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Military Operations and Artificial Intelligence

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Abstract

Artificial intelligence (AI) systems will most likely transform military operations. This paper explores how AI systems may affect and be affected by principal instruments for preparing and conducting military operations. Therefore, the paper analyses and discusses AI in the context of strategy, doctrine, plans, rules of engagement, and orders to situate opportunities, challenges, and open questions as well as offer overarching observations. The paper takes a broad angle of analysis that enables a general examination of the issue based on new policies and technological developments as well as the consideration of political, military, legal, and ethical perspectives. Thereby, the paper provides insights and avenues to advance further reflection, research, and policy-making on the appropriate integration, management, and use of AI for military operations.

Contents

1. Introduction

Military operations are the essence of warfare. The introduction of military applications of artificial intelligence (AI) will most likely transform the preparation and conduct of military operations. AI can increasingly support and replace humans for military tasks as they are becoming faster and more accurate as well as able to consider more information and higher levels of complexity. This may lead to an increased speed of military operations and better military decision-making, ultimately offering armed forces with performant AI significant advantages. The military use of AI may indeed lead to another revolution in military affairs.[1]

AI can be used for various military purposes. In multi-dimensional battlefields, AI technologies can be utilized as sensors, planners, and fighters, or a combination thereof.[2] More concretely, military applications of AI can range from systems supporting intelligence, surveillance, and reconnaissance (ISR) to autonomous navigation and target recognition systems.[3] This can lead to diverse forms of interaction between military staff and AI systems as well as various levels of delegation of military tasks to AI systems. AI systems may assist commanders and soldiers in decision-making processes, unmanned AI systems may operate together with manned systems, and AI systems may operate autonomously under minimal human supervision, for instance.[4] While currently only narrow and task-specific AI exist,[5] significant efforts for the development of artificial general intelligence (AGI) – systems with an ability to reason across a wide range of domains akin to that of the human mind - are underway.[6] This is in line with the continuous trend towards increased autonomy of AI systems.

Given AI's particular characteristics and future applications, how will the introduction of AI affect military operations? This paper explores this question. To this end, the paper analyses how AI may affect and be

[1] Jean-Christophe Noël, 'Will Artificial Intelligence Revolutionize the Art of War?' (2018) Winter Issue Politique étrangère 159, 159–170.

[2] MAJ William A Branch, 'Artificial Intelligence and Operational-Level Planning: An Emergent Convergence' (School of Advanced Military Studies 2018).

[3] Vincent Boulanin and others, 'Artificial Intelligence, Strategic Stability and Nuclear Risk' (SIPRI 2020); Michael C. Horowitz, 'Artificial Intelligence, International Competition, and the Balance of Power' (2018) 1 Texas National Security Review 37; Kelley M. Sayler, 'Artificial Intelligence and National Security' (Congressional Research Service 2020) R45178.

[4] Peter Layton, 'Algorithmic Warfare Applying Artificial Intelligence to Warfighting' (Air Power Development Centre 2018) 38–39.

[5] James Kraska, 'Command Accountability for AI Weapon Systems in the Law of Armed Conflict' (2021) 97 International Law Studies 407.

[6] For definitions and discussions of AGI see Phil Torres, 'The Possibility and Risks of Artificial General Intelligence' (2019) 75 Bulletin of the Atomic Scientists 105. For a survey of R&D projects into AGI see Seth Baum, 'A Survey of Artificial General Intelligence Projects for Ethics, Risk, and Policy' (Social Science Research Network 2017) Global Catastrophic Risk Institute Working Paper 17–1.

affected by principal instruments for preparing and conducting military operations. Therefore, the paper analyses and discusses AI in the context of strategy, doctrine, plans, rules of engagement, and orders to situate opportunities, challenges, and open questions as well as offer overarching observations. The paper takes a broad angle of analysis which includes aspects of, but is not limited to, military concepts such as force integration[7] and command and control (C2).[8] This enables a more general examination of the issue based on new policies and technological developments as well as the consideration of political, military, legal, and ethical perspectives.

Due to the only recent emergence of military AI, any analysis of future military operations incorporating AI can only be tentative and based on the premise that current challenges to the operationalization of AI with high levels of autonomy will be overcome. Yet, in light of rapid technological developments, this paper provides insights and avenues to advance further reflection, research, and policy-making for properly integrating, managing, and using AI for military operations.

2. Strategy & AI

Military operations serve states' political and strategic objectives. Of the three levels of warfare (strategic, operational, and tactical), military strategy is the highest which can be described as the 'orchestration of war'[9] or the 'direction of war'[10]. It provides the rationale for military operations, lying between the political and military realms.[11] In essence, military strategy is a plan which connects the end goal with the ways to achieve this goal. More specifically, military strategy can be defined as 'the use of armed forces to achieve the military objectives and by extension, the political purpose of the war'[12] or 'the performance of both conceptual and practical considerations for reaching the desired outcome in war, involving

[7] James Kennedy and Cecil E Wolberton, 'Force Integration: The Process and Challenges' (*The Field Grade Leader*, 23 December 2018) <http://fieldgradeleader.themilitaryleader.com/force-integration/> accessed 7 July 2021; James Mancillas, 'Integrating Artificial Intelligence into Military Operations : A Boyd Cycle Framework' (United States Army War College 2017) Strategy Research Project; Lora Saalman, 'China and India: Two Models for AI Military Acquisition and Integration' in Kanti Bajpai, Selina Ho and Manjari Chatterjee Miller (eds), *Routledge Handbook of China–India Relations* (Routledge 2020).

[8] John Cherry and Durward Johnson, 'Maintaining Command and Control (C2) of Lethal Autonomous Weapon Systems: Legal and Policy Considerations Fighting in the Law's Gaps' (2021) 27 Southwestern Journal of International Law 1; Paolo Spagnoletti and Andrea Salvi, 'Digitalization in Mission Command and Control: Fragmenting Coordination in Military Operations' in Sonia Lucarelli, Alessandro Marrone and Francesco N. Moro (eds), *NATO Decision-Making in the Age of Big Data and Artificial Intelligence* (NATO Allied Command Transformation 2021).

[9] Scott Nicholas Romaniuk, 'Military Strategy and the Three Levels of Warfare' [2017] Defense Report 5; Kraska (n 5) 22.

[10] Hew Strachan, 'The Lost Meaning of Strategy' (2005) 47 Survival 33, 33–54.

[11] Elinor C. Sloan, *Modern Military Strategy: An Introduction* (Taylor & Francis 2016) 2.

[12] ibid.

the organization, movement, and tactical, operational, and strategic use or commitment of forces against a given enemy.'[13] National security and defence strategies can build overarching frameworks for military strategies, and can oftentimes be found in white papers.[14]

States have not publicly communicated how they use or intend to use AI for military strategy. Accordingly, an analysis of AI's effects on military strategy and *vice versa* must, at this stage, rely on defence white papers and states' strategies on AI. In general, while around 50 states have published official AI strategies regarding the use, development, and financing of AI in multiple sectors (notably the civilian and industry sectors) in the past few years, these documents are generally not focused on, or barely mention defence applications.[15] However, most major military powers have recently adopted national strategies related to military AI, indicating that states have realised the strategic importance of military AI.

