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FACULTY OF SOCIAL SCIENCES

Institute of Political Studies

Department of Security Studies

Master's Thesis

2021 **Matyáš Ortmann**

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Department of Security Studies

Development and potential Regulation of Autonomous Weapon Systems: EU and U.S. policy strategies

Master's thesis

Author: Bc. Matyáš Ortmann

Study programme: Security Studies

Supervisor: Mgr. Petr Špelda, Ph.D.

Year of the defense: 2021

Declaration

1. I hereby declare that I have compiled this thesis using the listed literature and resources only.

2. I hereby declare that my thesis has not been used to gain any other academic title.

3. I fully agree to my work being used for study and scientific purposes.

In Prague on 25th of April, 2021 Matyáš Ortmann

References

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Abstract

This diploma thesis deals with the issue of autonomous weapon systems in connection with the phenomenon of artificial intelligence. Within the issue of AWS, the master's thesis addresses their potential regulation or complete ban. This burning topic is discussed based on an empirical analysis of international organizations and state institutions that deal with the matter. The main essence of the master's thesis is to approach the functioning of artificial intelligence and autonomous weapon systems, to map the development of AWS and to present the current situation in the context of AWS regulation. The secondary purpose of this this is to examine and analyze the international debate and to look at the arguments presented regarding the moral and ethical aspects of development and deployment of autonomous weapons.

The diploma thesis concludes that at present times, there are still no fully autonomous weapon systems operating in the field, but their development is gaining momentum. Regarding the matter of regulatory measures of AWS, discussions are taking place, which so far have resulted in individual agreements that correspond to the form of hybrid regulation. Individual countries approach the topic of AWS regulation based on their technological and economic capabilities and also in the combination of power and geopolitical realities.

Abstrakt

Tato diplomová práce se zabývá problematikou autonomních zbraňových systémů ve spojení s fenoménem umělé inteligence. V rámci problematiky AWS magisterská práce řeší jejich potenciální regulaci či kompletní zákaz vývoje. Toto palčivé téma je diskutováno na základě empirického rozboru postojů mezinárodních organizací a státních institucí, které se tímto tématem zabývají. Hlavní podstatou magisterské práce je přiblížit fungování umělé inteligence a autonomních zbraňových systémů, zmapovat vývoj AWS a představit současnou situaci v kontextu regulace AWS. Sekundárním účelem této práce je prozkoumat a analyzovat mezinárodní debatu a podívat se na předložené argumenty týkající se morálních a etických aspektů autonomních zbraní.

Diplomová práce dochází k závěrům, že v současné době stále neexistují plně autonomní zbraňové systémy, avšak jejich vývoj nabírá na intenzitě. Co se týče regulačních opatření

AWS, probíhají diskuse, které mají zatím za výsledek jednotlivé domluvy, které odpovídají formě hybridní regulace. Jednotlivé státy přistupují k tématu regulace AWS na základě jejich technologických a ekonomických možností, avšak také ve spojení mocenských a geopolitických reálií.

Keywords

Artificial intelligence, machine learning, autonomous weapon systems, regulation, modern technology, ethics, killer robots, potential threats, European Union, United States

Klíčová slova

Umělá inteligence, strojové učení, autonomní zbraňové systémy, regulace, moderní technologie, etika, roboti zabijáci, potenciální hrozby, Evropská unie, Spojené státy

Title

Development and potential Regulation of Autonomous Weapon Systems: EU and U.S. policy strategies

Název práce

Vývoj a potencionální regulace autonomních zbraňových systémů: přístup politik EU a USA

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List of abbreviations

AFRL	Air Force Research Laboratory
AGI	Artificial general intelligence
AI	Artificial intelligence
ANI	Artificial narrow intelligence
AWS	Autonomous weapon systems
CCW/CCWC	Convention on Certain Conventional Weapons
CSKR	Campaign to Stop Killer Robots
DARPA	Defense Advanced Research Projects Agency
DL	Deep learning
EGE	European group on ethics in science and new technologies
EP	European Parliament
EC	European Commission
EU	European Union
GGE	Group of governmental experts
HRW	Human rights watch
ICRAC	International Committee for Robot Arms Control
ICRC	International Committee of the Red Cross
IHL	International humanitarian law
JURI	European Parliament Committee on Legal Affairs
LAWS	Lethal autonomous weapon systems

MHC	Meaningful human control
ML	Machine learning
NGO	Non-governmental organization
ONR	Office of Naval Research
R&D	Research and development
UAV	Unmanned aerial vehicle
UK	United Kingdom
UN	United Nations
USA	United States of America
USDOD	The United States Department of Defense
VLOS	Visual line of sight

Introduction

"Machines can do many things, but they cannot create meaning. They cannot answer these questions for us. Machines cannot tell us what we value, what choices we should make. The world we are creating is one that will have intelligent machines in it, but it is not for them. It is a world for us."

- Paul Scharre, *Army of None: Autonomous Weapons and the Future of War (2018)*

The times, when the idea of autonomous machines and the use of artificial intelligence was connected preferentially to the sci-fi genre, are relatively recent in the context of the existence of human civilization. However, a certain desire for advanced robotics and automation is present much longer amongst people. Nevertheless, in these days, we already live in a world where these visions are yet a reality. Technological conveniences are used throughout society and therefore it is not just the prerogative of the military sector, as was the case before. Notwithstanding, military research is still the driving force behind the autonomy and deployment of artificial intelligence in robotic systems and of course autonomous weapon systems.

Technological development has been constantly accelerating over the last decades. This growth, in the last century, was conditioned mainly by war conflicts and later by arms races. The military powers have spent huge amounts of resources and employed millions of people for military-technological development, which would give them an advantage in the event of a potential conflict with their rivals. Indirectly, of course, I come across the events of the Cold War between the Western and Eastern blocs. After the collapse of the Soviet Union and the end of at least the formal division of the world for East and West, this situation changed in part. The United States has, for a time, become the only global power and has been at the forefront of almost every technological, military, and economic fields. However, as we can observe, this period did not last forever and the long-neglected "sleeping dragon" came on the scene of global stage. The People's Republic of China began to assert themselves in the new millennium and at present times represents a leader in artificial intelligence research and standing with largest army by active military personnel *(Statista 2021)*.

I presume, that the application of artificial intelligence in the field of military service and the development and production of autonomous weapon systems, which represent the core of the discussion of this diploma thesis, will form crucial aspects of potential war conflicts in the imminent future. The mentioned United States and mainland China are fully aware of this reality and therefore they are investing heavily in military technological development. However, it should be noted that the gap in military budgets spending between these countries is still enormous. According to the International Institute for Strategic Studies, in 2019 both the U.S. and China devoted significant sums to research and development (R&D) and procurement (defense investments), but perhaps unsurprisingly, given the disparity in sums they allocate to defense, the U.S. spent almost three times as much as China did (201 billion USD and 74.4 billion USD respectively, in current dollars) *(The International Institute for Strategic Studies, 2020).*

Global security is a far more reflected topic in today's world than it was usual in past decades. Given the fact, that today we, as a people, are already completely dependent on technology (at least in most parts of the world) and thus, it is necessary to take the influence of technology into account in the context of security. And it is precisely because of that dynamic development within the security environment, that individual states can be exposed to security threats. The identification of these security threats and the resulting risks, on which the development of security and military strategies and relevant security policies are based on, will not be possible without predicting possible future developments. However, autonomous weapon systems could represent a significant variable in these strategic prognoses. The issue of predicting and forecasting future security developments itself is influenced by a various number of important aspects. Such factors include, for example, growing and unpredictable technological developments, dynamic changes in the security environment and the interconnectedness and complexity of individual actors, as well as threats and risks. All these mentioned factors can negatively affect the process of creating safety forecasts. However, it should be noted, that the AWS are still at stage when they do not represent such a significant part of military arsenal within the armies of individual countries, so they do not represent such a risk yet.

Autonomous weapons systems do have specific features that include risks and challenges in applying existing laws in connection to armed conflict. Despite the fact, that it is possible to organize the current framework to consider the features of autonomous weapons in such a way that the proposed alternative of a direct ban on these systems is misleading. Such a move could be replaced by a three-stage process that would regulate the development, deployment and use of autonomous weapon systems.

Technological progress in the field of artificial intelligence, robotics and autonomous systems has also raised several pressing and complex moral questions. At present times, it is possible to observe numerous efforts to find answers to the ethical, societal, and other legal challenges associated with the technological development and to pursue them in the right direction. Therefore, it is these efforts, that have already led to mobilizing many initiatives in various jurisdictions, organizations, and national states. Some of these problems stem from issues related to the security, protection, and risk mitigation. This is an issue that is also addressed more in the master's thesis.

The diploma thesis aimed to explain and map the current situation around the development and regulation of autonomous weapon systems. The secondary intention of the master's thesis is the analytical connection of AWS with the concepts of artificial intelligence and machine learning. Since these two concepts represent key aspects in the framework of development of autonomy systems. The diploma thesis is built based on qualitative research. In my diploma thesis I dealt with the following research questions. What are the current regulatory trends in the field of AWS? Have autonomous weapon systems already achieved forms of full autonomy? How do individual states react to the topic of AWS? To what extent is the current development of ML and AI reflected in these regulatory trends?

The master's thesis is divided into six individual chapters, which mutually construct a complex insight into the matter. The first three chapters are of a theoretical nature. The beginning is made of methodological embedding of the thesis and then it is followed with a chapter where are explained selected concepts that must be understood in a successful orientation in the topic of the diploma thesis. The next chapters directly ensued this theoretical framework and discuss individual topics in a larger context and thus go more in depth.

The second chapter dealt with the two important topics for the issue of autonomous systems. These subjects are artificial intelligence and machine learning. Within these two key disciplines, additional topics such as their limitations, what threats and benefits pose to humanity are addressed as well. I also focused substantially on the issue of ethical debate regarding the development of these systems, where I also referred to various types of expert opinions. In the next chapter I dealt purely with the issue of autonomous weapon systems. Their historical development is deciphered, as well as the analysis of individual weapons that are actively used in the military today and the innovative potential and expectation of AWS in the proximal future.

In the fourth chapter I was engaged in the burning topic of regulation of autonomous weapon systems. There I analyzed the current form of the regulatory framework, the way in which there is a safe human control over robotic systems, the issue of responsibility and liability for acting of autonomous systems and finally I dealt with the international organization Campaign Stop Killer Robots, which asserts to ensure, that the AWS development will be banned as soon as possible.

The final two chapters function as two single case studies, where I was occupied with approaches to the regulation of AWS by two major global actors - the United States and the European Union. This example shows a significant difference in the perception of the involvement of autonomous technologies within the geopolitical position between transatlantic allies.

I chose the topic of my diploma thesis based on my interest in modern technologies and security issues on a global scale while concerning mainly European and transatlantic perspectives. I see the future of our civilization in coexistence with the artificial intelligence and autonomous systems. I am aware of the fact, that this topic is extremely complex and difficult to grasp, and if one wanted to cover all the contexts, it would result in scale of ten master's theses.

1. Theoretical definition of relevant terms of the diploma thesis

In the following chapter, I intend to address methodology on which the research of the diploma thesis is based on and also few concepts that are essential for the contextual understanding of the reader to the topic of the diploma thesis. It is rather a superficial representation of individual domains. These concepts consist of artificial intelligence, autonomous weapon systems, robotics, regulation, and autonomy.

This diploma thesis is composed of two single-case studies. These single-case studies are based on empirical research and they analyze in parallel approaches the development and potential regulation of autonomous weapons systems in the United States and the European Union. Based on the work with specific data that I obtained from the official documents of individual state groups, I came to the given conclusions.

An important aspect that needs to be realized in advance is that single-case studies cannot be generalized, and the goal of the social sciences is to provide theoretical generalizations. It follows that single-case studies therefore have very little in common with science. This fact is an exemplary of the often-repeated reproach to the use of single-case studies, which has plagued proponents of this methodology in the past but is still the case. Much of the history of case studies can even be conceived as a philosophical and methodological struggle with the objection that it is not possible to generalize from just one case *(Drulák et al. 2008, p. 29)*.

Unlike other research, single-case study research allows for the investigation and understanding of complex problems. A single-case study can thus be considered a thorough research method, especially in cases where holistic and thorough research is required to apply. *(Tellis 1997, pp. 11-12)*.

The purpose and goal of this type of single-case study is to examine cases as such and to reveal their specific features. It is therefore not a question of creating new theories, on the contrary, an analysis of the validity of existing statements and concepts. The final critical evaluation of the case study as a general methodology represents reality, that in comparison with its most frequently emphasized alternative, ie statistical analysis, this methodology excels in design validity and theoretical yield *(Drulák, pp. 56-57)*.

