Advisory Council on International Affairs

Advisory Committee on Public International Law

Autonomous weapon systems:

The importance of regulation and investment

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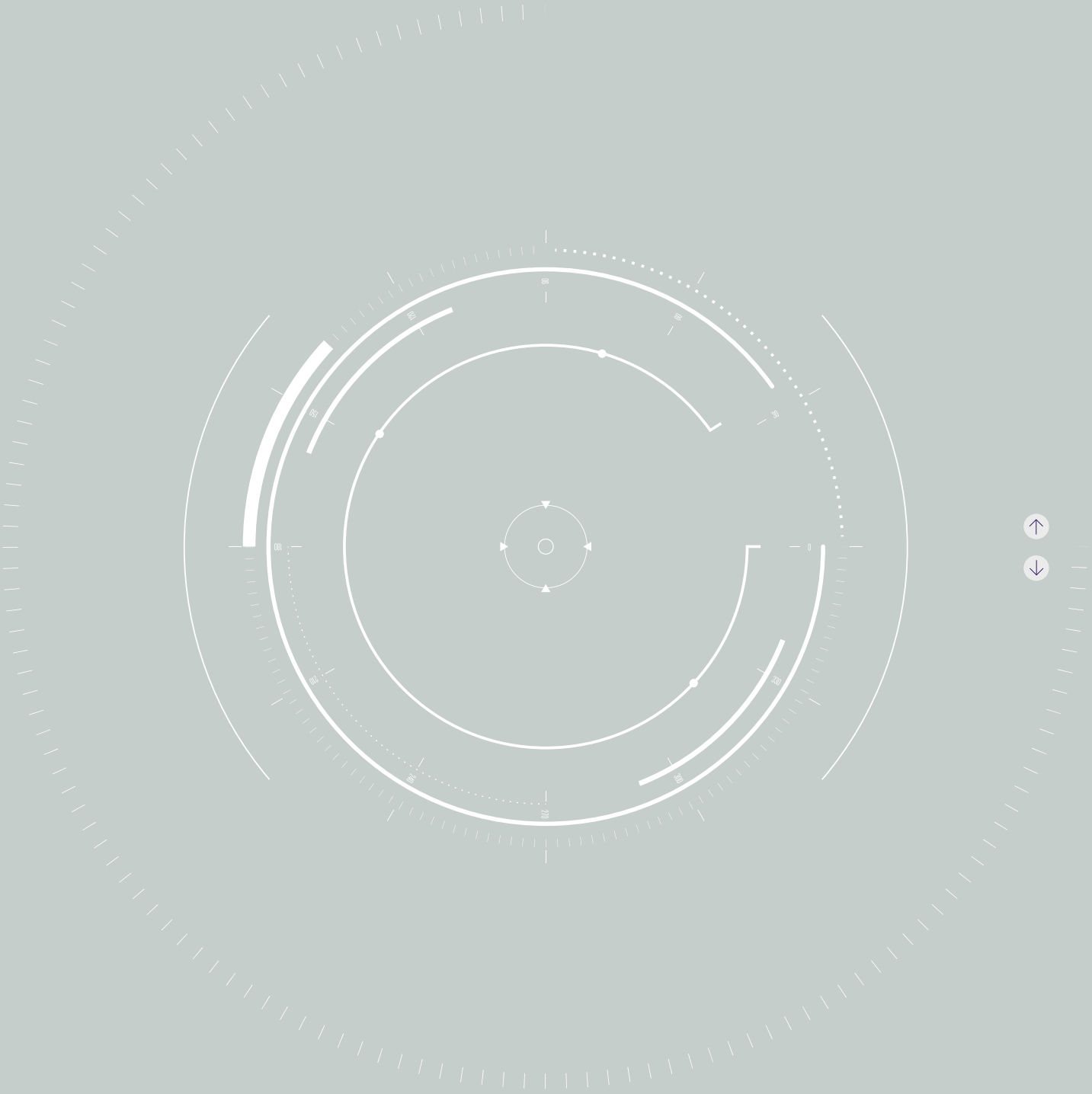

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Summary

The Dutch government asked the Advisory Council on International Affairs (AIV) and the Advisory Committee on Issues of Public International Law (CAVV) to draw up an advisory report on the development and use of autonomous weapon systems. The government thus requested an update of the 2015 advisory report *Autonomous Weapon Systems: The Need for Meaningful Human Control*, partly with a view to the five-yearly Review Conference of the United Nations Convention on Certain Conventional Weapons (CCW), to be held in late 2021.

Since 2015, the development and use of autonomous weapon systems have increased significantly internationally. The United States, China and Russia, as well as countries such as Israel, Turkey and South Korea, are working on the development of autonomous weapon systems and investing in technologies that include artificial intelligence and robotics, which are important for autonomous systems. Recent changes in geopolitical relations reduce the likelihood of an international consensus on the development and use of autonomous weapon systems. Meanwhile in the current political and social debate and in legal and ethical reflections, concerns are increasingly being raised over the use of autonomous weapon systems, and in particular the lack of clear regulation.

In this new advisory report the AIV and the CAVV discuss the developments in technologies such as artificial intelligence, robotics and quantum technology and the development and use of autonomous weapon systems in the geopolitical context. They also look at the current political and social debate and the legal and ethical considerations. Specific attention is paid to the concerns over the use of autonomous weapon systems, addressing both the advantages and disadvantages of such use. The AIV and the CAVV thereby answer the government's questions, as set out in the request for advice (see the annexe).

In this advisory report the AIV and the CAVV make a distinction between on the one hand *semi-autonomous* weapon systems that still involve a certain degree of human control, and on the other fully autonomous weapon systems where such control is absent. *Fully* autonomous weapon systems are weapon systems with autonomous functions for the selection and engagement of specific targets, without human involvement.

In this report the AIV and the CAVV take a two-track approach. On the one hand they consistently point to the problematic and high-risk aspects of the development and use of autonomous weapon systems. The alarming technological and geopolitical developments which have caused a rapid increase in the military deployment of semi-autonomous weapon systems over the past six years are compelling governments to consider further regulation of semi-autonomous weapon systems. On the other hand, the AIV and the CAVV see these developments as a cause – for reasons of security and the need for effectively equipped armed forces – to invest in the development, procurement and use of semi-autonomous weapon systems, provided they are regulated.

This advisory report differs on a number of important points from the 2015 report. The most important difference is the emphatic call on the government to speak out in favour of a ban on *fully* autonomous weapon systems. The AIV and the CAVV note that since their previous advisory report on autonomous weapon systems was published in 2015 there has been a significant expansion of activities and investments. Many state and non-state actors are working on the development of artificial intelligence-based weapon systems. The Netherlands should pay continuous attention to these developments in the political, diplomatic, technical and financial fields. To this end, it is necessary for the Netherlands to explicitly speak out in favour of a ban on fully autonomous weapon systems and for the regulation of semi-autonomous weapon systems.

As in their 2015 advisory report, the AIV and the CAVV continue to believe that human control is essential for compliance with the core rules of international humanitarian law regarding the principles of distinction, proportionality and taking precautionary measures. These rules still apply in full to the use of autonomous weapon systems. Fully autonomous weapon systems that self-learn rules and select and engage targets without any human involvement or without the possibility of human intervention (and thus without meaningful human control) cannot therefore be used in accordance with existing international law.

Unlike fully autonomous weapon systems, the use of *semi-autonomous weapon* systems could be lawful, provided they are under meaningful human control. The AIV and the CAVV conclude that further regulation is required for the development, procurement and use of semi-autonomous weapon systems. The AIV and the CAVV have a number of proposals for concretising how meaningful human control should take shape at the various stages of the decision-making process. This is a key difference compared to the recommendations set out in the 2015 advisory report.

In the case of meaningful human control there must in essence be sufficient and effective control by individuals who decide on the use of a semi-autonomous weapon. It is important in this respect that they have a minimum cognitive understanding of the information that needs to be processed and the context in which the weapon is to be deployed. In principle this will enable these individuals to make an informed decision on the lawful use of the weapon, in accordance with the criteria regarding distinction, proportionality and precautionary measures.

The AIV and the CAVV recommend situating the concept of meaningful human control within the different stages of the decision-making process – from design and procurement up to and including actual deployment. Besides the importance of meaningful human control in assessing the international humanitarian law criteria, it is also necessary for those who hold political office and positions of responsibility to be able to indicate how diligent and informed decision-making can take place with respect to the development, procurement and use of semi-autonomous weapon systems. To ensure this, ethical frameworks must be embedded within national and international organisations.

When it comes to exercising control over the deployment of autonomous weapon systems it is important to distinguish between *making* a decision and *implementing* that decision. Central to this is 'human-machine interaction'; the basic assumption here is that humans understand and can respond to the information concerning the context for deployment and the capabilities and limitations of the machine. In order to develop semi-autonomous weapon systems that involve intensive interaction between human and machine, concepts such as machine ethics and transfer of control need to be taken into consideration.

Safeguarding ethical concepts is essential now that new technologies such as artificial intelligence are increasingly going to influence the nature of warfare. Key geopolitical players and technologically advanced armed forces are investing heavily in the development of new technologies and in the development of semi-autonomous weapon systems. This compels the Netherlands to consider its own position. In order to ensure effectively equipped armed forces and from a security point of view, it is necessary for the Netherlands to have semi-autonomous weapon systems at its disposal. The Netherlands should therefore actively participate in international innovation programmes where advanced technological knowledge and experience can be exchanged. At the same time, the Netherlands should also consider international regulation and standardisation. Within the EU and NATO the Netherlands should seek consensus on the ethical and legal frameworks. Within the UN too, and specifically the CCW, the Netherlands should aim for further regulation.

When developing and deploying semi-autonomous weapon systems it is crucial to make clear where the responsibility lies in the event of unlawful use. Under general international law states can be held responsible for the unlawful actions of autonomous weapon systems that they use, for example when these systems open fire on civilians. Under international criminal law individuals can also be held responsible if they have played a role in the use and development of a semi-autonomous weapon system at any point during its entire life cycle, in particular developers, commanders and operators.

Due to the relatively high-risk nature of the use of semi-autonomous weapon systems in conflict situations, applying the principle of strict state responsibility, where responsibility is based solely on the damage caused, could be considered, particularly in the case of technical failures. In this regard it is irrelevant whether the state was negligent or is in any way culpable; even if the state has met its due diligence obligations it can still be responsible in a strict responsibility regime. States need to make agreements in this respect.

Given the potential for abuse by certain states and non-state actors, the speed of technological developments and the fact that private companies will be playing an increasingly important role in standardisation, the AIV and the CAVV deem further regulation necessary for semi-autonomous weapon systems. This regulation should go beyond the 11 'Guiding Principles' agreed within the UN CCW. It concerns regulation with respect to the development, procurement and use of semi-autonomous weapon systems and the responsibilities held by the actors at the various stages.

The AIV and the CAVV emphasise that there are various options for arriving at further regulation for semi-autonomous weapon systems. This does not involve developing new legal rules but rather primarily making existing legal rules more specific. Fully autonomous weapon systems cannot be deployed under international humanitarian law because they cannot independently apply the principles of international humanitarian law. The AIV and the CAVV advise the government to make explicit the prohibition on fully autonomous weapon systems arising from existing international humanitarian law.


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Recommendations

summary

The AIV and the CAVV would point out to the Dutch government that the subject of autonomous weapon systems has become very urgent in recent years. The government needs to recognise the importance of this subject and the potentially high risks involved in the development and use of autonomous weapon systems and do all in its power to give this subject a permanent place on the agenda. The AIV and the CAVV take a two-track approach in this advisory report with the aim of placing an emphasis on both regulation and investment. They recommend the following to the government:

▸ Recommendation 1

Pay more attention to developments in autonomous weapon systems.
The AIV and the CAVV note that since their previous advisory report was published in 2015 there has been a significant expansion of activities and investments in this field by state and non-state actors. It is crucial that the Netherlands pays continuous and intensive attention in political, diplomatic, technical and financial terms to these developments and pursues further regulation.

▸ Recommendation 2

Actively pursue a ban on fully autonomous weapon systems.
Fully autonomous weapon systems are unable to independently apply the core rules of international humanitarian law. Therefore they cannot be lawfully deployed. The AIV and the CAVV advise the government to actively pursue the explicit laying down in legislation of the prohibition on fully autonomous weapon systems arising from existing international humanitarian law. This can be achieved by drawing up an Additional Protocol to the United Nations Convention on Certain Conventional Weapons in which it is explicitly codified that development and use of fully autonomous weapon systems is prohibited.

▸ Recommendation 3

Take a more active role in the development of international regulation for the development, procurement and deployment of *semi-autonomous* weapon systems.
The AIV and the CAVV consider it essential that more clarity be created with respect to the meaning and scope of the criteria applied to development, procurement and use. The current Guiding Principles developed within the CCW and the UN are not concrete enough for this purpose. The AIV and the CAVV advise the government to explore the possibility of further regulation, including further regulation in an Additional Protocol to the CCW. At international and national level, consultations on this matter between government, businesses, civil society organisations and research institutes need to be intensified. The Netherlands' position should be prepared in a broad-based and open manner. To this end, structured consultations should be set up between government, businesses, civil society organisations and research institutes. Limiting development to semi-autonomous weapon systems must be central to this effort.