The U.S. Department of Defense (DOD) released an AI strategy in 2018, which highlights areas of priority for development, determines how development partnerships with civil society organizations should be undertaken, and establishes a plan for generating policies regarding the ethics of AI machines.[16] The U.S. National Security Commission on AI issued a report in 2021, presenting a national defence strategy related to AI.[17] The objective is to attain AI readiness by 2025, which implies 'organizational reforms, design innovative warfighting concepts, establish AI and digital readiness performance goals, and define a joint warfighting network architecture [...]'[18] as well as winning the 'technology competition'.[19]

China's 2019 Defence white paper speaks of the 'informationization of warfare' and sets goals to modernize and 'informationize' its armed forces. This modernization includes the development of AI capabilities.[20] The comprehensive AI strategy of 2017 (*A Next Generation AI Development*

[13] Romaniuk (n 9) 4. For definitions by NATO and the United States of America, see 'Glossary of Terms and Definitions AAP-06' (NATO 2020); 'Doctrine for the Armed Forces of the United States' (US Department of Defense 2017) Joint Publication 1.

[14] 'Draft Guidelines on Developing National Defense Policy and Doctrine Papers' (Organization of American States 2002) OEA/SerG CP/CSH-496/02 3.

[15] '50 National AI Strategies - The 2020 AI Strategy Landscape' (*HolonIQ*, 20 February 2020) <https://www.holoniq.com/notes/50-national-ai-strategies-the-2020-ai-strategy-landscape/> accessed 7 July 2021. See also Tim Dutton, 'An Overview of National AI Strategies' (*Medium*, 25 July 2018) <https://medium.com/politics-ai/an-overview-of-national-ai-strategies-2a70ec6edfd> accessed 7 July 2021.

[16] 'Summary of the 2018 Department of Defense Artificial Intelligence Strategy' (US Department of Defense 2018).

[17] 'Final Report' (US National Security Commission on Artificial Intelligence 2021) 8.

[18] ibid 9–10.

[19] ibid 11.

[20] 'National Defense in the New Era' (State Council Information Office of the People's Republic of China 2019) <https://www.andrewerickson.com/2019/07/full-text-of-defense-white-paper-chinas-national-defense-in-the-new-era-english-chinese-versions/> accessed 7 July 2021.

Strategy) briefly mentions the military domain, mainly focusing on the necessity for civil-military integration in research and development (R&D).[21] Russia has not published a policy on military AI so far but is actively financing research in both the private and public sectors. In 2018, Russia held a conference that produced ten policy recommendations (*AI: Problems and Solutions 2018*), which form the unofficial basis for its AI strategy.[22]

The United Kingdom published a new defence white paper in March 2021, which makes a few mentions of AI, but does not extend a clear strategy regarding how AI will be used.[23] The Ministry of Defence's (MOD) *Science and Technology Strategy 2020*, however, acknowledges that 'to avoid ceding strategic advantage by failing to integrate and use new capabilities, we must resolve technology policy challenges and shape continually evolving societal norms.'[24] It also mentions that the MOD has established a Defence Artificial Intelligence and Autonomy Unit and will publish a defence artificial intelligence and autonomy strategy.[25]

France's 2018 Villani Report merely states that 'the increasing use of AI in some sensitive areas such as [...] in Defence (with the question of autonomous weapons) raises a real society-wide debate and implies an analysis of the issue of human responsibility.'[26] Yet France's *AI for Defence* report highlights strategic advantages of the integration of AI in its armed forces, such as speed in analysis and decision-making, optimization of operational processes and logistics, and the increased protection of soldiers,[27] as well as categorizes machine learning as a main field for R&D.[28] Other countries have published analyses and policies on AI, oftentimes mentioning legal and ethical issues, but without offering insights on future military strategy.[29] Similar to states' strategy documents, the European Union's *Framework of ethical aspects of artificial intelligence, robotics and related technologies* encourages research in military-related AI fields and

[21] 'New Generation Artificial Intelligence Development Plan' (State Council of the People's Republic of China 2017) <https://www.newamerica.org/cybersecurity-initiative/digichina/blog/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017/> accessed 7 July 2021.

[22] Dutton (n 15).

[23] 'Global Britain in a Competitive Age: The Integrated Review of Security, Defence, Development and Foreign Policy' (UK 2021) CP 403.

[24] 'MOD Science and Technology Strategy 2020' (UK Ministry of Defense 2020); 'Mobilising, Modernising & Transforming Defence: A Report on the Modernising Defence Programme' (UK Ministry of Defense 2018); 'Autonomy Programme' (*GOV.UK*) <https://www.gov.uk/guidance/autonomy-programme> accessed 7 July 2021.

[25] 'MOD Science and Technology Strategy 2020' (n 24) 15.

[26] Frank Slijper and others, *State of AI: Artificial Intelligence, the Military and Increasingly Autonomous Weapons* (PAX 2019); Cédric Villani, 'Donner un sens à l'intelligence artificielle' (France National Assembly 2018).

[27] 'L'intelligence artificielle au service de la défense' (France Ministère des Armées 2019) 5–7.

[28] Villani (n 26) pt Annexe 1.

[29] National Canada Department of National Defence, 'Strong, Secure, Engaged: Canada's Defence Policy'; 'Artificial Intelligence in Land Forces' (Germany Army Concepts and Capabilities Development Centre 2019).

recognizes the importance of AI for the optimization of defence strategies and capabilities.[30]

Since states' defence strategies on or related to AI do not provide a clear picture of how AI will influence military strategy, respective expectations can be based on indications of potential future use of AI for strategic decision-making. Examples of AI applications at the strategical level of warfare are contributions to nuclear command, control, communications, and intelligence (C3I) architectures; target acquisition, tracking, guidance systems, and discrimination of missile and air defence systems; cyber capabilities; and nuclear and non-nuclear missile delivery systems.[31]

Most importantly for military strategy, AI applications may assist decision-makers to monitor the battlefield and develop scenarios. Indeed, AI could be developed to predict the behaviour and reactions of foreign countries or generate simulations of the progression of ongoing conflicts.[32] AI may also be useful to assess threats, provide risk analyses, and suggest courses of action, ultimately guiding decision-makers on the best response to take.[33] In addition, AI may support the alignment of the armed forces' ways and means with the given political and strategic objectives - a major function of military strategy. A consequence of such developments would be an increased speed and quality of military processes. While this would provide significant advantages to those states with the most performant AI,[34] this may also pressure armed forces to increasingly delegate the orchestration of military operations to AI systems.[35]

Indeed, the use of AI for military strategy may also lead to challenges. Reliable AI systems would need to be trained with vast data sets.[36] Furthermore, it has been warned that AI may exacerbate threats, transform their nature and characteristics, and introduce new security threats.[37] A tabletop exercise on the integration of AI into nuclear C2 systems showed that such systems were 'vulnerable to malicious manipulation that can severely degrade strategic stability',[38] for instance. Such vulnerabilities

[30] 'Resolution of 20 October 2020 with Recommendations to the Commission on a Framework of Ethical Aspects of Artificial Intelligence, Robotics and Related Technologies' (European Parliament 2020) P9_TA(2020)0275.

