ARTIFICIAL INTELLIGENCE AND ITS IMPACT ON MILITARY DECISION-MAKING IN FUTURE WARFARE

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Abstract

This paper explores AI's influence on military decision-making at the tactical, operational, and strategic levels. At the tactical level, AI enhances speed and precision, providing real-time data analysis and decision support in high-risk, time-sensitive situations. At the strategic level, where decisions carry broader geopolitical consequences, human oversight remains dominant due to the complexity and potential for inadvertent escalation. Humans and machines collaborate at the operational level, with machines having more autonomy at the tactical level and humans dominating at the strategic level. The paper concludes that military planners must carefully evaluate the appropriate balance of AI autonomy and human control across these levels. It also cautions against the risks of an emerging AI arms race and the dangers posed by asymmetric AI development, where uneven technological capabilities among nations could lead to instability and unpredictable escalation.

Keywords: *AI, Military Decision-making, Tactical, Operational, Strategic, Man-machine, Accuracy.*

Introduction

For centuries, philosophers, psychologists, economists, strategists, mathematicians, and social scientists have studied the art of decision-making. They have proposed various methods for decision-making, such as cost and benefit analysis, pros and cons, maximin and maximax methods, conjunctive and disjunctive methods, lexicographic method, game theory, theory of mind, utility maximization theory, theory of choice, and so on.[1]

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1 A. R. K. Sasikumar and S. V. A. V. Prasad, "Optimal Deployment of Decoys for Ballistic Missile Defence," *Applied Mathematical Modelling* 34, no. 11 (November 2010): 3251–63, https://doi.org/10.1016/j.apm.2009.11.016; V. Zhukovin, N. Chkhikvadze, Z. Alimbarashvili, "Decision Making:

In warfare, military decision-making is of utmost importance, and the notion has been examined and emphasized on since recorded history. Sun Tzu, in his book "Art of War", highlighted the importance of decision-making by stating that the quality of decision-making determines victory.[2] In 1954, Ward Edward, reviewing the theory of decision-making, developed two streams. The first stream was termed as the 'Theory of Riskless Choices,' which intended to maximize utility, and the second stream was termed the 'Theory of Risky Choices,' intended to maximize expected utility.[3] The Theory of Riskless Choices dealt with decision-making under certain circumstances, while the Theory of Risky Choices considered decision making under uncertain circumstances. Herbert A pondered these theories. Simon who heavily criticized the Maximize Utility Theory to suggest that decision-making was rather based on bounded rationality,[4] which was meant to achieve a satisfying objective.[5] The concept of bounded rationality was reevaluated in 2001 by Gred Gigerenzer and Reinhard Selten. Gigerenzer and Selten highlighted that common denominators in decision-making were limited time and knowledge of domains is uncertain in changing world. These factors, they believed, could have a negative impact on bounded rationality and satisfaction in decision-making in future decision making.

Future warfare would be heavily dominated by emerging technologies such as artificial intelligence (AI), machine learning, generative AI, cyber, space, quantum, unmanned systems, etc. This might impact bounded rational military decision-making due to compressed, limited time and novel knowledge, resulting in a high level of uncertainty. This would ultimately blur the typical lines on the battleground.[6] Jean B. McGrew, in his research, described that the decision-making in future warfare would be under a short time frame, shattering stress and disorientation. He alluded to this concept as 'Future Shock'.[7] The concept

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Lexicographical Procedure," Cornell University, March 2, 2010, https://arxiv.org/abs/1003.0569.

2 Lionel Giles, *Sun Tzu: The Art of War*, (London: Oxford University Press, 1994).

3 Ward Edwards, "The Theory of Decision Making," *Psychological Bulletin* 51, no. 4 (1954): 380.

4 Herbert A. Simon, "Rational Decision Making in Business Organizations," *The American Economic Review* 69, no. 4 (1979): 493-513.

5 Gerd Gigerenzer and Reinhard Selten, eds. *Bounded Rationality: The Adaptive Toolbox*, (Cambridge: MIT Press, 2002).

6 Orlando D. Critzer, *21st Century Strategy Needs Sun Tzu*, Army War College, (Carlisle Barracks: PA, Strategy Research Paper) 2012, https://apps.dtic.mil/sti/pdfs/ADA561113.pdf.

7 Jean B. McGrew, "Future Shock," *The Bulletin of the National Association of Secondary School Principals* 54, no. 349 (1970): 123-129, accessed on 11

was further elaborated by Major Wilson A. Shoffner who stated when too much change would hit too fast, it would become difficult for the military decision-makers to absorb information due to which they could either show signs of deteriorated or disorientated decision-making capability. Owing to the growing uncertainty in a war-like situation, war strategists are depending on technology such as AI to develop better comprehension and awareness of the battleground. AI would be able to extend enriching decision-making support to military decision-makers.[8]

While a few analysts on emerging technologies believe that the introduction of AI on the battleground would have minimal impact, many have shown an inclination towards the belief that emerging technologies, especially AI, would have an evolutionary impact.[9] A Congressional Research Service report studied the revolutionary impact of AI to reveal that many experts believe that AI would cause a seismic shift and fundamentally transform war.[10] James Johnson particularly studied the impact of AI on strategic decision-making to state that AI-enabled decision-making tools would substitute human empathy, critical thinking, and intuition in strategic thinking, which could be fundamentally destabilizing.[11] The Congressional Research Service Report also analysed the evolutionary impact of AI on warfare and revealed that some experts believe that AI would dramatically improve military effectiveness and combat potential. Presently, the debate on the evolutionary or revolutionary impact of AI on warfare, and especially on decision-making is ongoing, and the actual potential of AI remains to be seen and understood.[12] However, analyzing the sixth revolution in military affairs that involves organizational restructuring and doctrinal innovation that would be required to adapt to AI, Micheal Raska expressed that

March 2022, https://journals.sagepub.com/doi/abs/10.1177/01926365700543491 2?journalCode=bulc.

8 Gloria Phillips-Wren, and Lakhmi Jain, "Artificial intelligence for decision making," *In International Conference on Knowledge-Based and Intelligent Information and Engineering Systems*, Berlin, Heidelberg, 2006, accessed on 14 March 2022, https://link.springer.com/chapter/10.1007/11893004_69.

