

ZABIJÁČTÍ ROBOTI A TRANSFORMACE OZBROJENÝCH SIL PRO ROBOTICKOU ÉRU

KILLER ROBOTS AND ARMED FORCES TRANSFORMATION FOR THE ROBOTIC ERA

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Abstrakt

Vražední roboti nebo smrtící autonomní zbraňové systémy (LAWS) jsou předmětem dlouhodobé diskuse. V určitý čas budou války vedeny s vojenskými silami zahrnujícími lidské bojovníky, drony a robotické válečníky. Tato studie je věnována otázkám transformace ozbrojených sil pro robotickou éru. Obsahuje rovněž základní model nastiňující tento transformační proces. Nakonec poskytuje řadu doporučení pro tvůrce politik a vojenské činitele k řízení transformace ozbrojených sil pro robotickou éru.

Abstract

Killer robots or lethal autonomous weapon systems (LAWS) have been the focus of an ongoing debate. In due time, wars will be fought with a military force including human warriors, drones, and robot warriors. In this study, we discuss armed forces transformation issues for the robotic era. Furthermore, we present a basic model outlining the transformation process. Finally, we provide a set of recommendations to policymakers and military officials for managing the transformation of armed forces for the robotic era.

Acknowledgements

The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of any affiliated organization or government.

Klíčová slova

Vražední roboti; smrtící autonomní zbraňové systémy; transformace ozbrojených sil; robotická válka; spolupráce mezi lidmi a roboty; vývoj ozbrojených sil.

Keywords

Killer Robots; Lethal Autonomous Weapon Systems; Armed Forces Transformation; Robotic Warfare; Human-Robot Co-working; Armed Forces Development.

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INTRODUCTION

Militaries seek to benefit from technology¹ to become stronger and more effective than their adversaries. In recent years, we have seen significant advances in artificial intelligence and robotics research.² These advances are fuelled by the so-called Industry 4.0 revolution. Various technologies are supporting the realization of Industry 4.0.³ These are the internet of things, cloud computing, big data, and artificial intelligence, and robotics. Moreover, one of the emerging visions for Industry 5.0 is human-robot co-working.⁴ Various robotic and artificial intelligence (AI) systems are being deployed across a wide range of industries. Naturally, military forces are also interested in these developments as well. AI is enhancing defence capabilities.⁵ Therefore, defence systems with artificial intelligence capabilities are attracting the attention of military officials. The future of armed conflict will likely include the extensive use of killer robots.⁶ At this point, we cannot be sure whether the topic of Industry 5.0 will be human-robot co-working or not. However, we can easily envision that human-robot co-working will be an important concept and it may dominate society in due time. In the future, it will not just be human-robot co-working but even human-robot co-living. People will have robots in their homes for various purposes. For example, one emerging purpose is elderly care⁷. Robots will help elders in their homes. Human-robot co-working and co-living will not be an instantaneous event. It will be evolutionary. There will be many technological, psychological, sociological, organizational, ethical, moral, and legal issues.⁸ In the future, many scientific studies will focus on various aspects of human-robot co-working and co-living.

In the era of human-robot co-working, human resource management will naturally evolve, since the workforce will not mainly consist of humans. The workforce will be composed of humans, drones, and robots. Therefore, human resource management will become workforce resource management. Today's human resource management specialists will become workforce resource management specialists. These specialists will need to have

¹ MCNEILL, William H. *The Pursuit of Power: Technology, Armed Force, and Society since AD 1000*. University of Chicago Press, 2013. Available from: <https://bit.ly/3wxQ3y4>.

² WEBSTER, Craig, and STANISLAV, Ivanov. Robotics, artificial intelligence, and the evolving nature of work. In: George B., Paul J. (eds) *Digital Transformation in Business and Society*. Palgrave Macmillan, Cham, 2020. DOI: [10.1007/978-3-030-08277-2_8](https://doi.org/10.1007/978-3-030-08277-2_8).

³ DEMIR, Kadir Alpaslan, and CICIBAS, Halil. Industry 5.0 and a Critique of Industry 4.0. 4th International Management Information Systems Conference, Istanbul, Turkey. 2017. Available from: <https://bit.ly/2RXOCeN>.

⁴ DEMIR, Kadir Alpaslan, DOVEN, Gozde, and SEZEN, Bulent. Industry 5.0 and human-robot co-working. *Procedia Computer Science*. 2019, 158, pp. 688-695. DOI: [10.1016/j.procs.2019.09.104](https://doi.org/10.1016/j.procs.2019.09.104). Available from: <https://bit.ly/35q8Dfk>.

⁵ MALLICK, P.K. Artificial Intelligence in Armed Forces: An Analysis. *CLAWS journal*. 2018, Vol 11, No. 2, pp.63-79. Available from: <https://bit.ly/3xloYOq>.

⁶ SPARROW, Robert. Robots and Respect: Assessing the Case against Autonomous Weapon Systems. *Ethics and International Affairs*. 2016, Vol. 30, No. 1, pp. 93-116. DOI: [10.1017/S0892679415000647](https://doi.org/10.1017/S0892679415000647).

⁷ BROADBENT, Elizabeth, STAFFORD, Rebecca, and MACDONALD, Bruce. Acceptance of Healthcare Robots for the Older Population: Review and Future Directions. *International Journal Of Social Robotics*. 2009, Vol. 1, No. 4. pp. 319-330. DOI: [10.1007/s12369-009-0030-6](https://doi.org/10.1007/s12369-009-0030-6).

⁸ DEMIR, DOVEN, and SEZEN, ref. 4.

an understanding of how to benefit from robotic technology to the maximum extent. They need to know about the current robotic technology uses as well as evolving ones, the advantages and limitations of robots, the organizational effects of human-robot co-working. In the future, human resource management will encapsulate robotic workforce resource management. The organizational managers will need to develop organizational visions where work is efficiently and effectively distributed over humans and robots to reach organizational goals. In the human-robot working era, the military leaders will be responsible for creating military forces composed of human warriors, drones, and robot warriors. We cannot be sure whether humanity will choose to fight with robots only, eliminating or avoiding human casualties.

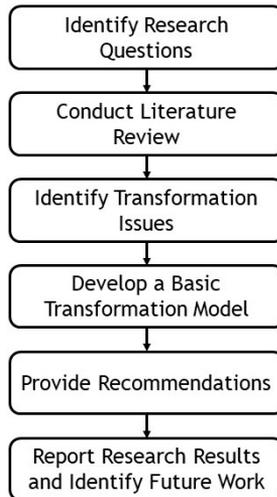
In this study, we discuss the issues of armed forces transformation for the robotic warfare era. The leading issues are the management of public perception and public relations, the development of the concept of operations for robotic warfare, the transformation of military forces, personnel selection and recruitment, the acquisition of robotic and AI defence systems, education and training in robotic warfare era. Furthermore, we provide a basic transformation model that aims at overcoming the issues. Finally, we provide recommendations for policymakers and military leaders. This study will help broaden and deepen the studies regarding armed forces transformation for the robotic era.

