeur's epistemology where belief and understanding are in a "relationship […] where one of the pair interprets and informs the other. Thus, there is no absolute pole. Belief cannot be absolute over understanding, neither can understanding be absolute over belief."[126] Indeed, the knowledge of the environment is a key prerequisite for situational awareness. Thus, as a hermeneutical circle, the whole OODA loop process enables the system to iteratively construct its knowledge. The dialectical approach of the orientation phase, based on analysis and synthesis and fueled by the observation phase leads eventually to the action phase based on the hypothesis underpinning the decision phase. Again, in Boyd's conception of the OODA loop there are constant interactions between the phases through positive and negative feedback which is enhanced by information. In fact, Bousquet underlines Boyd's "focus on the conditions of emergence and transformation of systems through information rather than merely the manner in which information is processed by a fixed organizational schema."

Therefore, Boyd's OODA loop is more than a cognitive model as it speaks to the co-evolution of a CAS within its environment. It takes into account the primacy of

[125]Michael Collender, "Complexity and Hermeneutic Phenomenology," (Dissertation, Degree of Doctor of Philosophy, University of Stellenbosch, 2008),149
[126]*Ibid.*

information as it enables warfare in the information age. Actually, "with explicit reference to Boyd's OODA loop, NCW documents note that the advantage for forces that implement NCW lies in gaining and exploiting an information advantage […] NCW derives its power from the strong networking of a well-informed but geographically dispersed force."[127] Thus Boyd has provided a concept that considers warfare as a CAS and defines an abstract solution to dealing with its complexity in the information era. Nonetheless, its interpretation has been more technological than philosophical and "Boyd would likely not agree with the way technology has come to be such a dominant factor and with the expectations of some proponents that NCW would 'lift the fog of war'."[128]

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To conclude this second part, beyond the definition of complexity, it is now possible to consider warfare in the information age as a CAS. Thus, military thinkers and deciders should be aware of the core properties of such systems, like emergence and non-linearity, or the importance of feedback loops whether they are positive or negative. To be effective, C2 needs to cope with the flows of information within the "system" and address the diversity of its agents. As a matter of fact, based on the interpretation of the ideas of Clausewitz and Boyd, even if they provide contemporary militaries with hindsight on the complex issues of warfare at the information age, the tendency in military affairs in the western world still seems to focus on the importance of technological solutions.

[127]Frans Osinga, *John Boyd and strategic theory in the postmodern era*, 5, http://www.au.af.mil/au/awc/awcgate/boyd/osinga_boyd_postmod_copyright2007.pdf
[128]*Ibid*, 6.

Indeed, networks have become essential to its concepts of warfare, especially as the number and the diversity of agents involved in the "system" increased. However, the technological solutions have not put an end to the unpredictable nature of warfare. It has even become more challenging in the non-linear environment on the 21st century. Actually, there are links between what could be named a technological dogma and the western philosophical approaches to knowledge. First, technology can be seen as enhancing the analytical processes and the reductionist perspectives. Second, networks develop interactions in a constructivist process. Hence, it might now be interesting to seek for a different way of thinking to counterbalance the technological bias which has not yet led us to mastering information age warfare.

3. A DIFFERENT APPROACH TO WARFARE IN THE INFORMATION ERA INSPIRED BY EASTERN PHILOSPHY

Ancient Greek philosophy is still at the origin of the contemporary Western way of thinking. Today, it appears that by challenging the concepts of this philosophical heritage one can find a different approach to thinking about warfare. Moreover, Eastern way of thinking has been influenced by philosophical concepts that give another perspective on how to think about information age warfare and its inherent complexity.

Therefore, to adopt a different approach to warfare, one would need a different viewpoint when considering the western methodology and its appetite for models, its concepts of actions and their relation to time and plans. Thus a different practical approach will be made possible by challenging how operations are conceived in order to shift from "actions-based" planning to "process-based" design. Inevitably, this will then have an impact on how to conduct warfare and to deal with the uncertainty of information age warfare.

3.1. A different mindset

The Eastern way of thinking, as it considers reality as an on-going flow of events, helps to challenge the Western methodology which highly relies on models. Moreover, it gives another aspect to how time can be perceived and to the Western primacy of actions over processes. Eventually, it gives another perspective to the relation between planning and design.

3.1.1. On models and methodology

Plato's "theory of forms" is one of the most enduring philosophical concepts that the Western way of thinking inherited from ancient Greek philosophy. Plato considered that "there is a more real and perfect realm, populated by entities (called 'forms' or

'ideas') that are eternal, changeless,"[129] and from which the perception of reality is derived. This concept is at the origin of the Western quest for ideals and consequently, its appetite for models that would reflect these ideals. Thus, reality is seen as an imperfect representation of the models and there is a split between theory and practice.

