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Applicability of Artificial Intelligence in Decision-Making for Land Forces

Použitelnost umělé inteligence v rozhodovacím procesu pozemních sil

Paul Tudorache

Abstract: Similar to other fields, also in the military one, the Artificial Intelligence has become recently an evident solution for optimizing specific processes and activities. Therefore, this research paper aims to highlight the potential uses of Artificial Intelligence in the military operations carried out by the Land Forces. In this regard, analysing the framework of the operations process and applying suitable research methodology, the main findings are related to AI's contributions in optimizing commander's decisions during the progress of planning and execution. On the other hand, picturing the AI upgrated combat power of the Land Forces is another significant result of this study.

Abstrakt: Podobně jako v jiných oblastech, také ve vojenské oblasti se umělá inteligence stala v poslední době evidentním řešením pro optimalizaci konkrétních procesů a činností. Cílem tohoto příspěvku je upozornit na možnosti potenciálního využití umělé inteligence ve vojenských operacích prováděných pozemními silami. Hlavní zjištění založená na analýze rámce procesu operace s využitím vhodné metodologie výzkumu se týkají vlivu umělé inteligence na optimalizaci rozhodnutí velitele během procesu plánování a vedení operací. Dalším významným výsledkem této studie je představení umělé inteligence jako nástroje zvyšující bojovou sílu pozemních sil.

Key words: AI; Operations Process; MDMP; Adjustment Decisions; Combat Power.

Klíčová slova: UI; proces operace; vojenský rozhodovací proces; aktualizace rozhodování; bojová síla.

INTRODUCTION

The interest of the world countries to develop Artificial Intelligence (AI), with wide applicability in various fields, has grown lately, becoming at this time a real competition between state actors. Specific to the military field, different armies, trying to gain operational advantages over their opponents, make huge efforts to revolutionize their military capabilities by developing and integrating AI into suitable activities and processes. By far, the most advanced armies in the field of AI development are those belonging to the United States of America (USA), Russian Federation and China, whose strategies cover all physical areas of the operational environment (OE), including space, and information environment with its component of cyberspace.

To emphasize the need of using AI in the military field, various researches have been conducted, which have concluded that AI has a multiple applicability, ranging from decision-making, intelligence, surveillance, reconnaissance (ISR) and all its derivatives, cyber defence, information operations (IO), up to anti-access/area-denial (A2/AD), and so on. In this sense, one of the most interesting surveys is RAND Project Air Force (PAF), completed in 2018, and whose primary scope consisted in identifying the most important AI's military applications in the USA, Russian Federation and China¹ (figure 1).

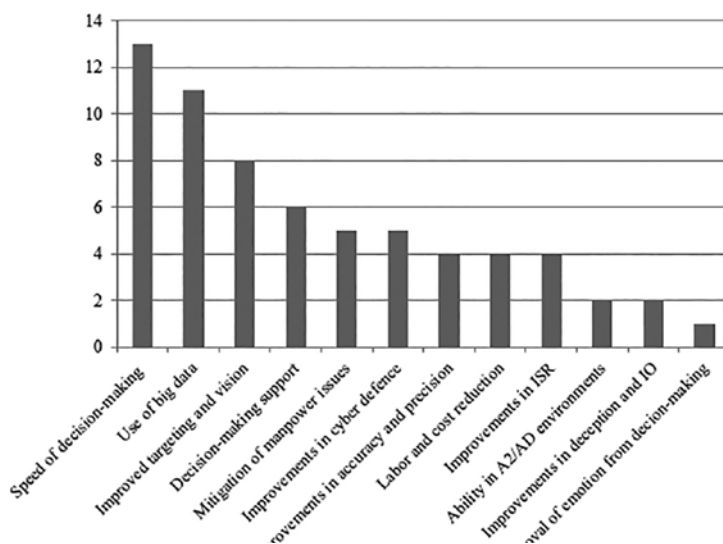


Figure 1: Applicability of AI in the military field

¹ MORGAN, Forrest, BOUDREAUX, Benjamin, LOHN, Andrew, ASHBY, Mark, CURRIDEN, Christian, KLIMA, Kelly and GROSSMAN, Derek. *Military Applications of Artificial Intelligence: Ethical Concerns in an Uncertain World*. Santa Monica, California: RAND Corporation, 2020, pp. 5-6. ISBN 978-1-9774-0492-3. [cit. 2020-12-20]. Available from: bit.ly/2KMtOII.