[31] James Johnson, 'The AI-Cyber Nexus: Implications for Military Escalation, Deterrence and Strategic Stability' (2019) 4 Journal of Cyber Policy 442, 445.

[32] Niklas Masuhr, 'AI in Military Enabling Applications' [2019] CSS Analyses 4 p.

[33] Ashley Deeks, Noam Lubell and Daragh Murray, 'Machine Learning, Artificial Intelligence, and the Use of Force by States' (2018) 10 JNSLP 1, 5–10.

[34] Kenneth Payne, 'Artificial Intelligence: A Revolution in Strategic Affairs?' (2018) 60 Survival 7.

[35] See also in this regard Michael C Horowitz and Paul Scharre, 'AI and International Stability: Risks and Confidence-Building Measures' (Center for New American Security 2021) 5.

[36] ibid 7.

[37] James Johnson, 'Artificial Intelligence & Future Warfare: Implications for International Security' (2019) 35 Defense & Security Analysis 147.

[38] Mark Fitzpatrick, 'Artificial Intelligence and Nuclear Command and Control' (2019) 61 Survival 81.

would derive mostly from the risk posed by third actors using techniques to deceive, disrupt or impair C2 systems,[39] which indicates the importance of system safety for AI to be used for military strategy.

Another significant challenge is that AI may accelerate the speed of warfare to the extent that humans cease to be able to follow the developments, ultimately leading humans to lose control.[40] This phenomenon has been termed battlefield 'singularity' or 'hyperwar'.[41] This may lead to strategic errors and accidents, including involuntary conflict escalation. Even if such risks can be alleviated, the increased reliance on AI would reduce the human element of military strategy, in particular psychology and human judgment. It has been argued that this could lead to a 'gap between how the AI solves a problem framed by humans, and how those humans would solve it if they possessed the AI's speed, precision, and brainpower'.[42] Yet it has also been argued that strategy development would require the understanding of values, the balance of costs, and the understanding of the complex social system in which war operates, thereby significantly limiting AI's use for military strategy.[43] Yet it is also possible that when enemies possess high levels of rational prediction power provided by AI systems, the decisive factor in warfare will not be the AI systems' capabilities but the human judgment, in particular concerning critical and difficult choices.[44] This, however, presumes a certain level of meaningful human involvement.

In sum, AI may enhance military strategy development and strategic decision-making, notably if able to process more data and make sense of complexity with more precision and at a higher speed than humans and simple computing. A likely result is an acceleration of military operations, which may increase pressure on armed forces to integrate AI and may marginalize human judgment. States' recent adoption of defence strategies on and related to AI indicate that states increasingly intend to develop, acquire, and operationalize AI for military purposes. As such, the possession and use of AI is a strategic objective itself. In light of secrecy around the

[39] ibid. The risks identified by Fitzpatrick are a risk of escalation via 'deep fakes', skewed early warning assessments (due to data poisoning, for example), false positive safety alerts, the high jacking of private sector breakthrough for malevolent purposes, and the malfunctioning of sensor/navigational systems.

[40] Horowitz and Scharre (n 35) 5.

[41] Chinese scholars call this phenomenon battlefield 'singularity'. For discussion see Elsa B Kania, 'Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power' (Center for New American Security 2017). U.S. scholars talk of 'hyperwar': 'On Hyperwar' (*U.S. Naval Institute*, 1 July 2017) <https://www.usni.org/magazines/proceedings/2017/july/hyperwar> accessed 7 July 2021.

[42] Payne (n 34) 28.

[43] Kareem Ayoub and Kenneth Payne, 'Strategy in the Age of Artificial Intelligence' (2016) 39 Journal of Strategic Studies 793.

[44] Avi Goldfarb and Jon Lindsay, 'Artificial Intelligence in War: Human Judgment as an Organizational Strength and a Strategic Liability' (*Brookings*, 30 November 2020) <https://www.brookings.edu/research/artificial-intelligence-in-war-human-judgment-as-an-organizational-strength-and-a-strategic-liability/> accessed 7 July 2021.

development of new technologies, states' investment in military AI can become a strategic liability as it may increase the risk of destabilizing arms races, misperceptions, and miscalculations.

3. Doctrine & AI

Military doctrine further guides the preparation and execution of military operations. Military doctrine can be defined as the 'generally accepted methods of performing military tasks and functions from an institutionalized point of view.'[45] As such, it represents 'institutionalized beliefs about what works in war and military operations'.[46] Doctrine generally contains three key elements, namely theory (what works and what will lead to victory), authority (doctrine must be taken seriously), and culture (who the organization and its members are).[47] Accordingly, doctrine answers 'what the service perceives itself to be ('who are we?'), what its mission is ('what do we do?'), how the mission is to be carried out ('how do we do that?'), [and] how the mission has been carried out in history ('how did we do that in the past?')'.[48] The U.S. Army *Doctrine Primer* describes doctrine as consisting of fundamental principles, tactics, techniques, and procedures, and terms and symbols.[49]

Given doctrine's purpose and function, it will probably continue to be created and revised by humans. Besides supporting the identification of what has worked in the past, specific roles for AI may be limited to a monitoring function regarding the alignment of armed forces' processes with their doctrine or for supporting evaluations of doctrine's quality and impact. To effectively inform military staff entrusted with defining doctrine, this would likely require transparent and explainable approaches to AI, as otherwise military staff would not be able to understand and take proper decisions. Doctrine, however, has a significant role to set the fundamental principles, values, and parameters for the use and interaction with AI. As such, doctrine can inform (other) military directives[50], which can contain more specific guidelines on military processes and behaviour.

In response to AI's particular characteristics, military doctrine is the appropriate means to define how armed forces perceive, understand, and value AI. Due to AI's high levels of autonomy, armed forces may need to specify whether AI is considered as a technical tool or rather as an agent. In

[45] James C Bradford, 'International Encyclopedia of Military History' (*Routledge & CRC Press*) 396.

[46] Harald Hoiback, *Understanding Military Doctrine: A Multidisciplinary Approach* (Routledge 2013) 1.

[47] ibid 10.

[48] Keith Grint and Brad Jackson, 'Toward "Socially Constructive" Social Constructions of Leadership' (2010) 24 Management Communication Quarterly 348.