1. 1 Artificial intelligence

To understand the functioning of autonomous systems, it is essential to comprehend, what artificial intelligence is in the general sense of the word. As it is usually the case, there are many definitions of artificial intelligence. Most of these definitions operate within the concept of computer programs or machines, which are capable of self-reliant acting, which can be called intelligent if they were made by the human operators. The problem with this approach to explaining artificial intelligence is the very definition of human intelligence. We, as humans, are accustomed to simplifying the description of the characteristics of certain concepts or phenomena into properties that are easily measurable and quantifiable with concepts or phenomena, which are already well known to us. Our acting is therefore based on our own experience. However, in this specific case, such a comparison does not function, as the concept of intelligence is not easily imaginable, and it is too difficult to generalize it or practically handle it *(Frankenfield, Investopedia 2021)*.

If we are talking in general, AI can be determined as a modern technology that automatically implicates patterns in the data and creates predictions based on this data analysis. This method is called inference analysis. This analysis method identifies correlations within the data summaries, that can be used as the indicators to classify the substance serving as a representative of a category or group in the case of profiling (*Daly, Hagendorff, Hui, Mann, Marda, Wagner, Wang and Witterborn 2019, p. 5)*.

The rapid development of artificial intelligence in the last years has been supported by several factors. One of these factors is the shift in machine learning (ML) due to the empirical success of artificial neural networks, which can now be trained with huge data sets and deep learning techniques (DL). Other factor is the development of hardware technologies for object sensing, perception and recognition, also new platforms, products, and markets. Artificial intelligence can also be defined by what AI researchers do *(Stone et al. 2016, pp. 12-13)*.

To give some definition of artificial intelligence, I will use a quote from the Cambridge dictionary, which reads as follows. *"The study of how to produce machines that have some of the qualities that the human mind has, such as the ability to understand language, recognize pictures, solve problems, and learn" (Cambridge dictionary 2021)*.

The famous American computer scientist, artificial intelligence expert and MIT professor Marvin Minsky defined AI as follows. *"Artificial intelligence is the science of creating machines or systems that will use a process to solve a task that, if done by man, would be considered a manifestation of his intelligence" (Digitalwellbeing.org 2017)*.

Machine learning is an integral and connected part of the issue of artificial intelligence. However, while AI is a broad science that mimics human abilities and characteristics, machine learning is a specific subset of artificial intelligence that shapes artificial systems as they are to be learned. I dealt with the issue of machine learning in more depth further in my diploma thesis *(Thompson, Li and Bolen, SAS 2020)*.

1. 2 Autonomous weapon systems

Autonomous weapon systems (AWS) are reusable weapon systems and smart munitions that can be differentiated from all the existing weapons by their full autonomy. Autonomy in weapon systems is manifested by the assumption of the machine's ability to perform actions without human control based on the interactions between set computer programs, that activate its physical components and the environment *(Solovyeva and Hynek 2020, p. 1)*.

Autonomous weapon systems are a somewhat controversial topic. This controversy is caused mainly because a substantial part of non-expert public thinks, that these autonomous weapons can do what they want without any human control but of course, this is not the case. At least not yet. Although some types of AWS are capable to choose its own targets, this does not mean that human operators are no longer able to do anything with these decisions. AWS are also considered to be machines in which their operators have control over and if necessary, there is a possibility to change or even stop their planned actions. A crucial aspect of autonomous weapon systems is their degree of autonomy. The level of autonomy can vary considerably. On a scale that includes a simple reactive mechanism at one end and human intelligence at the other end, AWS are gradually shifting towards the other. In this sense, AWS are defined as systems that, when activated, can track, identify, and attack targets with destructive force without further human intervention. Autonomous weapon systems therefore qualitatively surpass systems that are remotely controlled, such as drones or other types of unmanned aerial vehicle *(Bode and Huelss 2018, p. 5)*.

Applying autonomy to weapon systems on the one hand presents a plentiful number of benefits. For example, it is a sophisticated transfer of decision-making processes to weapon systems, that eliminates the problem of the communication line between the operator and the device system (robot), which is vulnerable to potential detection, interference of the transmitted signal or potential enemy takeover. Another advantage is the reduction of the time lag between the action and the reaction. This cutback eliminates the need for a remote human operator to decide at a given moment. Autonomous weapon systems are resistant to emotions that are affecting people and therefore influence their decision making. Robots do not know fear and do not feel stress. This reality greatly affects performance and many other aspects. Another advantage of autonomy is a significant improvement in efficiency and cost savings resulting from lower personnel deployment costs. But on the other hand, machines are susceptible to a vast number of potential problems that make them rather unpredictable in the action. These issues enlist such things as human errors, human-machine interaction failures, malfunctions, communications degradation, software coding errors, enemy cyber-attacks, infiltration into the industrial supply chain, jamming, spoofing, decoys, and other enemy countermeasures or actions *(Sharkey 2014, pp. 29-31)*.

The United States Department of Defense (USDOD) distinguishes between two categories of autonomous weapon systems. Firstly, there are the fully autonomous weapon systems and secondly, the semi-autonomous weapon systems. In addition, USDOD has recently issued a directive, which is restricting the development and deployment of certain classes of lethal robots, which appears tantamount to a quasi-moratorium *(Arkin 2014, p. 36)*.

Fully autonomous weapon systems are robotic weapons that, when activated by a human operator, can select, and hit targets without any further intervention by the human operator. Such systems are equipped with mechanical sensors that allow them to gain a degree of situational awareness, computers that process information gathered from the environment, and effectors (meaning weapons) that make their decisions made by computer calculations (*Petman 2017, p. 15)*.

In these days, we can observe, that technological development gradually leads to full autonomy of weapon systems. This means, that AWS will decide for themselves how long the task will take, while the semi-autonomous systems will still be dependent on the human decision factor. However, it is necessary to mention that the fully autonomous weapons systems will also be dependent on people to some phase in general. This issue of autonomy is especially the case of production, software development and its updates. However, if we compare them with semi-autonomous machines, human inputs are quite inappreciable. As for the main advantages of AWS, it is primarily the speed of response in action (Ibid., p. 16).

The computational capabilities of autonomous systems surpass other systems in many areas by far. These capabilities include for example speed and strength. These attributes allow them to make difficult decisions based on complex scenarios through adaptation and learning. Software development should look like in the way, that each task is written to the machine's memory, which then creates analyses based on the data. These analyses will lead systems to the best possible evaluation of the given situation. Compared to remotely controlled systems, AWS has greater computing capacity, which will allow them to complete the aiming process of the evaluated target much faster *(Ibid., p.17)*.

1. 3 Autonomy

In today's digital age, majority of people are basically accustomed to the fact that technology makes their lives easier in many ways and performs a significant number of activities automatically for them. However, we have still did not reach the stage, where could be argued, that the machines would take the initiative, realize their own existence, and conduct the assigned tasks completely independently on human factor. For now, it is rather the opposite situation. Behind every machine system controlled by a computer program/algorithm is the operator, who developed the computer application and who determined how to behave in a particular situation. The robot thus does not have the possibility to deviate from the original set instructions or to think about their (in)correctness *(Lawless, Mittu, Sofge and Russell 2017, pp. 1-3)*.

Machines only do what they have written in their programming. For these reasons, I believe that the autonomy of the systems cannot be perceived in terms of complete independence and self-initiative. Although the contemporary development of artificial intelligence aims to enable computer programs to solve problems and achieve with the same or even better results than humans. However, most autonomous systems are still comprehensively dependent on humans to perform their operations *(Ibid., pp. 4-5)*.

The autonomy of machines cannot be described as a concept that has been absolutely defined. It is rather an extensible feature for which a hierarchy has already been established in several cases. The fact, that there are different levels of autonomy, is also underlined by the fact that, that some systems are often called autonomous due to their ability to map the environment with the help of sensors and thus adapt their behaviour to the given environment. Therefore, for example, a vehicle that adapts driving characteristics to the driver's preferences is referred to as an autonomous machine. This determination is based on the fact, that it does only apply to the strict rules of conduct programmed to it by its creator to the specific situations. Thereupon, it is without any choice or possibility of learning new behaviour. Such a robot lacks the artificial intelligence, which I have already explained in the previous subchapter. Autonomy, therefore, is the ability of the system to act without direct human intervention, although it is a continuum with various levels and many grey areas. In civilian robotics, some autonomous systems perform prescribed actions that are fixed in advance and do not change in response to the environment (such systems as an industrial manufacturing robot) *(International Committee of the Red Cross 2019, pp. 7-8)*.

Within the context of the issue of weapon systems, it is important to distinguish between the concepts of autonomous and automatic. Automated systems are supposed to be predetermined procedures and are fully regulated by humans. These systems must be activated by the appropriate operator in the event of an imminent threat. At the same time, these automated systems can be switched off at any time. In contrast, autonomous systems already operate independently to some degree of human control when activated *(Schäfer 2018)*.

According to the Air Force Research Laboratory (AFRL), there are 11 degrees of autonomy in AWS that enable and calibrate trust between human and machines. Grades start from 0 to 10 in the following order: 0) Remotely piloted vehicle, 1) Execute pre-planned mission remotely, 2) Changeable mission, 3) Robust response to real time faults / events, 4) Fault / event adaptive vehicle, 5) Real time multi-vehicle coordination, 6) Real time multi-vehicle cooperation, 7) Battlespace knowledge, 8) Battlespace single cognizance, 9) Battlespace swarm cognizance and 10) Fully autonomous *(Marra and McNeill 2012, p. 24)*.

2. Artificial intelligence and ethical issues

The creation of artificial beings who have intelligence with themselves also raises the question of ethics and moral principles. Since we can only anticipate what the cognitive architecture of the artificial intellect will look like and how it will function, it is therefore very important to consider the mere development of consciousness in robots. Since it can be simple for artificial intellect to protect themselves from certain types of human errors and prejudices, while at the same time being at increased risk of other types of error that would not be made by human factor (*Bostrom 2003, pp. 12-13).*

The inner conscious life of the artificial intellect, if it has one, is also completely different from ours. If robots acquired a cognitive character, it is possible that they would continue to refuse to function in the style of "mindless slaves" because, as we know from our history, slavery is an unsustainable and undesirable model of existence *(Ibid., p. 14)*.

Algorithms created by artificial intelligence are playing an increasingly important role in our society. However, a key aspect for the future will be to ensure, that these algorithms are not only progressively efficient and better overall but, that it is particularly important to ensure their transparency. Other crucial aspects that must be included in the design of machine ethics algorithms incorporate auditability, predictability, responsibility, and incorruptibility *(Bostrom and Yudkowsky 2011, pp. 2-3)*.

Ability to know the differences in the thinking of individual people can often seem considerably difficult. However, if we analyze these differences in thinking more thoroughly and objectively, we would have probably concluded, that the individual nuances in thinking between particular people are rather minimal. It is because people are in almost constant contact with each other (unless a global pandemic is taking place), so they have lost this ability to differentiate, and their ideas of intelligent beings are subject to so-called "anthropomorphization". Nick Bostrom states that even if we could have established a relationship with extraterrestrial intelligence, they would probably still be closer to us than a computer with super intelligence and cognitive skills. This possibility is because in such a case we can assume, that the aliens on their planet had to go through an evolution and thus will have similar basic needs as we have (food consumption, reproduction, and protection of their own offspring). Therefore, we cannot expect advanced artificial intelligence to have similar needs, and wherefore its mentality will be very much distinct from ours *(Bostrom 2012, pp. 1-2)*.

2. 1 Threats and opportunities associated with the use of the artificial intelligence

One of the main threats of today linked with the use of AI are considered the insufficient use of artificial intelligence. This (non)use represents missed opportunities, which may mean poor implementation of crucial programs for individual states or even a loss of competitive advantage to other regions, which can lead to economic stagnation. Such underutilization of artificial intelligence may stem from the public and business distrust of artificial intelligence as well as from the insufficient infrastructure needed to operate with such sophisticated technology. Other causes include inadequate investment in AI or the fragmentation of digital markets. On the other hand, there is the opposite threat which may be an excessive use of artificial intelligence. One example of overuse is investing in applications that have proven to be inapplicable. Occasionally, artificial intelligence is also used where it is not needed, or it is not appropriate. It is an interpretation of complex and comprehensive social phenomenon, where knowledge of context and logical thinking is very much required *(European Parliament News 2020)*.