9 Daniel S. Hoadley and Kelley M. Sayler, *Artificial Intelligence and National Security*, report (Washington, D.C.: Congressional Research Service, 2020), https://sgp.fas.org/crs/natsec/R45178.pdf.

10 Daniel S. Hoadley and Kelley M. Sayler, *Artificial Intelligence and National Security*.

11 James Johnson, "Delegating Strategic Decision-Making to Machines: Dr. Strangelove Redux?," *Journal of Strategic Studies* (2020): 1-39, https://www.tandfonline.com/doi/full/10.1080/01402390.2020.1759038.

12 "Artificial Intelligence and NC3: P5 Perspectives," VCDNP, April 3, 2024, https://vcdnp.org/ai-and-nc3/

incorporating AI technologies would disproportionately impact countries and regions due to geo-strategic competition.[13]

The changing geostrategic environment altered how militaries are procuring AI. The U.S. military, for instance, has integrated commercial off-the-shelf and dual-use AI technology in systems such as drones and unmanned aerial vehicles.[14] This is because the commercial research and development is progressing faster than in the military. The cost per unit is low, and there is a large market for such AI technologies. Similarly, the People's Liberation Army (PLA) is also concerned about the ongoing strategic competition. Due to this, it has shifted from 'informatised' warfare to 'intelligentised' warfare that includes the development of innovative techniques in AI and machine learning to transform the overall operational capability of PLA including, human-machine integration, weapons, and ways of combat.[15] Russia, on the other hand, also stressed dual-use technology like the U.S. and attempted to make a breakthrough in AI through 'radical innovation centres or 'technoparks'.[16] Israel Defense Forces experienced the strategic effect of AI, and like the U.S., Israeli Defense Forces also relied on the dual-use nature of AI from the civilian sector.[17] Indian defence sector entered the AI strategic competition comparatively late. It was focused on developing AI capabilities for defence through a capacity-building model.[18] This showed that militaries around the world have progressed to induce AI into their operations in order to enhance their tactical, operational, and strategic capability and effectiveness which could have a significant impact on strategic competition as mentioned in the previous paragraph.

To club the above-stated debate, the introduction of AI and machine learning to the battleground and decision-making certainly marks a turning point in warfare, regardless of its accessibility.[19] However, many analysts were sceptical that war would be relevant in future times, given

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13 Michael Raska, "The sixth RMA wave: Disruption in military affairs?," *Journal of strategic studies* 44, no. 4 (2021): 456-479.

14 Stanley-Lockman, Zoe. "From closed to open systems: How the US military services pursue innovation." Journal of Strategic Studies 44, no. 4 (2021): 480-514.

15 Elsa B. Kania, "Artificial intelligence in China's Revolution in Military Affairs," *Journal of Strategic Studies* 44, no. 4 (2021): 515-542.

16 Katarzyna Zysk, "Defence Innovation and the 4th Industrial Revolution in Russia," *Journal of Strategic Studies* 44, no. 4 (2021): 543-571.

17 Yoram Evron, "4IR Technologies in the Israel Defence Forces: Blurring Traditional Boundaries," *Journal of Strategic Studies* 44, no. 4 (2021): 572-593.

18 Ambuj Sahu, "Artificial Intelligence in military operations: Where does India stand?," *Observer Research Foundation,* 2019.

19 Greg Allen, and Taniel Chan, Artificial Intelligence and National Security, (Cambridge, MA: Belfer Center for Science and International Affairs, 2017).

the high stakes it could inflict. To address this query, experts on state behaviour during warfare, conflict and peacetime, like John Mearsheimer and Lawrence Freedman, negated the theory that war was declining and becoming irrelevant; instead, they believed that war would stay relevant in the future. In his book 'The Future of War,' Lawrence Freedman built arguments that war would have a future. He stopped short of predicting what future warfare might look like, but he stated with certainty that technologies, such as AI, would likely play a role in future combats.[20] The above discussion attempted to highlight two aspects. Firstly, military decision-making has evolved over time, and secondly, AI would have a prominent role on the battlefield. This paper further addresses the research gap of what future warfare dependent on AI would look like. The research evaluates the introduction of AI on the battlefield by analysing the impact of AI on the speed and accuracy of military decision-making. It also analyses the man-machine teaming for decision-making. It then delves into the risks of introducing AI into military decision-making, and lastly puts forth recommendations.

The Character of Warfare and Military Decision-Making

Emerging technologies have introduced an evident shift in the character of warfare.[21] Due to this shift, it would be necessary that military decision-making processes also evolve to keep pace with technological development. Emerging technologies, such as AI, cyber, nanotechnology, space, quantum, etc., have added to the complexities and uncertainty on the battlefield that would need to be considered during the decision-making process from tactical, operational and strategic levels in future warfare. As discussed by Karel and Adelbert in their research, the analytical decision-making approaches of present times might give human decision-makers a false sense of covering the entire spectrum of the battlefield.[22] This false sense could be due to negligence or unavailability of information which may create a wrong interpretation of the battlefield, and lead to incorrect decision-making. In addition, the decision-making process has been consuming for humans, which dramatically complicates

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20 Lawrence Freedman, *The Future of War: A History*, (New York: NY: Public Affairs, 2017).

21 Otto Kreisher, "Emerging Tech Will Change the Character of War, and the US Must be Ready, Milley Says," *Sea Power Official Publication of Navy League of the United States*, 2021, https://seapowermagazine.org/emerging-tech-will-change-the-character-of-war-and-the-us-must-be-ready-milley-says/

22 Karel van den Bosch, and Adelbert Bronkhorst, "Human-AI cooperation to benefit military decision making," NATO, 2018, https://www.karelvandenbosch.nl/documents/2018_Bosch_etal_NATO-IST160_Human-AI_Cooperation_in_Military_Decision_Making.pdf.

the process and limits the number and diversity of options to explore. They discussed that classical military decision-making demands time, which is not suitable for modern warfare. This is because with the emerging and future battlefield technologies, the time from taking a decision and executing an action would shrink while the quantum of available data for decision-making would rise. Therefore, to provide a timely response to the changing character of warfare, it would be important to look into why AI could be a valuable asset for decision-making.