[49] 'Army Doctrine Publication - Doctrine Primer' (2019) ADP 1-01. See also 'Field Manual 3-0 Doctrine Addressing Today's Fight' (US Army 2008) FM 3-0.

[50] For types of directives, see 'Dictionary of Military and Associated Terms' (US Department of Defense 2021); 'Department of Defense Publications Definitions' (US Department of Defense).

this sense, doctrine can define if the armed forces perceive AI as simply a mathematical, technical system, or rather a tool with cognitive abilities which can act as an autonomous influencer.[51] As a corollary and based on doctrine's function to shape armed forces' culture, principles, and identity, doctrine can define the value, place, and role of humans in the organization and its processes. Since military operations and warfare remain endeavours for human purposes in a human world, doctrine can specify what this means. In this context, doctrines can also define values and principles on human interaction with AI systems, including that AI needs to serve humans and not the opposite.

Similarly, doctrine is the appropriate tool to define ethical standards for the development, acquisition, and use of AI systems. As military doctrines are drafted in accordance with international law and generally call upon members of armed forces to respect international law, doctrine can also define the modalities for AI systems and operators' compliance with international law. As such, doctrine is an important tool to impose constraints regarding AI and human-machine teaming which apply across services to all members of the armed forces. This can imply the general need for meaningful human control of AI systems or the prohibition of the delegation of certain functions to AI systems.

More specifically, doctrine can set the principles and parameters for the integration of AI into organizational processes. For example, AI systems working on the consolidation, prioritization, and framing of data are likely to require revised military doctrine and guidelines on armed forces' use and collection of information.[52] While systems whose tasks are limited to observation would require limited doctrinal adjustments, systems that have more 'active' tasks will likely necessitate more specific guidelines on elements such as safeguards, degree of autonomy, and communication with the operator as well as on their interaction with human forces, including human-machine teaming.[53] Furthermore, it has been argued that tactical applications generally make rule-based decisions, whereas operational and strategic decisions are often value-based. In this case, what type of decision-making process is preferred at each level, and whether it should be standardized among all systems are questions that should be explored at the doctrinal level.[54]

To this date, the U.K. MOD Joint Doctrine on *Unmanned Aircraft Systems* is the only publicly available military doctrine that addresses autonomy in

[51] Thomas H Drohan, 'Artificial Intelligence in the Operational Information Environment: The Need for Proactive Doctrine' (*OTH*, 26 February 2020) <https://othjournal.com/2020/02/26/artificial-intelligence-in-the-operational-information-environment-the-need-for-proactive-doctrine/> accessed 7 July 2021.

[52] Samuel R White Jr., 'Closer Than You Think: The Implications of the Third Offset Strategy for the US Army' (US Army War College, Strategic Studies Institute 2017) 78.

[53] ibid 76.

[54] ibid 80–81; ML Cummings, 'Artificial Intelligence and The Future of Warfare' (Chatham House Royal Institute of International Affairs 2017) 7.

military systems and is explicitly termed as doctrine. While the doctrine principally addresses unmanned systems without AI, it does establish that human control must be retained over autonomous weapons to guarantee both oversight for risk mitigation and accountability.[55] Further military doctrines on or related to AI are likely to be developed based on policies on the ethical use of AI.[56] Indeed, several states and organizations have recently adopted policies on the ethical use of military AI.

The U.S. DOD established five ethical principles for the development and use of AI. Systems need to be responsible, equitable, traceable, reliable, and governable. These principles further establish that the personnel of the DOD must be responsible for the 'development, deployment, and use' of AI systems, and thus must show a good level of (human) judgment. In addition, the DOD explicitly stated that efforts must be made to minimize bias in data on which AI operates.[57] Furthermore, the U.S. DOD *2012 3000.09 Directive* establishes the U.S. position regarding lethal autonomous weapons. It defines lethal autonomous weapons systems (LAWS), identifies three categories of intelligent weapon systems (autonomous, semi-autonomous, and human-supervised autonomous systems), and sets general boundaries for their actions as well as standards regarding the role of human operators and legal reviews.[58]

Similarly, the EU Parliament adopted a report entitled *Artificial Intelligence: Questions of Interpretation and Application of International Law* (Guidelines on the civil and military use of AI) which, *inter alia,* discusses military applications of AI.[59] The report contains mandatory guidelines on the development and use of various military AI applications by EU member states as well as general conclusions. First and foremost, the report states that AI cannot replace human decision-making or human responsibility. AI technologies must also be human-centred, which implies that AI systems must follow guidelines for human supervision. External independent audits should further be periodically conducted on systems to check for risks.[60]

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[55] 'Joint Doctrine Unmanned Aircraft Systems' (UK Ministry of Defense 2017) JDP 0-30.2 42.

[56] It is noteworthy, however, that doctrine is oftentimes based on lessons from the past rather than anticipation of future challenges. This arguably applies less to ethical dimensions of the use of AI, however, as this should be resolved before the introduction of such systems. See Drohan (n 51).

[57] Defense Innovation Board, 'AI Principles: Recommendations on the Ethical Use of Artificial Intelligence by the Department of Defense' (US Department of Defense 2020).

[58] The doctrine expresses that LAWS must be designed to 'allow commanders and operators to exercise appropriate levels of human judgment over the use of force.' The concept of appropriate human judgement is flexible to allow an adaptation of the form and level of human control to the system. At a minimum, LAWS must be used 'with appropriate care and in accordance with the law of war, applicable treaties, weapon system safety rules, and applicable rules of engagement.' US Department of Defense, 'Directive 3000.09' (2017) 2.

[59] 'Resolution of 20 January 2021 on Artificial Intelligence: Questions of Interpretation and Application of International Law in so Far as the EU Is Affected in the Areas of Civil and Military Uses and of State Authority Outside the Scope of Criminal Justice' (European Parliament 2021) P9_TA(2021)0009.

[60] ibid 8, 22, 26.

Second, to be lawful, LAWS must be subjected to meaningful human control. Humans must be enabled to intervene or stop actions by all AI systems to comply with IHL.[61] Third, AI technologies as well as their use and management must at all times respect and comply with IHL, the Rome Statute of the International Criminal Court, EU treaties, the EU Commission's *White Paper on AI*,[62] and principles that include transparency, precaution, distinction, non-discrimination, accountability, and predictability.[63] The EU's AI Framework similarly calls for maintaining a 'human-in-the-loop' for all LAWS and calls to exclude LAWS that do not allow for meaningful human control.[64]

In April 2021, the French Ethics Committee published an opinion on the integration of LAWS and semi-autonomous weapons into the armed forces. Although its contents have yet to be approved by the Minister for Defence, it is indicative of potential future military doctrine. It reiterates the importance for humans to retain a level of control over the lethal actions of autonomous weapons and asserts that France will not develop nor use fully autonomous weapons.[65] The German Army Concepts and Capabilities Development Centre has published a position paper on AI in land forces, which discusses the advantages and applications of AI, but does not represent an official view of the Federal Ministry of Defence.[66] The paper states that 'the employment of LAWS is an undesirable and unintended option.'[67] Similarly, Australia published a report entitled *A Method for Ethical AI in Defence*, which discusses ethical and legal considerations related to military AI applications, but does not represent an official position.[68]

To conclude, it is unlikely that AI will have a substantial function for establishing military doctrine since it serves to define and regulate military organizational issues and aspects of military operations which strongly relate to beliefs, values, and identity. Yet because of this function, doctrine has an important role to define armed forces' fundamental relation to AI. In particular, doctrine is appropriate for establishing in general terms for what tasks AI will (not) be used, how AI will (not) be used, and how the organization and its members perceive and value AI. Most importantly given AI's characteristics, doctrine can establish how humans can and should interact with AI and what organizational culture should reign in this regard. This can set the normative framework for further military directives and

[61] ibid 27–41.