Another fundamental problem that bothers all creators of solutions based on artificial intelligence, is the easy vulnerability of algorithms through so-called adversarial attacks. The essence of this issue lies within the fact, that the AI algorithms are substantially simple to manipulate in a targeted manner. Because the algorithms that make AI systems work so well are imperfect, their systematic limitations are creating opportunities for mentioned adversarial attacks. At least for the foreseeable future it is only a fact of mathematical life. This problem mainly concerns autonomous systems and poses a potential threat especially in transport domain and military sector *(Comiter 2019, pp. 10-11)*.

Artificial intelligence undoubtedly offers many opportunities for the future. Whether it is labour shortages in some areas or improving inclusive measures by involving disadvantaged groups to participate in the economy. As my example I chose the case of the use of information and communication technologies, that support the inclusion of pupils with disabilities and special educational needs. Artificial intelligence helps to increase efficiency and optimize costs and also contributes to the emergence of new fields of human activity as well as brand new professions. However, each coin has two sides. Automation and robotics also threaten many jobs in their current form. Therefore, AI phenomenon could lead to a significant increase of unemployment in the proximal future *(Marr, Bernard Marr & Co 2021)*.

Of course, there is a potential risk in passing human control to machines, mainly because they may not share our values and “humanity”. However, this risk is exacerbated by two factors that can cause the transition from human control to machine control to be quite sudden and unexpected. These are the possibilities of overhang of calculation and so-called recursive self-improvement. Recursive self-improvement describes the assumption that advanced artificial intelligence systems will have instrumental goals to conserve, gain resources, and improve, because these goals are useful intermediaries to achieve almost any set of ultimate goals. Thus, if to create artificial intelligence that is capable of the same or even better results in the process of designing AI systems, there is a potential initiation of a rapid cascade of cycles of self-improvement, which is motivated by artificial intelligence. If this momentum came into reality, it would most likely mean, that artificial intelligence would surpass the level of human intelligence *(Muehlhauser and Bostrom 2013, pp. 1-3)*.

In the debate on autonomous weapon systems, it is important to mention the so-called Martens Clause. The Martens Clause, or also referred to as the Martens annex, was formulated by the Russian ambassador to the Congress in The Hague, Friedrich Martens, in 1899 and is an important tool for guaranteeing the technological neutrality of international law. Originally, this clause was enshrined in the preamble to the Hague Convention on the Laws and Customs of Land Warfare of 1899 as: *"Until a more complete code of war law is issued, the High Contracting Parties consider it appropriate to declare that in cases not covered by this regulation adopted, the inhabitants and the warring parties remain under the protection of international law as a result of the customs established among civilized nations, the rules of humanity and the dictates of public conscience."* In today's world, the Martens clause is rather seen as a safeguard which is effective in the event of rapid technological development. This problem can be observed more in military technology than anywhere else. However, in addition to the Martens Clause represents a specific value framework of ground warfare, and its location within the preamble can be considered mainly in a declaratory or symbolic way *(Sparrow, Humanitarian Law & Policy 2017)*.

In the case of the mentioned Martens Clause, the question is, whether it should be or not considered, when assessing the legality of autonomous weapon systems. The crucial problem is the disagreement between the petitioners and the defendants regarding the role of the clause. While opponents, such as Human Rights Watch, argue that due to diligence it should take the clause into account. Whereas the appellants claim that the clause can be applied only in the absence of contract law. In its defense, Human Rights Watch states that the International Court of Justice recognizes the clause as part of customary law, and also notes, that the Martens Clause has proved to be an effective means of addressing the rapid development of military technology *(Andersson 2014, p. 45).*

The mentioned two institutions share the view, that the Martens Clause should be duly considered in the legal review. However, the opposition is of the opinion that the clause only functions as a fail-safe mechanism and should not be considered as a safeguard. Thus, it should no longer have a discretionary function at all. Opponents are of the opinion that the legality of weapons is sufficiently regulated by contract law and therefore this clause does not deserve consideration in the review process. Although the (non)applicability of the Martens Clause is not crucial in the debate on legality. Nevertheless, the disagreement in this case shows profound that there is a strong contradiction between the two parties *(Ibid., p. 46)*.

2. 1. 1 Machine Learning

Machine learning is a subgroup of artificial intelligence, which focuses mainly on development systems that it further develops. ML increases its performance based on received and evaluated data. Machine learning, as well as artificial intelligence and other modern statistical methods, provides new opportunities to take advantage of rapidly growing data sources that could not be evaluated before, or it would take up so much time that it would be disadvantageous to even do that. Learning is often viewed as the most fundamental aspect of intelligence, as it enables the agent to become independent of its creator. Machine learning and artificial intelligence in particular should give desired benefits to companies more from the automation and deployment of machinery across a range of industries. *(Russel 2007, pp. 1-2).*

Machine learning is a large and active field of scientific research. While ML currently conducts an extensive quantity of research, which concern primarily the domain of technical fields, humanities and social sciences do not use it as much for various reasons. There is a significant shortcoming in the effectiveness of technology deployment in the field of social sciences. Although there is no consensus on what has worked in practice in this area, the deployment of artificial intelligence and machine learning continues in a variety of disciplines. Thanks to its high adaptability, machine learning is very effective in situations where data is constantly changing *(Ibid., p. 3).*

Another advantage of ML is the response to changes in requirements or if the assigned task, which is still in process. Programming the solution would not be effectively possible then. Machine learning thus adds many benefits. Based on data analysis, systems can predict, thanks to ML, customer behavior, help identify a pattern or structure within structured and unstructured data or reduce process costs and risks and most importantly, ML is a key aspect for the development of autonomous systems *(Ibid., p. 4)*.

2. 1. 2 Limitations of machine learning

Although machine learning uses very sophisticated algorithms based on the principle of artificial intelligence it still has many limitations. One of these limit scenarios is, for example, if the ML is working with incomplete data, then there are significant inaccuracies in the outcome, or it is not even able to process the data at all. However, even in cases where the data, that serve as a basis is a complete result, the ML that occurs may not always be 100 % correct. Another limit for ML is the understanding of the result in a broader context. Although machine learning will reach the result much faster than humans, it is more of a generalized output that does not have much overlap. Artificial intelligence in machine learning is not (yet) at such a level that there is a sufficient interpretation of the resulting data *(Hall and Kumar 2016)*.

Machine learning devices can encode the correlation of problems but cannot link the causation or ontological relations. The limitations are based on the commitments contained in the quantification itself, only after showing how unmodified dependencies can lead to cross-validation being too optimistic a way to evaluate the performance model *(Malik 2020, p. 1)*.

A controversial problem that is associated with machine learning is called bias. The concept of bias was first introduced in ML by American computer scientist Tom Mitchell in his 1980 article entitled *The Need for Bias in Generalizing Learning.* Applying what we have learned from experience to new situations is called the induction jump, and it seems possible only if we use certain prejudices to choose one generalization of the situation over another. By inserting some types of distortion into the machine learning buildup, we give algorithms the capacity to perform similar induction steps *(Mitchell 1980, pp. 1-4)*.

When deploying artificial intelligence and machine learning algorithms, there are likely to be more cases in the future, where potential bias gets into algorithms and datasets. The major problem is that in some cases, ML models that seem to perform well are catchy and capture noise in the data. Transparency and impartial decision-making are important elements, which should be one of the main advantages of machine learning. However, the mentioned error rate of the ML solution is based on the quality of its inputs data. Regarding to this matter, recently, the topic of facial recognition has become a greatly controversial issue. Various cases have taken place on social networks, which have raised tensions over the racial issue. However, bias in the data files provided by facial recognition applications can lead to inaccurate results. Training data must always be neutral, otherwise there are results that are discriminatory, and the dataset is thus devalued. The ideal way to solve this problem is to collect data that is more random and diverse in a sense. A heterogeneous dataset reduces exposure to bias and leads to better ML solutions *(Aggarwal, Towards Data Science 2020)*.

2. 1. 3 Machine learning and ethical debate

The ethics of machine learning deals with the behavior of machines not only towards people and other machines. Due to the fact, that our society is becoming more and more dependent on the help of artificial intelligence, it is necessary to define some rules and restrictions that will lead to maintaining secure environment. At present times, there is a relatively significant disparity between professional work and the debate in general, which concerns the technological aspects of artificial intelligence, or machine learning, and the ethical-moral debate of the issue. This disparity could be reflected in frequent security breaches *(Lo Piano 2020, p. 2)*.

The essence of the focus of machine learning ethics is the evaluation of responsible and irresponsible use of artificial intelligence and machine learning processes. In the last century, when the technological development of machines and computers was not yet at the same level as in recent years, the topic of ethics was not so much addressed. It was conditioned by that reality, that impact of computers on society was relatively negligible. However, with the growing intelligence of machines, the need to supervise machines and having ethical rules in place in the event of unwanted interaction between machines and humans also grows considerably. Addressing such a matter retrospectively could be problematic. Our society should not overlook the fact that responsibility is being increasingly transferred to machine systems. It is necessary to always be one step ahead (*Saltz, Skirpan, Fiesler, Gorelick, Yeh, Heckman, Dewar, and Beard 2019. pp. 2-3).*

Emerging ethical dilemmas are already touching the practices of computing professionals, who use ML to solve problems, forcing them to make difficult decisions. In fact, the need for ethical considerations when using machine learning techniques has been frequently noted. The majority opinion of the scientific community on the issue of machine learning ethics is, that it is possible to create such ML systems which can make decisions based on ethics and morality. The goal for the future is that machine learning and artificial intelligence should use the human factor to establish clear ethical rules and drastically reduce the level of violence in a human-to-human context and potentially a human versus machine *(Ibid., p. 4)*.

According to the Michael Anderson and his wife Susan L. Anderson of the University of Connecticut, there are 4 main approaches to understanding ethics in ML. These approaches consist of concepts of biocentrism, anthropocentrism, ecocentrism and info-centrism. These four perspectives of machine learning understanding may overlap each other at a time. Each of these attitudes take a certain perspective on the question of moral and ethical constitution *(Anderson and Anderson 2011, pp. 118-119)*.

The key issue for anyone working in an environment with machine learning and artificial intelligence is undoubtedly the context. This means that it is necessary to have a concrete idea of why I am trying to do the thing and what could be the possible consequences from such actions. For the time being, machine learning is perceived as a tool to make work easier for people and like other tools, it can be used positively or negatively or in this case (un)ethically. Ethics does not deal directly with decisions about the correctness of behaviour, but rather draws the attention of society to the issue, while the final decision depends on the morality of the individual. Implementing machine learning into practice raises ethical questions *(West and Allen, Brookings 2018)*.

Today, transnational companies are applying machine learning on a large scale without prior testing, while they exploit consumers directly for testing even though they often have not given their consent to this behaviour. In this case, therefore, it is definitely not possible to speak of ethical conduct. Although the process may seem approximately harmless, there is still a potential eventuality that it can lead to unintended consequences. The rapid and insufficiently safety-based deployment of machine learning in practice is also linked to the issue of legality and legitimacy. Legal procedures and setting social norms are often so. When collecting data, it is necessary to proceed with regarding to the privacy of users and in accordance with laws and contractual conditions. In such a case, one can speak of ethical behavior *(Gall, Packt Hub 2019).*

Discussions about machine ethics create a very important assumption that machines can in a sense represent ethical factors responsible for their actions or so-called autonomous moral factors. The idea that forms the basis of machine ethics today is to find a way into real robotics. In this area, it is not usually assumed that these machines are artificial moral agents in any sense of the word. It is sometimes pointed out that a machine that is programmed to follow ethical rules can be very easily modified to follow unethical rules *(Müller 2020, p. 17)*.

2. 1. 4 Deep learning

Deep learning is still a relatively new and nowadays very popular discipline that falls under domain of machine learning. Deep learning represents especially the development stage of artificial neural networks. The predominant essence of DL is to mimic the functioning of the human brain. As part of this process, DL builds many layers of artificial neurons in the machine, which are interconnected in large networks. The word deep in the name refers to artificial neural networks and their deep variants. Deep learning allows computers to learn from experience and understand the world in a complex hierarchy of concepts. The machines gather knowledge from experience, so it is not necessary for the human computer operator to formally specify all the knowledge needed for the machine. The hierarchy of concepts thus allows the computer to learn complex concepts by assembling them from simpler ones. Deep learning, in its short period of existence, has yielded extremely promising results for various tasks in understanding natural language. In this case, it is in particular the classification of topics, sentiment analysis, answering questions and translating languages *(LeCun, Bengio and Hinton 2015, pp. 436-438)*.