RESEARCH METHODOLOGY

The goal of this research study is to identify and discuss the issues that will be faced during armed forces transformation for the robotic era. Furthermore, we also discuss a basic transformation model and recommendations for policymakers and military leaders. The research questions guiding the study are as follows:

- What are the issues that will be faced during the transformation of armed forces for the robotic era?
- What is a basic transformation model that deals with the issues?
- What are the recommendations for the policymakers and military leaders?

To answer the research questions, we review the current literature and ongoing discussions about the issues surrounding robots on the battlefield. We identify the current trends and extract issues related to armed forces transformations. We develop a basic transformation model that has the potential to overcome the issues. Based on the issues, we also provide recommendations. The research methodology is presented in Figure 1.

Figure 1: Research Methodology

ROBOTIC WARFARE ERA

The use of unmanned systems on the battlefield is increasing.⁹ Furthermore, weaponizing unmanned systems attracts the attention of military leaders. As a result, the number of weaponized unmanned systems is also increasing. The main advantage of using unmanned defence systems is moving the military personnel out of harm's way. Currently, almost all weaponized unmanned systems are drones. Drones are remotely operated by human operators. Therefore, the decision to eliminate human targets is made by humans. Note that these weaponized unmanned systems are equipped with autonomous capabilities. For example, weaponized unmanned aerial systems can take off and land autonomously. They can also fly to a certain location autonomously. With the current operational procedures, the targets are determined by human operators. Again, the decision to take these targets out is made by human operators. However, with the current technology, the decision to harm a human target may also be made by artificial intelligence of the unmanned system. Therefore, there is a thin line between a drone and a robot warfighter. The technology is there but the current operational procedures dictate the use of human operators in the decision of firing a weapon. For example, we have air defence systems that can be set to autonomous mode. In the autonomous mode, these air defence systems may search, engage, and attack an air target carrying humans. According to Noel Sharkey, a professor of artificial intelligence and robotics, robot wars are a reality.¹⁰ However, currently, most weaponized unmanned systems are commonly used against human warriors. The use of autonomous lethal weapon systems created a debate among various

⁹ DEMIR, Kadir Alpaslan, CICIBAS, Halil, and ARICA, Nafiz. Unmanned Aerial Vehicle Domain: Areas of Research. *Defence Science Journal*. 2015, Vol. 65, No. 4, pp. 319-329. DOI: [10.14429/dsj.65.8631](https://doi.org/10.14429/dsj.65.8631). Available from: <https://bit.ly/3xkFhLm>.

¹⁰ SHARKEY, Noel. Robot wars are a reality. *The Guardian*. 2007. Available from: <https://bit.ly/3gDpYGO>.

scientists and public groups.^{11,12} As more people are aware of these uses, it is likely to increase public attention on the issue.

An armed drone pilot stationed in one part of the world can accomplish a mission involving destroying targets on the other side of the world. During the mission, the pilot does not have the fear of losing his/her life. After the mission, the pilot goes home and lives his or her civilian life. This has only become a reality recently.

Today, military forces are composed of human warfighters. With the recent advancements, unmanned systems, in other words, drones, are also taking their place within the military force composition. Currently, the ratio of drones to human warfighters is low. The drones require military drone pilots and operators. The use of robots for military purposes is non-existent, at least according to public knowledge. As the use of drones and robots for warfighting increases, the composition of military forces will change. Even today, with the current use of drones for military purposes, it is possible to state that the robotic warfare era has started.

TYPES OF COMBATANTS IN THE ROBOTIC ERA

Robotic technology is advancing fast. Today, there are many drones on the battlefield. Soon, there will be robots on the battlefield. In the robotic warfare era, there will be three types of combatants: humans, drones, and robots. We briefly discuss each type of combatant. Please see a more detailed discussion of types of combatants.¹³

Humans

Humans are the main type of warfighters or combatants of the military forces. A human warfighter has various strengths and weaknesses compared to a drone or a robot. First of all, humans are intelligent. A battlefield is a complex environment. The intelligence possessed by humans helps determine the best course of action on the battlefield. Furthermore, humans have character, morals, and ethics. On the other hand, humans have weaknesses such as fear of death or fatigue.

Drones

A drone is a remotely operated unmanned vehicle. Today, the use of drones is expanding, especially for military purposes. Using drones enables us to take our personnel out of harm's way. Therefore, their use is easily justified for the armed forces utilizing these drones. However, when weaponized drones are used against human targets, there is an important ethical problem.

¹¹ SHARKEY, Amanda. Autonomous weapons systems, killer robots and human dignity. *Ethics and Information Technology*. 2019, Vol. 21, No. 2, 75-87. DOI: [10.1007/s10676-018-9494-0](https://doi.org/10.1007/s10676-018-9494-0).

¹² PERRIGO, Billy. A Global Arms Race for Killer Robots Is Transforming the Battlefield. April 9, 2018. *Time Magazine*. Available from: <https://time.com/5230567/killer-robots/>.

¹³ DEMIR, Kadir Alpaslan, and CAYMAZ, Ebru. Robotic Warfare, Law of Armed Conflict, and Law of Robotic Armed Conflict. In *Proceedings of the 12th Scientific Conference on Defense Resources Management in the 21st Century*, 2017. Available from: <https://bit.ly/3gxsu1v>.

Drones do not have the weaknesses that humans have. Furthermore, they have the advantage of human decision-making. On the other hand, drones have limited operational time. They are costly and prone to cyber vulnerabilities.

Robots

The difference between a warrior robot and a drone is their level of autonomy in selecting and engaging targets. For a drone, the decision to engage targets is made by humans. A warrior robot does not necessitate a human in the loop. According to the open letter presented at the opening of the International Joint Conferences on Artificial Intelligence (IJCAI) 2015 conference, “autonomous weapons select and engage targets without human intervention. They might include, for example, armed quadcopters that can search for and eliminate people meeting certain pre-defined criteria, but do not include cruise missiles or remotely piloted drones for which humans make all targeting decisions.” While robot warriors are free of human weaknesses, they lack the strengths of humans such as character, will, morality, and ethics. However, they have an incredible advantage. Using robot warriors enables us to take our personnel out of harm’s way.

Note that in many studies, drones are considered a subset of robots. For example, Sheridan and Verplank¹⁴ proposed automation levels in man-computer decision-making. The automation levels proposed are listed in Table 1. The automation levels proposed by Sheridan and Verplank include both drones and robots. The United States Department of Defense Directive (DoDD) 3000.09¹⁵ dated 2012 defines an autonomous weapon system as “a weapon system that, once activated, can select and engage targets without further intervention by a human operator. This includes human-supervised autonomous weapon systems that are designed to allow human operators to override operation of the weapon system, but can select and engage targets without further human input after activation”. This definition is in line with our view of a warrior robot. A report¹⁶ prepared for the US Congress states that there is no agreed definition of lethal autonomous weapon systems. The definitions for different categories of LAWS are provided by the DoD Directive 3009.09. “These definitions are principally grounded in the role of the human operator with regard to target selection and engagement decisions, rather than in the technological sophistication of the weapon system.”¹⁷ We believe the main reason behind these definition distinctions based on the role of the human operator is that the current ethical and moral debate about killer robots focuses on the autonomy in killing humans. Therefore, for the purposes of this study, we made a distinction between drones and robots. A drone requires a human operator to engage and eliminate human targets. A robot does not require a human operator in such decisions.