Indeed, the difference between theory and practice appears in Clausewitz' dialectical conception of war. He believed that friction was responsible for such a difference as he wrote that friction is "the only concept that more or less corresponds to the factors that distinguish real war from war on paper."[130] In fact, more generally and from a Western perspective, theory is used to think about warfare and to serve as guides through the "fog of war". Thus, the Western way of warfare is supported by theoretical concepts, such as "centers of gravity" or "decisive points", that are used to plan and conduct operations.

From an Eastern perspective, the issue is not to build models which would be used as a set of norms, but preferably to focus on the course of events. Moreover, by doing so, the idea is to feel the propensity of situations (the promises of its natural evolution) and to be able to use its potentials (the constantly changing latent capacity or ability). [131] Thus, one can acquire knowledge of reality through its perception and understanding of a situation, not as it is related to specific theoretical concepts.

Then, to make sense of a situation, the Eastern way of thinking tends towards a holistic assessment when the Western way is predominantly based on analytical studies. Indeed, the Eastern way of thinking considers "the world [as] a complex place […]

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[129] Richard Kraut, "Plato", Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/entries/plato/#PlaCenDoc

[130]Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1976), 119.

[131]François Jullien, *Traité de l'efficacité*, (Paris: Grasset, 1996), 37.

understandable in terms of the whole rather than in terms of the parts"[132] and this is due to the fact that it believes "the world [consists] of continuously interacting substances."[133] This also puts more attention in figuring out the propensities and potentials of a situation as they are linked to the context and the environmental conditions.

However, holistic and analytical approaches are not incompatible. These methodologies give different perspectives which can be fairly complimentary. They both contribute to the understanding of the situation. Indeed, when a holistic standpoint can better highlights interrelations between events, an analytical one will better point out the causal links, if they exist. Therefore, one should adapt its approach according to the perceived complexity of the situation and be ready to change methodology for a better understanding.

3.1.2. On actions and time

Since the Homeric epics celebrating heroic achievements and praising military exploits, the Western way of thinking has greatly valued actions, especially when these are found to be decisive. Thus whether it is Marathon, Hastings, Waterloo or Gettysburg, Western military culture tends to focus on the conclusive nature of specific battles. Moreover, each of these battles had its hero, Pheidippides the messenger, William the Conqueror, the Duke of Wellington and John Burns the civilian combatant, whose actions have been glorified for posterity. Hence, actions are fundamental in defining the Western heroic mythology.

This explains how the Western approach to warfare can be considered as "actions-based" while the Eastern one is comparatively "process-based". By focusing on process

[132]Richard E. Nisbett, *The Geography of Thought* (New York: Free Press, 2003), 100.
[133]*Ibid*, 21.

as a combination of actions, the Eastern approach values the combined effect of interrelating actions. In fact, on the one hand, the Western "actions-based" approach is both derived from the idea of overarching theoretical models, and underpinned by a technological conception of warfare[134]. On the other hand, the Eastern "process-based" approach focuses on the idea of a continuous transformation of situations. Thus, it also takes into account the impact of time as this transformation drives the evolution of potentials and reveals propensity. Thus, time generates a maturation process which actually needs to be considered as the source of effects.[135]

Therefore, when considering time as it drives processes, decisiveness does not come anymore from specific actions but instead, it is about the ability to seize occasions. Indeed, from an Eastern perspective, occasions are not deliberately generated by an action, whether this action is heroic or not, but they are to be seen as spontaneous visible emergence of a continuous transformation. [136]

Furthermore, Western linear concepts of warfare rely on the causal links supporting successive actions. Therefore, to address non-linearity in warfare, it appears necessary to give credit to the Eastern "process-based" approach and to manage time as a key factor of transformation. This would undoubtedly put more weight on designing operations to identify and define the transformation processes.

3.1.3. On plans

From a Western perspective, planning establishes the link between theoretical models and the actions undertaken to wage war in order to achieve strategic objectives. For example, the Canadian Forces (CF) Operational Planning Process (OPP) states that

[134]François Jullien, *Traité de l'efficacité*, (Paris: Grasset, 1996), 27.
[135]*Ibid*, 95.
[136]*Ibid*, 129.

"the CF approach to force employment and operations is command driven. Part of this encompasses the requirement to plan for operations."[137] Thus, to conduct an operation, Western militaries dedicate quite naturally a lot of energy into planning.

Furthermore, operational art is meant to address the complex nature of warfare and to deal with unpredictability, "in designing, commanding and conducting a campaign"[138]. Therefore, it appears that planning is supported by design and the ability to adapt to changing situations. This is in line with the previously mentioned "actions-based" approach to warfare since the goal is to plan for the up-coming actions. Now, from a "process-based" perspective, the idea would be to create the conditions for the transformation process to take place. Thus, from an Eastern viewpoint, "rather than thinking about making plans, one should know how to benefit from what is implied in the situation and what its evolution promises."[139] Hence, design would become the focal point of attention and plans would be established to make the best out it. In consequence, and from this perspective, planning would now support design.