Deep learning is criticized by a substantial number of people (computer scientists, AI experts and politicians) who fear that it can carry many risks and be the reason why we should not have autonomous weapon systems. The main problem is often the fact, that even long-term testing and many control measures taken by experts and scientists may not ensure sufficient predictability of systems using deep learning processes, as their learning operations often work on unclear principles. American scientist and author Gary Marcus, who is devoted to geometric and artificial intelligence, proclaimed following: *"Deep learning is a terrific tool for some kinds of problems, particularly those involving perceptual classification, like recognizing syllables and objects, but also not a panacea."* One of the reasons for this statement is, that deep learning learns complex correlations between input and output features with no inherent representation of causality *(Marcus, Medium 2018)*.

Deep learning is currently most widely used in the areas of image and video recognition. This is mainly the so-called automated tagging of the image. This technology is used by internet giants like Google and Facebook. These multinational companies use automated tagging, for example, to recognize products and parts on production lines, to visually check the quality of products or infrastructure. The most well-known and controversial features include face and character recognition. Other functions are the recognition of handwritten documents, automatic translations of written texts and signs or video recognition in autonomous cars without a driver. Another phenomenon of recent years is the sound recognition or voice control, which has already been operating for a while now within the software of Apple (Siri), Android and Google (Google assistant) or Amazon (Alexa) *(Huang 2018, pp. 3-4)*.

2. 2 "Roboethics" - applying human ethics to the machines

In 2002, the Italian roboticist Gianmarco Veruggio came up with the concept of robot ethics or so-called "roboethics". Two years earlier, Veruggio founded the association School of Robotics in Genoa to promote this new science among young people and the society at large by means of educational robotics *(Open Robotics institute 2021)*.

Veruggio defined roboethics as follows: *"Roboethics is an applied ethics whose objective is to develop scientific / cultural / technical tools that can be shared by different social groups and beliefs. These tools aim to promote and encourage the development of Robotics for the* *advancement of human society and individuals, and to help preventing its misuse against humankind."* This definition does not describe the ethics of robots or other machines with artificial intelligence, but human ethics, which is implemented in machine systems *(Operto and Veruggio 2008, p. 1504)*.

As part of the implementation of robotics in the spheres of human life, which include the household up to the provision of health care, the professional public resonates with discussions on the potential threats posed by the increasing use of robots. The introduction of technology into everyday life may have another negative aspect. It is namely the fact that the gap between developed countries, especially located the northern hemisphere, and the less developed (third world countries), will widen even more *(Ibid., 1507-1508).*

In recent years, the potential misuse of technology by corrupt governments or terrorist organizations has also been addressed. However, this potential security threat should be prevented by regulatory measures to some extent. A country that already uses robots as its primary force in some industries today is, for example, Japan. In Japan, robots are manufactured based on strict regulations and safety measures. This firmly defines who is responsible for the robots in the event of an incident and also guarantees the ethical and social safety of the robots and the people *(Ibid., pp. 1509-1510).*

In the context of dealing with safe production and assistance of robots as efficiently as possible, it is necessary, that safety and insurance law will be standardized as good as it goes and adapted to the current state-of-the-art technology. This fact must be determinately defined. It is due to the fact, that in many countries we still encounter very obsolete standards. It is this outdated system of standards, that prevents countries from reaching their potential in the field of technological development. As a result, coordinated cooperation between humans and machines cannot take place. The European Union is precisely the institution that attaches great importance to similar matters, which is why the European Machinery Directive is one of the good examples of how these standards can be effectively linked and technologically raised *(IBA Global Employment Institute 2017, p. 64)*.

One of the arguments why it is not desirable to improve the cognitive functions and properties of machines in the future is, that there could be potentially a form of such robots, that would intellectually surpass humans. Such robots could revolt and take power of decisions into their own hands. Machines that are using artificial intelligence with cognitive functions, emotions, and the ability to learn and to communicate between themselves, would mean an unprecedented situation that could potentially have a catastrophic scenario. As a protective element against possible loss of control, every robot should have a button for immediate shutdown (*Operto and Veruggio 2008, pp. 1511-1513).*

The intelligence capabilities of robots are currently governed by the evolutionary path of artificial intelligence. Today's robots have capabilities compatible with so-called artificial narrow intelligence (ANI). This means that these robots can perform specific targeted tasks, but they cannot functionally develop own cognition with just themselves. As a result, they outperform people in specific repetitive and rather simpler operations. However, change is expected to come relatively quickly. It is assumed that by year 2040, robots will perform tasks compatible with artificial general intelligence (AGI). This would mean, that these kinds of robots would be able to compete with people across all the possible professions and there is also potential eventuality that robots would even convince people that they are "people" themselves. Soon after this period of AGI, robots are expected to demonstrate intelligence, which goes beyond human capabilities *(Tzafestas 2018, p. 20)*.

3. Autonomous weapon systems – their development and situation today

In the last decade, we can observe how much technological development, in the field of military and information technology, has progressed. The development and production of military means with a certain degree of autonomy is advancing much faster than their regulation precautions and the mere reflection on what these machines will represent in the future. The current public debate is largely focused on the issue of drones, which are today the most widespread and most accessible type of unmanned and autonomous weapons. However, the discussion on the issue of autonomous military robots and especially those autonomous weapon systems disposing lethal force has become more and more relevant *(Chin 2019, p. 770).*

These weapon systems have come to be referred to as killer robots, as they are to be able, to varying degrees, to make their own decisions about the use of their destructive military force. The biggest concern is that lethal autonomous weapon systems (LAWS), should be potentially completely independent of the control of human factor. Although the mentioned weapon systems have not yet been deployed in combat and do not yet physically exist, several states are heading for their development. NGO representatives, but also even the European Union, consider essential matter that the issue of autonomous weapon systems should be discussed as frequently as possible, especially regarding the issues of its legal, ethical and security aspects. Appropriate conclusions should then be drawn from such political discussions. So, the key question is, how will the technological development of autonomous weapon systems shape the future of war and the resemblance of states? This is a matter of great concern both in academia world and in policy making and also in the public sphere *(Ibid., pp. 771-772)*.

Since 2013, the management and design of lethal autonomous weapons systems have been widely discussed at the international level in the framework of the United Nations Convention on Certain Conventional Weapons (CCW). This convention, which entered into force in 1983, regulates the design of weapons that can be considered to have an excessively harmful or reckless impact for humanity. The countries that have joined the CCW have agreed to formalize their discussions by setting up a Group of Governmental Experts (GGE). The discussion, which would oblige these states to take formal measures around LAWS, has not yet taken place officially, but is necessarily the central point of the GGE discussion. In November 2019, the CCW Meeting of High Contracting Parties decided that the GGE work will continue in 2020 and 2021 *(Geneva Internet Platform 2019)*.

However, at recent CCW meetings, most of the involved states have stated, that they are not ready yet to discuss this possibility. They justified it by the fact, that they are still in the process of understanding the full implications of increasing autonomy in weapon systems. The main engines that drive the development of autonomous weapon systems include the following. Firstly, these are strategic motives. In recent years, the United States has defined autonomy as a key standpoint of their strategic capabilities and plans to develop military modernization. According to all indicators, this trend led to their rivals also beginning to focus on autonomy. These rivals are especially the People's Republic of China and the Russian Federation. The second motive of AWS development is of an operational nature. Designers within the military structure believe that autonomy allows weapon systems to achieve better results on the battlefield, which would revolutionize conflict management. The third motive is related to sphere of economics. Experts believe that autonomy means opportunities to reduce the operating costs of weapon systems, especially through a more efficient use of human labour and fulfill the potential of robotic systems *(Boulanin and Verbruggen 2017, pp. 1-3)*.

Current situation on the international stage is such, that Russia and more importantly China are increasingly pursuing an expansionary and aggressive policy in their spheres of influences. This action considerably increases the likelihood of conflict in the future, whether it is a regional or global issue. The military powers, led by the United States, have a relatively visible ambition to produce and then deploy more and more autonomous weapons in the forthcoming years. As I have already mentioned previously in my diploma thesis, it is extremely important for people in senior political positions to consider in detail the potential risks that such a use of autonomous weapons would mean for humanity. Among these risks are currently potential catastrophic scenarios, which are more of a hypothetical nature, but the actual problems are rather associated with moral and ethical values and also with human rights. If we will allow robots to replace human representation, in this case in the military sector, there would be ground for further, more substantial, problems. Most of these risks and dangers associated with the implementation of the AWS are so far only assumed, as these types of weapons are appropriately in their beginnings of development. However, the development of AWS is advancing rapidly. Another crucial aspect is related to the deployment of AWS in actual combat, and that is the thorough testing of weapons in various conditions under the careful supervision of experts. If we slightly change the subject from military to civilian sphere, a convenient example concerning this issue of testing is Elon Musk's Tesla. Musk has invested heavily in the development and safety of machining resources and time, and thanks to that, their semi-autonomous cars are so safe. Indisputable events that take place during conflicts are a serious problem. Despite the perfect algorithms which form the foundations of AWS, potential accidents are almost inevitable. And it is these accidents that could mean the potential catastrophe *(Klare, Arms Control Association 2019)*.

3. 1 Technological foundations of autonomy in armaments industry

Systems that operate on the principle of autonomy use sensors and other data sources for their operation. These aspects help them to collect the necessary information about environment in which they operate. Advanced algorithms and artificial intelligence are used for subsequent processing and understanding. Based on these technologies, it is decided how autonomous systems will respond and perform tasks in certain situations. They can be used physically or digitally to achieve the set goals. Other groups are robotic systems. These are automated machines that can conduct sophisticated actions independently in connection with humans. Autonomy has many uses in the military sector. Autonomous systems can be used, for example, in cases where takes place a high-risk situation in which human lives could be seriously endangered or even lost. In this case, a scenario is offered for replacing human operators with machines in dangerous environments, such as supplying logistics in hazardous areas or disposing of explosives and unexploded ordnance *(Ministry of Defence of United Kingdom 2019, p. 20).*

Thanks to the deployment of autonomous robots, it is possible to free up many military personnel who deal with more trivial tasks and thus use them elsewhere, where they are more needed. Autonomous systems can also be used in places, where deployment of military personnel was not previously possible or would be highly unproductive. As a final example, I would mention the creation of a completely new operating procedure, which would work based on integrated mixed teams. These teams would form people and machines together. This cooperation of human and artificial factors would combine the strengths of both groups, which could potentially lead to an overall improvement in processes. In any case, it must be mentioned that this is a hypothetical assumption *(Ibid., p. 21).*

Autonomy in robotic systems in the technical aspect of autonomy consists in the transfer of data from the environment into targeted plans and actions. Regardless of the type of human-machine relationship, the degree of complexity of the system or the type of task performed, autonomy (in a physical system) is always made possible by the integration of the same three basic skills. These skills consist of decision-making, perception, and action *(Boulanin and Verbruggen 2017, p. 7).*

In order, for a task to be completed independently with the use of perception, the autonomous systems must be able to efficiently perceive the environment in which it is located and work. This condition requires the sensors to collect data (the cognitive part of cognition) and the computer using a special program called acquisition software that can merge and interpret the data (the thinking part of cognition). As part of decision-making in autonomous systems, the data, which are processed by the scanning software serves as input for the decision-making process provided by the control system. The reason that the control system determines the next step towards the target, which is specifically designed for a given task, can vary considerably within different types. As for the action decision-making formed by the control system, it is taken in the real world by computational or physical means. In the field of computers and cyberspace in general, this can be, for example, a software program that implements a certain action. Such a software can prevent malicious code that could damage whole system network *(Ibid., pp. 8-11).*

3. 2 Approach and position of the expert public on the topic of development and implementation of autonomous weapon systems

Autonomous weapon systems, which have partial or even full autonomy, cause considerable concern, especially among experts. One of the most burning issues is the potential implementation and related compliance with international law. Since deployment of AWS could undermine legal liability. Such weapon systems could have also transcended ethical and moral boundaries and their security and humanitarian risks could outweigh the potential benefits for warfare. By eliminating human involvement in the decision making of using lethal force in armed conflicts, fully autonomous weapon systems would subvert other non-legal protections for civilians *(Human Rights Watch 2012, p. 1).*

The debate on the development, implementation and potential regulation of fully autonomous weapon systems began to resonate on the international stage in 2012. Since then, it has continued to deepen. Lawyers, military experts, various human rights activists, scientists, and diplomats have argued on a few occasions about the legality, legitimacy, and overall moral and ethical proprieties of these weapons, which would select and interfere with targets without meaningful human control over individual attacks. As military technology leads to ever-increasing autonomy, they also aggravate the view of the matter. Opponents, but not only among them, are getting worried about a possible conflict, where such autonomous weapons would be deployed *(Ibid., pp. 2-3).*

In the spring of 2014 and then again in 2015, the United Nations Convention on Certain Conventional Weapons was held. These events included widespread discussions on possible, practical, political, and moral issues surrounding the AWS. Part of these debates involved public opinion, as some experts said, that there was already augmented opposition to autonomous weapons in the United States at the time. This resistance allegedly stemmed from the absence of human control over the use of lethal force. This means that such autonomous weapon systems would infringe the provisions on public awareness set out in the mentioned Martens Clause of the Hague Convention and because of such infringements, the use of AWS could be prohibited as interferences of international law *(Ekelhof and Struyk 2014, pp. 5-6)*.