¹⁴ SHERIDAN, Thomas B., and VERPLANK, William L. *Human and computer control of undersea teleoperators*. Table 8.2. Man-Machine Systems Laboratory Report, MIT, Cambridge, USA, 1978. Available from: <https://apps.dtic.mil/dtic/tr/fulltext/u2/a057655.pdf>.

¹⁵ US Department of Defense, *Autonomy in Weapon Systems, Directive No. 3009.09*, November 21, 2012. Updated in May 8, 2017. Available from: <https://bit.ly/3goArXK>.

¹⁶ SAYLER, Kelley M. *Defense Primer: US Policy on Lethal Autonomous Weapon Systems*. Congressional Research Service. March 27, 2019. Available from: <https://bit.ly/3gqdrtr>.

¹⁷ Ibid.

Table 1: Automation Levels

Automation Level	Automation Description
1	No computer assistance: the human must make all decisions and take actions.
2	The computer offers a complete set of decision/action alternatives.
3	Computer narrows the selection down to a few.
4	The computer suggests one alternative.
5	The computer executes a suggestion if the human approves.
6	The computer allows the human a restricted time to veto before the automatic execution.
7	The computer executes automatically, then informs humans when necessary.
8	The computer informs the human only if asked.
9	The computer informs the human only if it decides to.
10	The computer decides everything and acts autonomously, ignoring the human.

Source: SHERIDAN - VERPLANK, ref. 14

Each type of combatant has different strengths and weaknesses over each other. Artificial intelligence and robotic technology have a long way to reach human intelligence. While in certain specialized tasks such as playing chess, a computer (for example the chess-playing computer called Deep Blue) may beat even the most skilled human, the same computer may not be able to differentiate a car from a truck as it is not programmed for that. Humans have common sense and empathy, some argue that robots cannot have these qualities.¹⁸ Currently, humans are more intelligent in assessing the battlefield theatre¹⁹ and identifying the best course of action for a variety of operations. Currently, human warfighters are easier to acquire compared to warfighting robots.

Furthermore, humans are moral and ethical agents.²⁰ Note that humans may not behave morally and ethically at all times,²¹ but they have the capability to do so. Humans have character, meaning they have “the mental and moral qualities distinctive to an individual”.²² In some situations, different points of view resulting from different characteristics of human warfighters will lead to identifying the best course of action and reducing the possibility of human loss or unethical and immoral actions. As killer robots will be programmed similarly, some may argue that they cannot have a character by definition, others may argue that they will only have one type of character. Therefore, if one robot makes a mistake in judgment (programmed decision-making) on the battlefield, all robots repeat the same mistake. One of the most important arguments for

¹⁸ SUKMAN, Daniel. Lethal autonomous systems and the future of warfare. *Canadian Military Journal*. 2015, Vol. 16, No. 1, pp. 44-53. Available from: <https://bit.ly/3gypTEy>.

¹⁹ SHARKEY, ref. 11

²⁰ Ibid.

²¹ SULLINS, John P. Robowarfare: Can Robots be more Ethical than Humans on the Battlefield? *Ethics and Information Technology*. 2010, Vol. 12, No. 3, pp. 263-275. DOI: [10.1007/s10676-010-9241-7](https://doi.org/10.1007/s10676-010-9241-7).

²² Oxford English Dictionary.

placing robots on the battlefield is to take humans out of harm’s way,²³ as we value human life above many things. Smith argues that humans are prone to human weaknesses such as fatigue, fear, or anger, while LAWS or killer robots experience none of these.²⁴ Drones are operated by humans, therefore, they have the advantage of having human decision-making over robots. When drones or robots are used on the battlefield, we eliminate the possibility of losing our warfighters, resulting in no human loss. As drones and robots are developed with computing technology, it is possible to achieve high precision. The first general-purpose electronic digital programmable computer called ENIAC is designed to calculate artillery firing tables, basically to increase precision. Mobile implementations of drones and robots require stored power to operate, therefore, they have limited operational time. Also, drones and robots are prone to cyber vulnerabilities as all computing systems are. Currently, drones are costly. Killer robots will be subject to rigorous defence system acquisition processes since they will be complex computing systems. Therefore, they will be hard to acquire, at least in the near future. There is public resistance against the use of advanced artificial intelligence systems on the battlefield. It is discussed in detail in the following sections. One of the main reasons supporting the argument for robotic and autonomous systems is to achieve effectiveness and efficiency on the battlefield.²⁵ Table 2 presents a comparison of combatants.

Table 2: Comparison of Combatants in the Robotic Era

Combatant	Strengths	Weaknesses
Human	Intelligent Easy to enlist Has character Has moral Has ethics	Possibility of human loss Prone to human weaknesses (fatigue, fear, etc.)
Drone	Human decision-making No human loss High precision	Limited operational time Public resistance Costly Prone to cyber vulnerabilities
Robot	No human loss No human weaknesses (no fatigue, no fear) High precision	Limited operational time Public resistance Hard to acquire Costly No moral No character No ethics Prone to cyber vulnerabilities

Source: Author

²³ United States Department of Defense, Office of the Under Secretary of Defense for Acquisition and Sustainment. *Unmanned Systems Integrated Roadmap FY2017-2042*, 2018. Available from: <https://www.hsdl.org/?view&did=826737>.

²⁴ SMITH, Patrick Taylor. Just Research into Killer Robots. *Ethics and Information Technology*. 2019, Vol. 21, No. 4, pp. 281-293. DOI: [10.1007/s10676-018-9472-6](https://doi.org/10.1007/s10676-018-9472-6).

²⁵ United States Department of Defense, ref. 23.

RELEVANT LITERATURE

Robots on the battlefield have attracted the interest of various scholars for some time now. There are many ethical concerns related to the concept of robots on the battlefield. Therefore, currently, a significant portion of the research studies focus on the ethical implications of the use of lethal autonomous weapon systems (LAWS). While there are proponents of putting robots on the battlefield, there are also a significant number of studies calling for a ban on killer robots.

A good resource on the topic of robots on the battleground is a book edited by Doaré et al.²⁶ The book consists of 21 chapters in three sections. The first chapter is the introduction. There are 20 more chapters. The first section is about the changing nature of wars due to robotization and the significance of its impact. There are 4 chapters in this first section. The second section is about ethics and law. 10 chapters discuss various aspects of military ethics and law for integrating robots into armed forces. In the last section, there are 6 chapters. The last section is about the future of robots in the military. The chapters in this section mostly discuss how robots and warriors will operate together. Furthermore, how to acquire these robotic systems is also discussed. This edited book is a general representation of current literature on the subject. Most current studies focus on ethical and legal aspects of robotics for military use. Half of the book is devoted to this subject. One quarter of the book is devoted to the significance of robotics use for military purposes and how it will impact the nature of wars. The last quarter is devoted to human-robot cooperation on the battlefield. Acquisition of military robotic systems and training of military personnel are also discussed. In one or two chapters, the need for a robotization strategy is highlighted. Again, in one or two chapters, the importance of training is stressed.