As a matter of fact, since plans are perishable, planning must also take into account time considerations, especially as regards to the complexity of warfare in the information era when conditions can change very rapidly. Indeed, referring to Ralph Stacey, Matthews highlights "the decline of the 'long-term' planning paradigm [which] should coincide with the rise of the 'learning organisation' paradigm."[140] Actually, plans

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[137]Department of National Defence, B-GJ-005-500/FP-000, *Canadian Forces Operational Planning Process (OPP)* (Ottawa: DND Canada, 2008), 1-2.
[138]*Ibid*, 1-3.
[139]François Jullien, *Traité de l'efficacité*, (Paris: Grasset, 1996), 37.
[140]David Matthews, "Rethinking Systems Thinking: Towards a Postmodern Understanding of the Nature of Systemic Inquiry," (Thesis, Degree of Doctor of Philosophy, University of Adelaide, 2004), 215.

focus on actions whereas learning is about transformation which an on-going process that makes the best out of time.

Therefore, in a different approach to warfare, one should not consider planning as the main focus of command but as a tool in conducting operations. Indeed, certain operational functions, like logistical support, cannot work without a proper planning process. To completely disregard planning would obviously be counterproductive. In fact, one of the strength of Western militaries is its planning for logistics, as the Chinese noted from the First Gulf War. Nonetheless, focusing on design rather than planning fosters the adaptability that is needed to address the complexity of information age warfare.

3.2. A different practical approach

With a different mindset, a different practical approach to warfare in the information era is therefore made possible. Nonetheless, some of the basic concepts underpinning the way of thinking about warfare still need to be challenged. Then, the adoption of a "process-based" approach to warfare will set forth design as the focal point of attention. Moreover, a design tool will help to describe a different way of thinking about warfare and will eventually lead to a different approach to planning.

3.2.1. Basic Concepts

When thinking about warfare, Western militaries refer to concepts such as "end states", "centers of gravity", "decisive points" and "lines of operation" that are defined to give a logical justification to the planning of actions. However, these theoretical concepts have been inherited from a linear conception of warfare as they are based on causal links

which guide the planning process. Today, it appears that they need to be revised to address the complexity and the non-linearity of information age warfare.

Desired states vs End States

An "end state" is usually understood as a situation that one wants to achieve to be able to call for the end of the military engagement. It is generally condition based. However, the CF OPP explains that the end state is "always defined by government" and that "it is important to remember that it can change over the course of the campaign."[141] Thus, end states are politically driven.

Nonetheless, from an Eastern perspective "an 'end' is also a 'beginning', and present time is a continuous transition."[142] Therefore, the concept of "end state" is flawed as it does not reflect the transitory nature of the "state". In comparison with the idea of an "end state", the concept of a "desired state" does not establish a limit in time. Moreover, it still embodies the idea of a strategic aim given for an operation. The aim can change during the operation but the concept remains valid, and even if the "desired state" is not attained, it does not imply that a conflict will not end. In fact, the "termination criteria" to an operation can very well be different from the "desired state". As a matter of fact, the "desired state" is also a theoretical concept, but it appears sufficiently open to be used in designing operations, and it is a better reflection of reality.

Center of Gravity

The CF OPP defines the center of gravity (COG) as "characteristics, capabilities or localities from which a nation, an alliance, a military force or other grouping derives

[141]Department of National Defence, B-GJ-005-500/FP-000, *Canadian Forces Operational Planning Process (OPP)* (Ottawa: DND Canada, 2008), 2-1.
[142]François Jullien, *Traité de l'efficacité*, (Paris: Grasset, 1996)121.

its freedom of action," and it recognizes that the concept sparks debate.[143] In fact, the CF OPP explains that searching for a COG should not draw too much attention when campaigning, but if the COG is obvious it still should be used. This position is actually quite ambiguous and questions the relevance of a concept that will only be employed when facing a simple context.

As matter of fact, the long lasting debate about the relevance of using the COG concept in linked to how Clausewitz initially defined his concept of *schwerpunkt*. Even Echevarria, who argues that its definition should stand as a close analogy to mechanical physics, admits that the concept is only appropriate to wars where "the total military collapse of the enemy is commensurate with our political objectives and end state" and where the system is sufficiently connected to act as a unity[144]. Hence, even if there is great value in using COG for linear wars, and if it might be applicable it some specific non-linear conflicts, one should consider not using this concept in warfare at the information age.