▸ Recommendation 4

4. Call on states to implement or include in their national legislation the obligation to perform weapon reviews arising from article 36 of Additional Protocol I to the Geneva Conventions.
The obligation to publish these weapon reviews can also be included in additional legislation. The AIV and the CAVV advise the government to make a serious effort to strengthen the role of the Advisory Committee on International Law and the Use of Conventional Weapons and to give it a coordinating role in consultations between central government and businesses and scientific institutions.

▸ Recommendation 5

5. Continue to adhere to the concept of meaningful human control (MHC) as a basis for the regulation of *semi-autonomous* weapon systems.

As in 2015, the AIV and the CAVV still firmly believe that humans must always retain ultimate responsibility for the deployment of a weapon system. A distinction exists between *fully* autonomous and *semi-autonomous* weapon systems. In the case of fully autonomous weapon systems human control is absent; in the case of semi-autonomous weapon systems such control is a possibility. This provides the basis for the regulation of semi-autonomous weapon systems. The AIV and the CAVV have a number of proposals on how this meaningful human control can be assigned and further defined.

▸ Recommendation 6

Work with EU partners, the United States, the United Kingdom and other NATO Allies to achieve joint development and production of semi-autonomous weapon systems (in which meaningful human control is effectively assigned), export control and investment screening for dual-use technologies.

The AIV and the CAVV firmly believe that new technologies are of great importance to the organisation and functioning of modern armed forces. This includes the development of semi-autonomous weapon systems, which are crucial to the support and effectiveness of the armed forces. Furthermore, within the EU and NATO the Netherlands should pursue the establishment of platforms where government, knowledge institutions and businesses can together explore the industrial, legal and ethical aspects of autonomous weapon systems.

▸ Recommendation 7

Encourage NATO Allies to jointly play a key role in pursuing interoperability and standardisation in the field of disruptive technology and semi-autonomous weapon systems.

This is an essential precondition for effective joint action. The Netherlands should take on a leading role in this respect.

▸ Recommendation 8

Make the concept of explainable artificial intelligence the basis for Dutch policy when it comes to the development, procurement and use of semi-autonomous weapon systems.

The technologies applied must be explainable at all times. Responsible use requires clarity on where in the chain the decision-making and meaningful human control take place and what responsibilities this entails. The Dutch armed forces must be trained in effective human-machine interaction and on how to use this artificial intelligence.

▸ Recommendation 9

Make agreements with businesses and scientific institutions on the development and procurement of semi-autonomous weapon systems.

At the procurement stage developers' efforts to achieve effective human-machine interaction, to reduce automation bias, and to define ethical conditions in the system should be assessed, and thus included in the development phase and in contracts for such development.

▸ Recommendation 10

Have this advisory report updated.

Lastly, the AIV and the CAVV advise the government to request an update of this advisory report in good time given the pace of technological, military, geopolitical and legal developments. In doing so, the government should evaluate whether the commitment to further international regulation is being achieved and implemented in practice.

Chapter 1

Autonomous weapon systems: terminology and definitions

1.1 Introduction

On 30 June 2020, the government asked the AIV and the CAVV to publish an advisory report on the development and deployment of autonomous weapon systems.[1] In its request for advice, it asks for advice on the latest state of affairs with regard to international developments, relevant concepts and agreements made.[2] The government seeks further guidance on military strategic considerations and potential arms control initiatives. In addition, it wishes to gain insight into the degree of government control over technology and a clear understanding of the risks of the use of autonomous weapon systems by terrorist groups.

The government's request for advice contains nine questions, intended to serve as a starting point for the AIV and the CAVV (see the annexe to this advisory report). In practice, it was decided to focus on a number of cross-cutting issues raised by these questions. These issues determine the report's structure. The report offers recommendations that the government can use to determine its position in the run-up to the five-yearly UN CCW review conference, to be held in Geneva at the end of 2021.

This report comes at an important time. Political and public debates on the deployment of autonomous weapon systems are taking place with increasing frequency. A dilemma appears to be emerging. For example, a lot of attention is rightly devoted to the problematic aspects of deploying autonomous weapon systems. One of the main risks of deploying such systems, for example, is thought to be that they could lower the threshold for warfare. Scientists and non-governmental organisations regularly express such concerns. Stories about soldiers carrying out drone attacks from shipping containers located somewhere in the desert in the US, taking out opponents at the touch of a button as if they were 'ordering a pizza', alternate with reports about drone operators experiencing psychological problems as a result of such 'anonymous' remote warfare.[3] Stories like these fuel scepticism about the use of autonomous weapon systems.

However, attention is also being devoted to the other side of the coin. Countries face new threats that are almost impossible to counter without the use of autonomous systems. An incoming hypersonic missile, for example, is too fast for humans to anticipate in time; their reaction speed is simply too slow. Systems that can be controlled remotely – or that are even autonomous – can minimise the risk of military and civilian casualties.

Against the background of this dilemma, which will be discussed below in detail, the AIV and the CAVV follow a two-track approach in this report. On the one hand, they consistently point to the problematic and dangerous aspects of the development and use of autonomous weapon systems. On the other hand, they also devote attention to international cooperation on investment and the need to develop semi-autonomous weapon systems, provided they are better regulated.

The present advisory report differs on a number of important points from the 2015 report. The most important difference is the emphatic call on the government to speak out in favour of a ban on fully autonomous weapon systems. The AIV and the CAVV note that there has been a significant expansion of activity and investment since the publication of their previous advisory report on autonomous weapon systems in 2015. Around the world, many state and non-state actors are working on the development of weapon systems controlled by artificial intelligence. It is therefore very important that the Netherlands pay constant and rigorous attention to these developments in the political, diplomatic, technical and financial fields. To this end, the Netherlands must explicitly speak out in favour of a ban on fully autonomous weapon systems.

From a legal perspective, the rules arising from international humanitarian law have not changed since 2015, and on their basis the development and use of fully autonomous weapon systems remains incompatible with international humanitarian law. The situation is different for *semi-autonomous* weapon systems because a certain degree of meaningful human control can be ensured there. As regards the development and use of semi-autonomous weapon systems, the AIV and the CAVV are urging further regulation. In this report, the AIV and the CAVV pay specific attention to the way in which existing international humanitarian law can be operationalised with regard to the development and use of semi-autonomous weapon systems in order to effectively embed meaningful human control. More than in 2015, the AIV and the CAVV also call attention to the importance of ethical frameworks within the organisations that have to make the decisions.

The present report also differs from the 2015 report in terms of the terminology it employs. The AIV and the CAVV no longer use the terms 'in the loop', 'on the loop' and 'beyond the loop' to indicate how meaningful human control should be incorporated into the use of semi-autonomous weapon systems. These terms have not proved helpful in the context of international efforts to obtain more clarity concerning conceptual frameworks and regulation. Unlike in 2015, the AIV and the CAVV also approach the concept of 'autonomy' from a wider perspective, based on an expanded 'autonomy scale'. Other definitions employed in the 2015 report are left intact.

The report is structured as follows. This first chapter discusses the relevant terminology and definitions. The second chapter deals with the political and public debate on autonomous weapon systems. The third chapter describes recent technological developments. The fourth chapter discusses the geopolitical context and the advent of the international use of autonomous weapon systems. The fifth chapter discusses legal and ethical considerations. The sixth chapter presents the synopsis, findings and detailed recommendations of the report.

1.2 Autonomous weapon systems: definitions

The international debate on autonomous weapon systems has the characteristics of a semantic Gordian knot. The wide variety of definitions used produces a confusing picture of what is understood by the term autonomous weapon systems.

The 2015 advisory report *Autonomous Weapon Systems: The Need for Meaningful Human Control* employed the following definition of an autonomous weapon system: 'A weapon system that, without human intervention, selects and engages targets matching certain predefined criteria, following a human decision to deploy the weapon on the understanding that an attack, once launched, cannot be stopped by human intervention.'[4] The AIV and the CAVV continue to use this definition.

In this new advisory report, the AIV and the CAVV note that autonomous weapon systems can be used for both lethal and non-lethal purposes. In line with the request for advice, the report focuses exclusively on lethal autonomous weapon systems. However, the AIV and the CAVV emphasise

that there is a distinction between *fully autonomous* weapon systems and *semi-autonomous* weapon systems. A fully autonomous system that is deployed for lethal purposes is referred to internationally as a lethal autonomous weapon system (LAWS).

International humanitarian law prescribes that the principles of distinction, proportionality and precaution must always be respected when deploying weapons. In 2015, the AIV and the CAVV noted that fully autonomous weapon systems cannot independently apply international humanitarian law. Because the deployment of fully autonomous weapon systems does not involve human control – and thus no assessment against the principles of distinction, proportionality and precaution – the AIV and the CAVV are opposed to their deployment. Fully autonomous weapon systems are incompatible with international humanitarian law and are therefore unacceptable. The AIV and the CAVV maintain this position in their new advisory report.

In the present report, the AIV and the CAVV go a step further than in their 2015 report, recommending that the Netherlands more actively promote the prohibition arising from existing international humanitarian law and that it pursue an explicit ban on fully autonomous weapon systems. The AIV and the CAVV set out their arguments in this regard in Chapter 5 of this report.

The development and deployment of autonomous weapon systems must always involve some form of meaningful human control. The AIV and the CAVV therefore focus not so much on fully autonomous weapon systems (systems without meaningful human control) but rather on semi-autonomous weapon systems. The main question in this regard is how a system can autonomously perform certain tasks and actions and at the same time still be under human control. The key issue is to clearly define what shape meaningful human control should take in the deployment of semi-autonomous weapon systems. The AIV and the CAVV start from the premise that humans must always retain ultimate responsibility for decision-making. The question is how such human control can be guaranteed.[5] The concept of meaningful human control (MHC) remains the key principle in this regard.

1.3 Semi-autonomous weapon systems

In order to clarify what they mean by semi-autonomous weapon systems in this report, the AIV and the CAVV refer to the concept of partially autonomous lethal weapon systems (PALWS), as defined in a report by the Ethics Committee of the French Ministry of Defence.[6] According to this report, PALWS can be defined as a category existing between automatic weapon systems (which perform simple predetermined repetitive tasks) and fully autonomous weapon systems (which are entirely self-guided and self-learning). On the one hand, PALWS are not automatic weapon systems, because they include a certain amount of autonomy that enables them to determine, on the basis of the preprogrammed criteria, whether deployment is appropriate. On the other hand, PALWS are not LAWS, because they cannot independently change their preprogrammed deployment criteria (e.g. when environmental factors might give them reason to do so) and they cannot initiate the use of lethal force without human intervention.

Examples of PALWS include systems such as the Israeli Harpy (munition that independently detects targets) but also the Turkish STM Kargu-2 (a self-navigating drone with rotating wings) and the American Collaborative Small Diameter Bombs (CSDB) (which independently detect targets), as well as the unmanned Sea Hunter warship. These *semi-autonomous* weapon systems are characterised by the extensive 'integration of automation and software'. They also contain technical safeguards that are designed to prevent misuse and failure as much as possible.

Source: Jean-Baptiste Jeangène Vilmer, 'A French Opinion on the Ethics of Autonomous Weapons', *War on the Rocks*, 2 June 2021.

The AIV and the CAVV note that many new autonomous weapon systems deployed today are in fact semi-autonomous systems that can be classified as PALWS: weapon systems that incorporate a high degree of autonomy while simultaneously operating under a form of meaningful human control. The MQ-9 Reaper, an unmanned aerial vehicle (a large drone), is an example of this. In the academic, political and public discourse, this system is regularly (and incorrectly) classified as a *fully autonomous* weapon system, or 'killer robot'.[7] From a technical viewpoint, however, it is a *semi-autonomous* system: it is remotely controlled, meaning that humans retain control over its operation and are able to make adjustments at any time. As a result, there is clearly a high degree of meaningful human control.