Walker recently published the doctoral dissertation titled “War without Oversight; Challenges to the Deployment of Autonomous Weapon Systems”.²⁷ This dissertation is a good recent resource outlining the current state of the literature on autonomous weapon systems. Walker categorized the bibliography in his study. The categories are ethical, historical, legal, operational, and technical perspectives. There is also a section for online resources. There are numerous online resources.

The analysis of the current literature on killer robots or lethal autonomous weapon systems reveals certain trends. First of all, the debate on the use of the LAWS is trending. There are proponents of and opponents to the idea and the opposition is gaining attention. The proponents mainly argue that robotic and autonomous weapon systems (RAS) reduce the number of human warfighters in harm’s way, increase decision speed in time-critical operations, and provide the ability to perform missions impossible for humans.²⁸

²⁶ DOARÉ, Ronan, DANET, Didier, HANON, Jean-Paul, and de BOISBOISSEL Gérard. *Robots on the Battlefield. Contemporary Perspectives and Implications for the Future*. Army Combined Arms Center Fort Leavenworth Ks Combined Studies Inst, 2014. Available from: <https://bit.ly/3gzu6HX>.

²⁷ WALKER, Patrick William. *War without oversight; challenges to the deployment of autonomous weapons*. PhD Thesis. University of Buckingham. 2019. Available from: <https://bit.ly/3iOdTBD>.

²⁸ United States Army Training and Doctrine Command. *The US Army Robotic and Autonomous Systems Strategy*. p. 17. Fort Eustis (VA): US Army Training and Doctrine Command, 2017. Available from: <https://bit.ly/3gxsM8B>.

Furthermore, some argue that robots may be more ethical in battle.²⁹ Opponents argue that LAWS are a threat to human dignity.³⁰ It is also hard to predict how killer robots will affect our way of thinking in many ways. Some believe that not just killer robots but robots in general are a threat to humanity.³¹ There is even a campaign to stop killer robots. We discuss the campaign in the following section. In addition to the killer robot ethics debate, there are also several studies discussing legal issues. How killer robots will fit into the current Law of Armed Conflict (LAC) is being discussed.³² If killer robots are to be employed, the necessary ethical and legal bases have to be formed. The ethical and legal debates affect each other. Some political studies discuss how killer robots will change international politics especially for countries having the technological advantage. Historical studies discuss the evolution of warfare when killer robots take the military theatre. On the technical side, the human-robot collaboration issues are discussed in addition to advancing the AI and robotic technology for warfare. A high level of collaboration is required between humans and robots on the battlefield. If human fighters are unable to trust robots on the battlefield, the anticipated benefits will not be obtained. The robots should be reliable and trustworthy enough to eliminate the possibility of endangering allied units. The operational studies investigate the use of robots for different kinds of military operations. In addition to warfighting operations, robots may also be used for rescue operations. These operational studies will help develop the necessary concept of operations documents for robotics warfare. There are also a few studies discussing how killer robots affect the “profession of arms”.³³ The necessity of training is highlighted in various studies,³⁴ while how education and training should evolve is a future research topic. Almost all of the issues related to killer robots or Lethal Autonomous Weapon Systems are still being researched. Some areas, such as ethical and legal issues, attracted more attention than others. Our literature analysis indicates that armed forces transformation issues have not been discussed in detail. Therefore, in this study, we discuss armed forces transformation for the robotic era to contribute to the current literature. Table 3 lists some of the selected studies focusing on the use of robots on the battlefield issues.

²⁹ SULLINS, ref. 21.

³⁰ SHARKEY, ref. 11.

³¹ DEMIR, Kadir Alpaslan. *Human-Robot Co-working and Roboethics*. Master’s Thesis, Gebze Technical University, 2019.

³² PAGALLO, Ugo. Robots of Just War: A Legal Perspective. *Philosophy & Technology*. 2011, Vol. 24, No. 3, pp. 307-323. DOI: [10.1007/s13347-011-0024-9](https://doi.org/10.1007/s13347-011-0024-9).

³³ HAMEL, Alison M. *Killer Robots: Death to the Profession of Arms*. AIR UNIV MAXWELL AFB AL MAXWELL AFB United States, 2018. Available from: <https://bit.ly/3iD4ZGW>.

³⁴ DOARÉ et al., ref. 26.

Table 3: Selected List of Studies Focusing on Robots on the Battlefield Issues

Study	Theme/Goal of the Study
SHARKEY, Amanda. Autonomous weapons systems, killer robots and human dignity. <i>Ethics and Information Technology</i> . 2019, Vol. 21, No. 2, pp. 75-87. https://doi.org/10.1007/s10676-018-9494-0 .	The ethical implications of killer robots and threats to human dignity. To provide arguments against killer robots.
SMITH, Patrick Taylor. Just Research into Killer Robots. <i>Ethics and Information Technology</i> . 2019, Vol. 21, No. 4, pp. 281-293. https://doi.org/10.1007/s10676-018-9472-6 .	To argue that killer robots should be researched.
WALKER, Patrick William. <i>War without oversight; challenges to the deployment of autonomous weapons</i> . Ph.D. Thesis. University of Buckingham. 2019. https://www.researchgate.net/publication/336022548_War_without_oversight_challenges_to_the_deployment_of_autonomous_weapons .	The practical and technical feasibility of removing supervision from lethal engagements by autonomous weapon systems.
NOYES, Matthew Freeman. <i>Autonomous Weapons: The Future Behind Us</i> . US Army Command and General Staff College Fort Leavenworth United States, 2019. https://apps.dtic.mil/sti/pdfs/AD1085435.pdf .	To identify potential military uses of autonomous weapons and to make predictions for future use around 2030.
PAGALLO, Ugo. Robots of Just War: A Legal Perspective. <i>Philosophy & Technology</i> . 2011, Vol. 24, No. 3, pp. 307-323. https://doi.org/10.1007/s13347-011-0024-9 .	To clarify how the advancement of military robotic technology is transforming a 2,000-years-old legal debate on the concept of “just war”.
LIN, Patrick, BEKEY, George, ABNEY, Keith. <i>Robots in war: issues of risk and ethics</i> . US Naval Academy, Annapolis, MD. 2009. https://apps.dtic.mil/dtic/tr/fulltext/u2/a541977.pdf .	To discuss a variety of issues including legal, just war, technical, human-robot cooperation, societal, other challenges surrounding the use of robots in war.
SULLINS, John P. RoboWarfare: Can Robots be more Ethical than Humans on the Battlefield? <i>Ethics and Information Technology</i> . 2010, Vol. 12, No. 3, pp. 263-275. https://doi.org/10.1007/s10676-010-9241-7 .	To propose and discuss the hypothesis that robot warriors may be more ethical than human warriors.
SHAW, Ian GR. Robot Wars: US Empire and geopolitics in the robotic age. <i>Security Dialogue</i> . 2017, Vol. 48, No. 5, pp.451-470.	To discuss how robot wars will change the geopolitics from the view of the US.
United States Department of Defense, Office of the Under Secretary of Defense for Acquisition and Sustainment. Unmanned Systems Integrated Roadmap FY2017-2042, 2018. https://www.hsdl.org/?view&did=826737	To discuss the overarching themes of interoperability, autonomy, secure network, human-machine collaboration for shaping the unmanned systems strategy of US DoD for the next 25 years (2017-2042).