[62] 'White Paper on Artificial Intelligence -A European Approach to Excellence and Trust' (European Commission 2020) COM(2020) 65.

[63] 'Resolution of 20 January 2021 (n 59) 5, 7, 16, 17, 21, 23, 25.

[64] 'Resolution of 20 October 2020 (n 30) para 89.

[65] 'Opinion on the Integration of Autonomy into Lethal Weapon Systems' (French Defense Ethics Committee 2021).

[66]'Artificial Intelligence in Land Forces' (n 29).

[67] ibid 28.

[68] Kate Devitt and others, 'A Method for Ethical AI in Defence' (Australian Department of Defense 2020) DSTG-TR-3786.

military procedures. States' emerging ethical guidelines may serve as a basis and be incorporated into military doctrines.

4. Plans & AI

Produced in accordance with the respective military doctrine, military operation or action plans are concepts and instructions to achieve military objectives in line with the available means. Plans reflect the commander's intent and oftentimes include different courses of action (COA). A variety of military planning and decision-making models exist. NATO's Comprehensive Operations Planning Directive (COPD) provides a good overview and synthesis of various Western models.[69] The Canadian Armed Forces, for instance, follow six steps, namely initiation, orientation, concept development, decision plan development, and plan review.[70] According to a general description, planning consists of '[p]lanning and scheduling the detailed tasks required to accomplish the specified COA; [a]llocating tasks to the diverse forces [...]; [a]ssigning suitable locations and routes; [e]stimating friendly and enemy battle losses (attrition); [and p]redicting enemy actions or reactions.'[71]

While plans will certainly need to take into consideration the use of AI systems for military operations, AI will most likely be employed for planning itself. AI applications for or related to military planning are ISR systems, proper planning tools, map generation robots, and threat assessment and threat prediction tools.[72] Further AI applications related to planning may include big data-driven modelling and wargaming.[73] The U.S. Army, for instance, has developed a programme for its Military Decision Making Process (MDMP) that takes a 'high-level COA' (namely a sketch of goals, actions, and sequencing) and constructs a detailed COA based on this overall sketch, to then test its feasibility.[74] This suggests that AI may serve various functions, from suggesting COA to deconstructing and testing them.

[69] 'Allied Command Operations Comprehensive Operations Planning Directive' (NATO 2013) COPD V2.0.

[70] (1) Initiation corresponds to mission trigger and task reception; (2) orientation includes mission assessment, mission statement and decision-maker's planning guidance; (3) concept development includes staff's analysis, friendly and enemy courses of action development and analysis, and decision-maker's estimate; (4) decision includes courses of action comparison and selection, course of action approval, decision-maker's direction, review of critical assumptions; (5) plan development mainly concerns synchronization and finalization; (6) plan review includes analysis and revision of plans. See: Micheline Bélanger and Adel Guitouni, 'A Decision Support System for CoA Selection' (Canadian Department of National Defence 2000).

[71] Robert Rasch and Alexander Kott, 'Incorporating AI into Military Decision Making: An Experiment' (2003) 18 Intelligent Systems IEEE 18.

[72] Sayler (n 3) 9–15.

[73] Johnson (n 31) 445.; Ben Conklin, 'How Artificial Intelligence Is Transforming GEOINT' (*GCN*, 20 April 2018) <https://gcn.com/articles/2018/04/18/ai-transform-geoint.aspx> accessed 7 July 2021.

[74] Alexander Kott and others, 'Toward Practical Knowledge-Based Tools for Battle Planning and Scheduling' (AAAI 2002) 895.

Such AI applications will probably have strong ramifications on planning. Planning military operations is a slow and burdensome process, which relies on estimations of 'outcomes, attrition, consumption of supplies, and enemy reaction'.[75] It involves understanding a given situation, time-space analysis, and logistics concerns. Time and labour limitations restrict how many options of plans can be explored.[76] Moreover, prediction is arguably 'one of the most vexing tasks of the operational commander'.[77] Provided that sufficient quantity and quality of data can be made available, AI may excel in prediction making both in quality and speed. Data analytics further enables the processing of much more information than human computing, eventually reducing the 'fog of war'.[78] As AI programmes can deconstruct operations into specific tasks to then allocate resources accordingly, predict enemy actions, and estimate risks, this would improve the general speed and accuracy of decision-making.[79] An increase in the number of COA that can be considered would further allow a qualitative improvement of planning processes.[80]

There are potential drawbacks to using AI for planning, however. Increased speed of warfare due to faster AI-powered planning will arguably reduce (re-)action time for decision-makers, which could impair the quality of decisions.[81] It has also been questioned if AI-powered planning would 'encourage excessive fixation on analytical aspects of command, by the book and by numbers, detracting from the intuitive, adaptive, art-like aspects of military command decision making'.[82] Commanders and other military staff may also become dependent on technology, which could render them vulnerable.[83] A remaining challenge is to generate sufficient and relevant data for AI planning systems to work properly and produce meaningful results.[84]

Even if AI systems will execute planning tasks, it can be expected that AI systems will assist and inform military staff yet not take proper decisions based on such plans. Indeed, it has been argued that AI systems would struggle to fulfil tasks related to command, such as setting goals, priorities,

[75] ibid.

[76] Rasch and Kott (n 71) 19.

[77] Kraska (n 5).

[78] Notably big data and its 'four Vs', namely, volume, variety, velocity and veracity, can reduce the 'fog of war'. See Forrest E. Morgan and others, 'Military Applications of Artificial Intelligence: Ethical Concerns in an Uncertain World' (RAND 2020) 18.

[79] For examples of AI applications for operational-level planning, see Branch (n 2) 26–31.

[80] Michael C. Horowitz, 'The Promise and Peril of Military Applications of Artificial Intelligence' (*Bulletin of the Atomic Scientists*, 23 April 2018) <https://thebulletin.org/2018/04/the-promise-and-peril-of-military-applications-of-artificial-intelligence/> accessed 7 July 2021.