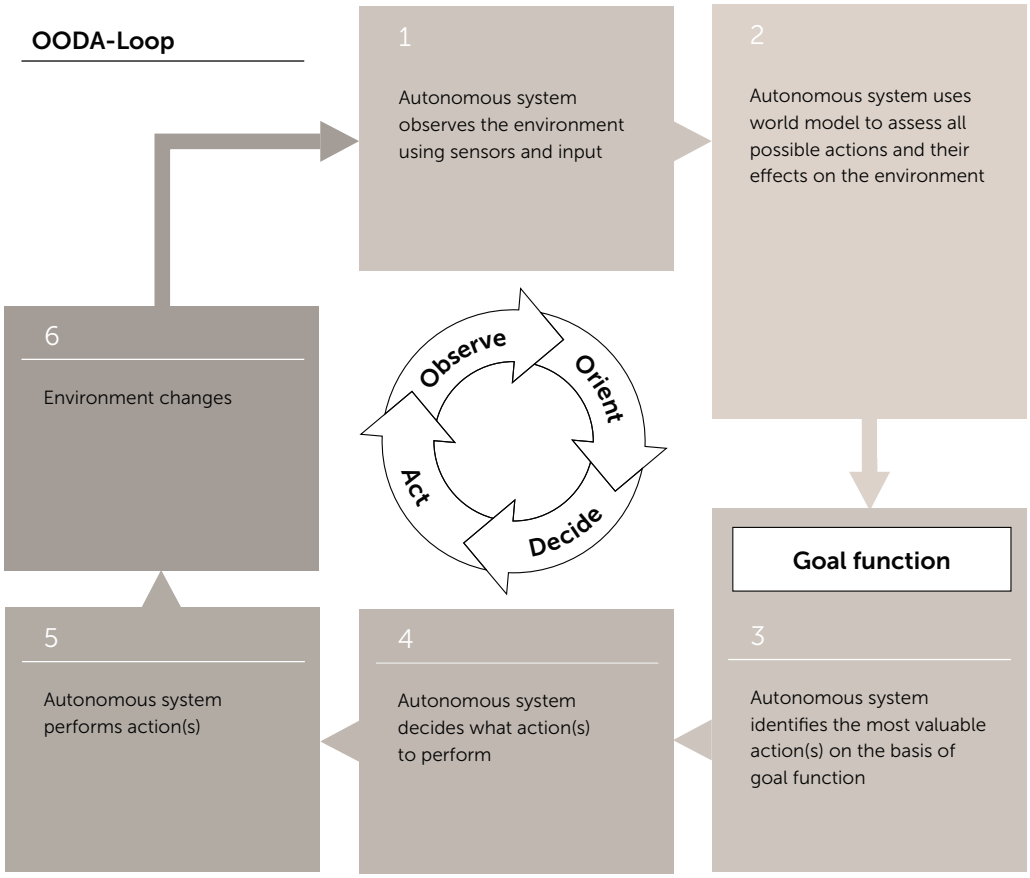
1.4 The autonomy scale

In this report, the AIV and the CAVV examine not only the degree of autonomy of weapon systems but also the effects and implications of autonomous systems. In this, they follow a recent report by the International Committee of the Red Cross (ICRC) which argues that the more autonomous a system is, the more unpredictable the effects of its use are. According to the ICRC, autonomous systems designed in such a manner that their effects cannot be sufficiently 'understood, predicted and explained' should be banned, as there is in sufficient clarity as to whether they are able to comply with the principles of international humanitarian law.[8]

The extent to which a system can act autonomously depends on its degree of intelligence. An autonomous system does not have to be inherently smart (or intelligent). The distinction between more and less intelligent systems lies in the difference between behaviour (movements) and cognition. Some robots are good at movement and physical behaviour but are not necessarily truly intelligent: they simply carry out built-in commands.[9] Although many robots can act autonomously, they are not yet capable of displaying social awareness or empathy. They lack the cognition to interact independently with their environment. When robotics and computational thinking are combined, the result is an autonomous system (an intelligent robot). Such a system encompasses both cognition and the ability to act upon it.

In order to understand how an autonomous system functions, it is useful to consider exactly what happens before a system takes action. An autonomous system operates within a continuous OODA loop (Observe–Orient–Decide–Act).[10] It examines its actual task and relates this to new input from the environment. The system observes the environment with its sensors and sometimes also receives input through other channels. If necessary, it adjusts its picture of the environment accordingly. On the basis of this picture of the environment, the autonomous system assesses what actions are possible and what effect they will have. It then determines which one of a series of predefined actions will be the most effective. The system then makes a decision and performs the action. This creates a new context, and the system restarts the loop.

Figure 1 - A fully autonomous system going through an OODA loop. Source: TNO.[11]



No matter how much new input the environment provides – and how much the system thus learns from its environment – in the end it is always the software that determines whether the system can carry out the task. As soon as it cannot execute the task, the system freezes or does something unintended. It is also true that the greater the system's self-learning capacity, the more independently it can act.

Technological developments are changing ideas about autonomy.[12] In order to understand how meaningful human control can be guaranteed, a broader definition of 'autonomy' is needed. That is why the AIV and the CAVV focus on a model developed by Noel Sharkey, as further elaborated by Daniele Amoroso and Guglielmo Tamburrini.[13] This model differentiates between five levels of autonomy in a weapon system, depending on the operational context. The AIV and the CAVV consider this model of added value both for professional discussions and for public debate on the issue of autonomous weapon systems.

Five levels of autonomy according to Sharkey, Amoroso and Tamburrini:

I. A human engages with and selects targets and initiates any attack.
II. A weapon system suggests alternative targets, and a human chooses which to attack.
III. A weapon system selects targets, and a human must approve these targets before the attack.
IV. A weapon system selects and engages targets but is supervised by a human who retains the power to override its choices and abort the attack.
V. A weapon system selects targets and initiates attack on the basis of the mission goals as defined at the planning/activation stage, without further human involvement.

Source: Amoroso and Tamburrini (2020).

The strength of this model lies in its broad range. In practice, the scale encompasses all forms of autonomy currently conceivable in connection with the development and deployment of autonomous weapon systems. The fifth level of the scale describes a situation in which there is no longer any human control (fully autonomous weapon systems). Due to the lack of meaningful human control, such weapon systems are incompatible with international humanitarian law. In contrast, the other levels describe various forms of partial autonomy in which a certain form of meaningful human control is retained.

In Chapter 5, the AIV and the CAVV discuss in detail how meaningful human control takes shape in the context of the different levels of autonomy and in the various stages of decision-making.

Chapter 2

Political urgency and public debate

summary

In recent years, doubts regarding the desirability of developing and using autonomous weapon systems are expressed with increasingly frequency in the political and public debate. At the same time, governments appear to want to make increasing use of technologically advanced, unmanned and autonomous weapon systems. This chapter discusses the current political and public debate on this issue and presents the advantages and disadvantages of deploying *semi-autonomous* weapon systems.

2.1 Autonomous weapon systems and the Dutch parliament

The Dutch parliament has expressed concern regarding the development and use of autonomous weapon systems on a number of occasions. In 2019, in a successful motion submitted by then MP Sven Koopmans (People's Party for Freedom and Democracy; VVD), it called on the government to push, together with a number of like-minded countries, 'for the adoption of a treaty or other binding international instrument that is as widely supported and far-reaching as possible to control the production, stationing, proliferation and use of new potential weapons of mass destruction'.[14] The motion explicitly condemned the development and deployment of autonomous weapon systems, implying that they could potentially develop into weapons of mass destruction. However, the motion did not clearly differentiate between *fully autonomous* and *semi-autonomous* weapon systems. In the absence of this distinction, it remains unclear to what type of autonomous weapons the motion was referring.

In May 2021, MP Salima Belhaj (Democrats '66; D66) published a private member's policy proposal for a ban on autonomous weapon systems.[15] The proposal called for the adoption of an international treaty to regulate the use of autonomous weapon systems. This can be achieved by ensuring meaningful human control, but also by banning fully autonomous weapon systems ('killer robots'). Belhaj argued that the Dutch government should no longer invest in the development of technology that enables the creation of fully autonomous weapon systems. She also called on the government to explicitly define the exact division of tasks between humans and machines within autonomous systems (in the case of human-machine collaboration). In her proposal, Belhaj did not clearly differentiate between fully autonomous and semi-autonomous weapon systems.

Despite the terminological ambiguity they provoke, initiatives from the House of Representatives such as those of Koopmans and Belhaj address an important underlying problem: the lack of explicit rules for the use of autonomous weapon systems. Non-governmental organisations such as the ICRC and Pax for Peace have also warned the Dutch government about this, pointing to the dangers of lethal autonomous weapon systems in which humans are no longer in control and the system can independently make life-or-death decisions. Pax for Peace points out, for example, that the overly generic rules of contemporary international humanitarian law offer little in the way of frameworks for the regulation of new weapon systems. [16]

The Dutch government acknowledges that to date it has not been possible to reach an international consensus on the concept of meaningful human control.[17] The government has indicated that it

wants to push for the establishment of international normative frameworks and believes that it is vital to conclude international agreements on the development of artificial intelligence in the military domain, especially regarding the use of drones and in the field of cyber operations or information warfare. To date, these efforts have been unsuccessful.

International consultations on this issue show that countries have different views on banning fully autonomous weapon systems. That is one of the reasons why the talks within the UN CCW have progressed so slowly since 2013. Compromise is almost impossible at conceptual level: governments seem to approach the phenomenon of human control from completely different paradigms. Some countries consider the concept of meaningful human control from an ethical perspective, others approach it primarily from a legal angle, while still others adhere exclusively to a military-operational approach.[18]

2.2 Advantages and disadvantages of autonomous weapons

Why do countries choose to use autonomous weapon systems? Governments and armed forces see important advantages in the development of new technologies. Technology makes it possible for some of the 'dull, dirty and dangerous' work to be taken over through automation, digitalisation and robotisation. The increasing integration of (and interaction between) humans and technology results in a more effective deployment of limited resources, which increases the productivity of defence personnel.[19] This can apply to a wide range of applications, such as the automation of cyber operations, algorithmic targeting and the automation of planning processes.[20] It can also play a role in enhancing situational awareness and understanding, medical analysis, encryption, simulation and training.[21]

When it comes to *semi-autonomous* systems, there are relevant military advantages. Such systems provide armed forces with a more extensive arsenal that enables them to better ensure the safety of their personnel, counter threats more efficiently and increase the effectiveness of their striking power. Autonomous systems are generally more precise, faster and often safer.[22] In the dangerous environment of a combat situation, the deployment of robots can be more accurate than the deployment of human operators, for example in the case of complex combat operations, mine clearance or logistical supply on the front line.[23] Today, the use of autonomous systems is becoming increasingly important in reducing decision times. In the case of an incoming hypersonic missile, for example, human reaction speed is too slow, whereas an air defence system can react in a split second.

There are also disadvantages. The risks and drawbacks of using autonomous systems are primarily ethical in nature. In January 2017, robotics and AI researchers and Big Tech entrepreneurs published an open letter to the UN calling for a ban on autonomous weapon systems that lack meaningful human control.[24] The offensive deployment of autonomous weapon systems may lower the threshold for warfare: states and non-state actors are more likely to use weapon systems if there are no risks to military personnel and the act of war takes place remotely. There are also disadvantages relating to the technical reliability of autonomous weapon systems. For instance, operational failures may occur as a result of malfunction or hacking.

Experts fear the development of autonomous robots that are no longer under human control and therefore capable of independently making life-or-death decisions.[25] Such robots could be deployed for both civilian and military purposes, resulting in great uncertainty: to what extent can autonomous machines act in accordance with international humanitarian law? At international level, it is not yet clear exactly what legal and ethical frameworks autonomous systems should comply with. In addition, it is still far from clear who is responsible and who is in control when it comes to the deployment of autonomous weapon systems. The AIV and the CAVV examine these important legal and ethical considerations in Chapter 5.

The use of lethal autonomous weapon systems

Advantages:
- Enhance military safety;
- More precise, faster and often safer;
- Can be deployed in inaccessible and dangerous areas;
- Can take over 'dull, dirty and dangerous' work;
- Complementary to the work of military personnel and existing weapon systems.

Disadvantages:
- Offensive deployment may lower the threshold for warfare;
- The danger of independent target selection and elimination without human control;
- Blurring of the distinction between civilian and military targets;
- Uncertainty as to who is responsible and who is in control;
- Uncertainty regarding legal and ethical frameworks.

Sources: Arkin (2010); Etzioni and Etzioni (2017); Hanlon (2018); Gibbs (2017); Morgan, Boudreaux and Lohn (RAND) (2020).

2.3 A moratorium: suspension through political agreements

Some international organisations, scientists and politicians are pushing for a total ban on the development of autonomous weapon systems, such as the Campaign to Stop Killer Robots, a coalition of non-governmental organisations. At the same time, certain bodies and countries do not seek an outright ban but would like to introduce a moratorium aimed at suspending the development or deployment of autonomous weapon systems by the international community for an extended period. Imposing a moratorium on the development and use of autonomous weapon systems, as advocated by some countries within the CCW, has proved complicated. A group of 30 countries is currently calling for such a moratorium on fully autonomous weapon systems.[26] Within this group, however, there is considerable uncertainty as to whether the moratorium should apply only to fully autonomous weapon systems or also to semi-autonomous weapon systems.

A moratorium is a political tool that can be used to compel states not to develop or use autonomous weapon systems. The problem is that technological developments in this area have a strong civilian component. It is complicated, if not impossible, to put a stop to technological developments in the civilian domain in order to prevent their military application. In order to impose a moratorium, moreover, there needs to be a consensus on the specific category of weapons to which these autonomous weapon systems belong. At present, there is no consensus on this issue.

As will be explained in more detail in Chapter 5, the AIV and the CAVV believe that the international community must look for a political and legal means to regulate the development and use of *semi-autonomous* weapon systems. The Dutch government should actively seek the development of detailed legal and ethical guidelines for this purpose. Although a moratorium is not deemed appropriate at this time, regulation is becoming increasingly urgent, especially now that developments in the civilian world – which will also have repercussions in the military domain – are accelerating. The AIV and the CAVV also advise the Dutch government to speak out more strongly in favour of an explicit ban on fully autonomous weapon systems. In doing so, they go a step further than in their 2015 report, prompted by the pressing need to ensure human control.

Hoofdstuk 3

Technological developments

summary

Autonomous weapon systems exist thanks to the development of new disruptive technologies. These are technologies that substantially and profoundly influence the nature of conflict and warfare.[27] International studies on future trends, such as the *Global Strategic Trends* report published by the UK Ministry of Defence, have long highlighted the increased importance of artificial intelligence.[28] Since the publication of the 2015 AIV/CAVV advisory report, developments in this area have accelerated rapidly. This chapter discusses the opportunities offered by these technological developments with regard to the deployment of *semi-autonomous* weapon systems. It also examines the ways in which human-machine interaction can take place.

3.1 Changes in the nature of warfare

Technology will increasingly influence the nature of warfare. According to NATO, this will mainly happen through the development of data (including big data), artificial intelligence, biotechnology, nanotechnology, robotics and quantum computing. One characteristic of these technologies is that they are applied in a versatile and often mutually dependent manner. The rise of these technologies is also changing the way in which conflicts are fought. The traditional view of warfare (e.g. on large plains) is gradually being displaced by concepts such as urban warfare (in built-up areas), in which the combination of humans, artificial intelligence, big data and technology provides a strong operational advantage.