AI-Based Data Sorting for Decision Making

AI could be a useful asset on the battleground as it improves situational awareness. The three broad categories employed for improving situational awareness are;

- Data Extraction: AI algorithms are useful assets in extracting an abundance of data from various streams on the battleground such as from land, sea, air, space, and cyber. For the purpose of data extraction, three methods are used. Firstly, the user-centric data extraction gathers the data of the solider.[23] For instance, at field level, the geo-location of the solider, terrain, distance from the enemy or home base and so on. Secondly, the network-centric data extractions gather data that is in transit or flowing within a network through sensors.[24] Such data could be helpful for situational awareness at the operational and strategic levels. Thirdly, domain-centric data extraction collects information from physical assets and cognitive data from multiple domains.[25] This type of data extraction gathers alphanumeric and behavioural data. The purpose of data extraction is to sense patterns in large amounts of data and aid in processing, segmentation, and segregation of data, such as identifying enemy soldiers, and the type of ammunition, as well as identifying anomalies in the data stream.[26]

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23 Maxim Bakaev, and Tatiana Avdeenko, "Data Extraction for Decision-Support Systems: Application in Labour Market Monitoring and Analysis," *International Journal of e-Education, e-Business, e-Management and e-Learning 4,* no. 1 (2014). http://www.ijeeee.org/Papers/295-A0076.pdf.

24 Maxim Bakaev, and Tatiana Avdeenko, "Data Extraction for Decision-Support Systems: Application in Labour Market Monitoring and Analysis."

25 Gen David G. Perkins, "Multi-Domain Battle," *Military Review July-August,* 2017, https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/MilitaryReview_20170831_PERKINS_Multi-domain_Battle.pdf.

26 Philip Kerbusch, Bas Keijser, and Selmar Smit, "Roles of AI and Simulation for Military Decision Making," *In STO Meeting Proceedings MP-IST-160*, 2018.

- Data Description: The data extracted from various sources is in raw and unclassified form. To make an informed decision, this data needs to be described in a manner that generates either the latest or the real-time picture of the operational environment. Data description for that purpose finds human-interpretable patterns, correlations, and associations.[27] Within the data description, data is sorted through two methods, first by segmentation and change, and second by deviation detection.[28] The purpose of a data description is to develop a situational understanding of the current operational environment in order to make military decisions. Data description automatically builds models of available information, human combatants and physical terrain by describing all relevant entities, their relationship, and unseen attributes such as goals and ambitions.[29]
- Data Prediction: Data prediction is the most critical factor as it aids military decision makers in planning their next moves. Data prediction constructs one or more sets of data models by analyzing the described data in order to predict the behaviour of available data sets.[30] The descriptive and predictive data can be used interchangeably as data predictive models are also in the form of descriptive, human-interpretable and understandable, while descriptive models of data can also be used to make predictions.[31] Al technologies used for data prediction assist in generating future decisions and courses of action at tactical, operational and strategic levels such as the suggestion of time and location to shoot a missile to inflict the most damage. Nevertheless, uncertainty remains an inherent factor and cannot be ignored. For instance, the knowledge and understanding relevant to one operational

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27 Madhuri Agrawal, Gajendra Singh, and Ravindra Kumar Gupta, "Predictive Data Mining For Highly Imbalanced Classification," *International Journal of Emerging Technology and advanced Engineering* 2, no. 12 (2012): 139-143, https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.414.2260&rep=rep1&type=pdf.

28 Madhuri Agrawal, Gajendra Singh, and Ravindra Kumar Gupta, "Predictive Data Mining For Highly Imbalanced Classification."

29 Philip Kerbusch, Bas Keijser, and Selmar Smit, "Roles of AI and Simulation for Military Decision Making," *In STO Meeting Proceedings MP-IST-160*, 2018.

30 Madhuri Agrawal, Gajendra Singh, and Ravindra Kumar Gupta, "Predictive Data Mining For Highly Imbalanced Classification," *International Journal of Emerging Technology and advanced Engineering* 2, no. 12 (2012): 139-143. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.414.2260&rep=rep1&type=pdf.

31 Madhuri Agrawal, Gajendra Singh, and Ravindra Kumar Gupta, "Predictive Data Mining For Highly Imbalanced Classification."

environment might no longer be valid after a certain time.[32] Therefore, in order to make informed decisions, better knowledge and understanding of the battlefield can result in acurate predictions. Similarly, a larger amount of relevant data can yield better and more informed decisions.

Impact of AI on Military Decision Making

John Boyd's OODA loop (observe-orient-decide-act) is prominent in military decision-making processes.[33] The Department of Defense released a cycle similar to the OODA loop that involved AI in future decision-making.[34] The decision cycle laid out three functions of AI in decision making which are; 'sense', 'make sense', and 'act'. The function of 'sense' would be for the AI sensors in friendly, adversary, and neutral domains to discover, collect, correlate, aggregate, process and exploit data. While the 'make sense' function would be responsible for analyzing information for understanding and predicting. This function would transform data into knowledge. Lastly, the 'act' combines cognitive and technical decision-making to take an action.[35] This model showed the role of AI in the decision-making of future warfare, and how advanced militaries around the world could depend on AI-aided decision-making processes. It also highlighted how AI can assist militaries in understanding and predicting the decision cycle of adversaries by analysing their actions. As discussed earlier, such dependence on AI would increase during constrained environments or when the human cogitative ability is overwhelmed with information to process. Under such circumstances, AI would significantly impact the speed, accuracy, and man-machine team for military decision-making at the tactical, operational, and strategic levels. These aspects are looked into in detail subsequently.

Speed Due to emerging and future warfare technologies, the character of war has changed from long and extensive to quick, short, intense, destructive, shock-and-awe situation. This has compressed the reaction time drastically, requiring military decision-makers at tactical, operational, and strategic levels to speed up the process of decision-making in order to ensure victory or survival.

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32 Philip Kerbusch, Bas Keijser, and Selmar Smit, "Roles of AI and Simulation for Military Decision Making," In *STO Meeting Proceedings MP-IST-160*, 2018.

33 Scott E. McIntosh, "The Wingman-Philosopher Of Mig Alley: John Boyd and The OODA Loop," *Air Power History* 58, no. 4 (2011): 24-33. https://www.jstor.org/stable/26276108.