<p>MALLICK, P.K. Artificial Intelligence in Armed Forces: An Analysis. <i>CLAWS journal</i>. 2018, Vol 11, No. 2, pp. 63-79. https://media.neliti.com/media/publications/327345-artificial-intelligence-in-armed-forces-8259b5d9.pdf.</p>	<p>To discuss how AI impacts future military technology and AI in the Indian Context.</p>
<p>DOARÉ, Ronan, DANET, Didier, HANON, Jean-Paul, and de BOISBOISSEL Gérard. Robots on the Battlefield. Contemporary Perspectives and Implications for the Future. Army Combined Arms Center Fort Leavenworth Ks Combined Studies Inst, 2014. https://apps.dtic.mil/sti/pdfs/ADA605889.pdf.</p>	<p>An edited book that discusses various aspects of robots on the battlefield. The changing nature of wars due to robotization and the significance of its impact, military ethics and law for integrating robots into armed forces, the future of robots in the military, and how robots and warriors will operate together are discussed.</p>
<p>JAPERTASA, Saulius, and SIMONAVICIUTEB, Agne. Ethical and Legal Aspects of the use of Artificial Intelligence in Combat Operations. <i>Challenges To National Defence In Contemporary Geopolitical Situation</i>. Vol. 2020, Issue 1, pp. 193-200. https://doi.org/10.47459/cndcgs.2020.25.</p>	<p>To propose a classification of challenges faced due to AI use in combat operations. The categorization includes social, moral, legal, political, military, and technical challenges.</p>
<p>SHARKEY, Noel E. The Evitability of Autonomous Robot Warfare. <i>International Review of the Red Cross</i>. 2012, Vol. 94, No. 886, Summer 2012, pp. 787-799. https://doi.org/10.1017/S1816383112000732.</p>	<p>One of the leading articles that call for a ban of “autonomous lethal targeting by free-ranging robots”.</p>
<p>SPARROW, Robert. Killer robots. <i>Journal of Applied Philosophy</i>, 2007, Vol. 24, No. 1. pp. 62-77. https://doi.org/10.1111/j.1468-5930.2007.00346.x.</p>	<p>To discuss the responsibility for war crimes when autonomous weapon systems are used in war. One of the leading papers on killer robots.</p>
<p>ARKIN, Ronald C. Governing Lethal Behavior: Embedding Ethics in a Hybrid Deliberative/Hybrid Robot Architecture. <i>Report GIT-GVU-07-11</i>, Atlanta, GA: Georgia Institute of Technology’s GVU Center. 2007. https://www.cc.gatech.edu/ai/robot-lab/online-publications/formalizationv35.pdf ARKIN, Ronald C. <i>Governing Lethal Behavior in Autonomous Robots</i>. Chapman & Hall/CRC Press, 2009. ISBN: 978-1-4200-8594-5.</p>	<p>An in-depth technical study on how to embed ethical controls to govern lethal behaviour. This study is funded by US Army Research Office.</p>
<p>SIMPSON, Thomas W. Robots, Trust And War. <i>Philosophy & Technology</i>. 2011, Vol. 24, No. 3, pp.325-337. https://doi.org/10.1007/s13347-011-0030-y.</p>	<p>To discuss the problems related to robots on the battlefield. The researcher discusses that robots will not help us win wars since modern warfare tends to be asymmetric. Furthermore, not having a motive may lead to unwanted results in using robot warriors.</p>

<p>HAMEL, Alison M. <i>Killer Robots: Death to the Profession of Arms</i>. AIR UNIV MAXWELL AFB AL MAXWELL AFB United States, 2018. https://apps.dtic.mil/sti/pdfs/AD1098400.pdf.</p>	<p>To discuss how killer robots affect the “Profession of Arms”.</p>
<p>HOROWITZ, Michael C. Public Opinion and the Politics of The Killer Robots Debate. <i>Research & Politics</i>. 2016, Vol. 3. No. 1, pp. 1-8. https://doi.org/10.1177/2053168015627183.</p>	<p>To present a survey regarding robots on the battlefield. The study suggests that the opinion on banning killer robots is contextual. Public opinion may change depending on the context.</p>
<p>DEMIR, Kadir Alpaslan, and CAYMAZ, Ebru. Robotic Warfare, Law of Armed Conflict, and Law of Robotic Armed Conflict. <i>In Proceedings of the 12th Scientific Conference on Defense Resources Management in the 21st Century</i>. 2017. http://www.codrm.eu/conferences/2017/DEMIR%20Kadir_Caymaz%20Ebru.pdf.</p>	<p>To discuss how robotic warfare may affect the Law of Armed Conflict. The authors develop a set of guidelines for developing the Law of Robotic Armed Conflict (LORAC).</p>

Source: Author

ARMED FORCES TRANSFORMATION ISSUES IN THE ROBOTIC ERA

Robotic warfare will change the nature of wars. Naturally, a new type of armed force is required in the robotic warfare era. These new armed forces will be composed of humans, drones, and robots. We may call these new armed forces robotic armed forces. In the distant future, there is even the possibility of robotic armed forces composed of only drones and robots. The transition to robotic armed forces will not be an instantaneous event. The current armed forces will evolve into robotic armed forces. During the transition to robotic armed forces, several issues will arise. Next, we will discuss these issues.

Management of Public Perception

Management of public perception will be one of the most important issues of the robotic warfare era. Autonomous systems killing humans is not an easy notion to accept for many. There is already an international debate on the use of Lethal Autonomous Weapon Systems (LAWS).³⁵ In 2013, at the United Nations (UN) Convention on Certain Conventional Weapons (CCW) Meeting of States Parties, delegates decided to act upon the developments regarding the use of LAWS. At the 2016 Fifth CCW Review Conference, the UN decided to establish a Group of Governmental Experts (GGE) to investigate and discuss the use of LAWS. Several countries are already calling for a ban on LAWS.³⁶ Naturally, the countries possessing robotic warfare technology are reluctant to such a ban.

³⁵ ULGEN, Ozlem, Human Dignity in an Age of Autonomous Weapons: Are We in Danger of Losing an ‘Elementary Consideration of Humanity’? (2016) 8(9) ESIL Conference Paper Series 1-19. European Society of International Law (ESIL) 2016 Annual Conference (Riga). Published on January 31 2017, ESIL SSRN. Available from: <https://bit.ly/3vq1BC1>.

³⁶ DEMIR and CAYMAZ, ref. 13.

In 2013, “The Campaign to Stop Killer Robots (<https://www.stopkillerrobots.org/>)”³⁷ was launched in London, UK. The campaign calls for “a pre-emptive and comprehensive ban on the development, production, and use of fully autonomous weapons, also known as lethal autonomous weapon systems or killer robots”. The goal of the campaign is to warn the United Nations, governments, and the public about the threats posed by killer robots. In 2015³⁸ and 2017,³⁹ open letters were presented at the major conferences on artificial intelligence. These letters warn the United Nations and the public about the dangers of LAWS. These letters were signed by more than twenty thousand people, including AI and robotics scholars as well as founders and directors of AI and robotics companies.

Currently, only a very small portion of the public is aware of the threats posed by LAWS. As awareness increases, the management of public perception will be a crucial issue during the development of robotic armed forces.