Indeed, Zweibelson explains that "to liberate cognitive approaches to military sense-making, the COG must be removed from its artificial cornerstone position in doctrine and practices so that we might move on to more pressing concerns."[145] He argues that the use of COG in military thinking is a consequence to ontological and epistemological choices. The concept of COG actually reflect the Western way of thinking as "technical rationalism", a "driven belief that complex systems can be both

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[143]Department of National Defence, B-GJ-005-500/FP-000, *Canadian Forces Operational Planning Process (OPP)* (Ottawa: DND Canada, 2008), 2-1.
[144]Antulio J. Echevarria, *Clausewitz's Center of Gravity: Changing Our Warfighting Doctrine – Again !*, (United States Army War College Press, 2002),19.
[145]Ben Zweibelson, "Gravity-Free Military Decision-making: Breaking Away from Clausewitz's 'Centers of Gravity' in Military Planning," in *Directorate of Future Land Warfare* (manuscript pending publication in Spring 2016 with Australian Department of Defence), 32.

understood and even controlled through a regimented scientific approach, reductionism and quantified measurements."[146]

Therefore, the issue with COG speaks to the Eastern idea of models which have become sets of norms (cf. paragraph 3.1.1) and limit creative thinking about a situation. One should rather concentrate on understanding properly the situation, and design can be a very valuable approach. Actually, Zweibelson introduces three different design concepts, a first one based on "narratives" as they relate to "pre-configured states", a second one based on "assemblage" to understand relationships at different scales, and a third one based on "problematization", to challenge assumptions in a "destructively creative" process[147]. As a matter of fact, these concepts do not come the Eastern way of thinking as they are linked to post-modern philosophy. Nonetheless, they are valuable tools to contribute to the understanding of the course of events and perfectly adapted to a holistic perspective to complex and non-linear systems.

Decisive points and lines of operation

In CF OPP, a decisive point is defined as a "critical event that paves the way to the end-state. [They are] conditions that must be set in order to achieve the aim of the campaign"[148] step by step. Moreover, these conditions are supported by a number of tasks, evaluated with measures of effectiveness and associated to a risk. Then, "lines of operation establish the relationship between decisive points, produce a critical path in time and space along the path to an end state and ensure that events are tackled in a

[146]*Ibid*, 20.
[147]Ben Zwebelson, "Three Design Concepts Introduced for Strategic and Operational Applications," *Prism* 4, no. 2 (2013).
[148]Department of National Defence, B-GJ-005-500/FP-000, *Canadian Forces Operational Planning Process (OPP)* (Ottawa: DND Canada, 2008), 2-1.

logical progression."[149]The issue is the fact that these lines of operation and decisive points are conceived in a reverse-engineering process as the campaign is constructed backwards. In the end, the lines of operation are pointed in the right direction, as time is concerned, *id est* towards an expected future. However, their conception started with the definition of the end state and went back in time. This implies that things are to be sufficiently predictable. Therefore, it appears that the complexity of warfare and potential unexpected emergent events will continuously challenge the plan to an extent where the plan might not be relevant anymore and fail to address the reality of the true course of events.

Furthermore, the idea underpinning the decisiveness of the "points" is in fact linked to the Western concept of "action" (cf. paragraph 3.1.2) which seeks to reach a desired outcome through visible steps, sometimes heroic. However, if the conditions related to this "point" cannot be met, if the "actions" fail, then there will probably be a contingency plan. Thus, if there is another way to achieve success without meeting the conditions of the "decisive point", this also questions the true "decisiveness" in the first place.

From a different perspective, the idea could be to start a "process" from which will emerge tangible occasions to achieve success. Setting processes may seem less tangible but eventually, the emerging occasions will be truly decisive and concrete. For example, "gaining air superiority" is a quite common decisive point to place in a campaign. One could rather see it as an objective supported by a process. This process would be embodied by an air component fighting for air superiority. Whether air superiority is achieved or not, does not preclude from launching other processes.

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[149]*Ibid*, 2-2.

What is important is to determine when it is relevant to launch new processes and how they will create the conditions to eventually attain the objectives, not to set in advance that they will be decisive in achieving these objectives. In the end, decisiveness will come from the occasions that will emerge from the accumulation of all the on-going processes. The challenge is then to ensure that the necessary processes are identified and launched, and for sure, to keep track of their effectiveness.

3.2.2. A tool for design

Design can be defined as "a methodology for applying critical and creative thinking to understand, visualize, and describe complex, ill-structured problems and develop approaches to solve them."[150] It is meant to "assist [commanders] in understanding the operational environment, framing the problem, and developing a broad general approach to its solution."[151] Moreover, tools can be helpful to assist the design in these three steps.

The tool suggested here is a schema (figure 2) that should not be seen as a model of warfare. It is meant to be used for design as it helps to describe the situation as it is related to the different stake holders. Furthermore, it will also help framing the problem since it contributes to compare the situation from different perspectives and as regards to the different stakeholder's desired states. Eventually, it will contribute to developing an approach to what should be done to make the current states reach the "friendly" desired state.

[150]Department of Defense, Field Manual 5.0 "The Operations Process" (March 2010), 3-1.
[151]Department of Defense, Field Manual 3.0 "Operations" (February 2008), 6-1.