34 Department of Defense, *Summary of Joint All-Domain Command and Control (JADC2) Strategy*, report (Washington, D.C.: Department of Defense, 2022). https://media.defense.gov/2022/Mar/17/2002958406/-1/-1/1/.

35 Department of Defense, *Summary of Joint All-Domain Command and Control (JADC2) Strategy.*

At the tactical level, the decision-making time is shortest as combatants on the ground are required to respond quickly. For instance, in case of a first shot or a tactical missile launched, field units would require a quick response to neutralise the attack. AI, in this matter, could be useful to speed up the decision-making process to respond. Firstly, by providing information on identifying the type of approaching threat. Secondly, AI could assist in analyzing the offensive environment, and suggest the appropriate response based on its predictive capabilities. This information and options could significantly speed up the decision-making process at the tactical level.

At the operational level, the decision-making time is relatively more than at the tactical level. This allows more time to analyse the situation in order to make an informed decision. At the operational level, the decision-making programs generate abundant information from various sources and/or networks. Air Force Academy in Romania studied decision making in a networked force and identified that as militaries are evolving into a networked force, decision-makers would need to select and filter information promptly. For this purpose, AI permits a greater range of options with in-depth analysis quickly at the operational level.[36]

The strategic level of military decision-making requires time and access to a large amount of information from all domains, including air, sea, land, space, and cyber, to make rational decisions. In such a scenario, AI is essential for decision-making as it can quickly sort and analyse the data to aid in making informed decisions. [37] In the future, the decision-makers at the strategic level will rely on AI to process and understand the vast amount of information, as it might be beyond human capabilities. Without the use of AI, traditional decision-making methods may not be efficient or effective in a contested environment, and could lead to delays or incorrect decisions. Therefore, incorporating AI in military decision-making could improve decision-making.

Accuracy The speed of future warfare would require speed in the decision-making process; however, the speed of decision-making does not ensure the accuracy of decisions. With the future speed and lethality of war, the room for error and miscalculation would be significantly reduced. For this reason, military decision-making would require accuracy to

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[36] Xiren Zhou, Siqi Wang, Ruisheng Diao, Desong Bian, Jiahui Duan, and Di Shi, "Rethink AI-based Power Grid Control: Diving into Algorithm Design," arXiv:2012.13026, (2020).

[37] David K. Spencer, Stephen Duncan, and Adam Taliaferro, "Operationalizing Artificial Intelligence for Multi-Domain Operations: A First Look," *In Artificial Intelligence and Machine Learning for Multi-Domain Operations Applications Proceedings* 11006, p. 1100602, International Society for Optics and Photonics, 2019. https://www.spiedigitallibrary.org/conference-proceedings-of-spie/11006/2524227/Operationalizing-artificial-intelligence-for-multi-.

ensure that the objectives of the military decisions are met. Accuracy could be increased with the assistance of AI as AI would be able to sort, filter, and sequence data from repetitive information coming from the battleground as well as detect anomalies.[38] In future warfare, emerging technologies, such as drones and unmanned vehicles that depend on sensors and AI-decision making, will surround every angle of the battlefield. The accuracy of their actions would be increased due to AI's sorting and assessment at the tactical, operational, and strategic levels.[39]

At the tactical level, the room for error and miscalculation is inevitable compared to the operational and strategic levels. However, at this stage, the life of a pilot or solidier is at risk, which makes the accuracy of the decision an important factor. AI, at this level, can support the accuracy of decisions by providing accurate information regarding the enemy, for instance, the position of the enemy, coordinating fires and maneuvering options via AI-driven systems.[40] AI could also assist in deciding when a soldier's life is under threat, and when it must act as a loyal wingman and take over the dangerous and tedious tasks that risk the lives of human soldiers/pilots.[41] Additionally, during aerial combat, the AI algorithms could accurately sort the data to identify and help the pilot decide which threat neutralization needs to be prioritized to save the pilot's life. Using AI, the pilot could identify with accuracy which signals are insignificant and by eliminating those signals, a clear picture for decision-making becomes available.[42]

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38 Wiphada Wettayaprasit, Nasith Laosen, and Salinla Chevakidagarn, "Data Filtering Technique for Neural Networks Forecasting," *In Proceedings of the 7th WSEAS International Conference on Simulation, Modelling and Optimization*, pp. 225-230, World Scientific and Engineering Academy and Society (WSEAS), 2007. https://citeseerx.ist.psu.edu/viewdoc/

39 Michael C. Horowitz, "When Speed Kills: Lethal Autonomous Weapon Systems, Deterrence and Stability," *Journal of Strategic Studies* 42, no. 6 (2019): 764-788. https://www.tandfonline.com/doi/abs/10.1080/; Nancy Jones-Bonbrest, "Artificial Intelligence improves Soldiers' Electronic Warfare user Interface," *United States Army,* 2019. https://www.army.mil/article/218705/.

40 Kareem Ayoub and Kenneth Payne, "Strategy in the Age of Artificial Intelligence," *Journal of Strategic Studies* 39, no. 5-6 (2016): 793-819, https://www.tandfonline.com/doi/full/10.1080/.

41 Kerim Goztepe, "New Directions in Military and Security Studies: Artificial Intelligence and Military Decision-Making Process," *International Journal of Information Security Science* 4, no. 2 (2015): 69-80, http://ijiss.org/ijiss/index.php/ijiss/article/view/155.

42 Nancy Jones-Bonbrest, "Artificial Intelligence improves Soldiers' electronic warfare user interface," US Army, 2019, https://www.army.mil/article/218705/artificial_intelligence_improves_soldiers_electronic_warfare_user_interface.

