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CHALLENGES FOR THE COMMAND AND CONTROL SYSTEMS IN THE INFORMATION AGE

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Abstract: *The exponential technological development that we faced in the last period put in the hand of military deciders, for all levels, increasingly sophisticated tools to support their actions and an unlimited quantity of information available in a large diversity of forms. The question that we try to answer is whether the command and control systems, as they are built today, can access, and efficiently use this information or they must adapt themselves to go through the new challenges.*

Keywords: information age, command and control, communication systems, network

1. Introduction

The history of humankind and, implicitly, the military conflicts that have always accompanied it, can also be seen as a permanent adaptation of technological developments to armed forces needs in order to optimize them and obtain superior effects compared to the declared or not declared adversaries. The military power of a state is, further, the most consistent guarantor of its independence and sovereignty, even more so in the conditions of complexity and insecurity that have been manifested in the recent period. That is why we can state, without fear of being wrong, that the faster an army has the ability to adapt to technological innovations, the more it will be able to exercise its role as a guarantor of national security. "*Obviously information age technologies and the modern management concepts has a great influence of the army for the point of organisation, endowment, training, fighting, protection and the way to conflict solving*" [1] but the simple modernization or replacement of some categories of weapons proved not to be sufficient for the appropriate adaptation of the concepts of conducting military actions at all levels. In the present article, we aim to identify, without intending to be exhaustive, some of the challenges facing command-control systems in the information age, and also some solutions that we have identified for their implementation.

2. Command and control systems in the information age

The main transformation that the information age has brought to the military field, and not only that, is the huge amount of information available almost in real time, which makes decisions much faster and more efficient. At the heart of any military organization or process, command

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and control appear to be the main beneficiaries of this progress, and how well command-and-control systems are able to receive, process and disseminate it in a timely manner depends on the success of a military action. The basic concept that lies in the middle of the new transformations is the concept of the network, and it was defined some time ago by the concept NCW [2] (Network Centric Warfare) and also tested and experienced in recent operations such as Bosnia, Kosovo, Afghanistan, Iraq and Ukraine, but we appreciate that the full understanding and implementation of this concept is only at the beginning of the road. As always, the development of a transformation process cannot take place at the same time, at the same level or at the same speed for all components of a system, there are always some that seem to evolve faster and others that show reluctance to the transformation process itself or to which adaptation to new technological developments becomes more difficult. NCW essentially involves translating informational superiority into combat power by connecting information-carrying entities on the battlefield. Practically by connecting in the network the main actors, respectively sensors, command posts and shooters, the aim is to significantly increase the chances of success of a mission by distributing information, increasing the speed of command, increasing the tempo of the operation, increasing the lethality, increasing the survivability and achieving a high degree of self-synchronization.

The command-control process viewed from a broad perspective is the process by which all decisions related to a military action are substantiated and taken regardless of its scale or level. For this, the operation of the trinomial information - communications - decision is essential for the proper functioning of the process, as well as of each subdivision separately and the way they mutually support each other give coherence and consistency to the process itself as well as to the system that supports it, respectively C4ISR (Command Control Communication Computer Intelligence Surveillance Reconnaissance). Information is, without a doubt, the raw material of the entire decision-making process and the way it is collected, processed, transported, and delivered is vital for it, or precisely this - information is also the main actor of the transformations already present in our everyday life. From the perspective of the command-control process, achieving informational superiority is equivalent to achieving success in battle. But in order to achieve this goal, the command-control systems must be designed, constituted, endowed and framed so that they can reach the desired level of efficiency, which can mean a radical change of paradigm and a different approach to them compared to the traditionally known way.

3. Challenges from the Information Systems

A first set of challenges to command-control systems comes from information systems, specifically how they should adapt to new ways of obtaining and distributing the necessary information to make the most of it. From this perspective, a major challenge is the huge amount of information available at a given moment and which, in order to be exploited, must be analyzed, ranked and distributed at a high speed to be exploited during its validity which, in the modern battlefield, is getting shorter and shorter. It is obvious that lack of information leads to "*lack of predictability*" [3] in the implementation of plans, but this aim involves the existence of staff structures able to go through this process at high speed and to be assisted by efficient software products which, in turn, are able to deliver the information in the required formats. Thus, a first conclusion could be the very way the personnel who frame the command posts should look from this perspective, what training and what skills they should have in order to be able to face the current technological challenges and be able to operate an increasing

number of decision support tools in an efficient and timely manner. We appreciate that the officers of the future, regardless of the army services they belong, should have solid skills and abilities in the operation of complex IT (Information Technology) systems, be able to adapt quickly and efficiently to the exponential changes existing in this field to give coherence to the whole process without any discrepancies. This implies the start of an extensive process of re-analysis of the system of initial and continuous training of future officers, and equally of the other categories of personnel, who can obtain the necessary skills as early as possible and later be able to improve and train them in order to quickly adapt to collaborative work in the network and be able to efficiently manage a large amount of information.