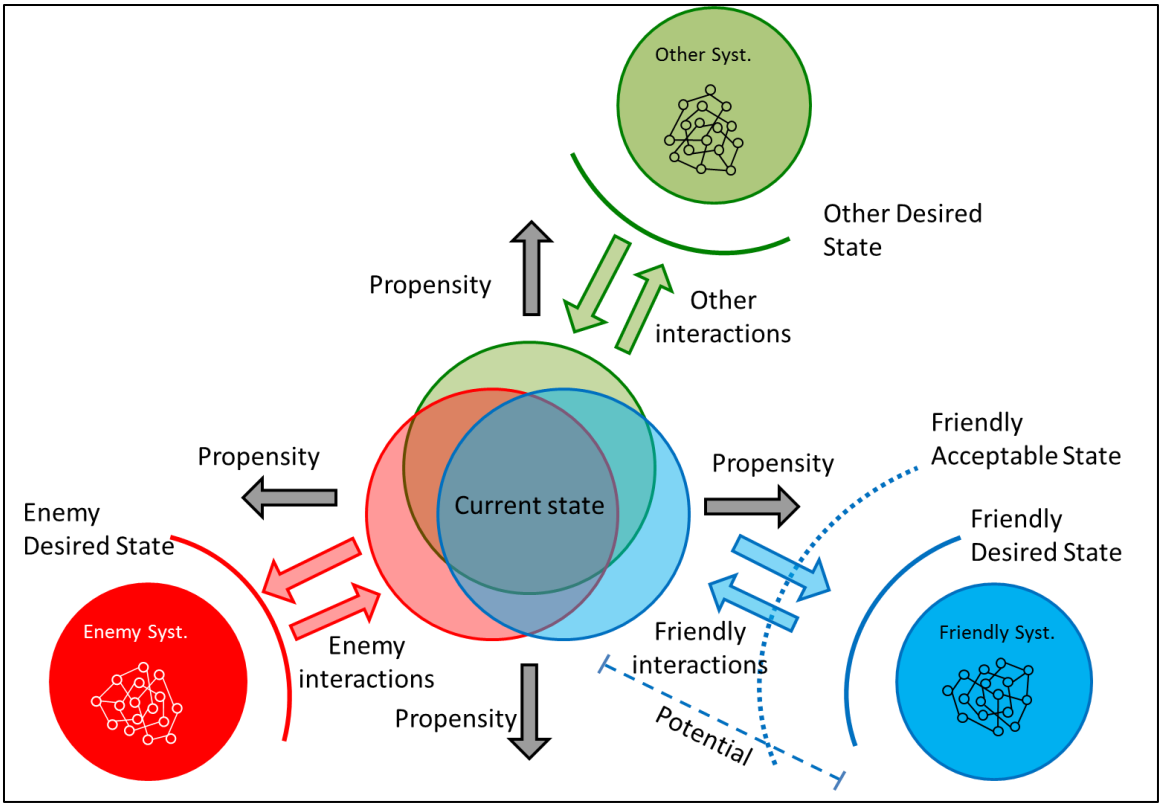

Figure 2 – Design schema

Understanding the current situation is the first determining step in an operation. There are multiple approaches in doing so. A classical analytical approach would use a Diplomatic, Informational, Military, and Economic (DIME) perspective for elements of power or a Political, Military, Economic- Social, Infrastructure, Information Systems, Physical Environment and Time (PMESII-PT) categorization to break down a system into separate categories. However, Zweibelson argues that this approach "ignores linkages across scale and beyond narrow boundaries of groupings."[152] Moreover, it introduces uncertainty in each category which multiplies it instead of reducing it by establishing links between the elements of the system.

[152]Ben Zwebelson, "Three Design Concepts Introduced for Strategic and Operational Applications," *Prism* 4, no. 2 (2013), 94.

Therefore, the challenge is to find a proper method to best describe and understand the current state. In the end, one must not omit the fact that this situation will be assessed differently depending on the stakeholder and so one should also understand the differences between each of these views (each colored circles depicted around the "current state" in figure 2).

Then, for each stake holder[153], starting by oneself, it is necessary to define how the system is constructed, what the desired state is, as regards to the current situation, and how the stakeholder interacts with that same situation. Indeed, these interactions can be attractive as they make the current state move towards the desired state, or repulsive as they make it move away from the desired state. For example, by securing an area, one is bringing the current "unsecured state" of the region towards he desired "secured state". On the contrary, by mistreating civilians, one is preventing the current "inhospitable state" of a population away from the desired "cooperative state" of that same population.

In fact, these interactions exist for all the stake holders. Thus, by describing them in this manner, it is possible to understand the processes that will help to drive the current state towards one's desired state. Indeed, one will also be able to identify the attractive and repulsive interactions of the enemy with the current state, in order to reduce or increase these interactions accordingly. The potential of one's situation is then given by the existing difference (pictured as a distance between the current state and the friendly system in figure 2) between the current state and one's desired state. The greater the distance, the less potential one has since the interactions will need to be stronger.