Transformation of Military Forces

There will be two main types of transformation issues during the development of robotic armed forces. The first one is social. The second one is organizational. Humans naturally resist change. Any organizational transformation is hard. It is even harder when the organization is big and bureaucratic. Armed forces are big bureaucratic organizations with traditions and discipline via persistence on well-defined procedures. Therefore, the transformation of military forces is simply hard. Even though military forces are highly technological, robotic technology will bring issues unseen before. First of all, there may be even human warfighters as opposed to the notion of killer robots. Serving in the military is an honour for many servicemen. When robots start to take over the duties of these servicemen, the notion of serving in the military honourably may become worthless. This may create unprecedented challenges. Also, military personnel will lose their jobs to robotic systems. When a transformation brings unemployment, it becomes unfavourable. Robotic warfare will likely introduce a culture change. These are some of the social issues. Restructuring big organizations creates many problems and requires quite an effort. New policies and procedures need development and existing ones need rewriting. There will be a need for extensive education and training. For military organizations, when the unit’s mission and reporting structure change, there will be ineffectiveness and inefficiencies until these changes are understood. Furthermore, organizational transformations under time pressure lead to mistakes. There will be time pressure for countries when their enemies are ahead on their transformation toward robotic armed forces. Countries will need a well-thought and detailed transformation plan addressing a wide range of issues.

³⁷ The Campaign to Stop Killer Robots, <https://www.stopkillerrobots.org>.

³⁸ Future of Life Institute. *Autonomous Weapons: An Open Letter from AI & Robotics Researchers*. Available from: <http://futureoflife.org/open-letter-autonomous-weapons>.

³⁹ Future of Life Institute. *An Open Letter to the United Nations Convention on Certain Conventional Weapons*. Available from: <https://bit.ly/3xf30wy>.

Development of Concept of Operations (CONOPS) For Robotic Warfare

According to the 2010 Joint Publication 1-02 - US Department of Defense Dictionary of Military and Associated Terms⁴⁰ - a concept of operations is “a verbal or graphic statement that clearly and concisely expresses what the joint force commander intends to accomplish and how it will be done using available resources”. A concept of operations is abbreviated as CONOPS. The wide use of artificial intelligence and robotic technology for military purposes is already changing and will dramatically change how warfare is conducted. As the missions involving drones and robots increase, a set of CONOPS will be required to describe how these missions will be conducted with these new sets of warfighters. A report⁴¹ on U.S. Military’s Next-Generation Unmanned Aerial Systems Force stresses the importance of CONOPS for the UAS Force. Furthermore, the report addresses the need for new CONOPS. Without adequately developed CONOPS, we will not be able to effectively use robotic technology on the battlefield. Furthermore, the development process of various CONOPS helps us identify what is really required from these systems and how to use them more effectively. The process will also bring out the training needs of the human warfighters using or fighting along with these systems.

Personnel Selection and Recruitment in the Robotic Era

Human resource management will be different in the robotic era. We will likely use the term workforce management and the workforce will consist of humans, drones, and robots. In the robotic era, some tasks will only be handled by robots, some tasks will only be handled by humans. The rest of the tasks will be accomplished by human-robot collaboration. In addition, drones may be used by humans to complete some tasks. Today, human resource managers or teams mainly focus on how to best match the qualified applicants or employees with the jobs to be filled. However, in the robotic era, the human resource managers or teams will become workforce managers or teams and they will have to be able to categorize jobs to be filled with the new workforce elements, i.e., humans, drones, and robots. Traditionally, human resource specialists are trained to deal with human-related issues. In the robotic era, they will have to know about the robotic technology as well. They have to learn about the capabilities and limitations of this technology. Moreover, they have to follow the robotic technological advancements continuously. As robots and drones become more capable, they will take over more tasks from humans. In addition, there will be new types of jobs for humans. These new jobs will require new skills and additional education and training.

There will be two main methods for military personnel acquisition in the robotic warfare era. The first method is recruitment from civilians that are best suited for working with

⁴⁰ Joint Publication 1-02 - *US Department of Defense Dictionary of Military and Associated Terms*, 8 November 2010. Available from:

<http://www.acqnotes.com/Attachments/Joint%20Publication%201-02.pdf>.

⁴¹ Center for Strategic and Budgetary Assessments. *Thinking About the U.S. Military’s Next-Generation UAS Force: Final Report*. Prepared for the Office of Net Assessment Office of the Secretary of Defense under the Contract HQ0034-09-D-3007-0013. Sep. 2013. Available from: https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Litigation_Release/Litigation%20Release%20-%20Thinking%20About%20the%20U.S.%20Military's%20Next%20Generation%20UAS%20Force%20Final%20Report%20%20201309.pdf.

the necessities of the robotic era. There will be special recruitment processes for the selection of suitable civilian candidates. Today, we already have specialized recruitment processes for the selection of military cadets. The second method is selecting the most suitable personnel among the existing military personnel. We will have special selection processes for the selection of personnel that are most suitable and comfortable with working robotic and AI military systems. Today, there are various branches of military forces, such as special forces, submariners, divers, etc., that undergo a special selection process.

Acquisition of Robotic and Artificial Intelligent Defence Systems

The complexity of defence systems is increasing. Thus, the acquisition of these systems gets harder every day. Most defence systems are mission-critical systems. As a result, one of the main distinguishing aspects of defence systems is the need for high quality. Developing high-quality systems requires extensive testing. In a defence system, users expect complete determinism. However, sometimes, the response of an AI system may be hard to predict. AI in a system may lead to non-deterministic behaviour. Therefore, the testing of artificial intelligence (AI) properties in systems is challenging. As a result, defence systems with artificial intelligence capabilities are costly due to the need for extensive testing.

On the battlefield, the human warriors should be able to trust the robot warriors. Robot warriors must be highly reliable, trustworthy, and deterministic in their behaviour. To acquire such robotic systems with AI capabilities will be hard. This will be one of the main challenges in the robotic warfare era.

Education and Training in the Robotic Era

Without any training and practice, assuming high coordination between human and robot warriors on the battlefield is naive. Human warriors will need education and training for effective robotic warfare. The drone operators and human warriors need to know the capabilities and limitations of the robotic systems. Furthermore, they should be able to trust these machines at the right level. Human warriors will feel the need to exactly know the tactical, ethical, and moral decision-making capabilities of the robotic systems on the battlefield. This will require extensive education, training, and practice. Robotic systems are complex. The maintenance of these systems will require well-educated and highly skilled maintenance personnel. As a result, the education and training needs of human warriors and maintenance personnel in the robotic warfare era may be even more than what is required today.