At the operational level, AI could assist in making an informed decision, which would ultimately improve the accuracy of the operation. Accuracy is important at an operational level, as there is little room for error and miscalculation. Accuracy with AI could be ensured as it would be based on concrete information from various sensors, networks, and domains rather than abstract assumptions based on experience. Additionally, AI could be helpful in making an accurate decision as it would provide an improved understanding and a complete and real-time picture of the enemy forces and terrain. AI would gather, filter, and select information regarding the friendly and enemy forces, assets, and their capabilities.[43] Such vast information would increase the analysis ability and ultimately improve the accuracy of decisions.[44]

At the strategic level, there is little room for error and miscalculation; therefore, the highest level of decision-making accuracy would be required. For this purpose, AI-enabled command and control systems would likely avoid many shortcomings of cogitative strategic decision-making capabilities by analyzing vast amounts of data, recognizing patterns that could be missed by human decision-makers, and challenging assumptions.[45] These capabilities could especially be useful in the fog of war as well as in high-risk and reduced response-time scenarios. Additionally, decision-making at the strategic level could become more accurate with AI as error-free data would reach the decision-makers. With the help of AI, accurate data would be available in real time from various domains. This could be helpful for military decision-makers to plan a course of action for the present as well as predict future national security threats.[46]

Man and Machine Teaming: With AI, man and machine teaming would shift from one-way messaging to two-way messaging. This would form an actual teaming in systems such as Battle Management Systems with the capability to exchange information and ideas to make informed decisions. Under man and machine teaming, AI would become a partner on the battlefield. Research conducted at Florida Institute for Human and

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43 Emma Schuster, *When Something Has to Give: The Intersection of Artificial Intelligence, Military Decision-Making and International Humanitarian Law*, Master's Thesis (Lund, Sweden: Lund University, 2018), https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8955234&fileOId=8955235.

44 Emma Schuster, *When Something Has to Give: The Intersection of Artificial Intelligence, Military Decision-Making and International Humanitarian Law.*

45 Kareem Ayoub and Kenneth Payne, "Strategy in the Age of Artificial Intelligence," *Journal of Strategic Studies* 39, no. 5-6 (2016): 793-819, https://www.tandfonline.com/doi/full/10.1080/.

46 James Johnson, "Artificial Intelligence & Future Warfare: Implications for International Security," *Defense & Security Analysis* 35, no. 2 (2019): 147-169. https://lup.lub.lu.se/student-papers/search/publication/8955234

Machine Cognition studied man and machine teaming to coin the term co-active, which is meant to convey the reciprocal and mutually constraining nature of actions that are conditioned by coordination.[47] The research further explained this relation as playing a sheet of music in a duet. Similarly, on the battleground, the man and machine team, which could also be referred to as the man and AI decision-making team, would have a varying degree of interdependent relationships in order to make informed decisions.

At the tactical level, AI would be able to detect visual perception, perform speech and facial recognition tasks, and make semi- or complete-autonomous decisions during combat.[48] At this level, the machine can be given more decision-making authority as the speed of combat is fast, which requires fast reactions. In the future, decisions could be taken by the machine independent of human supervision, while at present, there are only a few militaries that have developed and deployed complete autonomous decision-making[49] systems, such as the United Kingdom, United States, Russia, South Korea, Israel, and China.[50]

At an operational level, humans and AI could act as wingmen to support decision making in future operations. The two could distribute decision-making tasks, especially under a constrained environment when the cognitive state of a human is stressed and congested.[51] This distribution would also be useful to interact with multiple threats at the same time.[52] Similarly, under normal conditions, human could solely take over the decision-making task with support and assistance from AI. The human and AI team would strengthen their understanding of each other

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47 Matthew Johnson, Jeffrey M. Bradshaw, and Paul J. Feltovich, "Tomorrow's Human–Machine Design Tools: From Levels of Automation to Interdependencies," *Journal of Cognitive Engineering and Decision Making* 12, no. 1 (2018): 77-82, https://journals.sagepub.com/doi/abs/10.1177/1555343417736462.

48 James Johnson, "Artificial Intelligence & Future Warfare: Implications for International Security," *Defense & Security Analysis* 35, no. 2 (2019): 147-169. https://lup.lub.lu.se/student-papers/search/publication/8955234.

49 Michael T. Klare, "Autonomous Weapons Systems and the Laws of War," Arms Control Association, 2019, https://www.armscontrol.org/act/2019-03/features/autonomous-weapons-systems-laws-war.

50 Human Rights Watch, "Killer Robots," 2022, https://www.hrw.org/topic/arms/killer-robots.

51 Michael J. Barnes, Jessie Y. Chen, and Susan Hill, *Humans and Autonomy: Implications of Shared Decision Making for Military Operations*, report (Aberdeen, WA: US Army Research Laboratory Aberdeen Proving Ground United States, 2017), https://apps.dtic.mil/sti/pdfs/AD1024840.pdf.

52 Michael J. Barnes, Jessie Y. Chen, and Susan Hill, *Humans and Autonomy: Implications of Shared Decision Making for Military Operations*.

and develop common grounds for decision-making by harvesting the feedback and information gathered from their interaction.[53]

At the strategic level, the man and machine team would be considered effective, however, it could become potentially dangerous if complete decision-making autonomy is given to machines.[54] Since the room for error and miscalculation is the least at this level, AI is thought of as not up to the task yet. Due to this, at the strategic level, man is the primary decision maker[55] while AI retrieves information, processes it, and stores it. This allows the decision-makers greater situational awareness, prepare for crisis and make informed independent decisions.[56] Presently, at the strategic level, there is a general agreement that even if technology allowed, AI would not be given full autonomy due to reasons of unforeseen problems associated with AI algorithms.[57] Nevertheless, since the level of threat and its repercussions at a strategic level are the greatest, for example, from an incoming dual-capable missile; it is being contemplated that AI could be deployed to make decisions to carry out second-strike missions.[58]

Analysis

At the tactical level, where the life of the combatant is at high risk with less warning and reaction time, AI would provide the required information to make decisions to carry out offensive and defensive manoeuvres. Additionally, under a highly volatile environment, AI would

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53 Karel van den Bosch, and Adelbert Bronkhorst, "Human-AI cooperation to benefit military decision making," *NATO*, 2018, https://www.karelvandenbosch.nl/documents/2018_Bosch_etal.

54 Vincent Boulanin, Lora Saalman, Petr Topychkanov, Fei Su, and Moa Peldán Carlsson, *Artificial Intelligence, Strategic Stability and Nuclear Risk*, report (Stockholm, Sweden: Stockholm International Peace Research Institute SIPRI, 2020) https://www.sipri.org/sites/default/files/2020-06/artificial_intelligence_strategic_stability_and_nuclear_risk.pdf.