Many experts and influential people in the field of artificial intelligence or other technical fields are very skeptical about the development of autonomous weapon systems in the military and security areas in general. Amongst the most well-known experts was, for example, the late theoretical physicist Stephen Hawking, who dealt mainly with space problematics, but the topics of artificial intelligence and autonomy were quite close to him. In one of his interviews for the BBC, he said the following: *"The development of full artificial intelligence could spell the end of the human race."* Hawking did not question the significant contribution of artificial intelligence to humanity but feared, where it might escalate, if autonomous systems reached or even surpassed capacity of human intelligence *(Jones, BBC News 2018)*.

According to Human Rights Watch, fully autonomous weapon systems are unacceptable, and their development must therefore be prevented immediately. Furthermore, according to HRW, all sovereign states have a moral duty to protect humanity from this dangerous development of artificial intelligence and thus to ban fully autonomous weapon systems. HWR denotes ethical imperatives, legal necessities, and moral obligations as the major reasons for strict regulation of AWS. Every autonomous weapon must be subject to full human control *(Human Rights Watch 2020, pp. 1-2)*.

Already in July 2015, more than 1,000 developers and scientists wrote a letter, which was warning of the dangers associated with armaments in the field of artificial intelligence and autonomous weapon systems *(BBC News 2015)*.

Two years later, in August 2017, 116 experts focusing on artificial intelligence and the use of modern technology sent an open letter to the United Nations warning of the potential impact of autonomous weapons systems on humanity. The leader of this group was none other than technology magnate Elon Musk. This group of experts warns against the so-called war of the third age, where people would be on one side and machines on the other. Such a scenario, which is well known from popular culture, would mean huge losses for humanity on all fronts. This hypothetical future outcome is said to be inevitable unless world leaders ban the development of fully autonomous weapon systems. Modern autonomous weapon systems should result in a faster conflict over a much larger area than the conventional arsenal can cover (except for weapons of mass destruction). The denote global terror is another possible threat, which could occur if such weapons fell into the hands of terrorists or militant autocratic leaders *(Gibbs, The Guardian 2017)*.

The ban on the development of autonomous weapon systems is also resonating in the European Union. In September 2018, the European Parliament (EP) voted with an overwhelming majority of MPs the resolution on banning autonomous weapon systems. The official document dealing with this ban states the following: *„European Parliament resolution of 12 September 2018 on autonomous weapon systems (2018/2752(RSP)) underlines the fact that none of the weapons or weapon systems currently operated by EU forces are lethal autonomous weapon systems; recalls that weapons and weapon systems specifically designed to defend own platforms, forces and populations against highly dynamic threats such as hostile missiles, munitions and aircraft are not considered lethal autonomous weapon systems; emphasizes that engagement decisions against human-inhabited aircraft should be taken by human operators" (Official Journal of European Union 2018, p. 3)*.

However, the European Union must enforce such a ban globally at the UN, which so far seems quite unachievable *(European Parliament News 2018).*

Amongst the states that support the development and production of autonomous weapon systems are two permanent members of the UN Security Council, namely Russian Federation and the United States. The other permanent members (France and United Kingdom) take rather similar view on the matter. China also makes no secret of its interest in the AWS, but stresses, that the current framework of international law concerning deployment of fully autonomous weapons should be strengthened. This process should be integrated into a new international treaty, which would be approved unanimously. Other democratic states, which are against banning AWS are, for example, South Korea or Israel *(The Campaign to Stop Killer Robots 2018)*.

3. 3 “Killer robots” and the threat they pose to humanity

Before I get into the subject of killer robots, it is convenient to first define what such a robot actually represents. As for the definition of the robot, it is a mechanical machine that is using a remote control. Robots can also be controlled on the principle of programming patterns of behavior. Thanks to this complex programming, robots are then able to perform more comprehensive assignments and can also have independence from the human factor. This autonomy of the robots can take place in different settings *(Reekmans, Oqton 2018)*.

Today, autonomous machines are increasingly used in the military. Such a machines therefore fulfill the functions of a component of the armed forces and thus the term robotic weapon or autonomous weapon system is used to describe it. Technological advances in areas such as mechatronics, electrical engineering and computer technology can develop increasingly sophisticated sensorimotor functions in robotics. These features allow machines to adapt to their ever-changing environment. Until recently, the system of industrial production was organized around the machines. The machines are calibrated according to their environment and thus tolerate minimal deviations. However, thanks to technological advances that have gone up sharply forward in recent decades, this system can be more easily integrated into the existing environment. Regarding the definition of autonomy in robot systems, it can be divided into perception, planning, and execution, which includes aspects such as manipulation, navigation, and cooperation. An imperative idea in the convergence of the fields of artificial intelligence and robotics is to try to optimize their level of autonomy using learning techniques. Such a level of intelligence can be measured as the ability to forecast the future. This prediction can be made when planning a task, or when interacting (either by manipulation or navigation) with the world *(Perez, Deligianni, Ravi and Yang 2017, pp. 24-25)*.

We already do have autonomous robotic systems with some form of intelligence, although creating a system with human-like intelligence remains unattainable for now. Robots that can perform specialized autonomous tasks, such as driving a vehicle (Tesla automobiles and others), flying in natural and artificial environments (autonomous drones), swimming, carrying boxes and material in various terrains, collecting objects and more, already exist today. These robots are even essentially fully functional and fault-free machines *(Ibid., p. 26)*.

Lethal autonomous weapon systems or also called killer robots would be able to decide on the use of deadly force without human control in decision-making via human-out-of-the-loop model. The level of robot autonomy is an aspect that is crucial and can vary with a great range. Autonomous weapon systems are often divided into three categories according to the degree of human participation in their activities. The first level is the human-in-the-loop weapons. These AWS include robots that can select targets and execute operations only with direct human chain of command. The second types are human-on-the-loop weapons. These AWS include robots who can select targets and carry out action under the supervision of a human operator who can override the actions of robots. The last group consists of human-out-of-the-loop weapons. This AWS category contains robots that are capable to select targets and are also capable of action without any human intervention or interaction. There is a burning issue with killer robots concerning their level of autonomy. The decision-making process for autonomous weapon systems should operate on the principle of allowing a reasonable level of human judgment regarding the use of lethal force and control over their critical functions, in particular. However, the problematic aspect is to determine what such a reasonable level is *(Human Rights Watch 2012, pp. 2-3)*.

As it stands for the argument that there is no responsibility for the actions committed by autonomous weapons systems during the conflict since the AWS have a so-called "atmosphere of triviality". Because the autonomy of these weapon systems does not mean that they operate completely independently on the human factor. Autonomous weapon systems, like any other artificial systems designed and programmed by a man, is thus directly responsible to their creators. Therefore, the responsibility for their operations and actions lies unconditionally with the originators. This reality follows from this essence that the authors will always have the main responsibility, given the fact that it is them, who put the machines into action. However, if we really allow the machine systems to make independent decisions, the responsibility for their actions, such as choosing the targets targeted, will be completely theirs *(Solovyeva and Hynek 2018, p. 195)*.

The level of autonomous actions of these systems in killing is thus described as a basic ethical and moral problem, but at the same time the idealization of people's ability to pass better judgments is also taking place *(Karppi, Böhlen and Granata 2016, p. 6).*

3. 4 Analysis of different types of autonomous weapon systems

As part of the deployment of robotic systems in war conflicts in the last decade, one type of weapon can be described as dominant. This weapon system is drone. One of the primary causes of the development and deployment of unmanned autonomous weapons in the military industry is the reduction of the risk of death of soldiers and military personnel in general. These machine systems, in this case unmanned aircrafts, are controlled far from places where there is a running conflict. The operator is usually located in a safety of military base or another safe place. Today, we still observe a growth trend of drone production, both in the military and civilian sphere. Therefore, it is not surprising, that there is an enormous interest and demand in the market for the development of semi-autonomous and fully autonomous systems, which will perform tasks without direct human involvement. In recent years, the role and importance of drones has increased, especially in the military. Drones thus become a very significant "partner" of man. The role of drones is very likely to become even more eminent in the future than it is already today. Whether it is of importance for the military or civilian life *(Miller 2013, pp. 3-4)*.

Drones are flying machines that belong to the group of unmanned aerial vehicles (UAVs). These types of aircraft can handle long distances in a scale of thousands of kilometers, but they are also small types of aircrafts, that operate indoors. Drones are a type of “autonomous” machine that must be controlled by an operator from the ground but can be semi-autonomous or even fully autonomous. Technological advances have resulted in the production of a wide range of drones today. Drones can thus be used in environments where it is difficult or dangerous for people to get. Drones originated strictly as an army affair. Their main functions including reconnaissance, supply and patrolling the given territory. Drones proved themselves in a very short period and became literally a prodigy. Thanks to their success, it did not take long time and drones started to be produced for commercial purposes outside the military sector. This is not the first time that military technology has penetrated to the civilian sphere. UAV's regulatory frameworks vary from state to state and even within territories. At present, regulatory frameworks for the UAV sector pose a major challenge for both commercial and humanitarian purposes. Regulations stating that UAVs must fly within visual line of sight (VLOS) of the operator limit the distance and potential of using UAVs in health supply chain delivery *(United States Agency for International Development 2017, pp. 15-16)*.

As I mentioned above, the military sector is a cornerstone for the use of drones. As we already know from history, war conflicts are the driving force of technological development, as states compete in the development of weapons and other crucial technologies to have advantage over their enemies. Although drones have proven successful in combat, the emphasis today is on the use of smaller drones, which are used regularly by ground forces. Mobile drones are mainly the domain of the United States Armed Forces, which invest considerable financial resources in improving and developing them. There are currently dozens of companies in the United States dedicated to the technological development of small and large-scale drones. State and private entities are trying to integrate drone technology into their military programs. Military and technological experts believe that the capabilities of drones will increase dramatically in the upcoming years and thus will increase their use in combat *(The Friends Committee on National Legislation 2016)*.

As a specific example of unmanned aerial vehicle that is capable of remotely controlled or autonomous flight, I would mention the American General Atomics MQ-9 Reaper, which was developed for the United States Air Force. This drone began operations in early 2001, so it was deployed during an international military campaign called War on Terror, which was launched in response to the terrorist attack on the World Trade Center in New York City on September 11, 2001. The MQ-9A is equipped with a fault-tolerant flight control system and a triple redundant avionics system architecture and it is an extremely reliable aircraft. This drone is engineered to meet and exceed manned aircraft reliability standards *(General Atomics Aeronautical 2021)*.

The naval autonomous weapon system includes, for example, the American Sea Hunter. Sea Hunter is a new class of unmanned sea surface vehicle developed in partnership between the Office of Naval Research (ONR) and the Defense Advanced Research Projects Agency (DARPA). This vessel can detect and continue to monitor submarines without the involvement of a human operator. Shortly after the US Navy launched Sea Hunter, it was reported by intelligence services, that the Chinese military has an almost identical autonomous weapon system *(Eckstein, U.S. Naval Institute 2020)*.

If we are talking about stationary autonomous weapon systems, it is definitely worth mentioning the South Korean sentry gun SGR-A1 manufactured by Samsung. SGR-A1 is a robotic system with the ability to autonomously identify and encounter given targets. The development of this weapon began in 2006 and the first tests in terrain started 4 years later.

This weapon system was developed for the purpose of patrolling the Korean demilitarized zone at 38 parallel north. SGR-A1 has three low-light cameras, heat and motion detectors and pattern-recognition software, that enable to spot targets up to two miles (3.22 kilometres) away during the daytime and one mile away at night. When the intruder is spotted, the SGR-A1 can issue verbal warnings and recognize surrender motions, such as if the target drops his weaponry and raises his hands. If the intruder does not surrender, the robot can engage him with a Daewoo K3 light machine gun from up to 800 meters away. The system of this weapon works on the principle of human on the loop, which was already explained earlier in this chapter *(Velez-Green, Lawfare 2015)*.