These changes are being reinforced, among other things, by what scientists refer to as the 'robotisation' or 'dronification' of warfare, which is expected to result in a military robot revolution.[29] Future drones will become progressively smaller and more autonomous and will increasingly be able to work together in swarms through artificial intelligence, while remaining closely connected to military personnel on the ground. This manner of operation requires an integrated approach by humans and machines. The interaction between military personnel on the ground and remote systems in the air or at sea is much more decisive than in the past. Military doctrines have therefore devoted increasing attention to multi-domain and cross-domain operations over the past decade. The development and deployment of autonomous systems for such operations is premised on human-machine interaction.

3.2 Artificial intelligence and robotics

Autonomous weapon systems owe their existence to artificial intelligence and robotics. At its core, artificial intelligence consists of algorithms (software).[30] These are mathematical formulas and models that – once they have been fed with available data – enable a system to function. Robotics (hardware) describes the physical components of a machine, with which it is able to take action in the physical world. By interacting with the software and the environment in which it operates, a robot is able to simulate complex movements.

Advances in computational technology in particular have opened up many possibilities in terms of the development of autonomous, self-learning systems. For the most part, however, such systems are still hampered by major limitations: existing semi-autonomous systems are self-learning to a limited degree only. In addition, their degree of robustness and high energy consumption often stand in the way of effective operational deployment. These are challenges that cannot be overcome in the short term.

At present, the greatest successes of artificial intelligence seem to lie in the fields of simulation, image recognition, logistics and decision-making support.[31] Artificial intelligence appears to be especially useful in controlled environments, where algorithms have been able to learn using large quantities of data. In the operational domain, however, the use of artificial intelligence and robotics is still proving complicated.

The land domain is by far the most complex setting for the development of intelligent robots, because in this chaotic environment the large number of variables and the simulation of movement create technical hurdles.[32] This was apparent, for example, during the Syrian civil war, when Russia deployed the Uran-9, an unmanned ground vehicle. This remotely controlled tank, equipped with artificial intelligence and robotics, struggled to effectively operate autonomously once it ventured far away from its operators and entered difficult terrain.[33]

A well-known example of a lethal autonomous weapon system

In discussions about lethal autonomous weapon systems ('killer robots'), reference is often made to the South Korean Samsung SGR-A1. This weapon system is characterised by the close integration of artificial intelligence and robotics and operates with a relatively high degree of autonomy. The SGR-A1 is a sentry gun that can autonomously identify and eliminate targets. In the demilitarised zone between North and South Korea, it supports members of the armed forces in their surveillance tasks. When an intruder is spotted, the SGR-A1 can issue verbal warnings and recognise surrender motions, for instance if the target drops their weapon and raises their hands. If an intruder does not surrender, the robot can engage them with a Daewoo K3 light machine gun with a range of up to 800 metres.

Source: Alexander Velez-Green, 'The Foreign Policy Essay: The South-Korean Sentry – A "Killer Robot" to Prevent War', Lawfare Institute – Brookings, 1 March 2015.

Because it contains a smaller number of variables, the air domain imposes fewer demands on the controls of robotics. Developments in this domain are also occurring at a faster pace, since the air domain is a relatively predictable environment. The underwater domain remains a major challenge. Because data still cannot travel through water at high speeds, communication in the underwater domain remains a very complex issue. The cyber domain, finally, places different demands on the degrees of autonomy and human control, due to the complexity and speed of cyberattacks and manipulation by enemy systems.

3.3 Quantum technology

Besides artificial intelligence and robotics, quantum computing will have a major impact on the development of autonomous weapon systems in the near future. Quantum computing makes it possible for computers to perform very large numbers of calculations simultaneously. In the case of semi-autonomous weapon systems, this would mean a huge increase in computing power. Quantum

sensing can perform up to 10 times better than nanotechnology when it comes to measuring gravitational and electromagnetic fields, which is an important prerequisite for the functioning of autonomous weapon systems.[34]

When it comes to research, progress is currently being made in the field of quantum communication, in particular. Quantum communication renders remote communications virtually unbreakable and unhackable, thus facilitating the secure and rapid exchange of data required by autonomous weapon systems.[35] At the same time, quantum computing also poses a threat. Quantum computers can perform complex calculations in such a short time that all current forms of encryption are now more susceptible to decryption or deliberate disruption.[36] This will obviously have an impact on the operation of semi-autonomous systems, which are dependent on the secure exchange of data.

Quantum technology will have an impact on military operations, intelligence gathering and the security domain in general. In September 2018, the US National Science and Technology Council (NSTC) published its National Strategic Overview for Quantum Information Science on the use of quantum technology in the military domain. [37] In this report, the US mainly sees opportunities in the accuracy of measurements and sensing and in the improvement of the digital infrastructure. It also identifies the main implications of quantum technology for the entire information domain and the field of data technology, which will be transformed by super-fast and powerful quantum computers. Scientists point out that quantum technology will have consequences for machine learning and deep learning, such as the potential of systems – including autonomous weapon systems – to accelerate their self-learning capabilities on the basis of input from the environment, without human intervention.[38]

3.4 Data governance

One of the conditions for the use of semi-autonomous weapon systems that guarantee the preservation of human control is the responsible handling of data. Data is the basic ingredient for the proper functioning of artificial intelligence. After all, the intelligence of a system does not lie so much in its algorithms – the mathematical models built by humans – but in the data to which these algorithms are applied and to which they can assign meaning.

New advanced systems can only function on the basis of data. That is why the United Nations Institute for Disarmament Research (UNIDIR) has called on governments to better monitor the use of data in the development of autonomous weapon systems within armed forces worldwide.[39] UNIDIR points out that the increasing digitalisation and datafication of the security domain places different requirements on the actions of armed forces worldwide. When data use is optimised, decision-making that is based on autonomous systems using the OODA loop can take place faster and more effectively. Such optimised data use is offset by the risk of using incorrect data, which is a problem when building algorithms for autonomous systems.

Monitoring the development and use of good data is vital to the development of artificial intelligence and autonomous weapon systems. The EU, which is a key player when it comes to the monitoring and use of data, published a data strategy for the civilian sector in 2020. The US has done the same for data use in the military domain. Both strategies indicate that data monitoring in the development of artificial intelligence should be regarded as vital to the formulation of ethical frameworks. Partly for this reason, the US armed forces are working on collective data management, data ethics, data collection, data access, training, ethical data storage and fully automated and secure information management.[40]

Following the example of the EU and the US armed forces, the Dutch Ministry of Defence is also working on its own data strategy. If the Dutch armed forces are to remain technologically advanced and focus on information-driven operations, they will want to make increasing use of semi-autonomous weapon systems, for which data is an essential ingredient. Much like the recently published *Strategic Knowledge and Innovation Agenda 2021-2025*, the data strategy will therefore highlight the importance of data and data governance. The armed forces are committed to improving human-machine interaction in a way that strengthens the human role in task performance, as apparent from *Defence Vision 2035*.[40] Ultimately this strategy is meant to result in the establishment of concrete ethical guidelines for the use of data and artificial intelligence within the Dutch armed forces.

For governments and armed forces, data is the most important ingredient for developing new technologies and using autonomous weapon systems. It is therefore vital to regulate the control and monitoring of data use. If data use is optimised, decision-making processes within autonomous systems will ultimately be faster and safer. The AIV and the CAVV advise the government to improve such monitoring and invest more – both financially and in terms of manpower – in the development of artificial intelligence, robotics, quantum computing and responsible data use.

3.5 Human-machine interaction

As regards control over the deployment of semi-autonomous weapon systems, it is important to distinguish between autonomy in making a decision and autonomy in implementing that decision. Central to this is 'human-machine interaction', which is based on the premise that humans understand and can respond to data concerning the context for deployment and the capabilities and limitations of the machine. In order to develop semi-autonomous weapon systems characterised by intensive human-machine interaction, consideration should be given to the application of concepts such as machine ethics and transfer of control.

The political and public debate often focuses on the basic contrast between humans and systems. The underlying assumption is that humans are always capable of making considered moral choices when military force is deployed. However, it is just as often the human factor that is the problem when using military force. Humans are prone to suddenly change their minds depending on the context: they argue, they can be tired, they hesitate.[42] In many situations, systems can make such decisions in a relatively simpler, better, faster and more efficient way, but they too are fallible and capable of making mistakes. In light of the emergence of disruptive technologies, humans must learn to think differently about their own position in relation to machines and about how ethical decisions are made.[43]

When it comes to ethical considerations in the development of autonomous weapon systems, the AIV and the CAVV take the concept of explainable AI as their starting point. Tech companies such as IBM define explainable AI as a set of processes and methods that allows human users of artificial intelligence to comprehend and trust the results and outcomes created by machine-learning algorithms at all times.[44] Explainable AI can be used to describe the structure, expected impact and potential biases of an AI model. This makes it possible to characterise the accuracy, fairness, transparency and outcomes of AI-driven decision-making. Explainable AI is essential for organisations that want to use artificial intelligence responsibly in their processes and decision-making.

In practical terms, this means that the artificial intelligence used for autonomous weapon systems – and the underlying mathematical models and data – must be explainable at all times. This is important, because the ethical values that are embedded in the system (and by extension the choices it makes) must be transparent. After all, this is the only way to ensure a certain degree of control while also leaving room for potential revision and improvement of the system. This approach can

also shed light on whether the artificial intelligence used includes the ability to exercise judgment. In other words, is an autonomous weapon system capable of making ethical choices using this artificial intelligence?

The AIV and the CAVV also regard the concepts of machine ethics and transfer of control as vital to assessing the ethical aspects of human-machine interaction. Machine ethics applies to situations in which the decisions that a system can make are predetermined and preprogrammed by humans. This can be challenging in the case of complex military operational conditions, because even with extensive preparation and testing unforeseen events will still occur. In order to deal with events of this kind, a mechanism that intervenes when legal or ethical boundaries come into view could be added to the decision-making process.

Transfer of control applies to situations in which decisions are only transferred to a machine under certain conditions and circumstances. This requires an ability to recognise specific situations and use ethical modelling. In complex data environments, artificial intelligence can propose solutions and offer recommendations, which must then be verified by humans in accordance with the relevant legal and ethical frameworks. With this form of explainable AI, the system must be able to coherently demonstrate why it has arrived at the proposed solution.

The AIV and the CAVV believe that, when it comes to the development of new semi-autonomous weapon systems, it should be clear from the design stage which parts of the decision-making process are subject to human control and what responsibilities this entails. The Dutch armed forces must be trained to work within these parameters.

In Chapter 5, the AIV and the CAVV discuss ways of ensuring that human-machine interaction complies with ethical principles and international humanitarian law.

Chapter 4

Geopolitical context

summary

A new geopolitical era appears to have dawned. Compared to 2015, the world is more deeply engaged in an international struggle for technological supremacy. States are increasingly suspicious of each other and are less willing to collaborate on international regulation. Meanwhile they are expanding their own networked, semi-autonomous military capabilities as quickly as possible. Technological developments are facilitating a new form of warfare. Countries with technologically advanced armed forces are increasingly focusing on remote warfare, in which 'precision bombings' and 'targeted killings' can be carried out by unmanned or semi-autonomous systems, such as drones.[45] Non-state actors and terrorist groups, such as Islamic State, are also making use of new technologies and developing autonomous weapon systems such as drones.

These complex threats raise questions as to what the military implications will be for NATO, the EU and the Netherlands. This chapter discusses the geopolitical context of the development of autonomous weapon systems and its implications for the Netherlands.

4.1 The global technology race

At the moment, the US, China and Russia, in particular, are leading the pack in terms of the budgets they devote to developing autonomous weapon systems and related technologies. These countries invest tens of billions of euros in the development of disruptive technologies for military use.[46] In terms of technological development and applications, South Korea and Israel are also ahead of the curve.

The United States

The US is the most important player when it comes to developing military applications in the field of artificial intelligence and robotics. The US government works closely with the private sector and invests heavily in military technology programmes. Under President Biden, the US is committed to strengthening its technological lead, especially in the field of emerging disruptive technologies (EDT), such as artificial intelligence.[47] The US is most active in the offensive deployment of semi-autonomous systems. This started under President George W. Bush and increased exponentially under President Obama.[48] In 2010, the US invested 3.3 billion euros in the development of semi-autonomous weapon systems. By 2021, it will have spent an estimated 14 billion euros on a complete drone programme, including 3,447 new unmanned ground, sea and air systems.[49]

The US deployed more than 8,000 drones and more than 12,000 armed unmanned ground vehicles in Iraq and Afghanistan.[50] In Afghanistan, drones fired Hellfire missiles and launched 500-pound bombs into inaccessible areas as part of Operation Haymaker, which ran from 2011 to 2013.[51] In addition, the US made use of a large arsenal of unmanned maritime systems developed by the US Navy, including the REMUS 600, the GhostSwimmer and the Knifefish.[52] According to reports, there were 473 drone strikes in Pakistan, Yemen, Somalia and Libya between January 2009 and the end of 2015.[53] The US also deployed drones in retaliation against attacks by Islamic State during the recent escalation of the conflict in Afghanistan.[54] It is widely believed that this use of drones in Afghanistan serves as an example of the battleground of the future.[55] However, the US does not merely want to be a leader in the technological field: it will want to continue to set the tone in the drafting of international standards and norms for the use of disruptive technologies in warfare.