ARMED FORCES TRANSFORMATION PROCESS FOR THE ROBOTIC ERA

Figure 2 presents the armed forces transformation process for the robotic era. While there will be other subprocesses in the process, the depicted ones are the main and essential ones. Furthermore, as many operational processes undergo, this process will evolve as necessary. The essential subprocesses are:

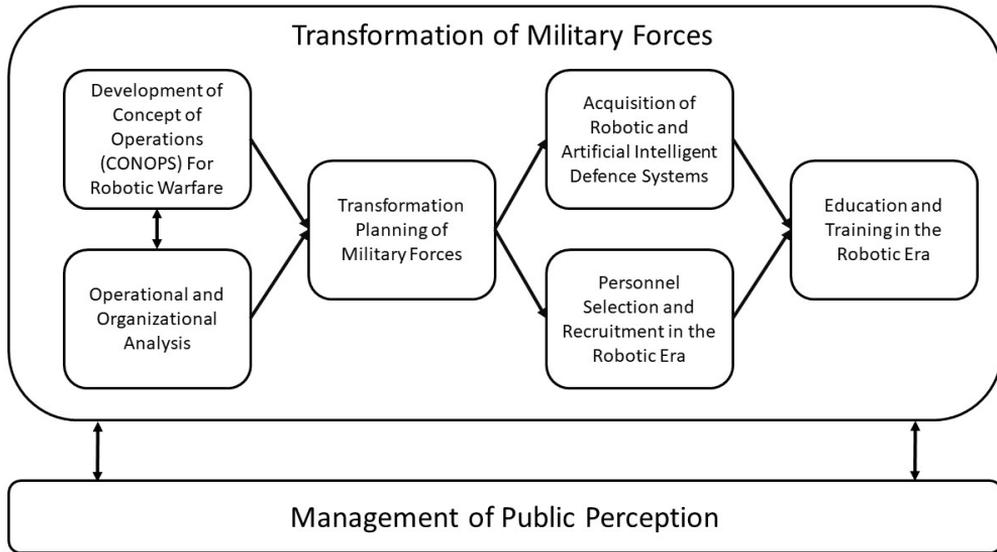
- Development of the Concept of Operations (CONOPS) for Robotic Warfare
- Operational and Organizational Analysis

- Transformation Planning of Military Forces
- Acquisition of Robotic and Artificial Intelligence Defence Systems
- Personnel Selection and Recruitment in the Robotic Era
- Education and Training in the Robotic Era

While the picture depicts a sequence between these subprocesses, the interactions between these subprocesses are more complex and interacting. Military forces are an important institution in any country. Naturally, the public is concerned with changes in the military forces. When drones and robots are replacing their military personnel and these machines are aimed at eliminating other humans, even though they are enemies, managing the public perception will become an important part of the armed forces transformation process. There are already discussions on the use of Lethal Autonomous Weapon Systems. In the following section, we discuss the issue in detail. The other one is the holistic process of the transformation of military forces. There will be a need for strategic alignment and timing between these two holistic processes.

To develop military forces to be used in the robotic era, we need to transform our current military elements. First, we need to develop CONOPS for robotic warfare. Military officials are quite familiar with the development of CONOPS, since CONOPS is developed for many types of operations in the military. However, in this case, the development of CONOPS will be harder than before as there is a need for close cooperation between robotics experts and military officials. To support the development of CONOPS, we need to conduct operational and organizational analyses. These analyses will reveal the organizational elements and operational procedures that will be replaced with robots and robotic automation. The analyses and CONOPS will provide the necessary input for the transformation planning of military forces. The output of this subprocess is a transformation plan. Note that this plan may be an evolutionary plan that will be implemented in stages. This plan will be an input for two subprocesses. First, the national departments of defence will acquire the necessary robotic and artificial intelligence systems to be used by military forces. This is not an easy task. The acquisition of defence systems is already a challenging endeavour. The acquisition of reliable, trustworthy, and safe robotic systems that will fight alongside soldiers in the field will require a significant effort. Another subprocess is the military personnel selection and recruitment for the robotic era. Most countries have a systematic process of their military personnel development. Some portions of this process are rigid and some are adaptive depending on the different strategies different countries adapt. In the robotic era, there will be needs for personnel with new skills and appropriate training. These have to be identified and military personnel selection and recruitment systems will be adapted according to the required changes. While some of the military personnel will be recruited, the existing personnel will need the education and training required for this robotic era.

Figure 2: Armed Forces Transformation Process for the Robotic Era



Source: Author

RECOMMENDATIONS FOR ARMED FORCES TRANSFORMATION

In this section, we provide a set of recommendations for policymakers and military officials responsible for the armed forces organizational development and transformations. These recommendations are developed based on the issues identified with this study.

Manage Public Perception

The idea of killer robots has many ethical and legal implications. There is already opposition to the use of lethal autonomous weapon systems (LAWS). As the use of LAWS increases, it is likely that this opposition will grow. Voters will put their elected representatives under pressure to ban or limit the use of these weapon systems. Armed forces are unsustainable without the necessary public support. The public provides the manpower, economic means, sociological, and psychological support for the armed forces. In many countries, serving in the military is considered an honourable service. Furthermore, militaries have core values developed based on centuries-old traditions. Taking the military service from humans and giving it to machines will result in questioning the core values militaries are based on. This will not be easy for the public and the current military personnel. Certain races, minorities, and women were not allowed to perform certain types of military services up until recent years. In some cases, they still are not. It took many years for the public to accept the military service of these groups. Replacing human warriors with robot warriors may face a similar reaction from

the public. The military and civilian officials responsible for armed forces development have to manage the public perception at every step of the transformation.

Develop the Concept of Operations (CONOPS) for Robotic Warfare

Ideally, CONOPS are developed for any type of military operation. Military operations have to be precise and well-understood for all personnel involved. Furthermore, they are optimized for mission effectiveness and ensured to adhere to the law of armed conflict (LOAC). CONOPS documents provide the necessary guidance for all types of planning including organization, procedures, reporting structure, responsibilities, logistics, training, etc. There may be many military uses for robots. All these uses have been carefully considered and standardized for mission effectiveness. This cannot be achieved without the development of necessary CONOPS for robotic warfare.

Develop a Transformation Strategy

Integrating robotic and autonomous systems into armed forces will not be easy.⁴² The transformation of robotic warfare will have significant impacts on all aspects of military operations. There will be technological, organizational, procedural, and educational impacts. Furthermore, a mental transformation has to accompany technological transformation. Armed forces are conservative since military procedures are developed based on years of experience. In military operations, mistakes may result in the loss of personnel and equipment. Therefore, military procedures are hardened with extensive experience and planning. Changing these procedures is not easy. Therefore, armed forces transformation for robotic warfare cannot be quick. A well-thought and well-planned strategy will be required for a successful transformation.

Develop a Transformation Model

In many countries, military organizations are bureaucratic and well-established organizations. Transformations of bureaucratic organizations are far from trivial. Transformation to armed forces composed of humans and robots will be a big change. Organizational changes are risky and challenging.⁴³ Therefore, the transformation has to be carefully crafted at every step. The military and civilian officials have to develop a transformation model based on the inputs from the CONOPS for robotic warfare and the transformation strategy. While in this study, we developed a basic and generic transformation model, there may be different models for different countries. These models may incorporate country-specific factors and may be enhanced based on different needs. The model proposed in this study guides this effort.

Create a Transformation Plan

The CONOPS for robotic warfare, operational and organizational analyses, the transformation strategy, and the transformation model will help develop a transformation

⁴² United States Army Training and Doctrine Command, ref. 28.