[153]Friendly, Enemy and others involved (some will be rather on the friendly side, others might be more on the enemy side).

Eventually, a current state has its own propensity that also needs to be evaluated. For all of the stakeholders, propensity can be favorable, neutral or unfavorable. It is important to understand this tendency because it will either be helpful, neutral or unhelpful in reaching one's desired state. The issue is that if one gets the propensity wrong, it might have negative consequences on the success of the operation. For example, in 2003, the American administration thought that once freed from the dictatorship of Saddam Hussein, Irak would have a propensity for Western democracy which would have helped the US to reach its desired state.

3.2.3. A different approach to planning

The CF OPP planning process "consists of five stages, leading from the initiation of planning through to plan review." Amongst these stages, before the development of the plan in itself, different Courses of Action (COA) are defined for the commander to choose the most adapted one. However, the COA are still structured in a linear way as they are constructed by lines of operations leading to main objectives which eventually will achieve the end state after having affected the enemy COG.

There is no doubt that, in the process, planning will need to address the linearity of time and the coordination required by certain functions such as logistical support. Nonetheless, a different approach to thinking about warfare would be to keep the linearity of planning just for synchronization purpose.

In fact, beyond the understanding of the situation, the design of the operation can lead to the definition of objectives that will set paths towards the desired state. Thus, the objectives will be at the origin of a momentum that needs to be created to change the current state. The idea underpinning the objectives is to support the favorable interactions

with the current state, while containing, disrupting or negating the unfavorable ones. The objectives will themselves be addressed by a combination of processes that can be represented in radial tree maps (figure 3).