China

China aims to build up a technologically advanced military by 2035. In recent years, the country has closed the gap with the US in technological terms. It is currently investing approximately 3.7 billion euros in drone technology.[56] China is interested in developing artificial intelligence, robotics and quantum technology for the purpose of developing unmanned weapon systems.[57] In this context, it focuses chiefly on linking artificial intelligence to data science and computer technology. In addition, it is strongly committed to using big data as a condition for the deployment of surveillance programmes and the use of new technologies in both the military and the civilian domain.[58] China's national military strategy indicates that it wants to focus on information-driven operations, specifically in the maritime domain.[59]

In a recent publication, the Rathenau Instituut cites China's rise in the field of research and development (R&D) as proof that a new technological superpower is emerging. China has now surpassed the EU in terms of investment in this area. A substantial increase in the number of scientific publications and research initiatives also points to its increasing interest in this field.[60] China has singled out artificial intelligence as an important strategic priority and is using all its resources to obtain knowledge and skills in this area.[61] In this context, it is also targeting top sectors and knowledge institutions in the Netherlands. China's focus is on the semiconductor industry.[62] Because the use of artificial intelligence is highly dependent on custom-made computer chips, this is of direct relevance for the Netherlands. As a major producer of both machines for the semiconductor industry (ASML) and semiconductors (NXP), it faces a significant threat from Chinese industrial espionage. The Threat Assessment on State-Sponsored Actors published by the General Intelligence and Security Service (AIVD), the Defence Intelligence and Security Service (MIVD) and the Office of the National Coordinator for Counterterrorism and Security (NCTV) in 2021 warns that China uses both legal and illegal means to gather knowledge in the Netherlands.[63]

Russia

Since 2014, Russia can no longer rely on Western suppliers, due to the prevailing sanctions regime, and is therefore developing semi-autonomous weapon systems independently. Although it invests less than the US, China or the EU, it has still made significant investments in the development of new weapon systems, including guided weapons, hypersonic weapons, ballistic missiles, air defence systems, anti-satellite systems, cyber weapons, weapons for electronic warfare and flying and floating platforms. Russia wants a third of its combat power to be semi-autonomous by 2030. It is therefore focusing its efforts on the further roll-out of robotics and seeking to acquire external knowledge on artificial intelligence. Suppliers to the Dutch armed forces and companies in the high-tech sector – companies with unique and advanced knowledge of technologies for both civilian and military applications – are susceptible to Russian espionage.[64]

South Korea, Israel and Turkey

In addition to the above-mentioned three powers, there are smaller countries which, while less significant in quantitative terms, are nevertheless at the forefront of technological development. Examples include South Korea and Israel, which both invest heavily in creating a high-tech innovation climate. South Korea is investing billions in new research and has recently granted tens of thousands of patents in the field of artificial intelligence.[65] During the recent conflict in the Palestinian Gaza Strip, Israel emerged as the first country in the world to actively operate swarms of military drones controlled by artificial intelligence.[66] The recent escalation of the conflict between Iran and Israel has also witnessed the use of drone technology, revealing that – besides Israel – Iran too has a growing arsenal of drones at its disposal.[67]

In addition to these countries, Turkey is making remarkable progress in the use of autonomous weapon systems. By deploying new weapon systems, it is seeking to play a more assertive role in international conflicts,[68] as in the recent wars in Libya and Azerbaijan. Turkish armed drones were deployed in both Libya (2019) and Azerbaijan (2020), ultimately providing the then Libyan

government and Azerbaijan with a decisive advantage.[69] Turkey's low-cost drones – ordinary drones equipped with modern digital technology and weapons – are regarded as an alternative to the expensive models developed by the US and Israel. Turkey currently exports these drones to Qatar, Azerbaijan and Ukraine and will export them to Poland in the near future.[70]

Non-state actors and terrorist groups

Increasingly, non-state actors, such as terrorist groups, are also acquiring new technologies and developing autonomous weapon systems. These groups are capable of independently developing advanced weapon systems, which enable them to have a highly disruptive impact on international peace and security. Such groups pay little attention to existing international humanitarian law or other international legislation in their acts of war. The way in which they develop their systems, which is often based on a combination of knowledge derived from private companies and the purchase of outdated systems from states, is seen as an ever-increasing threat.

The use of autonomous systems by non-state actors, such as terrorist groups, is a major problem for states. When Islamic State used drones during its countless attacks in the Middle East in 2017, states struggled to detect or counter these drone attacks in a timely manner.[71] The proliferation of new technologies among non-state actors has only increased since then.

Nagorno-Karabakh as a technological theatre of war

In 2020, the conflict in the region of Nagorno-Karabakh saw the heavy use of new weapon systems. Armenia's drone fleet consisted of smaller Russian-made systems designed for reconnaissance missions. Azerbaijan boasted a large drone arsenal that included Russian and Turkish UAVs and Israeli loitering munitions, including the Harpy and the SkyStriker, which are self-guided munitions that autonomously detect and engage targets. The new Turkish UAV platforms in particular proved effective at detecting, identifying and destroying Armenian defence installations. These systems were armed with smart, micro-guided munitions that independently detected and engaged targets, including behind enemy lines.

Sources: Shaan Shaik and Wes Rumbaugh, 'The Air and Missile War in Nagorno-Karabakh: Lessons for the Future of Strike and Defense', Center for Strategic & International Studies, 8 December 2020; Michael Kofman and Leonid Nersisyan, 'The Second Nagorno-Karabakh War, Two Weeks In', War on the Rocks, 14 October 2020.

4.2 The EU and NATO

The EU

Taken together, the EU member states currently have a combined defence budget of 234 billion euros, the second-highest defence budget in the world after the US. Member states such as France, Germany and Italy spend 53, 41 and 22 billion euros, respectively, on defence, including new autonomous systems. The EU member states are expected to purchase at least 6.5 billion euros worth of drone technology in 2021. Furthermore, the EU has the capacity to develop advanced hardware for autonomous weapon systems. In global terms, EU member states have published the most academic papers on artificial intelligence and also file the most patent applications in this area. If the expertise and capabilities of the member states can be effectively pooled, the EU could become a dominant player on the geopolitical stage of autonomous weapon systems.

However, the EU faces two challenges. First, it is internally divided between countries that support the development of semi-autonomous lethal weapon systems (such as France and Sweden) and those that are opposed to it (such as Austria). There is also uncertainty as to the direction of the political

debate on ethical frameworks and regulation. Second, although the combined defence budgets of the member states are indicative of formidable military power, such unity is often lacking in practice.[73] For the most part, member states develop semi-autonomous weapon systems at their own initiative. This has always been the case for the procurement of weapon systems within the EU. However, in the changing geopolitical context, where more emphasis will be placed on the EU's own strategic autonomy, this lack of unity appears to be having a negative impact on the EU's operational strength.

As regards the regulation of semi-autonomous weapon systems, the EU appears to be divided into two camps, with France and Germany on opposite sides of the spectrum. France sees the development of emerging disruptive technologies as part and parcel of geopolitical competition and has shown a clear interest in developing more military applications based on, for example, artificial intelligence and quantum technology. Germany approaches artificial intelligence primarily from an economic and social perspective and is more cautious. France wants the EU to play a more active role in the independent development of these systems and focuses on technological progress. In contrast, Germany wants the EU to play a prominent and steering role in the field of regulation.

The absence of a centralised approach at EU level leads to regular criticism from advocates of a coherent and bold EU security policy that is supported by the member states. Researchers emphasise that Europe is devoting too little attention to the implications of artificial intelligence for the EU's security.[74] In 2021, the European Commission presented both a coordinated plan and a proposal for a regulatory framework on artificial intelligence.[75] However, the plan and the regulatory framework focus mainly on the civilian domain. The EU's Executive Vice-President for a Europe fit for the Digital Age, Margrethe Vestager, underlined this during the presentation of the legal framework for artificial intelligence in April 2021, in which she concentrated on the civilian use of artificial intelligence by governments, private companies and civil-society organisations.[76]

In a new resolution on artificial intelligence adopted in January 2021, the European Parliament indicated that it is acutely aware of the need for greater coherence between the civilian and military aspects of artificial intelligence. The knowledge and skills available within the various EU member states in the field of military technology are on a par with those of the US and China, but the efforts – and investments – of the member states should be better orchestrated in order to compete with these two countries. The same applies to the establishment of normative frameworks for the development of dual-use (civilian and military) technology.[77]

The AIV and the CAVV note that the way in which EU member states view the development of national strategies on technology, innovation and industry, as well as the related civilian and commercial interests, is too focused on national and civilian priorities. Given the new balance of power in the world, the EU should strive to be seen by others as a key player and an important power in the field of new technology. However, this will only be possible if the member states act jointly in formulating rules for technological innovation.[78] In this context, the AIV and the CAVV refer to a report by the Swedish think tank SIPRI, which states that the EU would be wise to pursue a common position on the responsible military use of artificial intelligence for three reasons:[79]

1. It will enable the EU to promote shared values at global level.
   This will strengthen trust and transparency among EU member states.

2. It will enable the EU to influence how artificial intelligence is used by member states' armed forces. This will reinforce ideas on European strategic autonomy, interoperability and effective cooperation.

3. A joint approach will also make it easier for EU member states to scale up technological development while keeping costs manageable. When it comes to investing in new technologies for military use, member states cannot compete individually with the US and China, but together they can.

It is inevitable that European technological development and innovation are addressed in the context of European security policy. There is a need for closer cooperation at European level to foster technological developments in the security domain. This will require more European cooperation, a more centralised approach to security policy and a substantial increase in EU member states' defence spending.[80] International cooperation initiatives that bypass the EU, such as the recent AUKUS defence pact (an alliance between the US, the UK and Australia in the field of defence materiel and technological development), raise important strategic issues for the EU with regard to the future of European security policy.[81]

NATO

NATO has assumed a different role in recent years. Its strategic focus was originally on defending Allied territory and strengthening deterrence against Russia. Although NATO still sees this as its most important task, its responsibilities have been expanded to include combating non-state terrorism and entering into new strategic partnerships, for example in the Middle East.[82] NATO's active stance on the emergence of new technologies is consistent with its evolving strategic position.

NATO emphasises that the joint accumulation of knowledge and pursuit of development in the field of new technologies is a prerequisite for effective military action. The added value of collaboration in the field of disruptive technologies and autonomous systems lies mainly in the areas of interoperability and standardisation. At the beginning of 2021, the NATO member countries agreed to develop a strategy for the development of emerging disruptive technologies.[83] NATO wants to pursue a human-centric approach to the military use of autonomous systems.[84]

In October 2021, NATO released its first-ever strategy for artificial intelligence, in which it sets out parameters for the ethical use of this technology by armed forces.[85] NATO notes that it wants to work on international norm-setting, standardisation and interoperability among Allies. It also wants to provide a foundation for the ethically responsible development and responsible use of artificial intelligence by Allied armed forces, and improve its own ability to monitor this use. NATO is committed to accelerating the application of artificial intelligence within armed forces. To this end, the Allies' capacity for innovation needs to be strengthened and protected. The strategy also states that efforts should be made to counter the malicious use of artificial intelligence by state and non-state actors.[86] Collaboration and cooperation in the field of innovation among NATO countries and with knowledge institutions and innovation partners is essential for this purpose.

By adopting its own strategy on emerging disruptive technologies, such as artificial intelligence, NATO wishes to demonstrate the importance it attaches to the development of these technologies in the context of innovation, research and development, and entrepreneurship: a climate of innovation creates high-tech opportunities that can ultimately contribute to improved security. NATO approaches developments in the field of disruptive technologies from a strategic perspective. These technologies must contribute to NATO's main tasks: deterrence and defence.[87]

For this reason, NATO encourages close cooperation with private parties, knowledge institutions and government bodies. In 2021, it published its own trend analysis defining new technologies that are expected to have a significant and disruptive impact over the next twenty years. These technologies are big data, artificial intelligence and robotics, autonomous systems, quantum technology, space technology, biotechnology and human enhancement, and hypersonic technology.[88]

In the coming years, NATO wants to encourage Allies to invest more in the development of artificial intelligence and machine learning. In addition, it believes that armed forces should invest in the development of quantum technology and data security (algorithms and systems for securing and compromising the security of communications, data transactions and data storage, including quantum-proof encryption methods, blockchain and cybersecurity in general).[89] In light of the

dual-use nature of emerging disruptive technologies, NATO regards increased cooperation with the civilian world and research institutes as essential.

However, when it comes to these key technologies, in particular artificial intelligence, NATO emphasises that it is important to focus on establishing normative frameworks and regulating responsible use. In this context, there is scope for creating a dedicated ethical framework that ensures both individual liability and state responsibility. Since NATO has no legislative or executive powers, it will have to make use of the possibilities that its member countries have to offer. Thus, in order to have an impact, it should encourage member countries to align themselves in the areas of regulation and arms control.

Multilateral organisations such as NATO (and the EU) are less nimble when it comes to anticipating new developments at policy level. The AIV and the CAVV conclude that NATO, which is highly dependent on individual member countries when it comes to developing new technologies, is prone to certain vulnerabilities in this regard. Experts warn that the Alliance's lack of effectiveness in terms of policy setting undermines its operational effectiveness.[90]

Furthermore, the development of disruptive technologies, which are clearly dual use in nature, takes place mainly in the commercial domain. This means that such technologies can often be used for both civilian and military purposes, but also for both good and bad. Close international cooperation is needed to organise effective state supervision. The AIV and the CAVV advise the Dutch government to develop a joint screening policy for high-tech exports and investments, especially for dual-use technologies, within NATO and in collaboration with the US, the UK and EU partners. This will help prevent countries such as China and Russia from using European technologies to close fundamental qualitative gaps in their military capabilities (including semi-autonomous weapon systems).