55 Philip Reiner and Alexa Wehsener, "The Real Value Of Artificial Intelligence In Nuclear Command And Control," *War on Rocks*, 2019, https://warontherocks.com/2019/11/the-real-value-of-artificial-intelligence-in-nuclear-command-and-control/

56 Vincent Boulanin, Lora Saalman, Petr Topychkanov, Fei Su, and Moa Peldán Carlsson, *Artificial Intelligence, Strategic Stability and Nuclear Risk*, report (Stockholm, Sweden; Stockholm International Peace Research Institute SIPRI, 2020) https://www.sipri.org/sites/default/files/2020-06/artificial_intelligence_strategic_stability_and_nuclear_risk.pdf

57 James Johnson, "Artificial Intelligence and The Bomb: Nuclear Command And Control In The Age Of The Algorithm," *Modern War Institute*, 2020.,

58 James Johnson, "Artificial Intelligence & Future Warfare: Implications for International Security," *Defense & Security Analysis* 35, no. 2 (2019): 147-169; James Johnson, "Artificial Intelligence And The Bomb: Nuclear Command And Control In The Age Of The Algorithm," *Modern War Institute*, 2020.

be able to provide accurate information for the decision-making process by de-cluttering the information. At the tactical level, in man-machine teaming, the machine can be given more authority to make decisions in order to provide a quick reaction that is beyond human cognitive abilities. At the operational level, the time for decision-making is comparatively longer, but the abundance of information from various sensors and networks makes the decision-making a challenging task. Nevertheless, the abundance of information could be useful for more accurate decision-making for AI. Additionally, AI at the operation level could act as a wingman to assist with decisions when the situation becomes difficult. Lastly, at the strategic level, AI could gather information from various domains (such as air, sea, land, cyber, and space) to assist and speed up decision-making. This information can ensure accuracy and provide various options for offensive and defensive purposes. At this level, the man would hold more authority for decision-making as compared to the machine, as the room for error or miscalculation is minimal, and AI in its current stage is not yet up to the task.

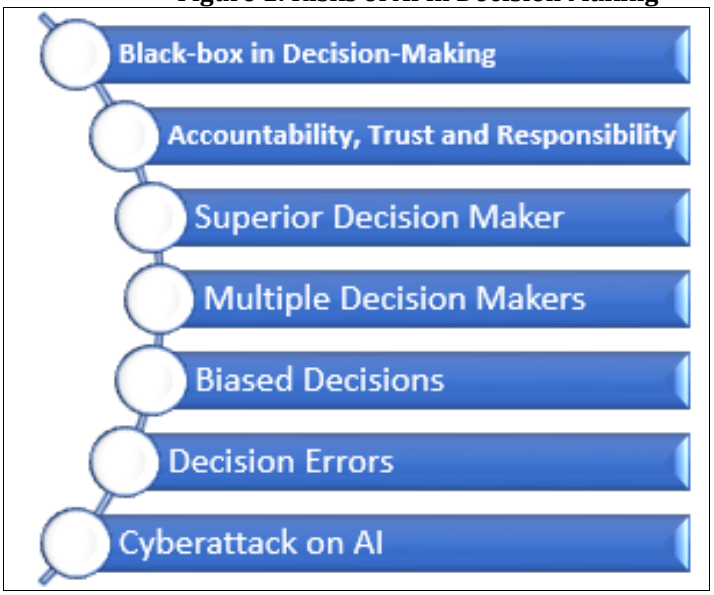
Table 1: Impact of AI on Military Decision-Making Process on Future Battleground

Levels	**Conditions**	**Speed**	**Accuracy**	**Man-Machine**
Tactical	Risk-high Decision making time- low/less. Room for error – more	AI would provide speedy information to take decisions	AI would accurately sort out insignificant information from significant information required for decision making.	Machine has more authority than man in the decision making process.
Operational	Risk – moderate Decision-making time – relatively more than tactical level. Room for error-less	AI would process the abundance of information for decision making.	Higher accuracy of decisions as data would be coming from various sensors and networks.	Man and machine would play a supportive in decision making process.
Strategic	Risks-highest Decision-making time – relatively the most Room for error-least	Speedy decisions may not always ensure accuracy of the decisions.	Al will sort and assess information to greater accuracy.	The man would need to hold more decision making authority.

Risks of AI in Decision Making

Although AI could assist in the decision-making process, the risks of introducing AI would raise a combination of legal, moral, accountability, and security concerns.[59] AI, during the decision-making process, could fail to sense the gravity of consequences which could lead to exaggerated, less optimal, or other errors in decision-making process. Under such circumstances, an accidental or inadvertent escalation of conflict or crisis could be triggered. Therefore, a discussion to elaborate on the risks of the introduction of AI for decision-making is expounded subsequently.

Figure 1: Risks of AI in Decision Making



Source: Author's Research

Black-box in Decision-Making The complexity arises when military decision-makers cannot understand the AI decision-making process. The matter of the black box adds to the complexity when the AI developer himself/herself cannot understand and explain specific AI algorithmic processes. Moreover, when the military purchases AI decision-making algorithms from a private company or another country, the data rights are owned by that developer or country and are subjected to their demands.[60] This presents a great risk as the military decision-making process varies from country to country and it could expose vulnerabilities and challenges in the AI algorithmic decision-making process.[61]

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59 Bonnie Docherty, "Humanitarian Disarmament in 2022," *Human Rights Watch*, 2022,https://www.hrw.org/news/2022/02/08/humanitarian-disarmament-2022

60 Zoe Stanley-Lockman, *Military AI Cooperation Toolbox*, Issue Brief (Washington, D.C.: Center for Security and Emerging Technology, 2021), https://cset.georgetown.edu/wp-content/uploads/CSET-Military-AI-Cooperation-Toolbox.pdf

61 Zoe Stanley-Lockman, *Military AI Cooperation Toolbox.*

Accountability, Trust, and Responsibility Increasing decision-making dependence on AI would require complex AI algorithms to make complex decisions. This would require the decision-makers to trust AI systems, which could cause overlooking accidental and deliberate errors in AI algorithms.[62] This dependence on the AI system, although it develops a man and machine team, blurs the lines of accountability and responsibility. It legally complicates the matter of accountability and responsibility for actions. As the coding, manufacturing, and assembling of a single drone, for example, is being done by multiple companies, it would be difficult to ensure responsibility and accountability between multiple actors. Additionally, in case fully autonomous weapons are given the responsibility to decide to engage the target, it is unclear who would be held responsible in case of casualties. Would the drone, military or AI developer assume responsibility?[63] This would also require questioning the morality of the data sets that the robot was trained on.[64]

Superior Decision Maker Within AI-based military decision-making, the two processes that lead to a decision are, firstly consensus between the human and AI on the decision and, secondly, the selection of the final decision.[65] Within this two-step decision-making process, it remains unclear who would be the superior decision-making authority. The superior decision-making authority must be aware of the legal, moral, and ethical implications of the decision.[66] Additionally, the potential risks that could be highlighted here included the legal, moral, and ethical awareness of AI developers, and if the data trained by the data scientist was aware of the implications of military actions.