Source: MORGAN, Forrest, BOUDREAUX, Benjamin, LOHN, Andrew, ASHBY, Mark, CURRIDEN, Christian, KLIMA, Kelly and GROSSMAN, Derek. Military Applications of Artificial Intelligence: Ethical Concerns in an Uncertain World. RAND Corporation. 2020, p. 16. ISBN 978–1-9774-0492-3. Available from: bit.ly/2KmtOI

Another important perspective to consider is the one adopted by North Atlantic Treaty Organization (NATO), according to which, AI development becomes a priority for the next 20 years, imprinting the following areas: decision-making, command, control, communications, and computers (C4) correlated with the ISR field (C4ISR), weapons and effects, platform autonomy, planning capabilities, chemical, biological, radiological and nuclear (CBRN), medical, enterprise management, logistics, cyber and info-space, training². In the same report, it is stated that NATO's opponents will try to develop AI for revolutionizing cyber, information, aberrant behaviour, and improvised explosive device (IED) capabilities³. A broader approach to NATO's trends in AI developments (time horizon 2035) is pictured in table 1.

Table 1: NATO's perspectives in AI development – time horizon 2035

Emerging, Disruptive Technology - AI	Technology Focus Areas	Estimated Impact	Technology Readiness Levels (TRL)	Estimated Time Horizon
	Advanced Algorithms	Revolutionary	TRL 4 – component and/or breadboard validation in a specific laboratory	2030
	Applied AI		TRL 6 – system/ subsystem/ prototype demonstration in a specific environment	
	Human-Machine Symbiosis	High	TRL 4 - component and/or breadboard validation in a specific laboratory	2035

Source: STO. Science & Technology Trends 2020-2040: Exploring the S&T Edge. Brussels: NATO Science & Technology Organization. 2020, p. 15. Available from: bit.ly/3rWz1rx

All these developments will be integrated in the principle of “*intelligent, interconnected, distributed and digital (I2D2)*”⁴, impacting the military capabilities, and especially those used in decision-making.

As can be seen from the beginning, one of the most important AI applicability in the military field is to optimize decision-making processes, with positive impacts on its effectiveness and efficiency.

² STO. Science & Technology Trends 2020-2040: Exploring the S&T Edge. Brussels: NATO Science & Technology Organization, 2020, pp. 55-56. [cit. 2020-12-20]. Available from: bit.ly/3rWz1rx.

³ Ibid. p. 56.

⁴ Ibid. p. 7.

1 RESEARCH METHODOLOGY

Taking into consideration these preliminary theoretical aspects, the purpose of this study is to determine some potential uses of AI for optimizing decision-making in the field of Land Forces' operations. The objectives, derived from the purpose of the study, are limited to: identifying the AI possibilities for optimizing the operations process; visualising AI contributions to the optimization of decision-making.

To cover these objectives are defined two research hypotheses: AI's capabilities influence in a positive fashion the Land Forces' operations process; during Land Forces' operations, the decisions of tactical commanders largely depend on the development and integration of AI's capabilities into suitable planning and execution activities.

Consequently, this study is conducted using the following research methodology:

- Reviewing the relevant literature – substantiates from theoretical stand point the proposed scientific approach;
- Empirical research based on observation – aims to exploit the elements resulting from the personal experience in the field of military operations accumulated as a result of multinational missions, exercises and training initiatives, in which I took part;
- Strengths, weaknesses, opportunities and threats (*SWOT*) analysis on the use of AI in the Land Forces' operations—aims to identify the positive and negative aspects so as to support the validation of the formulated hypotheses.

2 LITERATURE REVIEW

In connection with this research, there is an abundance of relevant studies conducted in the field of optimizing military operations using AI technology. Although most studies have valuable results, the most relevant are:

- "Artificial Intelligence and Operational-Level Planning: An Emergent Convergence" – analyzes the benefits of upgrading the division-level planning methodology using suitable AI tools; although the study concluded that AI can support significant aspects of division-level military decision making process (MDMP), also would be necessary to analyze the potential benefits of AI for combat functions⁵;
- "Artificial Intelligence and the Future of the Operational Art" – evaluates the possibilities in which AI may facilitate the operations process; performing two case studies, the most relevant results are related to the enhancement of operational art and mission command, using AI tool as a force multiplier⁶;

⁵ BRANCH, William. Artificial Intelligence and Operational-Level Planning: An Emergent Convergence. Kansas: Fort Leavenworth, 2018, pp. 47-48. [cit. 2021-05-19]. Available from: bit.ly/2S4DYB5.

⁶ OLIVA, Lazaro. Artificial Intelligence and the Future of Operational Art. Kansas: Fort Leavenworth, 2018, p. 36. [cit. 2021-05-18]. Available from: bit.ly/3yfnAOJ.