In other point of view, the unprecedented development of information systems manifested both by the increase in quantity and quality but also by the increased speed of their processing and transmission is likely to leave its mark in the future on the way of organization and operation of the command post in the sense of creating modular, space-dispersed and multifunctional structures. The new paradigm of providing the information necessary to support the military decisions is to transform it from a "goods" identified, requested and delivered to those who request it as it happens in traditional systems, into a "resource" available on the network from which each decision maker can take what he needs at a given time. This transformation is likely to implicitly lead to a new typology of the organization of command posts in the sense that the commander no longer needs so many staff members around him, a small decision and advisory team being sufficient for him, the rest of the staff can be dispersed in functional modules arranged in protected locations disposed at relatively large distances from the commander and from there feed the command team with the necessary information. Also, these specialized modules could support with information several structures participating in an operation without necessarily being part of their structure, something that could lead to a reduction in the number of personnel in the units' headquarters, thus increasing the degree of mobility and flexibility. The current and future capabilities of communication and information systems make this thing possible due to the increased speeds and capacities of information transfer as well as the unlimited possibilities of connecting numerous entities to the network and stay in limits of the NATO doctrine that state that "[*t]he commander should organize its staff, as deemed necessary to optimize its ability to plan, conduct and support the operation successfully*" [4].

Such a scenario, which seems increasingly feasible with today's technologies, also implies a series of new challenges for command-control systems, of which we consider information security to be paramount. There is no doubt that the increase in the amount and speed of information transmission is not desirable to happen at the expense of their quality because the advantage thus obtained is very fragile and can quickly turn into a weakness. That is why more attention must be paid to increasing the degree of security of the information that is delivered to the decision-makers, something that can be achieved both through technical systems and through operating procedures at the level of all actors involved. If from the point of view of ensuring technical systems things are essentially relatively simple because there are a multitude of effective products available, the only problem is to establish an appropriate strategy and finance them establishing effective information security procedures. This is a more complicated and lasting process which should represent a constant concern of all decision makers. In arguing this statement, we would like to emphasize the fact that in the middle of this approach are personnel of all categories, who should

have formed a solid security culture. Unfortunately, this desire cannot be achieved overnight, but it must be started during their training period and developed throughout their entire career, depending on the positions hold by each one. We return, thus, to the need to create a coherent and efficient system of initial and continuous training of military specialists, which we consider to be of overwhelming importance in this period. It must also be clearly understood that the formation of a security culture is not the objective of specialists working in the field of information or communications, but must be an objective of all military specialists, regardless of the army services they belong.

4. Challenges from the communication and information systems

Another series of challenges, equally important, to the command-control systems comes, this time from the communications and IT systems whose unprecedented development could not but influence their way of organization and action. We can state, without fear of being wrong, that the communication and information systems were the first elements to rise in the "network", thus opening the way for similar developments on the part of the other elements of the system. Their detachment from the traditional hierarchical organization demonstrated that an increased efficiency of communication and information support can be obtained without the need for an identical organization to the other elements of the system, and in particular the decision subsystem. A challenge, at that time, was the reduction of the dependence of the layout of the command posts on the layout places of the communication centres (as their component elements) which were, in turn, dependent on the technical characteristics of the equipment used (visibility of the antennas, the beat of radio stations, etc.). Thus, in the case of traditional systems it happened in most cases that the locations of command posts were decided to a significant extent based on the proposals of communication and information specialists due to the existing limitations regarding the disposition of radio and radio relay equipment in particular. The changes in the topology of the communications and information systems, among other advantages, also led to the freedom of commanders to decide the places of command posts according to functional and efficiency criteria. Also, the evolution of communications and information systems led to the emergence of a new category of support, namely command and control support, which includes communications and information forces and reconnaissance forces, which until then had been included in the category of combat support forces. We appreciate that the further development at the same pace of the communication and information systems is likely to bring new challenges to the command-control systems, of which we would like to highlight some.

The increase in transmission capacities and implicitly the speed with which information circulates through communication channels, as well as the growing complexity of the equipment used, could mean in the near future the need for the existence of some structures or at least some specialized people at the level echelon's subunit (company, platoon) that is able to effectively manage these systems in support of the fighting forces at these echelons. This is also predictable because, as seen in the conflict in Ukraine, we are witnessing an increase in the operational independence of these echelons at the tactical level both independently and in conjunction with other combat support subunits, not at all unlikely to see in the future at least at the level of the companies, the need for micro command-control structures or at least the provision of this support by the entities of the command posts of the higher echelons.

Another category of challenges, somewhat similar to those presented in the case of information systems, derives from the

increasing complexity of user interfaces and decision support software products that implied the existence of command and staff personnel with high skills in using their efficiency, which means the formation of these skills from the time of their formation and their development throughout their entire career in order to give coherence and effectiveness to the process. This approach is not a simple one at all, it requires a high degree of predictability and vision regarding the products used, and the skills needed for each of them, but we appreciate that this is the only way to go in the future.

5. Conclusions

Without pretending to exhaust all possible challenges facing command-control systems, our analysis wishes to bring to the attention of those concerned the need for continuous adaptation to technological progress, which, if carefully anticipated, planned and executed, can only lead to increase the efficiency of military actions carried out at all echelons in the particularly complex, dynamic and flexible conditions of the modern battlefield.

References List

[1] Roceanu I. Fundamente ale Sistemelor C4I, Editura Universității Naționale de Apărare, 2004, p. 7.

[2] Alberts D., Garstka J., Frederick P. & Stein F. Network Centric Warfare: Developing and Leveraging Information Superiority, 2nd Edition (Revised), Washington, DC: CCRP Publication Series 1999.

[3] Anton M. Hybrid Pedagogies for Hybrid War. In: Scientific Research and Education in the Air Force. Brașov: "Henri Coandă" Air Force Academy Publishing House; 2016, p. 512.

[4] NATO. Allied Joint Doctrine for the Conduct of Operations, Brussels: NATO Standardization Office; 20