Due to the versatile application of new technologies and cheap commercial production processes, it is likely that some technologies will also end up in the hands of non-state actors. Further regulation of the acquisition and development of autonomous weapon systems and compliance with international humanitarian law should therefore apply to both state and non-state actors.[91]

The AIV and the CAVV advise the government to focus its efforts, both within NATO and within the EU, on establishing a platform where government bodies, knowledge institutions and the private sector can jointly examine the industrial, legal and ethical aspects of autonomous weapon systems.

4.3 The position of the Netherlands

Through its Mission-driven Top Sector and Innovation Policy, the Netherlands has focused its efforts on the further development of key technologies, especially for the civilian world.[92] Its ambitions regarding civilian application of these technologies, and artificial intelligence in particular, resulted in the publication of the Strategic Action Plan for Artificial Intelligence and the establishment of the National AI Coalition in 2019.[93] As in various other EU member states, these efforts paid little attention to the security domain. A recent report on artificial intelligence published by the Netherlands Scientific Council for Government Policy (WRR) shows how a bridge could be built between civilian applications and the security domain, while also drawing attention to military applications and the particular importance of new technologies for strengthening national security.[94]

From a geopolitical perspective, the AIV and the CAVV believe it makes sense to highlight the added value for the security domain of investing in new technologies. After all, recent developments point to a future in which the use of drones for defensive tasks, robotics and artificial intelligence, as incorporated in hypersonic missile defence systems, and data science in the field of intelligence, will almost certainly become standard practice.

Some experts argue that the Netherlands will be exposed to grave dangers if does not keep up with these technological and military developments.[95] It is therefore important that the Netherlands continue to be actively involved in the fields of knowledge and innovation. In the recently published Defence Vision 2035, the Ministry of Defence presents a new profile of the armed forces as a technologically advanced organisation that is information-driven in operation and collaborates with partners. In this context, the ministry is committed to faster decision-making and fully integrated command and control at all levels. 'Using information as the driver to structure the operations of the armed forces as a whole requires network interoperability, both internally and with all our (potential) military and civil partners.'[96] In this regard, attention should also be devoted to the vulnerability of military control systems of semi-autonomous systems to cyber or hybrid attacks.

Semi-autonomous weapon systems have important military-operational advantages. In recent years, the Dutch armed forces have worked and experimented with semi-autonomous systems in various domains, such as the REMUS underwater drone, the MQ-9 Reaper aerial drone, the THeMIS unmanned ground vehicle and the Goalkeeper close-in weapon system (CIWS), a semi-autonomous anti-aircraft gun system used on Royal Netherlands Navy frigates. A classic example of a system that uses artificial intelligence – and which has been in use for much longer – is the Patriot air defence system.

The most recent example of the entry into operation of a non-lethal autonomous system is the introduction of a robot dog by the Royal Military and Border Police. The dog ('Spot') assists with observation and surveillance tasks and can independently detect targets.[97] Although this semi-autonomous system is deployed unarmed, it cannot be ruled out that states or non-state actors (such as terrorist groups) might arm it in the future.

In the future, the Dutch armed forces will have to make greater use of semi-autonomous systems. The AIV and the CAVV firmly believe that new technologies are vital to the organisation and functioning of modern armed forces. This includes the development of semi-autonomous systems, which play a key role in supporting and ensuring the effectiveness of those forces. More funds should therefore be invested in the development of artificial intelligence, robotics, quantum computing and big data. This applies not only to the ability to prevent disruptions in the functioning of the armed forces but also to the offensive use of such technologies.

At the same time, the AIV and the CAVV wish to draw the Dutch government's attention to the increased risk of violent escalation around the world due to the lack of proper international regulation. Experts point out that a combination of several factors is likely to lead to greater geopolitical instability.[98] Specific factors include: (1) the rapid development of dual-use technology; (2) the fact that it is relatively easy to convert a non-lethal weapon system into a lethal weapon system; (3) the increasing use of semi-autonomous weapon systems around the world; and (4) the relatively easy proliferation of these systems (including among non-state actors). The Dutch government is faced with the important task of pushing for international regulation.

Chapter 5

Legal and ethical considerations

summary

States have a keen interest in the manufacture, procurement and use of various types of autonomous weapon systems.[99] The deployment of such weapon systems is regulated primarily by international humanitarian law, which applies during armed conflict. However, since conflicts are increasingly conducted by hybrid means, they do not always involve 'armed conflict' in the traditional sense. This raises questions regarding the applicable law.

As noted in previous chapters, technological developments in the field of robotics, artificial intelligence and the use of big data are driven mainly by the private sector. Although these developments focus on civilian applications, they are also vital to the manufacture of autonomous weapon systems. This raises questions about the legal regime that currently applies to the development and use of certain weapon systems.

This chapter examines how the development and use of fully autonomous weapon systems relate to the rules of international law. It also discusses the criteria that apply to the lawful development and use of semi-autonomous weapon systems and the various concepts, such as meaningful human control, human-machine interaction and 'ethics by design', that emerge in the process of the development and procurement of such systems and the different stages of the targeting process. Various forms of responsibility and liability are also discussed. Finally, this chapter examines whether it is possible, given recent technological and geopolitical developments, to develop new international rules in this area.

5.1 A legal and ethical issue

This chapter focuses on the legal framework, specifically the compatibility of the use of weapon systems, including semi-autonomous weapon systems, with international humanitarian law, which is the law that applies in times of armed conflict (also known as the 'law of armed conflict'). However, the legal framework is not entirely divorced from the ethical framework, since the development, procurement and use of various types of autonomous weapon systems raise important ethical questions as well as legal ones. In the public debate, the key ethical question is whether life-and-death decisions should be left to a machine.

There is a certain amount of interplay between the legal and ethical perspectives, involving the following factors:

1. To a certain extent, the existing rules of international humanitarian law, such as the prohibition on treating civilians as military targets, are a form of 'solidified ethics'.

2. The core rules of international humanitarian law are general in nature, since they apply (or are meant to apply) to various forms of warfare and use of weapons. Ethical principles can thus be helpful when specifying legal criteria.

3. Ethical principles offer an additional, external perspective. They can also serve as a basis for the further development of international law with regard to the development and use of semi-autonomous weapon systems.

5.2 The current legal framework

Existing international law does not explicitly prohibit the development and use of fully autonomous or semi-autonomous weapon systems. Nevertheless, there are some important general rules, especially in the field of international humanitarian law. Because international humanitarian law applies only in armed conflict situations, a distinction is made below between peacetime and armed conflict.

Peacetime

In peacetime situations, characterised by measures to maintain public order, criminal-law interventions and skirmishes that are not severe enough to qualify as 'armed conflict', international human rights apply. The human rights that apply specifically to the use of lethal and non-lethal semi-autonomous weapon systems are the right to life and the right to privacy.

The use of force, including the use of autonomous weapon systems to eliminate specific individuals outside the context of actual hostilities, for example in the framework of police law enforcement, the maintenance of public order or a drone attack on the leader of a terrorist organisation outside the context of an armed conflict, will almost always conflict with international human rights law. Under this regime, the use of lethal force is only permitted in narrowly defined situations and subject to far-reaching restrictions.[100] The question is also whether such force truly provides an advantage or whether there are obvious alternatives, such as arrests.

In peacetime, lethal force may only be used in highly exceptional situations, for example in the event of an armed bank robbery or a terrorist act in which the perpetrators do not intend to surrender and there is a danger to bystanders and/or hostages. Nevertheless, if the use of lethal force in the context of law enforcement is absolutely necessary and unavoidable, it should always remain under human control. This is because the human rights protection regime places even more stringent requirements on the use of lethal force than international humanitarian law and because the application of these criteria is highly context-specific. In such situations, moreover, particular account must be taken of innocent civilians, who will often be at or near the intervention site. The risks associated with the deployment of these military systems in such cases are thus substantial.

As regards the right to privacy, the AIV and the CAVV highlight the importance of effective data governance in connection with the use of big data in systems powered by artificial intelligence (see also section 2.4).

Armed conflict

Unlike in peacetime, in the case of an international or non-international armed conflict, international humanitarian law applies in addition to human rights law. International humanitarian law lays down a number of criteria for the lawful use of all kinds of weapon systems. The most important criteria arise from customary law, as laid down in Articles 35, 51 and 57 of the First Additional Protocol to the Geneva Conventions relating to the protection of victims of international armed conflicts. They stipulate that, in the event of the use of force by weapon systems, a distinction must be made between combatants and non-combatants, the force must be proportional to the military objective, and the precautionary principle must be observed, meaning that the civilian population and civilian targets must be spared as much as possible during an attack.

In addition to the above-mentioned rules that apply specifically to international armed conflicts, the principles of distinction, proportionality and precaution also have the status of customary law and also apply to situations of non-international armed conflict.

In addition to the rules laid down in the Geneva Conventions, an important principle of customary law, the Martens Clause, stipulates that in situations not regulated in current agreements, civilians

and combatants continue to enjoy the protection dictated by the principles of humanity and the public conscience.[101] This principle also plays a role in assessing the lawful use of autonomous weapon systems during international and non-international armed conflicts.

As noted in their 2015 advisory report, the AIV and the CAVV believe that *fully* autonomous weapon systems are not (yet) able to independently apply the criteria of distinction and proportionality, not least in view of the fluid and dynamic combat environment in which they operate.[102]
These fully autonomous systems are unable to properly balance contradictory objectives such as humanity and military necessity, the principles that are meant to guarantee the proportionality of the use of force.[103] After all, such assessments are based not only on legal rules but also – chiefly – on ethical considerations, in addition to being dependent on the situational context. As discussed in section 2.2, it is unlikely that algorithms will be able to do this in the future. Fully autonomous weapon systems that apply machine learning to interpret rules and select and engage targets without human involvement or the possibility of human intervention therefore cannot be used lawfully.

As previously noted in this report, the main issue when it comes to decision-making is whether the decision to use the weapon system is subject to meaningful human control. After all, in the case of meaningful human control, a person has to make a conscious decision to deploy a certain weapon system in a certain situation, with a certain expected effect, while also striking a balance between humanity and military necessity. Meaningful human control should therefore be the key precondition for ensuring compliance with the principles of distinction, proportionality and precaution in an ethical manner. As noted, such control does not exist in the case of fully autonomous weapon systems.

According to this argument, the use of semi-autonomous weapon systems – as opposed to fully autonomous weapon systems – can therefore be lawful, provided they are under meaningful human control to ensure the careful application of the criteria of distinction, proportionality and precaution. If all these conditions have been met, such systems may also be deployed against individuals for the purpose of exerting lethal force, but obviously only in the case of combatants or persons directly participating in hostilities.

The position of the AIV and the CAVV differs from that of the ICRC, which denounces any use of lethal force against individual persons by autonomous systems, even in times of war.[104] The AIV and the CAVV believe that there are scenarios in which the risk to the civilian population, for example, would be minimal. That being said, semi-autonomous weapon systems should not be used against non-combatants under any circumstances, even if those persons are suspected of serious crimes (including war crimes).

In practice, this means that there must be scope to properly assess the environment in which the weapon system is deployed, in particular as regards the possible presence of non-combatants. All precautions must be taken to avoid harm to civilian persons and property. This also implies that there is a difference between using semi-autonomous weapon systems at sea, where no civilians are necessarily present, and in an urban environment, where combatants are located among (or actively blend in with) civilians. An opponent's ability to disrupt data analysis, making a proper assessment of the situation impossible, is another important factor that needs to be taken into account.

In the study, development, procurement or adoption of a new weapon system – or a new means or method of warfare – international law imposes a positive obligation on states, under Article 36 of the First Additional Protocol to the Geneva Conventions, to 'determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable (…).' On the basis of this obligation, states must carry out a 'weapon review' that verifies the new system's compliance with international law, including the criteria of distinction, proportionality and precaution.

States are not obliged to share the results of these reviews with others. According to the AIV and the CAVV, however, they would be well advised to provide the international community with some kind of insight into their assessment of the compatibility with international law of certain fully autonomous and semi-autonomous weapon systems, as other states could learn from their experience. Transparency also increases public support for the potential use of autonomous weapon systems. The Netherlands is already setting a good example by publishing the recommendations of the Advisory Committee on International Law and the Use of Conventional Weapons (AIRCW) on the government's official website. The government would be wise to make these recommendations more accessible and easier to find (e.g. on a dedicated website) and to publish them in English too so that international partners can read them.

5.3 Operationalising 'meaningful human control'

In their 2015 report, the AIV and the CAVV described the concept of 'meaningful human control' as an essential precondition for the development and use of semi-autonomous weapon systems. In this section of the present report, they flesh out this concept in greater detail.

The concept of meaningful human control was initially developed and promoted by a number of non-governmental organisations, but in recent years it has also been used increasingly by governments.[105] The concept itself represents a broad interpretation of what human control should entail. The AIV and the CAVV also take it to mean that the control exercised over a weapon system is effective and adequate. In practice, the concept therefore also relates to the role of human judgment in the deployment of weapon systems.