- “A Tactical and Strategic AI Interface for Real-Time Strategy Games” – introduces AI interfaces into Soar and Simulation Based Tactics Mining (SBTM) tactical systems to help commanders and staff in exercising command and control (C2) tasks⁷;
- “Artificial Intelligence for Decision Support in Command and Control Systems” – approaches the use of AI for decision-making in intelligence and operation processes, based on observe, orient, decide, and act (OODA) loop; most important findings are located at C2 level during the activities of sense-making, planning and execution.⁸

3 OPERATIONALIZATION OF CONCEPTS

In carrying out this study, it will be used the following concepts: AI, operations process, planning, execution, MDMP, execution decisions, adjustment decisions, and combat power. In this research, the concepts will be used with the following meanings:

- AI - *“the ability of machines to perform tasks that normally require human intelligence – for example, recognizing patterns, learning from experience, drawing conclusions, making predictions, or taking action – whether digitally or as the smart software behind autonomous physical systems”*⁹; during this study, AI will be used as an independent variable which will be transposed at the level of each subsequent concept (dependent variable);
- Operations process - *“the major command and control activities performed during operations: planning, preparing, executing, and continuously assessing the operation”*¹⁰; during the research will be analyzed only planning and execution activities;
- Planning - *“the art and science of understanding a situation, envisioning a desired future, and determining ways to bring that future about”*¹¹; it is the primary activity that starts the operations process;
- Execution - *“the act of putting a plan into action by applying combat power to accomplish the mission and adjusting operations based on changes in the situation”*¹²; in other words, it can be resumed at putting into practice the generated plan respecting the commander’s intent;

⁷ VAN LENT, Michael, CARPENTER, Paul, MCALINDEN, Ryan, TAN GUAN, Poeny. A tactical and Strategic AI Interface for Real-Time Strategy Games. California: University of Southern California, 2004. [cit. 2021-05-19]. Available from: bit.ly/3v0kgFa.

⁸ SCHUBERT, Johan, BRYNIELSSON, Joel, NILSSON, Mattias, SVENMARCK, Peter. Artificial Intelligence for Decision Support in Command and Control Systems. Florida: ICCRTS, 2018. [cit. 2021-05-19]. Available from: bit.ly/2QBzv8A.

⁹ USAF. The United States Air Force Artificial Intelligence Annex to the Department of Defence Artificial Intelligence Strategy [online]. 12.09.2019 [cit. 2020-12-22]. Available from: bit.ly/37HhPOB.

¹⁰ ADP 5-0. The Operations Process. Washington, DC: Headquarters, Department of the Army, 2019, p. 1-4. PIN: 102805-000. [cit. 2020-12-22]. Available from: bit.ly/3u6R26Q.

¹¹ Ibid. p. 2-1.

¹² Ibid. p. 4-1.

- MDMP - *"an iterative planning methodology to understand the situation and mission, develop a course of action, and produce an operation plan or order"*¹³; it is the planning methodology used by tactical structures with organic staff, based on detailed planning;
- Execution decisions - *"implement a planned action under circumstances anticipated in the order"*¹⁴; practically, these decisions are equivalent with decisions points (DPs) identified during the wargaming phase;
- Adjustment decisions - *"the selection of a course of action that modifies the order to respond to unanticipated opportunities or threats"*¹⁵; in other words, they represent those DPs that commander did not meet in the wargaming the courses of actions (COA);
- Combat power - *"the total means of destructive, constructive, and information capabilities that a military unit or formation can apply at a given time"*¹⁶; it is shaped by the interdependence of the following elements *"leadership, information. command and control, movement and maneuver, intelligence, fires, sustainment, and protection"*¹⁷; besides leadership and information, the other elements represent combat or warfighting functions.

The logic algorithm of the study is based on correlating the analyses that will be carried out for all dependent variables. This will be useful for accomplishing the purpose and objectives designed in the preamble of this research (figure 2).

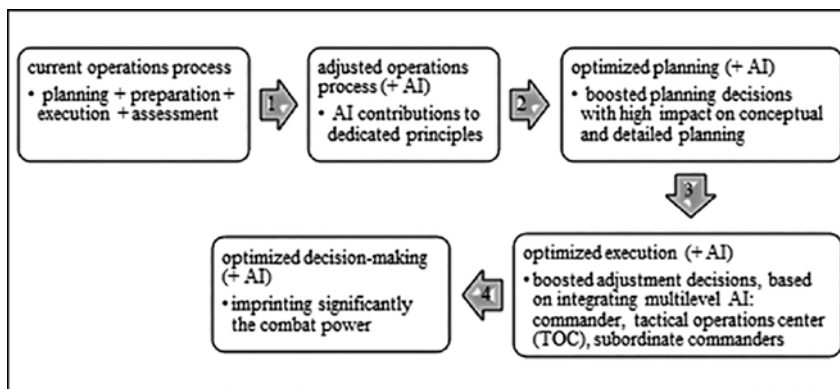


Figure 2: The logic algorithm of optimizing decision-making using AI capabilities

¹³ Ibid. p. 2-17.