Multiple Decision Makers On the future battleground, an army would comprise multiple warfighters and AI decision-makers. Under such a scenario, combatants would need to be able to understand their role, the role of AI, and the

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62 Melanie Sisson, *Multistakeholder Perspectives on the Potential Benefits, Risks, and Governance Options for Military Applications of Artificial Intelligence*, report (New York, NY: United Nations, 2019), https://reliefweb.int/sites/reliefweb.int/files/resources/TheMilitarization-ArtificialIntelligence.pdf.

63 Emma Schuster, *When Something Has to Give: The Intersection of Artificial Intelligence, Military Decision-Making and International Humanitarian Law*, Master's Thesis (Lund, Sweden: Lund University, 2018), https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8955234&fileOId=8955235.

64 George R. Lucas Jr, "Automated Warfare," Stan. L. & Pol'y Rev 25 (2014): 317, https://heinonline.org/HOL/LandingPage?handle=hein.journals/stanlp25&div=18&id=&page=.

65 Francisco Javier Cabrerizo, Juan Manuel Moreno, Ignacio J. Pérez, and Enrique Herrera-Viedma, "Analyzing Consensus Approaches in Fuzzy Group Decision Making: Advantages and Drawbacks," Soft Computing 14, no. 5 (2010): 451-463,https://idp.springer.com/authorize/casa?redirect_uri=https://link.springer.com/article/10.1007/

66 Emma Schuster, *When Something Has to Give: The Intersection of Artificial Intelligence, Military Decision-Making and International Humanitarian Law*, Master's Thesis (Lund, Sweden: Lund University, 2018), https://lup.lub.lu.se/luur/

role of other combatants on the battleground. Similarly, at the operational level, with multiple networks of AI involved, the team would be required to learn how decision-making with AI is designed and the responsibilities allocated.[67] Likewise, at the strategic level, the decision-makers would need a full picture of multiple decentralized operations in order to understand their roles and responsibilities.

Biased Decisions A combatant's cognitive decision-making process is overshadowed by biases such as past experiences or training. A combatant who barely survived an IED would be cautious of proceeding as compared to one who has no exposure to such a trauma. Likewise, within a man-AI decision-making team, a combatant's decision could be the result of his own experiences and biases rather than the suggestion of AI.[68] Similarly, AI could have various biases that occur at different stages in the AI algorithmic process and are based on how AI algorithms are trained to perceive, understand and experience decision-making.[69]

Decision Errors Human cognitive decision-making could experience miscalculation or inaccurate judgment of the available information. Research conducted on the matter by RUSI disclosed that human error in decision-making could be a failure of combatants to think 'outside the box'.[70] Within AI decision-making, an error in decision-making could present a grave implication, especially at the strategic level. Like humans, AI systems could also experience an algorithmic error, for instance, misidentifying an object on the battleground[71] such as a blue army tank as something other than a tank or misinterpreting the action of forces. Likewise, if a human makes a decision based on misidentifying the object, it could become a liability or a difficult situation on the battleground.[72]

Cyberattack on AI In the battleground, AI is actively being used for the decision-making process for a defensive and offensive operation. An offensive cyberattack on AI decision-making systems could tamper with the information

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67 Alexander Kott, and Ethan Stump, "Intelligent Autonomous Things on the Battlefield," In *Artificial Intelligence for the Internet of Everything* (Cambridge, MA: Academic Press, 2019), accessed on 14 March 2022, https://arxiv.org/pdf/1902.10086.pdf.

68 Stuart Armstrong, Kaj Sotala, and Seán S. Ó hÉigeartaigh, "The Errors, Insights and Lessons of Famous AI Predictions–And What They Mean for the Future," *Journal of Experimental & Theoretical Artificial Intelligence* 26, no. 3 (2014): 317-342, https://www.tandfonline.com/doi/full/10.

69 Cade Metz, "We teach AI systems everything, including our biases," *The New York Times* 11 (2019), https://people.eou.edu/soctech/files/2020/12/BERTNYT.pdf.

70 Malcolm James Cook, "Human Factors in Complex Decision-Making," *RUSI*, 2007, https://www.rusi.org/publication/human-factors-complex-decision-making.

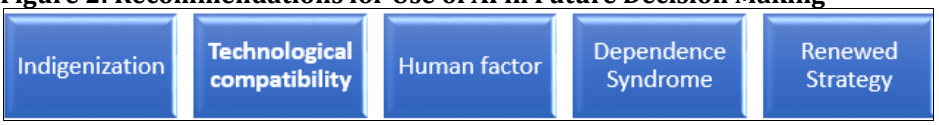
71 Greg Allen, and Taniel Chan, Artificial Intelligence and National Security, (Cambridge, MA: Belfer Center for Science and International Affairs, 2017), https://www.belfercenter.org/sites/default/files/

72 James Johnson, "Artificial intelligence in nuclear warfare: a perfect storm of instability?" *The Washington Quarterly* 43, no. 2 (2020): 197-211, https://www.tandfonline.com/doi/full/10.1080/m0IYUIt0pV7Xu9t_rmWeOpUREgDXVNtwKOTJ727GzFEhYSjeX.

cycle and develop a misleading prediction of the battleground.[73] If such an attack takes place at the strategic level, it could lead to unintended escalation and devastating consequences. Cyberattacks on AI decision-making facilities could hunt for potential weaknesses and exploit them when appropriate for the adversary.[74] For instance, a cyberattack on AI decision-making algorithms could mislead the troops into a vulnerable position and make them an easy target.