Internationally speaking, there is a consensus that meaningful human control must be ensured when using semi-autonomous weapon systems, although opinions differ concerning its specific interpretation. This applies in particular to the question as to whether there needs to be meaningful human control over the entire weapon system as such or whether such control should be limited to certain critical functions, such as target selection and actual use.[106]

Meaningful human control essentially means that there is sufficient and effective control by individuals who make the decisions on the use of a semi-autonomous weapon. In order to perform this role, it is important that they have a basic cognitive understanding of the information that needs to be processed and the context in which the weapon is to be deployed, as this will enable them to make an informed decision on its lawful use, taking into account the criteria of distinction, proportionality and precaution.[107] The question is whether it is sufficient for the individual to have the option of blocking the use of the weapon suggested by the system and/or whether it should be necessary for the individual to give explicit permission for an attack against specific targets.[108]

For this reason, the AIV and the CAVV employ a broad definition of the term 'autonomy' in Chapter 1, referring to the model developed by Noel Sharkey, Daniele Amoroso and Guglielmo Tamburrini. In doing so, they make it clear that alternative forms of autonomy are conceivable for the development and use of autonomous weapon systems, which in turn has consequences for the degree of human control. Not all weapon systems need to be equally autonomous and may include various forms of human control.

The precise interpretation of the concept of meaningful human control is also being discussed at international level, while other concepts that could serve as a starting point have also been introduced. Within the UN CCW, a special Group of Governmental Experts (GGE) comprising 70 countries has discussed autonomous weapon systems – and the legal and normative principles that are relevant to decisions concerning their use – several times a year since 2013. The participating

countries have drafted 11 Guiding Principles (see the box in section 5.5 below), with a number of them taking the normative position that a certain 'quality and extent of human-machine interaction' is needed to ensure that the potential use of autonomous weapon systems complies with international humanitarian law.[109] The assumption is that this human-machine interaction will enable states to ensure and protect human control.

The international debate increasingly revolves around the relationship between the concept of meaningful human control and concepts such as human-machine interaction and 'ethics by design'. Human-machine interaction focuses mainly on collaboration between humans and machines, which involves placing requirements on the technology to ensure that it can be operated reliably and intuitively and that its operation can be monitored.[110] In this context, it may be necessary to integrate a technological 'mediation tool' into the system to facilitate informed operation. This is supposed to eliminate the problem of 'automation bias', which describes a situation in which system operators place too much confidence in the reliability of the data they receive from the system. It also prevents meaningful human control from becoming an empty promise.

One explanation for the gradual shift of the CCW debate towards human-machine interaction is the growing recognition that technological mediation influences human decision-making in many ways. This means that the assignment of control and responsibility requires a different approach.[111]

The AIV and the CAVV highlight the importance of human-machine interaction when it comes to operationalising the concept of meaningful human control. In this regard, they note that it is also important to look beyond the specific moment when the decision to use the semi-autonomous weapon system is made, within its critical functions. After all, this decision is preceded by several stages of the targeting process. The AIV and the CAVV therefore follow a broad approach that considers the entire decision-making process within the various organisations involved in the design, procurement and use of weapon systems in order to assess the degree of meaningful human control and the resulting responsibility. In this context, it is reasonable to assume that the more autonomous the weapon system, the further forward meaningful human control should be brought in the decision-making process.

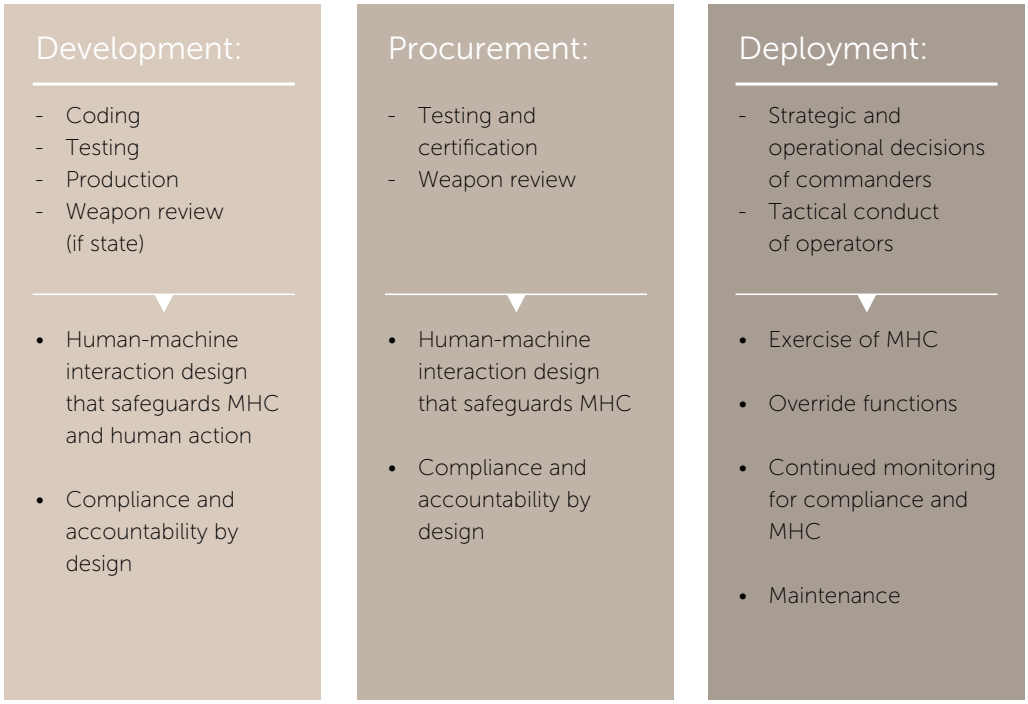
It is advisable to integrate meaningful human control into various stages of the decision-making process.[112] For a start, it should never be assigned to a single person: it is a responsibility that must be borne by multiple individuals throughout the entire decision-making chain. Various legal, policy and ethical decision points can be identified throughout the entire chain of command. Assessments are made during the entire life cycle of a semi-autonomous system and they must all be legally valid. This applies to the work of the developer and the supplier as well as to the decision-maker and the operational commander.[113] In other words, if responsibility needs to be assigned, it is vital to look at the wider context.

Moreover, even *before* a decision is made concerning a specific attack, decisions have already been made by political officeholders and those responsible for the development, procurement and general use of semi-autonomous weapon systems in a given conflict. It is therefore important that those who bear responsibility in the various stages of the decision-making process ensure that suitable agreements are concluded with manufacturers regarding the verifiability of a number of key criteria (see below).[114]

Ethical considerations and legal criteria should thus be addressed in the design phase of the weapon system, as this is where it can be determined what parameters should be built into the system, how the software is constructed, how the system fits together technologically and what type of assessments it should be able to make.[115] Moreover, when new systems are brought into

use, unfavourable and unforeseen side effects may reveal themselves. It is therefore important to carefully map out both the legal criteria and any such unfavourable and unforeseen side effects.[116] The principles of international humanitarian law apply in full in this context, as the CAVV previously highlighted in its 2013 advisory report on drones.[117] From a practical perspective, the above-mentioned considerations can be elaborated in a model, as the Asser Institute has done at the behest of the AIV and the CAVV.

Figuur 2 - Model with the elaboration of ethical and legal considerations. Asser Instituut.



At the development and procurement stage, design choices will have a significant impact on whether and how a semi-autonomous weapon system can be deployed lawfully and remain under meaningful human control. It is at this stage that developers can seek to ensure effective human-machine interaction, reduce automation bias and embed legal principles and ethical considerations in the system.

Besides the manufacturer, the state that decides to acquire a weapon system also incurs responsibility. Indeed, under Article 36 of the First Protocol to the Geneva Conventions, it has an obligation to determine whether the use of a semi-autonomous weapon system would, in some or all circumstances, be prohibited by the protocol or by any other rule of international law. The state must accordingly ensure that the weapon system is thoroughly tested in order to verify that the criteria relating to design quality have been met and that the certification process is carried out correctly.

In addition to the importance of meaningful human control in assessing the relevant criteria of international humanitarian law, it is also necessary – from the point of view of legitimacy and political and public accountability – that those who hold political office or positions of responsibility are able to demonstrate how diligent and informed decision-making on the development, procurement and use of semi-autonomous weapon systems takes place. By developing a detailed ethical framework for decision-making and accountability in advance, and ensuring that this framework is applied by the organisations that lay the groundwork for decision-making, it is possible to arrive at a decision that is not only legally but also ethically responsible.

One key element of the decision-making process is transparency when it comes to assessing the advantages and disadvantages of the use of semi-autonomous weapon systems. In line with the ICRC, the AIV and the CAVV argue that a number of criteria can be used to carry out risk assessments in the various stages of the decision-making process. In addition, they note that the actors involved in the various stages of this process should have the relevant knowledge and training to be able to make an informed decision.

This obviously includes assessing whether the principles of distinction, proportionality and precaution are safeguarded. Key issues include the target type, the geographical scope, duration and extent of the use of force, the use of force in civilian areas, and the scope for human supervision, intervention or deactivation when using the weapon system. For example, in the context of a political decision concerning the potential use of a weapon system, it could be specified that the system can only be used at sea or in non-urban areas, and whether or not it can be used against human targets, or that it may be used for defensive purposes only.

In the Netherlands, the government informs parliament of the deployment of the armed forces (for non-NATO Article 5 operations) by means of an 'Article 100 letter'. Since conflicts change and armed combat is highly likely to be conducted from a distance, this will have an impact on the deployment of troops and materiel, with a shift in emphasis from the former to the latter the likely outcome. The information position of those in positions of political responsibility is of crucial importance in this context. A thorough situational assessment must be carried out to determine the extent to which meaningful human control is feasible in the event of the deployment of a weapon system. All this suggests that Article 100 letters should devote more attention to the potential use of certain autonomous weapon systems in a specific conflict, taking into account the above-mentioned criteria.

Possible criteria for regulation:

- What is the nature of the intended target of the semi-autonomous weapon system?
  - Far-reaching autonomy is potentially acceptable in cases where a system only performs defensive functions and the focus is on neutralising incoming projectiles, such as the Israeli Iron Dome system or systems that protect ships against incoming missiles.
  - Far-reaching autonomy is less self-evident in cases involving the use of lethal force against persons. Sufficient human control must be ensured to prevent errors or technical malfunctions and the consequences thereof. Under no circumstances should a semi-autonomous system deliberately target civilians or civilian objects (although civilian 'collateral damage' is permissible in certain cases).

- What is the duration of the use?
  - The longer a semi-autonomous system is deployed, the greater the unpredictability. This is because conditions in the area of operations can change. In particular, there is an increased risk that civilians will enter the area. Far-reaching autonomy is therefore only acceptable if the duration of the deployment is limited.

- What is the geographical scope?
  - The larger the geographical scope of an operation, the greater the unpredictability. Far-reaching autonomy is only acceptable if the area of operations is limited in scope and the intended targets are clearly defined.

- What are the circumstances?
  - Autonomy should be restricted in cases where a large number of civilians or civilian objects are present in the area in which the system is deployed. After all, there is a real danger that the system will mistake the target or hit civilians who happen to be in the vicinity of a military target.
  - Greater autonomy is acceptable if states take measures to prevent civilians from entering the area of operations. In principle, this is possible in all types of operations (in the air, at sea and on land).
  - Greater autonomy is acceptable if the system is deployed in an environment where the opponent is not present, as this reduces the risk that the opponent will disrupt the planned deployment of the system or the communication between a human operator and the machine.

- Are the preconditions present for effective human-machine interaction?
  - The user of a semi-autonomous system must have a good understanding of the consequences of its deployment.
  - Designers must design an autonomous system in such a way that it is deactivated if it ceases to function properly or if it is used for longer – or in a larger area – than planned.
  - Human operators should be able to remotely monitor the operational deployment of semi-autonomous systems – visually or otherwise – and thus have an overview of the environment. This will enable them to intervene, especially in cases where a system uses potentially lethal force.

Sources: 'ICRC Position on Autonomous Weapon Systems', 12 May 2021; Vincent Boulanin, Neil Davison, Netta Goussac and Moa Peldán Carlsson, 'Limits on Autonomy in Weapon Systems', ICRC/SIPRI, June 2020; Amoroso and Tamburrini (2020).

5.4 Forms of responsibility and liability

When designing, developing and using fully autonomous and semi-autonomous weapon systems, it is very difficult to determine where exactly the responsibility for their use lies. Responsibility entails an obligation to retrospectively explain and justify an action by a person or system. Legal responsibility is commonly referred to as 'liability'. In principle, a person or entity can be legally liable for the unlawful or harmful actions of an autonomous weapon system. The system itself is *not* liable (at least for the time being) because it has no legal personality. This section discusses which actors are responsible (liable) – and under what circumstances – for the use of autonomous systems and the ensuing consequences. In this context, the emphasis is on international law.

Under general international law, states can be held responsible for the internationally wrongful actions of the autonomous systems they use, for example when these systems open fire on civilians in the absence of military necessity. Under international criminal law, individuals who have played a role in the use and development of semi-autonomous weapon systems at any point during their life cycle, in particular developers, commanders and operators, can also be held responsible. These different forms and levels of responsibility can be complementary, meaning that different actors can be held responsible for the same actions of a system.

For individuals, in particular, liability is closely related to human control, as they can normally only be held liable for (the consequences of) an action by an autonomous weapon system if they had some

degree of control over it. Enhancing meaningful human control over autonomous systems therefore increases the likelihood that individuals will be held liable. At the same time, the risk of liability can help ensure that human control is integrated more effectively into autonomous systems.

State responsibility

Under international law, states are responsible for acts and omissions attributable to them that constitute a breach of international obligations. The rules on state responsibility are laid down in the UN International Law Commission's Articles on Responsibility of States for Internationally Wrongful Acts (ARSIWA), which largely reflect customary international law.