¹⁴ WADE, Norman. BSS5 Smart Book: The Battle Staff – Leading, Planning & Conducting Military Operations. Florida: The Lightning Press, 2015, p. 1-56. ISBN: 978-1-935886-63-1.

¹⁵ Ibid.

¹⁶ ADP 3-90. Offense and Defence. Washington, DC: Headquarters, Department of the Army, 2019, p. 1-4. PIN: 102987-000. [cit. 2021-04-28]. Available from: bit.ly/32YfwTv.

¹⁷ Ibid.

Therefore, solving this research topic can be limited to approaching each piece of the puzzle above, having as an initial point the adjustment of the current operations process from AI perspective.

4 ADJUSTING THE OPERATIONS PROCESS USING AI CAPABILITIES

From the personal researches conducted so far in the field of Land Forces, the general framework of AI applicability is the operations process. Also in starting the validation of the research hypotheses it will be used the results of SWOT analysis from table 2.

Table 2: SWOT analysis on using AI in the Land Forces' operations

Strengths	Weaknesses
- amplifying the combat power of organic elements; - optimizing the activities and their dedicated principles of the operations process; - improving the fulfilment of the dedicated personnel's responsibilities and tasks; - making coherent and timely decisions	- manifesting the limitations on its use, especially from the perspective of expressing emotions; - huge efforts in developing and integrating it into the military operations
Opportunities	Threats
- boosting it by correlating with other types of new military technologies; - replacing the combatant personnel with dedicated AI elements; - supplementing the mental agility of commanders and subordinate personnel during operations conducted in volatile, uncertain, complex and ambiguous (VUCA) OEs	- accentuated dependence on using it by organic staff and structures; - making decisions instead of commanders and dedicated staff during different situations

Considering the results of SWOT analysis (strengths), definitions given above and the principles dedicated to the operations process such as driving the operations process, building/maintaining situational understanding, and applying critical and creative thinking¹⁸, in table 3 are highlighted some of the possible AI contributions in supporting Land Forces' commanders and staffs during the progress of military operations.

¹⁸ ADP 5-0. The Operations Process. Washington, DC: Headquarters, Department of the Army, 2019, p. 1-7. PIN: 102805-000. [cit. 2020-12-22]. Available from: bit.ly/3u6R26Q.

Table 3: AI contributions during the operations process

Principles of operations process	AI contributions
Driving the operations process	Supporting commander and dedicated headquarter (HQ) in: understanding the OE/ Area of Operation (AO); visualising the desired end state; describing the commander's visualisation; directing combat functions and subordinate forces.
Building/maintaining situational understanding	Enhancing/updating/optimizing: operational/mission variables; intelligence process; running estimates; collaboration and liaisons between structures and other partnered forces.
Applying critical/creative thinking	Supporting the commander and dedicated HQ in: making judgments by extracting and correlating the intelligence products provided; finding solutions for approaching unfamiliar situations.

To avoid misunderstandings, AI capabilities will not replace the commander during the progress of the operations process, but will support him through counseling activities, so as to maximize the probability of performing the actions triggered by his decisions. On the other hand, within this whole spectrum of activities, the essence of using AI will be materialized in the quality of commander for driving the operations process, and for this reason the most targeted element for optimization will be the commander's intent. In the same manner, related to the staff – AI relationship, the last one will support its organic elements (S2, S3, and so on) to assist commander throughout the operations process. The most targeted elements of AI optimization will be:

- understanding the situation - involves the enhancement of creating the common operational picture (COP);
- implementing commander's decisions and exercising the control over the operation - through optimizing the TOC activity;
- assessing the progress of the operation - involves the improvement of measures of performance (MOP) and measures of effectiveness (MOE).

Also, all these findings can be supported by similar results according to which, possessing this technology, "the commander and his staff can leverage AI to facilitate the operations process. AI will serve as a force multiplier through the planning, preparation, and execution"¹⁹.

Consequently, having all these AI contributions to the operations process, it can be stated that the first research hypothesis is validated. In this manner, the operations process will be much more robust, whose application will ensure the operational flexibility necessary to generate the desired lethal/nonlethal effects, and implicitly the desired end state.

¹⁹ OLIVA, Lazaro. Artificial Intelligence and the Future of Operational Art. Kansas: Fort Leavenworth, 2018, p. 35. [cit. 2021-05-18]. Available from: bit.ly/3yfnAOJ.