[81] For an experiment highlighting the production time of plans by humans versus machines, see Rasch and Kott (n 71) 24.

[82] Morgan and others (n 78) 21.

[83] Rasch and Kott (n 71) 20.

[84] Horowitz and Scharre (n 35) 7.

rules, and constraints. Human judgment would remain necessary for such tasks. AI would rather execute controlling tasks,[85] and eventually, compensate cognitive biases of military staff with which it is partnered with.[86] Yet it is noteworthy that with new versions of C2 (partially) incorporating AI, it has been questioned if it was clear who would have decision-making authority across domains, what role humans would and should have in such architecture, as well as whether technology would be ready for such grand-scale development.[87]

With powerful AI systems for military planning, however, the distinction between military planning and decision-making may become blurred. Similar to the risk that humans may not be able to properly follow the course of events due to the high speed of military operations, the increased delegation of planning tasks to AI may lead commanders and planners to not understand nor be able to retrace how the system has reached its conclusions. Similarly, commanders could be overwhelmed by the task to review numerous proposed plans or COA. AI-generated options may also imply higher levels of complexity. Accordingly, AI could digest information and feed only the most relevant elements to commanders.[88] Yet this may again lead to an overreliance on the system's outputs. Powerful AI systems would therefore need some levels of predictability and/or transparency.

In sum, compared to other military applications of AI, it is likely that AI will have the most significant influence on planning, at least in the short to medium term.[89] As planning is very time and resource-intensive, AI systems can lead to an increase in speed, precision, and quality. This may have significant effects on military operations and warfare, as it has been argued that the winner of the military competition is the one who works through the loop of observation, orientation, decision, and action (OODA loop) the fastest.[90] A further ramification may be that the automatization of planning leads to a (further) rationalization of military decision-making. Another consequence is the need for less manpower.[91] The need for fewer humans for planning, however, must not necessarily mean a reduced need for

[85] Alexander Kott and David Alberts, 'How Do You Command an Army of Intelligent Things?' (2017) 50 Computer 96, 98.

[86] Karel van den Bosch and Adelbert Bronkhorst, 'Human-AI Cooperation to Benefit Military Decision Making' (NATO & Science and Technology Organization 2018) STO-MP-IST-160.

[87] Stephen Russell and Tarek Abdelzaher, 'The Internet of Battlefield Things: The Next Generation of Command, Control, Communications and Intelligence (C3I) Decision-Making', *MILCOM 2018 - 2018 IEEE Military Communications Conference (MILCOM)* (2018) 2. See also Bryan Clark and Dan Patt, 'JADC2 May Be Built To Fight The Wrong War' (*Breaking Defense*, 14 January 2021) <https://breakingdefense.com/2021/01/jadc2-may-be-built-to-fight-the-wrong-war/> accessed 7 July 2021; 'Joint Operations' (US Department of Defense 2018) Joint Publication 3-0.

[88] Maj Amir ElMasry, 'Army of the Future: Artificial Intelligence and Its Impact on Army Operations' (Service paper, Canadian Forces College 2018). See also Ayoub and Payne (n 43).

[89] Kathleen McKendrick, 'The Application of Artificial Intelligence in Operations Planning' (NATO & Science and Technology Organization 2017) STO-MP-SAS-OCS-ORA-2017.

[90] Referred to in Mancillas (n 7); Layton (n 4) 37.

[91] Masuhr (n 32) 3.

human judgment for decision-making related to and based on military plans.

5. Rules of Engagement & AI

To delineate the circumstances and limitations for the deployment of military forces, armed forces issue rules of engagement (ROE).[92] ROE may take diverse forms, including execution orders, deployment orders, operational plans, and standing directives. Independently of their form, they provide authorisation for and/or limits on, *inter alia*, 'the use of force, the positioning and posturing of forces, and the employment of certain specific capabilities.'[93] ROE have common elements, such as their function and their place in operational planning, as well as basic components.[94] ROE are generally 'a mix of military and political policy requirements, [which] must be bounded by extant international and domestic legal parameters.'[95] As such, their elements and components reflect a military operational, a legal, and a political element.[96] Generic ROE and template documents, such as NATO's MC362/1[97] and the Sanremo *Handbook on ROE*, can serve as a basis or inspiration for ROE drafters, which usually are military legal advisers. While ROE are generally not disseminated to all lower ranks, soldiers oftentimes receive memory cards containing simplified, basic versions of the ROE.[98]

ROE are part of a larger regulatory framework related to the deployment of military forces and the use of force. As such, they interact with other types of military directives, notably targeting and tactical directives. Targeting directives provide specific instructions on targeting, including restrictions on objects and minimization of collateral damage. Tactical directives are 'orders directed either at the force as a whole or at specific types of units or weapon systems, regulating either the conduct of specific types of missions within the operation as a whole or restricting the use of specific weapon systems during the conduct of the operation.'[99] While ROE are not indispensable, they allow to provide more specific and nuanced instructions to units and their members.

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[92] 'Sanremo Handbook on Rules of Engagement' (International Institute of Humanitarian Law 2009) 1.

[93] ibid.

[94] ibid.

[95] ibid ii.

[96] RoE contain basic elements including general instructions for the commander (with general political and legal issues relevant to the operation); positioning of forces; boarding, seizure, recovery, rescue; warnings prior to use of force; diversions; targeting; regulate the use of specific weapons; restrictions and permissions for the use of force to defend civilians/objects or attack military objectives. JFR Boddens Hosang, *Rules of Engagement and the International Law of Military Operations* (Oxford University Press 2020) 32.

[97] 'MC 362/1 Rules of Engagement' (NATO 2003).

[98] 'Sanremo Handbook on Rules of Engagement' (n 92) Appendix 4.

[99] Hosang (n 96) 25.

ROE are appropriate tools to determine how to use AI under which conditions for specific contexts and missions. ROE – or related rules of behaviour – may set the parameters for diverse military applications of AI, thereby translating given political, military, legal, and ethical considerations and limitations of documents at a higher echelon, such as doctrine or international legal obligations, into concrete instructions. This can represent a framework for action to be programmed into the AI system. For example, ROE could determine a geographical zone or a certain list of potential tasks for which systems are authorized to take action. Outside those limits, they would not act on the processed information. Time checks or other limits, such as pre-set permission to (not) engage specific targets, may also be fixed by ROE.[100] Similarly, ROE can foresee that a system needs to flag unexpected events or issues. In this context, some have suggested that AI may be able to choose which ROE to apply based on the environment or its programmed mission.[101]

ROE can also define the interaction between humans and AI systems for specific missions. In particular, ROE can establish how a commander or operator needs to monitor and control the system during deployment. As the need for human control may vary according to the specific task attributed to an AI system and the respective context and operation, ROE for AI can define the level of autonomy for certain types of operations or phases thereof.[102] ROE can further address or refer to other sources, such as manuals and directives, on how to implement various forms of human control, such as direct, share, or supervisory control.[103] Importantly, ROE may limit commanders' or operators' authority, which may force them to refer up in the chain of command. This can be a significant role of ROE for the human-machine teaming in military operations, notably when confronted with unanticipated situations or issues for which the system or its use had not been previously authorized.