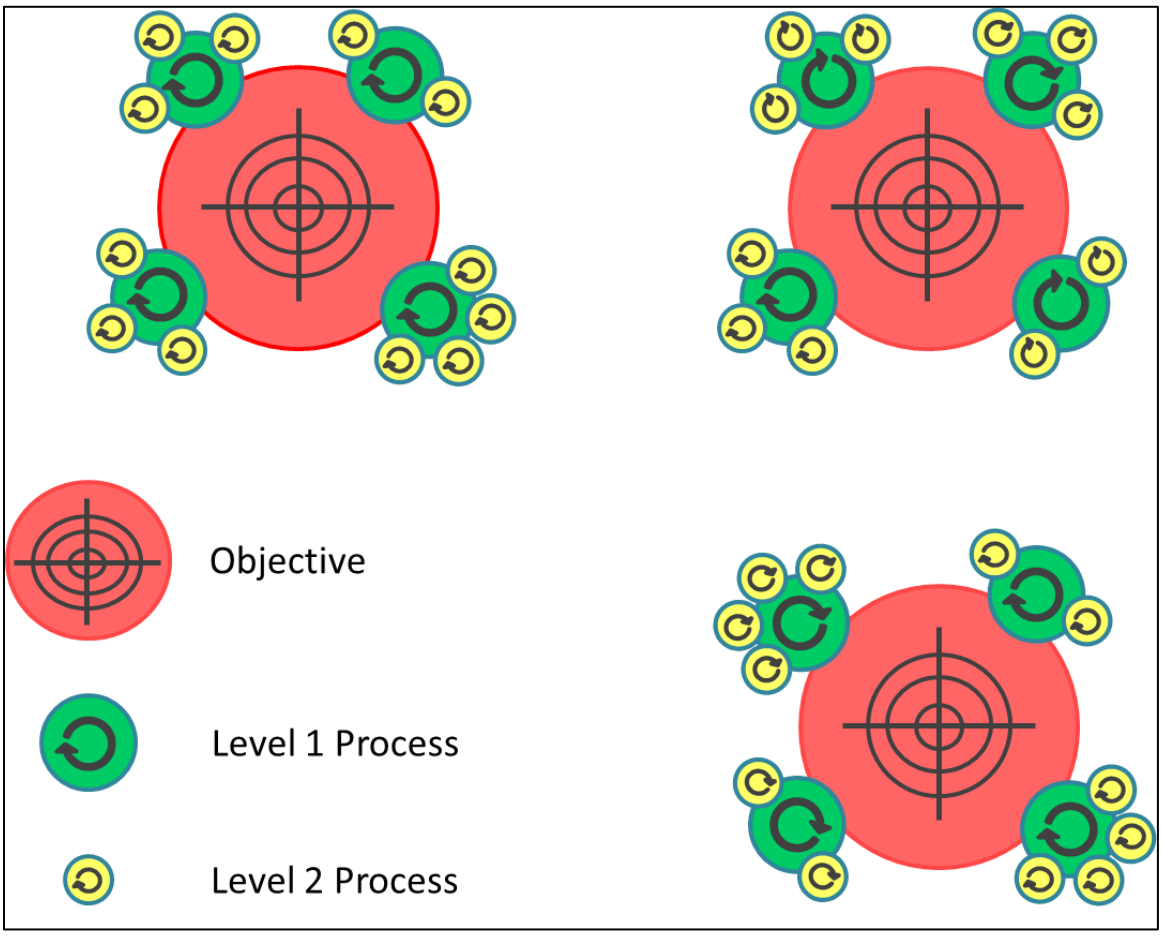

Figure 3 – Objectives and processes

Moreover, to reflect the different scales within operations, there is a hierarchy to the processes addressing each objective. The hierarchy can be linked to the hierarchical structure of the force, to their geographical distribution, or to the levels of war. Thus, the level 2 processes would be defined as sub-processes of the level 1. For example, if the objective is to "secure an area", the level 1 processes could be: "securing the urban areas", "securing the roads" and "securing the airspace above the area". The level 2 processes of "securing the airspace above the area" could be to "fly defensive counter air

missions in the airspace" and to "operate ground-based air defenses in the area". In this example, the hierarchy is linked to the structure of the air component.

Eventually, establishing objectives and launching processes will set the conditions for the emergence of decisive occasions that will lead to success in the operation. As a matter of fact, this is not a linear approach. It is open to creative options and also does not need "branch" plans since contingencies are part of the plan. Indeed, on the one hand, not all the processes have to be successful, as long as their overall combination is. On the other hand, the objectives and its associated processes are to be redefined iteratively therefore the plans are continuously adapted to the situation. Nonetheless, this does not preclude from anticipating failures and preparing for how to deal with their consequences.

Finally, the main focus remains the design of the operation in order to change the current state. Thus, the plan that describes the objectives and synchronizes its associated processes is meant to be in support of design and not the other way around.

3.3. A different way in conducting operations

A different practical approach to warfare induces a different way in conducting operations. The main difference is in dealing with uncertainty. A design centric and process-based way of thinking about warfare is by essence made to cope with uncertainty. Eventually, it will also give another perspective to the end of an operation and the definition of an acceptable state.

3.3.1. Dealing with uncertainty

Despite the advanced technology involved in information age warfare and especially its great capacities to collect intelligence, commanders still have to deal with

uncertainty when they give their orders. As Vincent Desportes writes, "the key to an efficient command will still be, in the end, its capacity to deal with uncertainty."[154] Thus, even with a different approach to understanding the situation, and designing operations, as it has been suggested in this paper, uncertainty will remain an issue that needs to be addressed. In fact, by acknowledging the complexity of warfare and its emergent property, uncertainty is already part of the equation. However, since the approach developed in this paper does not use a reverse-engineering process, there is less uncertainty to start with. Indeed, predictions cannot be totally certain and therefore applying a reverse-engineering introduces more uncertainty than using an iterative campaigning process.

As it has been explained previously, the approach defined in this paper relies on creating the conditions for the current state to move towards the desired state. The objectives defined in the design of the operation are supported by processes that must be launched in order to create these conditions. Thus, the first challenge for the commander is to carefully choose the starting point of the process. Indeed, before launching a process there will obviously be some linear preparation time and a necessary risk assessment that require to be taken into account by the commander.

However, one could argue that without a clear end state and a linear pre-determined COA these "processes" will lead nowhere, like a dog chasing its tail. In fact, this approach does have a desired state towards which its efforts are concentrated, but the desired state is part of the design. The processes are made to have an impact on the objectives which will change the operation environment and require reframing the design. The OODA loop thus becomes an Observe-Design-Decide-Process (ODDP) loop.

[154]Vincent Desportes, *Decider dans l'incertitude* (Paris: Economica, 2015), 208.

Furthermore, the approach does not preclude from anticipating unpredictable situations. Actually, an unpredictable situation resulting from the emergence of significant events is not necessarily unexpected, since it is one of the principles underpinning this approach. Therefore, alike being prepared to seize the occasions that will emerge from the process, the commander must be prepared to face the consequences of "negative" emergence. This means working to being prepared to deal with the consequences of such emergences rather trying to predict when these events might happen.

3.3.2. An acceptable state

As the operation changes the current state and makes it moves towards one's desired state, it might happen that the current state cannot reach the desired state, or that its evolution becomes insignificant compared to the risks taken by the forces and the energy put in the processes. This state corresponds to a point of equilibrium. In fact, at this point the friendly's repulsive interactions with the current state, and the enemy's attractive interactions, are as strong as the friendly's attractive interactions and the enemy's repulsive interactions (cf. paragraph 3.2.2 and figure 2).

For example, in counter-insurgency war, when after a time, there is hardly any more progress in the situation. At this point, the friendly force has reached a maximum in what it can do to increase the security of the operation area (friendly attractive interaction), the enemy force still has an influence since it is capable of convincing people to fight for them (enemy attractive interaction) and the population is becoming reluctant to the presence of friendly forces (friendly repulsive interaction). This is an equilibrium point in the operation that should be addressed.