5 AI CONTRIBUTIONS TO DECISION-MAKING

Although AI is beneficial to all activities describing the operations process, the follow up analysis will be directed at the level of planning and execution, due to the fact that the effects of using AI are much more visible on these activities. Practically, I will analyze the aspects of decision-making in planning and execution, from the perspective of integrating specific AI capabilities.

5.1 Optimizing decision-making during tactical planning

Even though most decisions are made during execution, they are also the subject of operation's planning. At tactical level, for military structures with organic staff, the context of decision-making is shaped by the MDMP, used by the majority of Land Forces from NATO, as detailed planning. Addressing previously the issue of adapting the MDMP by integrating AI capabilities, the conclusions drawn in the study conducted under Romanian Ministry of National Defence (MoND), which I led it as a project manager²⁰, can be summed up in that AI is suitable for all dedicated steps including 20 tasks, as follows²¹:

- Step I/Receipt of mission - 3 tasks: running estimate, initial situation's assessment, and initial commander's guidance;
- Step II/Mission analysis – 7 tasks: initial intelligence preparation of the battlefield (IPB), identifying critical facts and developing assumptions, initial risk management (RM), initial development of commander's critical information requirements (CCIR), initial commander's intent, initial mission statement, and initial planning guidance; from all these tasks, special attention should be paid to IPB, as well as to mission statement and commander's intent, the last two coagulating in the foundation of developing friendly forces COAs;
- Step III/COA development – 4 tasks: assessment of the relative combat power, arraying forces, generating the tactical options, and developing a broad concept; for the task of generating options, AI will not only improve the COAs generated by S3, but also it will multiply the tactical options in accordance with mission statement and commander's intent;
- Step IV/COA analysis – 1 task: wargaming the operation and assessing the results.

²⁰ Study no 24/609-5360. Studiu privind realizarea unui model al MDMP-ului adaptat la cerințele mediilor VUCA și JIIM, integrând aspectele socio-culturale și inteligența artificială (Study on Developing a Model for Adapting the MDMP to the VUCA and JIIM Requirements, Integrating Socio-Cultural Aspects and Artificial Intelligence. [cit. 2021-05-18]. Available from: bit.ly/3yhUXAx.

²¹ TUDORACHE, Paul. Adaptarea structurilor militare din Forțele Terestre la cerințele acțiunii în medii VUCA și JIIM (Adapting military structures from Land Forces to the requirements of VUCA and JIIM environments). Sibiu: "Nicolae Bălcescu" Land Forces Academy Publishing House, 2020, pp. 89-91. ISBN: 978-973-153-376-6.

- Step V/COA comparison – 2 tasks: performing the analysis of advantages, disadvantages, and comparing COAs;
- Step VI/COA approval – 2 tasks: commander's decision, and developing final planning guidance;
- Step VII/Orders production, dissemination and transition – 1 task: planning's transition to preparation/execution.
- Although the commander influences all MDMP tasks through his conceptual planning, it can be seen that the decisions with the greatest impact on planning are related to IPB and approval of friendly forces' COA. For the IPB situation, AI will be able to advise the commander so that he is aware of all relevant aspects characteristic to the enemy when adopting his probable COAs. In this regard, there have been already developed AI tools for IPB optimization, one of them consisting in Mission Assistance Computing (MAC) whose application *"generate the IPB outputs most heavily utilized throughout MDMP, the event template, initial information requirements, decision support matrix, and decision support template"*²².

Instead, for the second situation, AI will be able not only to propose the commander that COA with the highest probability of success, but also to make him aware of the necessity for integrating within selected COA the probable actions of other interest audiences such as indigenous population, local authorities, and other parties that may influence the operation.

5.2 Optimizing decision-making during tactical execution

Certainly, the execution will be the most advantaged in case of using AI capabilities. AI will influence in a positive fashion commanders' decisions and implicitly the HQ's activity, and subordinate forces' actions. The context of integrating AI in the execution is shown in figure 3, where the key element in attaining the end state is the adjustment decisions.

²² BRANCH, William. Artificial Intelligence and Operational-Level Planning: An Emergent Convergence. Kansas: Fort Leavenworth, 2018, p. 40. [cit. 2021-05-19]. Available from: bit.ly/2S4DYB5.