ROE are particularly relevant when AI is used for or in relation to targeting as this implies harming persons and objects. Notably if considered that AI cannot incorporate ethical or contextual assessments into its decision process,[104] human control and judgment should be meaningful in the context of decisions regarding the use of lethal force.[105] While most publicly available policies establish this principle, as described above, they do not

[100] Gérard de Boisboissel, 'Uses of Lethal Autonomous Weapon Systems', *International Conference on Military Technologies (ICMT) 2015* (2015).

[101] Andrew Williams, *Autonomous Systems: Issues for Defence Policymakers* (2015) 77.

[102] RoE cannot contradict any superior regulation or policy, however. Morgan and others (n 78) 124.

[103] 'Autonomy, Artificial Intelligence and Robotics: Technical Aspects of Human Control' (ICRC 2019) 8, 19.

[104] Some argue that making the judgment of proportionality of an attack, for instance, would require more than a balancing of quantitative data. This would entail an evaluative, qualitative, and ethical assessment by a human weighing and comparing complex values. See: Morgan and others (n 78) 31.

[105] ibid xvi. For discussion on meaningful human control and its meaning see Kraska (n 5) 427–430; Merel Ekelhof and Giacomo Persi Paoli, 'The Human Element in Decisions about the Use of Force' (UNIDIR 2020).

specify its precise meaning. ROE and directives can fill this gap. To this end, a code of conduct for operators of AI systems related to targeting or a model of ROE for such systems could be established.[106]

While no autonomous weapons enabled to attack human targets without prior human authorization tend to exist as of today,[107] there is an overall tendency towards more autonomous systems in the context of targeting. Existing military applications related to targeting are target recognition softwares, such as Super aEgis II which can detect explosives under clothing[108] and systems for target engagement.[109] The U.S. AI-guided Long Range Anti-Ship Missile (LRASM) is advertised as capable to autonomously select and engage targets, even in GPS- and communications-denied environments, such as deep-water and potentially outer space.[110] An important development was reported regarding a Turkish Kargu-2 drone that allegedly has hunted down and subsequently engaged human targets without authorization by a human operator in Libya in March 2020.[111] This may represent a significant precedent regarding the use of AI systems for targeting with very limited human control.

Since ROE need to be managed, AI may assist competent authorities to coordinate, implement, and eventually define ROE. Military, political, legal, and ethical objectives and parameters need to be provided by military staff, at least in the initial phase. As illustrated by NATO's MC362/1 and the Sanremo *Handbook on ROE*, the subsequent management of ROE is a systematic and iterative process. This includes attributing specific authority to the different levels of command as well as the monitoring of ROE implementation and compliance. Over time, an AI system may learn to ease frictions within and among ROE as well as provide efficiency gains for their adaptation. For example, although international law's material substance may intrinsically require value-based judgment which should not be delegated to AI systems, defining which rules need to be applied in which situations is not an overly complicated rational process. To not alter the substance of the existing legal framework, however, such function requires that any AI application for the management of ROE cannot trespass attributed authority.

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[106] Cortney Weinbaum, 'A Code of Conduct for AI in Defense Should Be an Extension of Other Military Codes' (11 September 2019) <https://www.rand.org/blog/2019/09/a-code-of-conduct-for-ai-in-defense-should-be-an-extension.html> accessed 7 July 2021.

[107] Jean-Baptiste Jeangène Vilmer, 'A French Opinion on the Ethics of Autonomous Weapons' (*War on the Rocks*, 2 June 2021) <https://warontherocks.com/2021/06/the-french-defense-ethics-committees-opinion-on-autonomous-weapons/> accessed 7 July 2021; 'Opinion on the Integration of Autonomy into Lethal Weapon Systems' (n 65) 15, 17; 'Parliamentary Fact-Finding Report on LAWS' (France National Assembly 2020) 4832 21–22; 'Autonomy, Artificial Intelligence and Robotics: Technical Aspects of Human Control' (n 103).

[108] Vincent Boulanin and Maaike Verbruggen, 'Mapping the Development in Autonomy in Weapon Systems' (SIPRI 2017) 44.

[109] ibid 24–26; 'Parliamentary Fact-Finding Report on LAWS' (n 107) 21–22.

[110] Cherry and Johnson (n 8) 15; Boulanin and Verbruggen (n 108) 49.

[111] 'Final Report of the Panel of Experts on Libya' (UNSC 2021) S/2021/229 para 63.

In sum, ROE can be a relevant tool to guide the use of military AI concretely and practically. As such, it can complement and implement policies, regulations, and guidelines at the higher echelon, thereby enabling the transformation of military, political, legal, and ethical objectives and principles into concrete action. This is notably relevant regarding human-machine teaming as well as the definition and concretization of meaningful human control and judgment related to AI systems in the context of targeting. AI applications may further increase the quality and efficiency of the management of ROE. While this may serve to assist military staff similar to AI applications for military planning, the military staff would need to keep effective oversight of the ROE's substance, namely who or what system gets to use force in which situations under which conditions. Ensuring this oversight may become challenging if AI enables a broader spectrum of more nuanced and more rapidly alternating ROE, however.

6. Orders & AI

The most specific and concrete instrument for planning and executing military operations are orders. NATO and the U.S. Army, for instance, define order as 'a communication that is written, oral, or by signal, which conveys instructions from a superior to a subordinate.'[112] While there are different types of orders,[113] they are generally brief and specific. Orders can be issued verbally, with graphics or plans, or with overlays.[114] They must comply with the law as well as guide military documents and instruments at superior echelons. Another frequent term is that of command, which is defined as 'an order given by a commander, that is, the will of the commander expressed to bring about a particular action.'[115]

Applied to AI, there will probably be no need for orders. Rather, instructions from (military) staff to AI systems will take the form of the initial development of the system, the programming of parameters regarding mission objectives and constraints, and operators' input during operations. These forms of interaction between humans and the AI systems, however, may fulfil the function traditionally attributed to orders. While the development and operationalization of AI systems, notably machine learning, have their particular challenges, experiences have shown that machines are not inherently at risk to disobey commands.[116] As human

[112] 'Glossary of Terms and Definitions AAP-06' (n 13) 95; 'Field Manual 5-0 Army Planning and Orders Production' (US Department of the Army 2005) FM 5-0 Annex G-4.

[113] The U.S. Army Planning and Orders Production Field Manual (FM 5-0), for instance, classifies five types of combat orders, namely operation orders; service support orders; movement orders; warning orders; and fragmentary orders. See: 'Field Manual 5-0 Army Planning and Orders Production' (n 112).