⁴³ DEMIR, Kadir Alpaslan, and OZKAN, Baris Egemen. Organizational change via social hubs: a computer simulation based analysis. *Procedia-Social and Behavioral Sciences*, 2015, 210, pp. 105-113. DOI: [10.1016/j.sbspro.2015.11.342](https://doi.org/10.1016/j.sbspro.2015.11.342).

plan. All these studies will serve as inputs to the transformation plan that needs to be carefully developed. In addition, the evolving public perception will affect the plan. This transformation plan will be revised as the public perception evolves. Furthermore, there may be setbacks in the implementation of the plan. The implementation is as important as the plan. The military and civilian officials have to remember that this transformation is a long-term and challenging effort. The transformation plan must be flexible enough to overcome risks and unexpected deviations.

Adapt the Defence Acquisition System

Defence acquisitions are problematic in many aspects.⁴⁴ There are numerous studies and reports on the challenges of defence acquisitions. Incorporating artificial intelligence capabilities into defence systems adds another layer of challenge to already problematic acquisitions. One of the main problems with artificial intelligence capabilities is indeterminism. Depending on the AI technology used, the system may or may not produce deterministic results. While AI technology enhances the system capabilities significantly, the indeterminism in the results poses significant challenges. Defence systems are required to be highly reliable. Moreover, these defence systems are expected to be determinate in their performance, functionality, and mission results. Therefore, defence systems need to be tested extensively. Ideally, these tests are designed to reveal all significant errors and/or bugs in the system. Some AI technologies may exhibit quite varying performance and functionality. Testing of AI-enhanced defence systems will be hard, long, and costly. In addition, human warriors should be able to trust these systems at all times. If the results produced vary significantly, the human warriors will not find these systems trustworthy. This will be an important problem on the battlefield. The current defence acquisition systems have to be adapted to overcome the challenges that AI in defence robotic systems bring. We need to determine “how to make lethal autonomous systems over their entire lifecycle (i.e., from conception to disposal) as trustworthy as economically and technically feasible.”⁴⁵

Adapt the Military Human Resources Management System

As drones and robots take their place on the battlefield, the numbers of human warriors are expected to decrease. Moreover, the skills needed by the human warriors should evolve. The human warriors must be equipped with the necessary skills related to the use of advanced information and other related technologies. The armed forces already have special branches that employ special and customized human resource management systems. Pilots, submariners, divers, special forces members, commandoes, cyber forces members, drone pilots are among the military personnel that are subject to special selection, recruitment, training procedures. In this aspect, armed forces have organizational experience in developing human resource management systems required for specialized branches. As robot warriors and other types of LAWS are employed, the

⁴⁴ DEMIR, Kadir Alpaslan. Characteristics of Large-Scale Defense Projects and the Dominance of Software and Software Project Management. In: MAHMOOD, Zaigham, ed. *Software Project Management for Distributed Computing*, Springer, Cham, 2017. pp. 59-85. DOI: [10.1007/978-3-319-54325-3_4](https://doi.org/10.1007/978-3-319-54325-3_4).

⁴⁵ MICHAEL, James Bret. Trustworthiness of Autonomous Machines in Armed Conflict. *IEEE Security & Privacy*. Nov.-Dec. 2019, Vol. 17, No. 6, pp. 4-6. DOI: [10.1109/MSEC.2019.2938195](https://doi.org/10.1109/MSEC.2019.2938195).

current military human resource management systems will have to evolve to acquire and employ the best personnel for the job. Hamel investigated how LAWS will affect the profession of arms. Hamel states that “as more weapon systems move professionals further from the battlefield and the decision-making process, the military needs to consider how to effectively maintain the characteristics and virtues of the profession of arms to ensure the military profession is not replaced by robots.”⁴⁶

Adapt the Military Education and Training System

Militaries are such institutions that have the best and well-established education and training systems. A Special Forces member requires 8 years of training; a fighter pilot requires 7 years of training; a submariner requires 5-6 years of training; a diver requires 6 years of training. These are only the basic trainings. Military personnel are subject to many types of education and training programmes throughout their careers. It is currently hard to predict how killer robots and LAWS will affect all these training programmes. Evolution will be inevitable. The military officials have to prepare for the robotic era and adapt the current education and training systems for the robotic era.

CONCLUSIONS

Robotic warfare is becoming a reality. Moreover, it will evolve as the capabilities of drones and robots available for military forces increase. The future armed forces will become robotic armed forces composed of humans, drones, and robots. Even in the distant future, there may only be drones and robots on the battlefield. At that time, we will have robotic armed forces. Up until that time, the development of robotic armed forces may be a challenge. There will be various issues that need consideration. These issues are the management of public perception, the development of the concept of operations for robotic warfare, the transformation of military forces, the personnel selection and recruitment, the acquisition of robotic and AI defence systems, education and training in the robotic warfare era. In this study, we discussed these issues. In addition, we provide a basic model for armed forces transformation for the robotic era. Based on the issues identified and the basic model developed, we provide recommendations to policymakers and military officials for the transformation of armed forces for the robotic era.

FUTURE WORK

There are many future work research opportunities related to armed forces transformation for the robotic warfare era. The issues identified with this research are the starting points for in-depth research studies. In this article, we have only identified and briefly discussed these issues. How to manage public perception will be the subject of various studies. Currently, the opposition to the use of LAWS grows as indicated by “the campaign to stop killer robots”. The ethical and legal debate on the use of LAWS has not been settled. Most current literature focuses on the ethical and moral justifications to use or not to use LAWS. The studies focusing on the management of public perception

⁴⁶ HAMEL, ref. 33.

should closely monitor these studies and develop strategies based on these debates. Currently, the effective use of drones is the main focus of CONOPS for the robotic warfare era. Development of CONOPS will continue as the technical feasibility of various types of autonomous and semi-autonomous lethal weapon systems increases. Development of armed forces transformation strategies, models, and plans will be needed. Depending on the needs and constraints of the countries, militaries will seek the best strategies and models for themselves. The topic of robots on the battleground (or killer robots or LAWS) is an emerging research area. Currently, the literature lacks survey studies. We believe survey studies will help identify trends and gaps in the current literature. How to adapt human resource management processes for the robotic era will be an important research area that has not been discussed in the literature yet.

There may be another type of warfighter in the robotic warfare era. Cyborgs may be a part of future armed forces. There are already successful implementations of replacing lost limbs with cyber-physical systems. There are companies “developing ultra-high bandwidth brain-machine interfaces to connect humans and computers”.⁴⁷ Some of the products developed by these companies are implants for the brain. Not just humans but also other types of living organisms are candidates for cyborg implementations. While helping disabled people with cyborg technology is humane, if the cyborg technology is used for enhancing various capabilities of healthy humans (or other living organisms), many ethical issues arise.⁴⁸ As a result, various implementations of cyborg technology may lead to super soldiers. While killer robots or LAWS are the focus of the current debate, super soldiers or cyborg warriors will be the focus of another hot debate.

⁴⁷ <https://neuralink.com/>

⁴⁸ DEMIR, Kadir Alpaslan. Research Questions in Roboethics. *Mugla Journal of Science and Technology*. 2017, Vol. 3, No. 2, pp. 160-165. DOI: [10.22531/muglajsci.359648](https://doi.org/10.22531/muglajsci.359648). Available from: http://www.softwaresuccess.org/papers/2017_Demir_MJSCI_Roboethics.pdf.