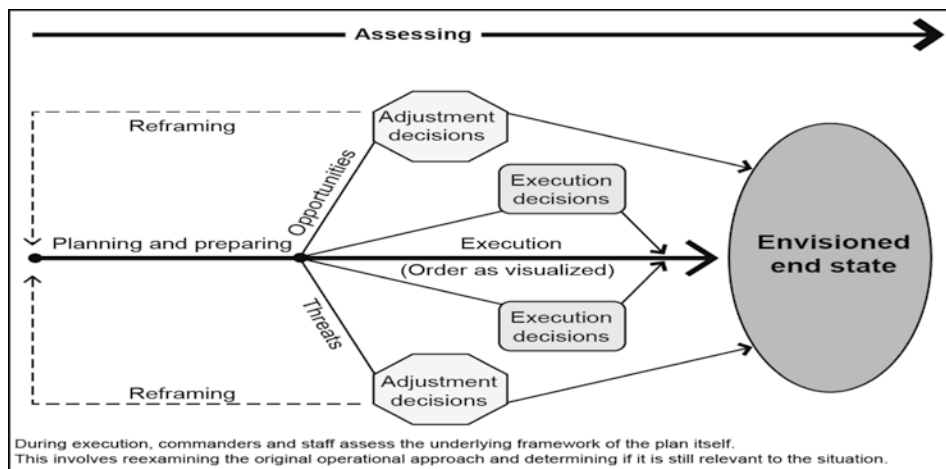


Figure 3: Decision-making during execution

Source: ADP 5-0. The Operations Process. Washington, DC: Headquarters, Department of the Army. 2019, p. 4-6. PIN: 102805-000. Available from: bit.ly/3u6R26Q

As I stated in the operationalization of concepts, execution decisions trigger actions in accordance with facts anticipated during planning phase, different from adjustment ones that are implemented to adapt or modify the COA approved. It becomes easily to understand that the biggest problems during performing execution are caused by the last of these. In this context, the use of AI will increase commander's mental agility, on the one hand, and on the other hand, it will supplement the decisional expertise and the level of his emotional intelligence (EI). Other secondary effects of optimizing adjustment decisions based on AI can be linked with the decisional speed and accuracy, which are important requirements to the operational flexibility.

Also, this principle can be applied at the level of subordinate commanders if AI applications are available (for counselling purposes). In this case, AI must be integrated in the command posts (CP) architecture. For instance, in a tactical operational context, assuming a battalion (BN) in charge with execution, besides the BN commander (CDR) who is responsible for adjusting the execution in accordance with unanticipated threats and opportunities, AI will be also beneficial for company (COY) and platoon (PLT) commanders to support them in applying the adjustment decisions made by BN commander. Moreover, taking into consideration the VUCA characteristics of the current and future OE, each commander at any level will be the subject of making decisions in unknown circumstances, meaning the ability to adopt the adjustment decisions. More schematically, the underlined aspects for tactical operational context are highlighted in figure 4. Even if, the figure is designed for BN level, the principles may be appropriate for the brigade (BDE) and division (DIV) levels, in this case being necessary to change the operational context with two levels up.

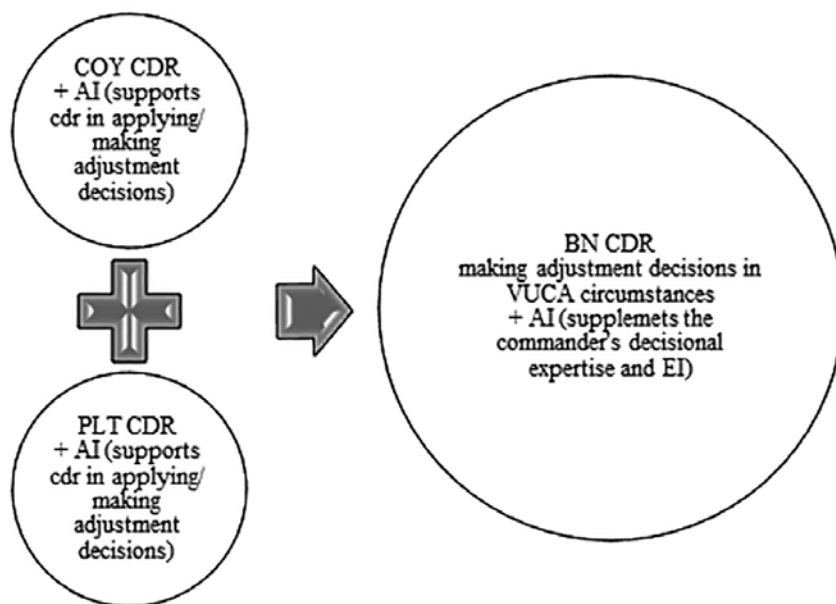


Figure 4: AI Perspectives in optimizing BN decision-making

NOTE: to ensure the efficient application of BN CDR's adjustment decisions (AI supported), it would be also necessary to develop AI's tools suitable for COY and PLT CDRs, who in turn make adjustment decisions.