Another weapon system that could be partially described as autonomous is Phalanx weapon system. The Phalanx weapon system is a rapid-fire, computer-controlled radar-guided gun that can destroy anti-ship missiles and other close-in threats on land and at sea. This weapon system is manufactured by the American Aerospace and Defense Corporation of General Dynamics Corporation. Phalanx is used by the U.S. Navy to destroy anti-ship missiles and nearby threats that have penetrated their defensive lines. On land, the U.S. military uses a weapon system to detect and combat missile, artillery, and mortar systems. This close-in weapon system performs functions usually operated by multiple systems. These include detecting, assessing threats, searching for, monitoring, engaging, and evaluating the use of lethal force. There is also a more sophisticated version called Block 1B that has an added control station that allows operators to visually track and identify targets before they are even launched. Furthermore, this version has an added infrared sensor, thanks to which it can be used at sea against helicopters and high-speed land vessels. This sensor can also identify and confirm incoming threats even on land. The Phalanx weapon system is installed on all classes of surface warships of the U.S. Navy, and also some of the Allied armies have this weapon system at their disposal. The ground version is deployed forward and was used in combat *(Raytheon Missiles & Defense 2020)*.

Of the heavy ground military equipment is worth mentioning tank called the Type-X. This armoured fighting vehicle was developed by the Estonian company Milrem Robotics, which manufactures robotic combat vehicles, and also deals with autonomous systems and artificial intelligence. CEO of Milrem Robotics, Kuldar Väärsi, declared about tank the following: *"The Type-X will provide equal or overmatching firepower and tactical usage to a unit equipped with Infantry Fighting vehicles. It provides means to breach enemy defensive* *positions with minimal risk for own troops and replacing a lost RCV is purely a logistical nuance."* The Type-X model currently works with the use of human operators, but in the proximal future, the company would like to go in the form of full autonomy. The advantages of this tank are, for example, that it is three to four times lighter to common tanks and its price is significantly lower than that of a conventional infantry fighting vehicles. Type-X was designed with intelligent predictive maintenance in combination with a health and use monitoring system and the principle of unit replacement. These aspects thus ensure a low life cycle costs and logistical footprints. Hybrid powertrains and rubber tracks also substantially reduce the overall life cycle costs of such machine *(Milrem Robotics 2021)*.

3. 5 Innovation, civilian sphere, and the promise of the future of autonomous weapon systems

Innovation in the field of autonomous weapon systems, like other technological areas, is directly connected with the civilian sphere. Although the international community has become increasingly interested in the prospects of lethal autonomous weapon systems in recent years, the debate over LAWS governance is moving very slowly. A potential obstacle is the fact, that LAWS would be very difficult to manage effectively in the traditional arms control regime. The main argument in this debate is the fact, that civil (private) companies occupy a leading position in the development of artificial intelligence and thus these companies are the most important actors in autonomous systems production. Technologies made by civilian sector are spreading much faster and easier and therefore represent a crucial element for technological innovation *(Verbruggen 2019, pp. 338-339).*

Technological innovation in the civilian sphere has become increasingly important in recent decades with national spending in the military sector declining since the end of the Cold War with just a few exceptions. This decline also occurred in military research and development (R&D). Civil industry thus took the place of an innovative leader. This means, that in these days, more technological companies are focusing on improving individual systems and technologies rather than developing completely new systems. Technology of autonomous systems and the way it is developed, is highly innovative. Development in the civilian sphere is rapid and efficient and that is thanks to the fact, that companies use extensively the opensource system. Individual companies regularly publish additional improvements to their technologies and again thanks to open software, they receive feedback from their users and other actors. This approach of transparency saves them time and money for demanding testing. It is the testing process that makes a significant difference between the civilian and state-military spheres. In the context of innovation, the state-military forces focus on long-term and therefore challenging goals. Demanding testing slows down the whole process and makes it quite expensive, significantly more than would be desirable. By combining the civilian sphere with the military one, which is subject to the state, great benefits arise for the army advancement. The development has thus accelerated many times over, to which the use of artificial intelligence also has a significant share. We can observe this phenomenon especially in the last 15 years *(Ibid. 340-342)*.

Technological innovation as such is usually the result of formal efforts in research and development. According to researchers Vincent Boulanin and Maaike Verbruggete of the Stockholm International Peace Research Institute, the field of research and development can be generally divided into three basic categories. These three categories contain basic research, applied research and experimental development. The summary of these categories is consequential. Basic research deals with the progress of the state of science and knowledge at the fundamental level through theoretical or experimental research. Knowledge of applied research brings findings of new methods and techniques that are further applied in the solution specific socio-technical problems. As the name of the second category suggests, applied research deals with the study of a specific goal. The last approach is the experimental development. Experimental development is based on the findings using basic research as well as applied research. The aim of this research method is to improve existing technologies or even to develop completely new ones. The experimental development phase is essential in the context of the development of commercial technologies that cover both civilian and state military technologies. At this stage, research is possible to use new methods, ideas or products and thus get the final form of the technology. This phase has also high priority in terms of control and regulation. Although this stage seems to be crucial, it is necessary not to forget the previous two categories, because without them it would not be possible to make major technological breakthroughs *(Boulanin and Verbruggen 2017, pp. 85-86)*.

4. Regulation of autonomous weapon systems

As I already mentioned in the subchapter *5.3 "Approach and position of the public expert on the topic of autonomous weapon systems"* since about year 2012, the debate on the issue of a possible preventive ban or regulation of autonomous weapon systems is becoming more relevant and more resonant in public space. Semi-autonomous weapon systems have been in operation for a few years and others, especially those with greater levels of autonomy, are in the process of being developed. Therefore, it is this technological development that accompanies the AWS regulation debate.

In June 2014, the Group of Governmental Experts met for the first time at the United Nations Office at Geneva, Switzerland, to address the security issues associated with lethal autonomous weapon systems. Since then, such meetings have been held every year. An exception, however, was last year 2020, when the event did not take place due to the global pandemic caused by the virus disease Covid-19 *(Reaching Critical Will 2020)*.

4. 1 The current form of the regulatory framework for autonomous weapon systems

Given the rapid pace of technological development in autonomous weapon systems, it is necessary to establish a framework of regulatory measures that would provide sufficient control over these systems through existing regulations. There is an ongoing debate among experts as to whether such a regulatory framework exists today and if it does in which form. Today, AWS are regulated by International humanitarian law (IHL) and other international and domestic laws, such as treaty on the non-proliferation, international technology standards or export controls. Within the mentioned international regulations there is already an emphasis on the control and regulation of potentially unpredictable impacts of technological developments more than on the aspects of specific technological systems. However, there is still an urge to specify how existing laws are or should be applied to many emerging technologies, especially those related to the military sector. Therefore, it is appropriate, in addition to the lack of regulation in the field of AWS, to clarify how the existing agreements apply specifically to autonomous weapon systems and the technologies of which they are composed. As part of the effective functioning of the regulatory framework, clarification of existing rules is very much needed it and national states, should insist, that the rules will be applied and complied with. There is also a strong need for greater openness to compromise and to conduct dialogue in the context of concluding and subsequently complying with international agreements. This represents one of the main problems of the current situation concerning regulation of AWS *(Chavannes, Klonowska and Sweijs 2020, p. 30)*.

The legal review of autonomous weapon systems under the well-known organization called Article 36 is essentially the only binding mechanism of its kind. Nevertheless, its implementation is not succeeding enough, one could say that it is even failing, and so Article 36 was only established in a few states. This underachievement has occurred due to the lack of concrete steps to implement international principles in autonomous weapon systems and an ambiguous definition of what AWS actually represents. As a result of this imperfect definition, some states have carried out a legal review, in order, to modify the mechanism to suit the specificities of the AWS. However, the technical side of things is not the crucial problem in this matter. There is a marked absence of political will in individual states to change something. This passivity means, that states which do not comply with the regulations and thus continue to develop and produce autonomous weapon systems are not persecuted/sanctioned at all. Meanwhile countries that follow regulations and rules thus fall behind and get into political and strategic disadvantages. The crucial aspect for the successful regulation of AWS is to ensure greater compliance with the principles of the new autonomous weapon systems *(Ibid., p. 31)*.

Regulatory issues may not always be obvious at first glance. They may stem from serious regulatory disconnections or may result from a more general stimulus problems for legislators who are just trying to keep up with technological developments. In the event of a regulatory challenges, various issues may arise. Who defines or decides whether such a challenge exists? Another such question may be for example: Who represents such a challenge for and who is directly affected by that challenge? In such a case, the dilemma of when and how to intervene arises. This dilemma is known as the so called "Collingridge dilemma". The Collingridge dilemma means that legislators face to face problems in regulating emerging technologies. One side of the problem is the hesitation to take precautionary measures, in the context of a lack of full information on the properties and effects of this technology. The other side of the aspect presents the difficulty in this matter. Once a given technology is fully developed, the management and treatment of its further development comes at a very high cost. These costs arise mainly due to the level of investments, which are spent on its development and subsequent implementation in practice or the benefits that this technology brings *(Cavelty, Fischer and Balzacq 2016, p. 457)*.

Regulators cannot intervene too soon or too late. Estimating this moment is therefore extremely difficult and risky. Then, it is also a factor of pressure and lobbying on the part of technology companies that want to participate in the creation of regulatory measures. As far as the European Union is concerned, the regulatory framework is already close to make. The essence of the EU is, that member states share common principles, which are enshrined in European Union law. The role of a strong framework of fundamental rights and values in the common European tradition also plays important role. However, the matter cannot be considered definitive. The regulatory framework itself requires constant attention in order to be successful *(Leenes, Palmerini, Koops, Bertolini, Salvini and Lucivero 2017, pp. 38-42)*.

4. 2 Meaningful human control over autonomous weapon systems

Since 2014, several major CCW parties have expressed interests and considerable concerns about meaningful human control (MHC) over autonomous weapon systems. There is an ongoing extensive scientific and engineering research on the dynamics of human-machine interaction in connection with human supervision of machinery systems. Fundamental aspects of MHC include ensuring the legality of human control over AWS and guaranteeing the precautionary measures taken to assess the severity of potential targets, their necessity and appropriateness, as well as the likelihood and possible effects of potential robot attacks *(Sharkey 2018, p. 2)*.

Meaningful human control forms the core of regulatory and ethical debates regarding autonomous weapon systems. Artificial intelligence-controlled systems signal the potential absence of immediate human decision-making on the lethal effects of AWS and the growing loss of meaningful human control. The mentioned concept of MHC has become a focus of the ongoing transnational debate at the UN and the CCW. The NGO Article 36 provides a solution to the problems we encounter in trying to establish a specific definition of what autonomy is in weapon systems. However, it also meets somewhat similar problems in defining other concepts that play an important role within AWS *(Bode and Huelss 2021, p. 3)*.

Heather M. Roff, a researcher in the Department of Politics and International Relations of Oxford University and Article 36 managing director, Richard Moyes, presented several aspects, that can help improve human control over technology in general. They state, for example, that the technology must be clearly predictable, reliable, and highly transparent. Users of the technology should have possessed accurate information. Having relevant data means timeous human response and the ability to intervene in a timely manner. These factors underscore the complex requirements that may be important for maintaining MHC. However, the manner and degree of interconnection of these aspects and the degree of predictability or reliability required, for example, for human control to make sense, remains unclear and these elements have still not been clearly defined *(Ibid., p.4)*.

The approach of meaningful human control is essentially to address three key issues. It is about accountability, moral responsibility, and controllability. In order, for MHC to be able to relevantly address the problems associated with the potential growth of the autonomy in weapon systems, it is necessary to consider the various ways and means by which such weapons are used in action today. Informed decision-making by meaningful human control is a crucial component in this matter. In this respect, an essential common feature is the sufficient information between people, which serves to assess the legality of the measures taken. This fact ensures both accountability and moral responsibility for the actions that people carry out. In addition to these aspects, maneuverability should represent an important point in the design of autonomous weapons. Although the required steps that should lead to stopping or rerouting the autonomous weapon systems after its launch do not have the necessary feasibility, there are several important design considerations that need to be examined to ensure effective and adequate control of AWS. Weapon systems, that are inherently uncontrollable, will most likely, be backbreaking to use in ways, that are directly in line with the laws of war and purposeful aspects that meet the military objectives set by human operators *(Horowitz and Scharre 2015, pp. 13-14)*.