Different options are possible when facing this point of equilibrium. First option is to continue the on-going operation as it is, and accept the slow progress as regards to the efforts put in the operation. Second option is to change the design of the operation and find new options. These options can be new objectives and new processes. Third option is to consider the situation as an acceptable state for the end of the operation that is different from the desired state.

The acceptable state is then to be considered as an equilibrium point where an occasion emerges for the beginning of the disengagement of the forces. An occasion to achieve what Galtun[155] names "negative peace." However, the course of events will obviously not stop at this point. In fact, the acceptable state relates directly to an operation, as the end state does today, but without being considered as an "end" but as a "transition".

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Eventually, this third part has defined a different way of thinking about warfare in the information age. To start, it has looked at what in the Western way of thinking could be challenged by an Eastern perspective. Unfortunately, it appears that the Western way of thinking and its philosophical taste for models is not as adaptable as it could be since it uses theoretical concepts as a set of durable norms. In fact, its perception of time and plans values an "action-based" approach to warfare.

From a different viewpoint, a "process-based" approach would focus on the conditions that need to be fostered in order to create the necessary momentum to change the current situation. Moreover, this approach would also change the priority of design

[155]Johan Galtun, "Violence, Peace and Peace Research," *Journal of Peace Research* 6, no.3 (1970):183.

over planning. In fact, this perspective would be supported by the design schema and the combination of objectives and processes suggested in this part. Therefore, the conduct of the operation would cycle through an ODDP loop to deal with uncertainty and, consider terminating the military engagement at an acceptable state if the desired state is not attainable.

Up to today, "action-based" planning has been supported by the Western's appetite for technology in its way to wage war. The "process-based" approach focusing on design, suggested in this paper, can give more credit to the thinking process. Even if there is little doubt that technology will still play a major part in warfare, this perspective should help rebalance the technological bias. As a matter of fact, with design, thinking is not an option.

CONCLUSION

Information age technology has considerably shaped contemporary warfare. However, it appears that this is more a consequence of the Western way of thinking than of the technological breakthroughs themselves. In fact, information age technology and especially its capacity to create networks, has changed societies and eventually the way to wage war. However, throughout the eras, the Western way to think about warfare has always been under the influence of its philosophy which has focused on models and given a primacy to actions since its origin is in Ancient Greek philosophy. Therefore, information age technology has been used in line with these concepts. With cutting edge technology, decisive actions are believed to be able to create decisive effects which will then change the outcome of an operation. Nonetheless, when considering warfare as a system, technology has also changed it into a CAS with non-linear and emergent properties that challenge the idea of decisiveness when it is only seen as a result of specific actions.

The Eastern way of thinking has evolved independently from the philosophical concepts developed in the Western world. It focuses on the course of events as a continuous transformation and thus values the processes rather than the actions underpinning these processes. Therefore, from this viewpoint and in thinking about warfare, one should rather focus on developing processes that will create the conditions for the emergence of decisive occasions. This perspective highlights the necessity to think about operations rather than to act which gives credit to design over planning. The idea is to understand in depth the environment and the current state, its propensity and potentials, its interactions with the different stakeholders, in order to define ones

objectives. These objectives will then be addressed through different processes. Since technological breakthroughs are not paramount in this approach, they will only come in support.

Therefore, this paper suggests a different approach in thinking about warfare that is inspired by the Eastern way of thinking. However, it does not disregard the Western's philosophical heritage. Most of the ideas about warfare come from the Western way of thinking. The concept of CAS has been developed by Western thinkers that were either influenced by analytical or continental philosophical epistemologies. Thus, the goal is more to challenge the core principles that buttress the Western way to wage war.

It appears, that design methodology is adapted to foster the approach developed in this paper. Indeed, it is sufficiently open to different philosophical concepts to enhance a way of thinking about warfare based on the primacy of processes. This paper suggests a design schema to support this approach. The idea is to use a descriptive viewpoint rather than a model in order to think about warfare. Nonetheless, the way to understand the "current state" will be determining in defining the objectives and the associated processes to wage war. The design schema does not suggest any specific approach though at some point it will need to be holistic since in complex systems the whole is an intricate sum of its parts. Nevertheless, the schema does not exclude analytical thinking as it is also part of the equation in understanding what relies on causal links in complex phenomena. Eventually, this paper suggests that operations cycle through an ODDP loop rather Boyd's OODA loop as it is design and processes that will address the issues of complexity in warfare, thus reinforcing the ability to cope with the everlasting uncertainty of war.

However, technological evolutions will, in turn, certainly challenge the approach developed in this paper. For example, the advent of artificial intelligence will undoubtedly influence how to approach complex phenomena, as computer technology changed the perception of non-linearity and chaos. In fact, the main idea here is that thinking and technology constantly interact. Thus, technological evolutions can enhance a broad way of thinking about warfare and creative thinking can imagine new ways to make use of technological evolutions.

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