Also, to have the adjustment decisions implemented, some AI insertions are required at the staff level, especially in optimizing the TOC activity. In general, during execution the TOC is responsible for putting into practice the commander's decisions. From this perspective, integrating AI in the TOC architecture, improvements will be made on: monitoring the designated AO, updating the COP, exercising the C2 over maneuvering forces during the progress of their missions, ensuring a prompt reaction to critical events, counseling the commander/staff, and coordinating fighting capabilities from organic or provided by higher echelon. In this way, the TOC's battle line, especially the battle captain (BC) and battle non-commissioned officer (NCO) will have amplified fighting abilities. Also to support the second research hypothesis' validation, a significant example of one of the first AI tool for optimizing decision-making is Real-time Adversarial Intelligence and Decision-making (RAID) developed by US Army based on Deep Green (DG) technology. Essentially, RAID *"leverages novel approximate game-theoretic and deception-sensitive*

algorithms to provide real-time enemy estimates to a tactical commander"²³ during the progress of the execution.

The last, but not least, all these multilevel insertions of AI for optimizing decision-making will be also transposed at the level of combat power applied during the execution. Understood as the correlation between all destructive, constructive and information capabilities, the combat power will have some elements upgraded with AI capabilities. As highlighted in figure 5, even if it would be indicated to have all combat functions amplified, for optimizing decision-making it is required to have AI insertions at least for components of leadership, information, C2, and manoeuvre.

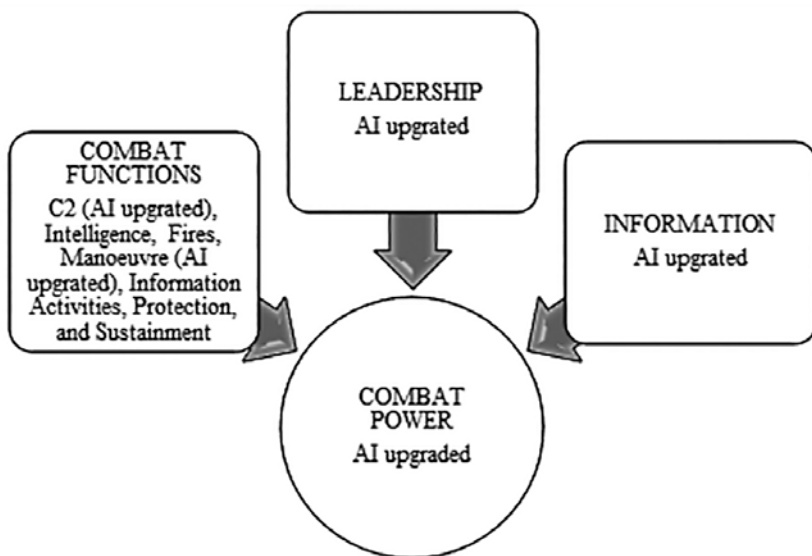


Figure 5: The combat power during execution – AI upgraded

NOTE: to optimize the application of combat power during the battlefield (directed at the right time and the right place), it is desired to have some specific elements reinforced with AI capabilities.

Also, for clarification, the information from figure above is different from the combat functions of intelligence and information activities. It refers to the overall cooperation between internal and external structures/sections based on the flow of information which can be horizontal and vertical (upward/downward) in nature.

In this formula with AI included, the commander will be able more easily to direct the combat power during the progress of execution.

²³ KOTT, Alexander, OWNBY, Michael. Tools for Real-Time Anticipation of Enemy Actions in Tactical Ground Operations. Virginia: Command and Control Research Program, 2005, p. 170. [cit. 2021-05-19]. Available from: bit.ly/3yi64Cj.

CONCLUSION

At the end of this research paper, it can be appreciated that the issues addressed, covering all research objectives through validating the formulated research hypotheses, have provided an innovative strategy to optimize decision-making for Land Forces' commanders, based on integrating AI capabilities. Even if the context of the analyses was limited to the tactical military structures, the highlighted principles can be also applied to higher levels of the Land Forces' operations such as operational and strategic, whose commanders also encounter difficult decisional contexts.

On the other hand, the innovative method of integrating AI at the tactical decision-making, is extremely suitable because, as we have seen, the current OEs, and especially those foreseen in the future, with pronounced VUCA characteristics, request different level commanders to possess mental agility in order to make bold and sound decisions. In these high changeable contexts, AI will significantly supply commanders with decision-making skills and will support their EI in high intensity situations.

As far as the planning decisions are concerned, the benefits of using AI can be manifested in the form of counselling commander and S2 personnel during IPB decisions, imprinting the enemy COAs which will be more probable, meaning much closer to the reality. Furthermore, anticipating the enemy with high accuracy (improved probability), the S3 section will be much more able to develop feasible COAs for friendly forces, shaping the commander's framework to adopt the best decision in COA's approval.