4. 3 Responsibility and liability for acting of autonomous weapon systems

Autonomous systems, and not just those associated with the military, which operate on the principles of artificial intelligence and machine learning technologies, raise significant apprehensions both in the public and mainstream media, as well as among security experts, legislators, and tech developers. Concerns about new technologies are not historically unusual, but in today's "information and digital era”, AWS represents a drastic turning point for the course of history. The form and structure of how to incorporate AWS into the legislative framework is quite uncertain. So far, no one can concretely introduce the possible consequences of the functioning of autonomous weapon systems, and therefore the issue of liability is relatively problematic. The uncertainty and complex unpredictability around AWS at the very moment, of what the machine will do in certain situations, also increases the risks of potential damages. The operation of autonomous weapon systems necessarily entails the risk of a few prospective detriments. Whether it is human health, damage to property or damage to legal values, which are protected by the legislative framework of the law. It is therefore extremely important to establish an adequate form of liability for actions of autonomous systems. If the system is disproportionately or incompletely set up, significant damage problems may arise in the event of potential harm. This matter could seriously jeopardize the entire existence and potential benefits of autonomous systems *(Fuzaylova 2019, pp. 1358-1359)*.

Thus, it is necessary for the field of law to respond to technological developments and definitively determine legal liability. Lethal autonomous weapon systems have a far higher potential to be significantly more dangerous than semi-autonomous weapon systems and such autonomous weapons, which do not serve to eliminate the opponent, should follow a strict standard of responsibility. If we are talking in general terms, strictly defined liability applies under sterner circumstances than any other form of liability under tort laws. As I have already mentioned earlier, the use of fully autonomous weapon systems, especially those with lethal purpose, does not currently fall into any of the categories of law. Therefore, in the context of security, it must be implemented as soon as possible, before it is too late *(Ibid., p. 1360)*.

The self-development ability of autonomous systems presents society with machines that have their own needs and agendas. Lack of liability can result, among other things, in public distrust of autonomous systems and artificial intelligence in general. Thus, it can happen if there is an incident where there is a robot on one side and on the other side is a human. In this case something unfortunate happens and people will probably blame the robot alone. It is therefore important to sufficiently define the nature of individual autonomous systems, the degree of their autonomy and the nature of their free will - what they are actually capable of themselves and what causes their programming. Of course, topic enlightenment of the public belongs to this aspect. It is likely that in the future, artificial intelligence will surround us more and more often and we will have to get used to it. The problem, however, is that the current trend in the robotics industry does not help this approach *(Osmani 2020, pp. 54-55)*.

A significant step in the issue of accepting the responsibility of autonomous systems took place in February 2017 on the territory of the European Union. The European Parliament, in the context of the Commission Recommendation on civil law for robotics *(2015/2103 (INL))*, called for a strong European common legal framework governing intelligent robots in response to societal trends in the development of artificial intelligence. Businesses that need clear conditions for the development of their systems could finally have some guidelines for that. So that, on the one hand, development is not that much hampered anymore, however it is also necessary to lay down rules for determining liability for damage caused by autonomous systems. In the context of liability, the document states the following: *"due to the fact that the more autonomous robots are, the less they can be considered to be simple tools in the hands of other actors (such as the manufacturer, the operator, the owner, the user, etc.); about this, in turn, questions whether the ordinary r ules on liability are sufficient or whether it calls for new principles and rules to provide clarity on the legal liability of various actors concerning responsibility for the acts and omissions of robots where the cause cannot be traced back to a specific human actor and whether the acts or omissions of robots which have caused harm could have been avoided" (The European Parliament 2017)*.

4. 4 Campaign to Stop Killer Robots organization, structure and its goals

The Campaign to Stop Killer Robots (CSKR) is a coalition of non-governmental organizations, that seeks to ban fully autonomous weapon systems, thereby maintaining meaningful human control over the use of lethal force. In October 2012, representatives of seven NGOs met in New York City to agree on the creation of this coordinated civil society. This global coalition brings together organizations from dozens of countries around the world. CSKR is working with researchers, scientists and other experts in robotics, artificial intelligence, and other military technologies to achieve a comprehensive preventive ban on weapon systems, that can select and attack targets without meaningful human intervention. The Campaign believes that human control over the use of violent force is essential to ensure the protection of civilians and to ensure compliance within international humanitarian law. According to the CSKR, all states must commit to a new international treaty, which is banning the development of lethal autonomous weapon systems. This treaty should also set out the principles of meaningful human control over the use of LAWS force. All technology companies and organizations, as well as individuals working on the development of artificial intelligence and robotics, should make a clear commitment that they will never contribute to the development of fully autonomous weapons *(The Campaign to Stop Killer Robots 2021)*.

5. The European Union 's approach to the development and regulation of autonomous weapons systems

The member states of the European Union are mostly supporters of multilateral regulations and the type of world order policy, which is in principle based on normative measures. However, these values, professed by European countries, have come under considerable pressure in recent years. In the context of this tension, it is very important for EU member states to stand firmly behind these principles more than ever. In order, to achieve an adequate solution to the problem in the context of the regulation of autonomous weapons systems, the concept of human control needs to be intensively discussed and developed. A strong political agenda and will is therefore needed. This topic is often discussed in the field of the European Commission, especially the issue of human control in the use of lethal force by AWS. However, a unified position of states is very much needed on this matter. Another important step is the discussion at the individual member states level and the operationalization of the concept of meaningful human control according to specific rules and measures. EU member states need to make clear, what levels and forms of human control are necessary to ensure compliance with legal and ethical standards in the assessment of AWS. This fact could form the basic platform for a legally binding instrument defining the necessary human control to ensure compliance with legal and ethical standards. So far, many important aspects have been put forward through European institutions. However, it is essential, that state delegations properly discuss these aspects, in order, to move the negotiations forward and to make it global *(PAX 2019, p. 24)*.

The principle that could form the basis of these dialogues is the organization of the International Committee of the Red Cross, which has been mentioned several times in this thesis. This discussion includes, for example, the obligation to impose restrictions on the use of weapons, in order, to ensure the commander's ability to comply with International humanitarian law. In a similar spirit, there is a need to ensure compliance with the IHL and to protect principles of humanity *(International Committee of the Red Cross 2019, pp. 23-24)*.

The European Union considers autonomous weapons systems to be one of the most critical issues that needs to be addressed intensively in the domain of international security. In the context of the development of AWS, the European Union presents its views based on a various number of scientists, researchers, technology companies and international organizations, which are very skeptical about the development, production, and subsequent deployment of lethal autonomous weapon systems *(European Parliament 2013, p. 33)*.

Already in 2013, the European Parliament commissioned a study on the impact of the use of drones, robots, and unmanned vehicles in general in war conflicts within the context of respect for adhering human rights. This study concluded with the outcome, that the current situation in the field of development and use of drones and robots can lead to significant divergence in the sphere of the international community and can also ultimately lead to a certain loss of balance of international security instance. The study also contained concluding recommendations for resolving the situation. In relation to drones and robots, the European Union should emphasize the rule of law as a pivotal priority of its common foreign policy. In addition, the EU should launch an intergovernmental dialogue regarding the legal standards that apply to these autonomous weapon systems, as well as on the legal and ethical constraints, that could apply to the future development of AWS. Subject to agreement at international level, adopt a binding international treaty or non-binding code that would restrict the development, proliferation and use of autonomous weapons systems by states *(Ibid., pp. 34-36)*.

In September 2018, the European Parliament adopted a resolution directly defining the concept of autonomous weapon systems. EP emphasized the importance of acceleration of the international debate and adopting common position on AWS on a European scale. European Parliament also expressed support for the adoption of a legally binding instrument to ban the development of lethal autonomous weapon systems. This resolution came up with definition of lethal autonomous weapon systems. This definition looks like this. *"Weapon* *systems do not use significant human control over essential functions, such as selecting and attacking individual targets." (European Parliament 2018, pp. 1-2)*.

Such lethal autonomous weapon systems include, for example, selectively targeted missiles or devices equipped with cognitive skills which have also the ability to learn to decide with whom, where and when to execute the strike. Excluded from this definition are remotely controlled automated systems and weapon systems specially engineered to protect their own platforms, forces, and population against highly dynamic threats. Dynamic threats include enemy missiles, ammunition, and aircrafts *(Ibid., p. 3)*.

The propensities to some regulation of autonomous weapon systems and especially artificial intelligence arose in the structures of the European Union already in the march 2012. At that time, the so called "RoboLaw" project was launched under the management of the European Commission. This project consisted of research into the impact of emerging robotic systems technologies concerning the law of European countries and what legal or ethical issues these technologies represent and bring to the matter. Probably the most important aspect of this project was the output of the *Guidelines on Regulating Robotics*. These guidelines, which were published in May 2014, set the recommendations and rules concerning the regulation of robotic technological systems in Europe *(European Commission 2014)*.

In 2015, the Committee of Legal Affairs of the European Parliament (JURI) set up a working group of experts to deal with legal issues related to regulation of robotics and artificial intelligence. The mentioned "RoboLaw" project served for this group as a starting platform, which was meant to help the group with their future conclusions. The results were published by the working group in mid-2016. A motion for a European Parliament resolution was issued, which included a sequence of recommendations for the European Commission. EP continued to work on corrections to this report and the final resolution was published in February 2017 comprising recommendations on civil law rules for robotics regulation *(European Parliament 2017)*.

For the European Union, as an international organization of almost thirty independent states, there is likely to be controversy in the way of thinking a deciding on common matters. The ongoing debate on human control within AWS is a platform for defining the normative quality of human control as it is delegated through policy or political processes. Member States and EU institutions that articulate different principles and standards, do so, in order to justify the relative weight or position of a given human control over autonomous weapon systems. However, EU member states are divided between those that support common position to regulate or even ban development of autonomous weapons and to those, who just make political statements against it. The European Parliament is leading a debate at EU level, which presents the institutional views on LAWS in conflicts of attitudes to address human control over AWS. The strategic culture or condition of the military sector does not play such an important role in the attitude of individual member states to the regulation of AWS, but rather the technological sophistication in the field of artificial intelligence and robotics *(Barbé and Badell 2020, pp. 140-141)*.

Within the European Union, the last 30 years have been mainly dominated by three regional powers. These most populous European countries are Germany, France, and the United Kingdom. After the UK formally left EU on 31 January 2020, the two Western European countries consolidated their positions even further *(BBC News 2020)*.

France and Germany often set the political direction in the field of the European Union and the issue of autonomous weapons systems is no exception. For these reasons, I have decided to give these two countries more space in the diploma thesis.

Germany and France do not share the same views in the context of the development and deployment of AWS and artificial intelligence in Europe. Germany considers these technological areas to be particularly relevant as an economic and social problem. However, France sees importance in these areas too, but the major significance perceives in the context of its geopolitical competition strategy and the use in military sector *(Franke 2019, p. 1)*.

France, as the EU member state with the strongest army, is one of the leading countries that invests heavily in technological areas such as artificial intelligence and autonomous systems. Especially during the term of current President Emanuel Macron, this area has become one of the significant priorities of military spending. The issue of autonomous weapon systems is thus very articulate in France *(Ministère de l'Europe et des Affaires étrangères 2020)*.

The Government of the French Republic stated that a clear characterization of the AWS must be the starting point for further discussions of potential regulation. The French Government further stated that it is necessary, to strive to improve the common understanding of the LAWS. France considers that lethal autonomous weapon systems are systems that do not yet really exist and so the whole debate that has been going on in recent years does not concern the automatic or tele-operative systems that are currently used by the French armed forces. According to French side, the autonomy of the AWS must be understood as full autonomy.

That means that robots are operating without any form of human supervision from the moment of activation and without any subordination of command. Such autonomous systems should be able to perform tasks in a complex environment. These systems should also be able to overcome the rules that man has defined for them. This skillset for example includes the creation of new rules that would be done without human validation *(PAX 2018, pp. 12-13)*.

According to the French representatives, the use of artificial intelligence and autonomy in weapon systems will be necessary in the future to ensure safety of military missions, to maintain power over potential opponents and to sustain France's important position vis-à-vis its allies. Cédric Villani, a French politician, mathematician, and artificial intelligence expert, claims that the growing use of AI in autonomous systems is provoking a society-wide debate in some areas, including defense and weapons development, addressing the responsibilities of AWS. President Macron believes that accountability and enforcement will always be needed. This is the point of opposing the development of AWS without human operator control and without a proper regulatory framework to be adopted at global level *(AI for Humanity 2018)*.