Recommendations

Figure 2: Recommendations for Use of AI in Future Decision Making



Source: Authors Research

Indigenization As the world is advancing in dual-use technologies, it is fundamental that a conducive environment for indigenous technological development is given attention. This would make the states less dependent on imported technologies. An indigenous AI software for decision-making would be less vulnerable to threats and open to improvements as dictated by the situation. Furthermore, indigenous AI decision-making software would be based on the requirements of terrain, strategy, and situation that the national military has planned. This would preclude the chances of any third-party exposure or proliferation of their own strategy and plan to the enemy.

Technological Compatibility If AI is to be employed for decision-making, it would require efficient and fast computers in order to ensure technological compatibility between the weapon systems. A lack of efficient and fast computers may cause unwanted errors and delays in AI algorithms which could jeopardise the purpose of using AI on the battlefield. Therefore, an investment in establishing an efficient and fast computer development setup could ensure progress in this field.

Human Factor Using AI to make decisions on the battlefield would require well-trained and technology-savvy soldiers. Soldiers must be trained in the function of AI technology and be aware of their actions' ethical, moral, and legal consequences.

Dependence Syndrome Although AI on the battlefield would play an assistive role, it is important that dependence on the assistive role of AI does not lead to a dependence syndrome. Technology so far is only playing a supportive role on the battlefield, and it should continue to do so. As of yet, AI has not become super intelligent that it can be given the authority to make the final decision.

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73 Muhammad Mudassar, Yamin, Mohib Ullah, Habib Ullah, and Basel Katt, "Weaponized AI for Cyber Attacks," *Journal of Information Security and Applications* 57 (2021): 102722, https://www.sciencedirect.com/science/article/abs/pii/S2214212620308620.

74 Rod Thornton, and Marina Miron, "Towards The 'Third Revolution in Military Affairs' The Russian Military's Use of AI-Enabled Cyber Warfare," *The RUSI Journal* 165, no. 3 (2020): 12-21, https://www.tandfonline.com/doi/full/10.1080/

Therefore, it is important that soldiers are trained in a manner that allows them to function on the battlefield with and without AI.

Review of Strategy Every time a new element or technology is introduced on the battleground, it requires a readjustment of the strategy to incorporate it. Similarly, the introduction of AI decision-making on the battlefield would require a readjustment of strategy. It may include opening new lines of communication within the military (vertically and horizontally) and between the military and the political and civilian decision-makers. The renewal or readjustment of the strategy to include AI decision-making could be an effective step to improve the speed and efficiency of individual and organisational responsiveness.

Conclusion

From the above discussion, it is clear that AI has a role in future warfare. Emerging technologies, especially AI, have spurred military competition between states. Under the security dilemma, this competition drives military technology development.[75] Due to this competition, states are investing in and resourcing AI projects in order to become more efficient than their competitors. This is also increasing the use of AI in military decision-making.[76]

Although AI speeds up and provides accuracy in the decision-making process, it also exposes the entire process to a number of risks and complications. The matter of trust, accountability, and responsibility with AI decision-making complicates the legal, moral, and ethical dimensions. It is unclear who would be the superior decision-maker in, for instance, a constrained timeframe that requires an immediate response. Similarly, in joint all-domain command and control where multiple decision-makers and multiple AI sensors are carrying out decision-making, the decision-making process would be complicated if proper and pre-defined roles are not identified and strictly adhered to. Additionally, a combatant's cognitive decision-making capability could be fogged by his biases based on prior exposures to certain events. Similarly, AI algorithms could also be biased if the data it is trained on is biased. These factors alone and in combination could impair the AI-aided decision-making processes. Practically, neither the combatants nor the AI algorithms are free of errors and miscalculations. This would also impact the decision-making process. In a high-threat environment, AI decision-making systems could also be exposed to cyber interferences and attacks, which present a risk of errors and/or misjudgment in decision-making. Lastly, the matter that risks decision-making the most is when AI algorithms are unexplainable by the developer or the combatant (the Blackbox Syndrome); this makes the AI decision-making process unexplainable, severely affecting the morality and legality of war.

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75 Zoe Stanley-Lockman, *Military AI Cooperation Toolbox*. https://cset.georgetown.edu/wp-content/uploads/

76 Erik Lin-Greenberg, "Allies and Artificial Intelligence: Obstacles to Operations and Decision-Making," *Texas National Security Review* 2*, no 2*, (2020): 56-76, https://tnsr.org/2020/03/

Witnessing the interest of states in becoming efficient powers in AI, it is believed that an AI arms race is in progress.[77] This AI arms race is dangerous as it is developing neither symmetric nor comparable AI decision-making applications. The U.S. development models for military AI are different from Chinese[78], and Chinese are different from Russian.[79] Although there is a debate on developing legal framework on AI development, no state has agreed on one set of principles. This creates greater ambiguity in comparing or finding parallels in AI development models. This could expose threats and vulnerabilities in a geopolitical environment that needs immediate attention. Although a pause in the AI progression and development by states is not in sight as heavy investments are pouring there, it is necessary that measures are taken at a global level that ensure that the development and deployment of AI in defense and military follow certain ethical guidelines and principles. These principles can be formulated through an international discussion of multiple stakeholders, such as AI researchers, concerned academicians, and military personnel. The relationship between AI and military decision-making presents a move ahead in technological development; however, this development should not be a move away from universal ethical practices and laws of warfare.

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77 M. L. Cummings, *Artificial Intelligence and The Future of Warfare*, report (London: Chatham House for the Royal Institute of International Affairs, 2017), https://www.chathamhouse.org/sites/default/files/publications/

78 Elsa B. Kania, "Artificial Intelligence in China's Revolution in Military Affairs," *Journal of Strategic Studies* 44, no. 4 (2021): 515-542, https://www.tandfonline.com/doi/full/10.1080/01402390.2021.1894136.

79 Katarzyna Zysk, "Defence Innovation and the 4th Industrial Revolution in Russia," *Journal of Strategic Studies* 44, no. 4 (2021): 543-571, https://www.tandfonline.com/doi/full/10.1080.