Also, as we have seen, the most difficult decisional situations during execution are outlined in the context of making adjustment decisions, which are required to counter different threats or to exploit opportunities. In these circumstances, possessing multilevel AI capabilities, integrated coherently in the architecture of decision-making process, different level commanders will be capable to direct and apply the organic combat power in a way which will overwhelm the enemy.

All in all, the proposed strategy for boosting Land Forces' decision-makers needs to have AI integrated and validated for all variables and stages of the decisional process such as:

- Commander – is the primary variable in the process, being responsible for overcoming the DPs during the progress of the operation; the most powerful AI tool should be developed at this stage to reinforce his mental agility;
- Dedicated HQ – is another variable that must be the subject of AI integration and validation; at this stage, AI will be the actual catalyst for staff sections in their work to support the commander with area expertise, before making decisions; also, AI optimizations will work for enabling the conversion of commander's decisions into desired actions, based on optimizing the staff activity; in this case HQ is the bridgehead which links the commander and subordinate units/subunits;
- Subordinate units/subunits – are the actionable variables/agents responsible for creating the effects on the battlefield (OE/AO); at this lower stage, AI will boost the effort of subordinate commanders to accomplish specific missions and tasks, having in their mind the superior commander's intent as well as his adjustment decisions; moreover, during the execution, subordinate commanders may deal with

unknown situations, and being AI orchestrated, they will be able to assume and make proper decisions to deconflict the subject areas.

Based on these principles, the logic algorithm presented during this research has pointed the most important elements of decision-making process that must be optimized. Also another strategy to boost decision-making using AI consists in selecting individual elements in accordance with the prioritization criteria and resources available for Land Forces. But to have all AI benefits, the strategy should be applied using a step-by-step algorithm, which starts with planning. After validation, the algorithm will continue in the same manner with execution, and will end with integration of AI capabilities, validated for both stages. It is recommended that the final validation of AI products to be conducted using computer assisted exercise (CAX) supported by command post exercise (CPX). Both will be constructive, virtual and real in nature, respecting the typology of simulations in the military field.

Consequently, as other revolutionary applications of AI technology in the military field such as fire precision and lethality, information accuracy, force resilience and so forth, the optimization of decision-making is another prerequisite for the success of future Land Forces' operations in terms of attaining the effectiveness and efficiency in high intensity VUCA environments.

LIST OF ABBREVIATIONS

A2/AD	Anti-access/Area-denial
AI	Artificial Intelligence
AO	Area of Operation
BC	Battle Captain
BDE	Brigade
BN	Battalion
C2	Command, Control
C4	Command, Control, Communication, Computers
CAX	Computer Assisted Exercise
CCIR	Commander's Critical Information Requirements
CDR	Commander
C4ISR	Command, Control, Communication, Computers, Intelligence, Surveillance, Reconnaissance
CBRN	Chemical, Biological, Radiological, Nuclear
COA	Course of Action
COP	Common Operational Picture
COY	Company
CP	Command Post
CPX	Command Post Exercise
DIV	Division
DG	Deep Green
DP	Decisions Point
EI	Emotional Intelligence
HQ	Headquarter
I2D2	Intelligent, Interconnected, Distributed, Digital
IED	Improvised Explosive Device
IO	Information Operations
IPB	Intelligence Preparation of the Battlefield

ISR	Intelligence, Surveillance, Reconnaissance
MAC	Mission Assistance Computing
MDMP	Military Decision Making Process
MOE	Measures of Effectiveness
MoND	Ministry of National Defence
MOP	Measures of Performance
NATO	North Atlantic Treaty Organization
NCO	Non Commissioned Officer
OE	Operational Environment
OODA	Observe, Orient, Decide, Act
PAF	Project Air Force
PL	Platoon
RAID	Real-time Adversarial Intelligence and Decision-making
RM	Risk Management
SBTM	Simulation Based Tactics Mining
SWOT	Strengths, Weaknesses, Opportunities and Threats
TOC	Tactical Operations Center
TRL	Technology Readiness Levels
USA	United States of America
VUCA	Volatility, Uncertainty, Complexity, Ambiguity

Author: ***LTC. Assoc. Prof. Paul Tudorache, PhD**, born in 1981 in Buzău, Romania. Currently working as a Vice-Dean of Military Science Faculty at the “Nicolae Bălcescu” Land Forces Academy from Sibiu. He completed bachelor, master and doctoral studies in Military Sciences, the last two at the “Carol I” National Defence University. He possesses high expertise of military operations, being deployed twice in Afghanistan (Operation Enduring Freedom - 2010, 2013). Also, he is the author of valuable books and scientific papers for the Military Science field, as well as a member of the scientific board of important conferences and magazines with national and international impact.*

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