Compared to France, Germany is far more in favour of a more rigid approach to AWS regulation and agrees with the need for change. German political parties such which are currently in opposition, such as Die Linke and Die Grünen, call on the German government to support the ban. As part of the discussion on the LAWS development ban, Germany has created a position closely resonating with a group (Campaign to Stop Killer robots) advocating a legally binding agreement aimed at a total ban on the use of weapons systems that do not have meaningful human control in the targeting process. The German government stated in 2015 that controls on legal weapons in the manner defined by NGO Article 36 would make legislation illegal *(Barbé and Badell 2020, pp. 141-142)*.

In this spirit, Germany also spoke out at the United Nations General Assembly in 2018, declaring that they are ready to negotiate implementation of total ban on lethal autonomous weapon systems and to prepare ground for the formulation of legislation on the principle of meaningful human control over robots. However, despite these strong statements, the German government, led by Angela Merkel, is willing to cooperate with France to enforce measures that should prevent a ban or a contractual agreement that would legally bind AWS *(Delcker, Politico 2018)*.

On these facts it is proved that for Germany the issue of LAWS regulation is a problematic topic as the country has several, partly contradictory, interests in this debate. The German government states that it is prepared to reject autonomous weapon systems that completely exclude human participation in the evaluation and decision-making on the use of lethal force *(PAX 2018, pp. 14-15)*.

6. The United States' approach to the development and regulation of autonomous weapons systems

In recent decades (the 21st century in particular), the United States has been considered one of the world's leaders in technology development, artificial intelligence, and autonomous weapon systems. We can just have a look at what technology companies have their origins and headquarters in U.S. The biggest global corporations like Apple, Google, Microsoft, Amazon, or Facebook. Breakthrough period for development of autonomous technologies took place during the second term of President Barack Obama (2013-2017). In 2016, the Obama administration introduced an analysis, which was addressing the topic of artificial intelligence and autonomous systems. This analysis reflects the way in which autonomous systems and artificial can be used to support social and government operations. Mentioned analysis also introduced the importance of fostering innovation while protecting the public sphere. According to the U.S. government, it is important to ensure the fairness, security and controllability of artificial intelligence and autonomous systems and to strive for the development of a skilled workforce *(Felten and Lyons, The White House President Barack Obama 2016)*.

As the People's Republic of China grows economically, politically, and militarily, the United States must continually increase their investments in technology development to maintain their position as a global power number one. These heavy investments are a part of the Department of Defense’s “Third Offset” strategy. This strategy aims to sustain U.S. technological superiority *(Leys 2018, p. 48)*.

Recognizing that potential future conflict will be determined by technological sophistication, the administration of former U.S. President Donald Trump expressed, in April 2018, the need to share the know-how and benefits of autonomous technologies before deciding on a specific policy response. The U.S. government believes that it is too early to start negotiations on any concrete legal or policy-based instrument concerning AWS. The U.S. government further states this reality based on the necessary need to realize the lack of common understanding in various AWS issues related to the law including their characteristics and elements *(The White House 2020)*.

The US government itself admits that these technological topics are very complex issues, and therefore there is a constant need for self-education and a deepening of understanding of new technologies. The United States of America are one of the world's leading proponents of the theory that artificial intelligence, machine learning, and autonomous systems can facilitate and even improve the ability to comply with international humanitarian law. These aspects also include the principles of proportionality and differentiation. The United States also claims that the goal of developing the AWS is to reduce the risks to civilians in armed conflicts *(The Future of Life Institute 2019)*.

In 2018, the United States Department of Defense issued a security strategy report including the use of AWS. The report stated that technologies that use unmanned systems could enable the development and deployment of autonomous weapon systems. Autonomous weapon systems could independently select and attack targets within unmanned systems. However, this proposal was met with considerable displeasure by many senior military officers, who have doubts about the functioning of machine learning flawlessness in the decision-making of autonomous weapon systems. Due to this concern, the USDOD is intensively involved in artificial intelligence research. One of these projects, within the Ministry of Defense, is the work of the Defense Advanced Research Projects Agency *(Defense Advanced Research Projects Agency 2018)*.

DARPA's research is called *Explainable AI* and this research aims to create machine learning techniques that will be far more sophisticated, than has been the case so far, and will be able to manage a wide range of options while maintaining a high level of learning. The machine learning techniques include, for example, modified deep learning techniques that teach machine systems explanatory functions. Furthermore, these methods learn more structured, interpretable, causal models or model induction techniques that derive an unexplained model from any black box model. Explainable AI thus should help human operators to understand and trust all the steps taken when working with autonomous systems *(Gunning and Aha 2019, pp. 55-57)*.

Autonomous weapon systems are a crucial issue for the United States, which is reflected in the political environment. Already in November 2012, the U.S. Department of Defense stated in *directive number 3000.09* information about how important factor does represent autonomy in weapon systems for their future strategy. The directive dealt with semi-autonomous weapon systems that are on board or integrated in unmanned drones must be designed in way, so that in the event of impaired or completely lost communication, the autonomous weapon systems are unable to cause any civilian damages, that would be contrary to the decision of the human operator *(Department of Defensive Directive 2012, pp. 1-3)*.

The top chain of command of the U.S. military believes, that the USA will have the technology approximately within 10 years, which will be sufficient to develop fully autonomous weapon systems. However, they add to this prognosis, that these systems should always be under the control of the human operator during attacks on a human target, which is in direct contradiction with the essence of these systems. This resolution was confirmed by former United States Deputy Secretary of Defense (2014-2017) Robert Orton Work. Work also stated that autonomous weapons are expected to make fewer mistakes than humans do in battle, which could lead to reduced casualties or skirmishes caused by incorrect target identification *(Dastin and Dave, Reuters 2021)*.

The United States' position on the development of lethal autonomous weapon systems is such, that they seek to prevent any attempts to stigmatize or ban emerging technologies. The United States argue that individual states should promote innovations that are consistent with the aims and purposes of the Convention on Certain Conventional Weapons. It is in the light of these objectives that the development of autonomous weapon systems should not be restricted by international platforms such as the Group of Governmental Experts. The United States justifies their support for the unrestricted development of the AWS by stating that they seek to fully protect civilians from unnecessary loss of life and needless suffering, which is the one of the main principles of international humanitarian law *(Mitchell 2020, p. 425)*.

The United States have even called on the GGE to discuss the benefits of autonomous weapons. As an advantage of AWS they stated, for example, the capacity for higher targeting accuracy and less collateral damage was also mentioned *(Evans and Salmanowitz, Lawfare 2019)*.

The United States are the world leaders of an informal coalition against the regulation of autonomous weapons systems. In addition to the Russian Federation and the People's Republic of China, which I both mentioned several times in my diploma thesis, other major military powers, such as the United Kingdom and Israel, are also joining the group. The opposition of these key states to regulation of AWS is one of the main reasons for the GGE's failure to reach a consensus on a binding legal instrument and finding a common definition of LAWS *(The Council on Foreign Relations 2019)*.

Conclusion

In today's world, states are found in the central moment regarding emergence of the autonomy in weapon systems. This autonomy is being pushed mainly by the military powers, which are disposing advanced technologies that propose the development of AWS as a technological solution to the problems caused by the increasing momentum of war conflicts. However, several experts and especially international organizations such as Campaign to Stop Killer Robots, Human Rights Watch, Future of Life Institute and The International Committee of the Red Cross do not agree with this advent of killer robots. These organizations and civil societies demand an interruption in the development of such robots, which have full autonomy and at the same time can hit their target with lethal force. Based on these facts, it is argued that these emerging weapon systems pose a major threat to international norms, ethical and moral and legal frameworks governing warfare and the use of lethal force.

There are three key aspects to which we can look at the issue of autonomous weapon systems. They are the ethical, legal, and technological elements.

From a moral-ethical point of view, the primary principle of which is the respect for human dignity enshrined in international humanitarian law, it foreshadows that robots should not be responsible for human life and death. Regarding the issue of legality and law, current indications suggest that the implementation of AWS in war conflicts is in breach of international humanitarian law by presenting problematic aspects related to the issue of liability and responsibility in the use of lethal force. From a technological point of view, autonomous weapon systems still lack the indispensable properties and components that are an integral part of ensuring compliance with the requirements for discrimination and proportionality of international humanitarian law. The behavior of fully autonomous weapon systems is thus inherently unpredictable, especially if we are talking about a potential scenario where there are more such robots interacting with each other’s.

Artificial intelligence and machine learning form undoubtedly crucial aspects of progressive autonomy in robotic systems. These two elements are increasingly penetrating military affairs and are already partially displacing the human factor not only from the role of the operator on the battlefield, but also from the possibility to directly participate in programming the behavior of individual robots. Thanks to the presence of machine and deep learning, robots can operate with substantial amounts of data and thus learn independently on humans. Deep learning is even based on artificial neural networks, modeled on the function of human brain. This element thus represents a milestone in machine knowledge for robotic systems. Thanks to these facts, autonomous weapon systems represent a revolution in conflict management. AWS can evaluate situations faster than people, they have basically unlimited endurance, they do not know fear, they are not subject to stress, in short, it can be said that robots are better than people in all respects. A similar argument is made by US military officials, who say that the use of AWS will result in a dramatic reduction in casualties as well as a reduction in overall conflicts.

The use of artificial intelligence in weapon systems will thus mean a certain revolution in warfare, just as the deployment of nuclear weapons did 75 years ago. States, that have these weapons at their disposal could therefore gain a significant advantage in terms of geopolitical and power influence, which could mean disrupting peace processes on a global scale. Another potential threat in connection to AWS is scenario where these weapons fall into the hands of terrorist organizations or other aggressors that would use these robots purely to harm innocent people. It is therefore not only for these reasons that it is very important to establish a regulatory framework, and associated control authorities, that would clearly define the extent to which autonomy AWS could function and what features or technological equipment they can have.

In the context of the deployment of autonomous weapon systems, it is important to define the scope and possible areas, as well as the actions, where these weapon systems would be an advantage and at the same time would not pose a potential threat. Furthermore, it is necessary to define and implement the extent to which a human factor will directly participate in the function and decision-making process of robotic systems. In this way, it would be the safest process possible. Regulatory measures can take many forms. For example, certain limitations can be identified in terms of their competencies or in what areas and situations they can be deployed. As I mentioned already once, the creation of a regulatory framework is an indispensable aspect in the future direction of AWS.

However, as we can currently observe no such regulatory framework, that would determine who is responsible for the individual actions of AWS, exists today. For this reason, it is fundamental to define who decides on attacks by autonomous weapon systems. Here we again encounter the issue of legitimization of autonomous robots. One of the main problems is the that AWS are not able to follow the views of the international legal framework at the same level as people do, or at least most of them. However, the military powers to which this regulation would significantly disrupt their technological development processes, in which they have invested huge resources, contribute greatly to this absence of regulation.

The basic premise of the development of AWS, that will be followed by their deployment, is that the benefits of autonomous weapons must outweigh their possible shortcomings. Another critical aspect of AWS is constant human supervision. It is very important that this element is never abandoned. These facts are agreed by artificial intelligence experts, as well as international platforms fighting to ban fully autonomous robots. AWS should primarily serve as an additional aid that will save lives and not take them per se. In the previous paragraph, I highlighted the benefits of robots to humans, but the cognitive abilities of AWS associated with reasoning and deduction based on context are still unrealistic scenario for now, and it is this lack of consciousness that can play an important role in conflict management.

The topic of autonomous weapon systems and artificial intelligence will certainly resonate very much in the upcoming years in the context of a society-wide debates. AWS is a topic that touches on many areas. Whether it is primarily concerning technological progress or a security issues at the global scale, however, it is also an ethical question of where, as humanity, we want to wend in the future. The issue of killer robots and their potential regulation will probably be with us for decades to come. Given the importance of the topic, it will be essential to talk about it as much as possible, not just at expert level but also on political or societal tiers.

Summary

The topics of autonomous weapon systems, and especially artificial intelligence, are nothing brand new, yet they are the technologies that are still in their infancy. Currently, the development of fully autonomous AWS is a topic that does not resonate so much in public space. Rather, only expert organizations and individual states, which see their future in technological autonomy, are dedicated to it. The strongest issue associated with autonomous weapons is thus probably their potential regulation. As the master thesis shows, although regulation has been discussed on international platforms for several years, a binding regulatory framework has still not been established and is still out of sight. The primary reason for the absence of regulatory measures is that the military and geopolitical powers are heavily involved in the development and eventual deployment of the AWS, and for these reasons partially block any indications that should be directed towards potential regulation.

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