[114] ibid.

[115] 'Glossary of Terms and Definitions AAP-06' (n 13) 29; 'Dictionary of Military and Associated Terms' (n 50) 40.

[116] Evan Ackerman, 'Researchers Teaching Robots How to Best Reject Orders from Humans - IEEE Spectrum' (*IEEE Spectrum: Technology, Engineering, and Science News*, 29 November 2015)

input during operations equals human control of the system, which is of particular importance if a system can autonomously adapt its behaviour according to proper learning, safeguards preventing systems from taking action without required human input are now being developed. The *US DOD 2012 3000.09 Directive*, for instance, prescribes that LAWS must be programmed in a way that prevents them from selecting and engaging targets without prior human approval, especially in the event of lost communication.[117]

Concrete forms of interaction between AI and operators continue to be developed. A U.S. Army laboratory has designed a software that enables robots to understand verbal instructions, execute tasks, and report back.[118] Talking AI is now also being developed to enable verbal dialogue between an operator and the system.[119] Such interaction allows the system to ask its operator for clarifications and to provide updates when tasks are completed so that soldiers work with the most up-to-date information.[120] Such applications may make it easier for military staff to work with AI. They may also reduce its learning curve regarding the control of AI.[121] Yet AI applications may also support commanders in their task to give orders and commands. AI may be used to improve the robustness and the tolerance for errors of communication systems, which notably can make the transmission of orders more secure.[122]

Although AI systems will probably not be entrusted with formally issuing orders themselves, similar dynamics may arise nevertheless. For the interaction between AI systems, orders are not necessary because systems simply exchange information as part of a network of digital applications. Regarding orders to military staff, it seems improbable that armed forces would accept that AI systems give instructions to its members. Yet, as AI systems are likely to make recommendations for action that serve as input for human decision-making at an increasingly higher speed and complexity, military staff may not question the recommendations, not have time to

<https://spectrum.ieee.org/automaton/robotics/artificial-intelligence/researchers-teaching-robots-how-to-best-reject-orders-from-humans> accessed 7 July 2021.

[117] Slijper and others (n 26) 8; US Department of Defense (n 58) s 4(c)1.

[118] David Hambling, 'The US Army Is Creating Robots That Can Follow Orders' (*MIT Technology Review*, 6 November 2019) <https://www.technologyreview.com/2019/11/06/132036/the-us-army-is-creating-robots-that-can-follow-ordersand-ask-if-they-dont-understand/> accessed 7 July 2021.

[119] An example is the U.S. Army Combat Capabilities Development Command's Army Research Laboratory's Joint Understanding and Dialogue Interface, or JUDI, which 'enables a Soldier to interact with autonomous systems through bidirectional speech and dialogue in tactical operations where verbal task instructions can be used for command and control of a mobile robot.' ibid.

[120] Loukia Papadopoulos, 'Army Researchers Create Conversational AI to Improve Soldier-Robot Communications' (1 August 2020) <https://interestingengineering.com/army-researchers-create-conversational-ai-to-improve-soldier-robot-communications> accessed 7 July 2021.

[121] 'Army Research Enables Conversational AI between Soldiers, Robots' (*www.army.mil*, 27 July 2020) <https://www.army.mil/article/237580/army_research_enables_conversational_ai_between_soldiers_robots> accessed 7 July 2021.

[122] Daniel Schutzer, 'Applications of Artificial Intelligence to Military Communications', *MILCOM 1983 - IEEE Military Communications Conference* (1983); Masuhr (n 32).

critically assess the recommendations, or simply not be able to understand how the system has reached its conclusions. If they nonetheless base their actions on the recommendations, such over-reliance on the system's input could mean that the system *de facto* issues orders to humans. It is also possible that operators and soldiers at lower hierarchical levels who receive instructions via information technology (IT) tools may not be able to know whether a given order was created by a human or an AI system. To preclude such results, military doctrines and (other) directives would need to establish transparency regarding processes related to orders.

To conclude, it is likely that formal orders will be irrelevant for controlling AI in military operations. Nevertheless, the traditional concepts of orders and commands can be helpful to analyse, categorize, and develop future interactions between AI systems and human operators. In this context, the traditional distinction between the managerial approach and *Auftragstaktik,* as developed by Carl von Clausewitz, suggests that human input to AI systems, namely the development, programming, and operational control of AI systems, could be categorized according to the level of discretion as to the details of the execution of a task. Given AI's qualities, it is reasonable to assume that AI systems will be most valuable for armed forces when being attributed high levels of autonomy, similar to *Auftragstaktik*. Direct human input during operations may be very precise, however, resembling the managerial approach.[123] Most importantly, however, this reverts to the fundamental issue of how much autonomy can be granted to AI systems, as discussed in the chapters above.

7. Conclusion

At this stage, AI technologies and their military applications, as well as respective policies, are only emerging. Yet the integration of AI into armed forces will most likely transform the preparation and execution of military operations. This paper has analysed how AI systems will most likely affect and be affected by principal instruments for preparing and conducting military operations. Overall, the introduction of AI for military operations leads to a tension between AI influencing these instruments and these instruments serving to properly manage military AI.

With regard to strategy, it can be expected that AI will be used for developing strategies, similar to planning activities. The introduction of AI applications throughout armed forces will likely also need to be considered by military strategists, as the speed and complexities of military operations may increase. Doctrine is an appropriate tool to define armed forces' perception of AI as well as humans' role regarding the use and control of AI, thereby serving as a hook for institutional ethics, values, and identity. Given doctrine's purpose, AI will likely not have a major role in determining doctrine. Yet the planning process will likely be heavily supported by AI systems, which may lead to higher quality and speed of planning processes,

[123] For a discussion in the context of the digitalization of C2, see Spagnoletti and Salvi (n 8).

eventually improving military decision-making. While AI can well support the management of ROE, these are instruments that can serve to guide the concrete authority attributed to AI systems and define human-machine teaming for specific missions in line with superior guidelines such as doctrine, (other) directives, and plans. Orders, however, are likely to become irrelevant for the interaction between AI systems and human-system interaction.

Overall, a recurring theme is the interaction between AI systems and commanders, operators, and soldiers. Indeed, human control is a requisite for the purposeful use of AI in a human world. Yet, human-machine teaming remains subject to challenges. Many processes related to military operations will still require human input. Moreover, it seems crucial that military staff will be enabled to follow, understand, and keep appropriate control of AI systems. This is not only an ethical and legal challenge but a requisite to achieve effective enhancement of military operations through the introduction of AI. Further reflections and research on AI and military operations in general as well as on AI and strategy, doctrine, plans, ROE, and orders, in particular, should therefore focus on the human-machine interaction, as this remains the most pressing challenge of AI-enabled warfare. This may serve to find and define an adequate balance between AI influencing instruments for preparing and conducting military operations and these instruments serving to properly manage military AI.