If a state uses an autonomous weapon system, it is in principle responsible for any violations of international humanitarian law committed as a result of this use. However, the state in question may already be responsible if it has violated its due diligence obligations, i.e. the duty of care of states to take all measures within their power to prevent a certain undesirable result. Since this is a best efforts obligation, a state can be held responsible as soon as it fails to comply with its procedural duty of care, even if no damage has yet been caused. Due diligence obligations exist in both international humanitarian law and international human rights law.[118] They are therefore relevant to the use of autonomous weapon systems.

In practical terms, states must ensure that the use, design and development of autonomous weapon systems all comply with international law. When purchasing technology or systems from third parties (private parties), states have a duty to verify whether the artificial intelligence has been designed and developed in accordance with international law. If a state develops or commissions systems and then uses them in an unlawful manner, it is obliged to provide full legal redress for any damage resulting from the unlawful use of those systems.

Given the relatively risky nature of the use of autonomous weapon systems in conflict situations, consideration should be given to the introduction of a principle of strict liability in the context of state responsibility, especially in the case of technical defects and design flaws. This form of liability has not yet been generally enshrined in international law. Strict liability is based solely on damage caused. In this context, it is irrelevant whether the state was negligent or at fault in any way. Even if it has complied with its due diligence obligations, the state may still be held responsible under a strict liability regime. Likewise, it is irrelevant whether or not the damage in question results from the formal violation of an obligation under international law.

A strict liability regime is ideally suited to the regulation of autonomous weapon systems.[119] It is an ethically appropriate way of attributing the risk of technical malfunctions, accidents and design flaws – and the resulting damage – to the state. Strict liability may also encourage states to demand high quality standards in the development stage. However, not every use of autonomous weapon systems gives rise to strict liability. If a state lawfully uses such a system against military targets, in full compliance with international humanitarian law, it is not responsible for the harm caused.

Various treaties, for example in the field of space law, already impose strict liability on states for damage caused by certain – in themselves permissible – activities.[120] The introduction of strict state liability for damage caused by autonomous weapon systems will require a new treaty.

Procedurally speaking, a state can in certain cases and under certain conditions be held responsible before international courts, such as the International Court of Justice, the European Court of Human Rights or an international court or tribunal specifically established for cases relating to the use of autonomous weapon systems. In some countries, such as the Netherlands, a state can also be held responsible before its own courts (e.g. the Srebrenica case against the Dutch state which was heard by the Dutch courts).

State responsibility has three advantages over individual liability. First, states have more financial resources than individuals and will therefore be able to compensate victims more easily. Second, the threat of state responsibility causes states to operate more carefully in the various stages of the development, procurement, integration and use of autonomous weapon systems. State responsibility thus leads to more systemic change than individual liability.[121] Third, as explained in the next section, it is difficult to hold an individual liable for wrongful acts committed through the use of autonomous systems, as the individual concerned generally has no intention of committing or causing these acts. On the other hand, in order to hold a state responsible, it is not necessary to prove intent.

Individual criminal liability: the operator

In addition to states, individuals can in principle be held liable for violations of international law caused by autonomous weapon systems. This is done mainly on the basis of international criminal law. However, it is not self-evident that an individual will be held criminally liable for the consequences of using autonomous systems, as they may not have wanted or accepted these consequences and may therefore not be at fault. In such cases, the requirement of *mens rea* is not met. *Mens rea* is formed by (1) an intent in relation to the consequences or (2) an awareness of the consequences. In the case of military operators who operate autonomous weapon systems and carry out attacks but only exercise limited human control in the final phase of the use of force, it is questionable whether intent can be proven.

Nevertheless, it could be argued that the requirement of *mens rea* is met not only in the case of intent in the strict sense but also when a person knowingly acts in a risky or 'reckless' manner, thereby causing unintended harmful consequences (*dolus eventualis*). This approach makes it possible to attribute liability to human operators who 'envisage and accept the risk of civilians being attacked' when using autonomous weapon systems. However, operators are not liable for attacks against military targets that cause civilian casualties in so far as this loss of life is proportional to the expected military advantage. This is because such attacks do not constitute war crimes.[122] It could thus be argued that *dolus eventualis* is already part of current international criminal law.[123]

Another option that could be considered is holding operators liable not only in the event of intentionally or knowingly risky or reckless action but also in the event of ordinary or gross negligence. As a result, the entire military decision-making chain might devote more attention to the risks associated with the use of autonomous systems. The negligence standard of liability has not yet been adopted in international criminal law, although it features in various national criminal codes.[124] Dutch criminal law also recognises a form of guilt based on negligence, known as *culpa*, for example in the case of culpable homicide.[125]

However, in cases where the actions of a semi-autonomous system could not have been foreseen, for example due to a technical malfunction, the human operator will not be liable. This is because the operator has acted neither intentionally or recklessly, nor in a negligent manner. It would be morally indefensible to hold an operator criminally liable in such situations.[126]

Individual criminal liability: the commander

International criminal law holds commanders responsible if they (1) had effective control over the actions of their subordinates as a superior during military operations (i.e. there was a relationship of dependency); (2) had knowledge of the actions of their subordinates; and (3) nevertheless did not prevent or punish the commission of the criminal offence. Under the doctrine of command responsibility, military superiors can be punished for their role in failing to place appropriate limits on the use of autonomous weapon systems if such failure results in wrongful acts.[127]

Under such circumstances, a commander's negligence may lie in not taking a sufficiently active approach to obtaining information and knowledge about the performance of the system and the consequences of its use by the operators. Like operators, moreover, commanders can also be held

liable for reckless conduct, i.e. knowingly deciding to activate an autonomous weapon system whose performance and effects they cannot reasonably predict.[128] However, commanders are not criminally liable – directly or indirectly – if they or their subordinates had no intention of committing a crime and did *not* behave recklessly. They are consequently not liable in the event of unforeseeable technical malfunctions in autonomous systems. As long as the targeting process contains sufficient safeguards and commanders ensure that the system is used judiciously, they will not be liable for wrongful acts committed by subordinates.

Under military law, commanders nevertheless remain responsible, if not necessarily criminally liable, for all 'actions on the battlefield', including the use of autonomous systems. In this context, it does not matter whether a subordinate makes a mistake, a machine acts in an unexpected manner or an unforeseeable incident occurs.[129] In such cases, the government can impose disciplinary or administrative sanctions against the responsible commanders.

Liability of the developer

Whether developers, be they individuals or companies, can and should be held criminally liable is a controversial issue. A developer or programmer who programs an autonomous weapon in such a way that it operates in violation of international humanitarian law may be liable as an accessory.[130] Even if the programmer did not want any violations to take place as such, they can still be held liable, like an operator, if they acted recklessly, knowingly took risks or were grossly negligent.

However, the problems associated with a malfunctioning autonomous system often stem from a combination of design choices, human error and operational circumstances. In practice, it is difficult to place responsibility for an unexpectedly malfunctioning autonomous weapon system on the developer, not least because such systems have already been extensively tested – or at least should have been. In addition, developers are located at such a distance from the operational environment, namely at the very beginning of the system's life cycle, that attributions of liability are very difficult to defend.[131]

National and international civil law, which does not require intent *per se* but rather negligence (including its lighter forms), may provide opportunities to hold developers civilly liable for wrongful acts resulting from the use of autonomous systems (product liability).[132] In principle, however, a developer cannot be held liable if the actions of such a system were unforeseeable, unless a strict liability regime is introduced.[133]

Corporate social responsibility

Leaving aside their potential legal liability for wrongful acts resulting from the use of autonomous systems, companies have at the very least a moral responsibility to develop autonomous weapon systems whose subsequent use is compatible with international humanitarian law and human rights. This is also in keeping with the principles associated with 'corporate social responsibility'.

In accordance with international law, however, the responsibility for regulating the use of autonomous weapon systems rests primarily with states, which have a duty to enact and/or enforce national legislation and supervise the activities of companies. Corporate responsibility with regard to autonomous weapon systems should therefore be enforced primarily on the basis of national law. The government should consider reviewing national civil and criminal law to determine whether any tightening of national legal rules and liabilities would be appropriate.

Towards an enhanced responsibility and liability regime

At the end of the day, it is quite possible that nobody can be held legally liable for the harmful outcome of the use of autonomous systems, because each individual properly performed the specific role assigned to them.[134] In spite of this, states can still be held responsible, potentially on the basis of a strict liability regime. In order to prevent the state from incurring responsibility, it would in

any case be advisable to strengthen human control over autonomous weapon systems at the various technical, socio-technical and governance levels.[135]

It is recommended that the government, in consultation with the private sector, promote a culture of 'shared responsibility' throughout the decision-making chain, while simultaneously avoiding excessive 'fragmentation' of representatives or decision-makers. Compliance with the appropriate rules in the phase prior to the actual implementation should prevent this. To this end, the government must develop concrete guidelines as well as verification tools and certifications.

5.5 Further regulation of fully autonomous and semi-autonomous weapon systems

The 11 Guiding Principles formulated by the UN CCW Group of Governmental Experts (GGE) and the European Parliament's resolution of 20 January 2021 on artificial intelligence both discuss human control and responsibilities across the entire lifespan of a system.[136]

The AIV and the CAVV note that the UN's 11 principles are formulated too broadly in their current form. The principles do not in themselves constitute a normative framework, nor do they address a core standard for human control or contain any real rules. However, they do send states a clear message regarding the values that the international community would in any case like to see safeguarded in the development of autonomous weapon systems. They also serve as a guideline for the further conceptual elaboration of human-machine interaction and possibly even human-machine teaming.[137]

Like the AIV and the CAVV, SIPRI believes that the 11 Guiding Principles provide some useful pointers but that they are not sufficient from a legal perspective. Many issues remain unclear. For example, it is not clear precisely what international humanitarian law requires, allows or prohibits when it comes to the development or use of autonomous weapon systems. All this while the CCW should be the pre-eminent forum for determining how human-machine interaction can take place in full compliance with international humanitarian law.[138]

As demonstrated in previous sections, the mere linkage of the lawful use of semi-autonomous weapon systems to the presence of meaningful human control is not sufficiently specific to make it possible to determine in practice whether this is actually the case. Moreover, there is still no international consensus on the exact meaning of meaningful human control.

It was established earlier that there is currently no absolute prohibition on the development and use of autonomous weapon systems in international law, but that such use is nonetheless conditional on certain factors. However, given the potential for abuse by certain states and non-state actors, the speed of technological developments and the fact that private companies will start playing an increasingly important role in the standardisation of norms in the absence of state-imposed norms, the AIV and the CAVV believe that it is necessary to develop further regulation on the development, procurement and use of fully autonomous and semi-autonomous weapon systems and the responsibilities of actors in the various stages of the life cycle of such systems. They therefore believe that the Guiding Principles are not sufficiently specific to guarantee the lawful use of semi-autonomous weapon systems with due regard for meaningful human control.

The 11 Guiding Principles of the UN in summary:

1. International humanitarian law applies under all circumstances to the development and use of weapon systems, including the potential development of lethal autonomous weapon systems (LAWS).
2. Human control and responsibility should always be guaranteed.
3. Human-machine interaction may take various forms but should always aim to enhance the quality of action in an operational context and comply with international law, in particular international humanitarian law.
4. It should be clear who bears responsibility for the use of force.
5. Risk mitigation should be part of the design, development, testing and use of emerging disruptive technologies (EDT) within weapon systems.
6. The use of EDT must comply with prevailing international humanitarian law.
7. Human responsibility cannot be transferred to a machine. The nature and locus of responsibility are of crucial importance.
8. Countries should always be able to guarantee a weapon review.
9. Due to the risk of direct physical or non-physical (hybrid) threats, dual use and the use of EDT by terrorist groups, the risk of proliferation should be taken into consideration.
10. LAWS should not be anthropomorphised.
11. Multilateral debates and discussions on LAWS within the context of the CCW should not impede or delay the development of peaceful intelligent autonomous technologies.

Source: Guiding Principles, GGE LAWS CCW UN 2019: UN-191213_CCW-MSP-Final-report-Annex-III_Guiding-Principles-affirmed-by-GGE.pdf (ccdcoe.org)

This position also enjoys increasing support in academic circles. For example, SIPRI advises states to draw up standards and codes of conduct that will allow users of autonomous systems to foresee whether the operation, performance and effects of these systems would be lawful. In this regard, it is important to ensure that the consequences of the use of an autonomous system can be traced back to the actions of a person and/or a state. In addition, SIPRI recommends that states further elaborate the legal and ethical foundations for human-machine interaction as regards compliance with international humanitarian law.[139]

The AIV and the CAVV emphasise that there are various options for establishing further regulation for both fully autonomous and semi-autonomous weapon systems. This is not so much about developing entirely new legal rules as it is about putting the rules described in this chapter into practice.

The AIV and the CAVV see possibilities in drawing up an Additional Protocol to the CCW or a new Protocol to the Geneva Conventions. This protocol could explicitly codify a prohibition of the development and use of fully autonomous weapon systems (even though such a prohibition already follows implicitly from the consideration that such systems are unable to independently apply the humanitarian law principles of distinction, proportionality and precaution).

As regards the development, procurement and use of semi-autonomous weapon systems, this protocol could also specify how meaningful human control should be guaranteed in the various stages of the decision-making process. Earlier in this chapter, the AIV and the CAVV indicated how this specification might take shape. A new protocol could also lay down further rules regarding the various forms of liability. Examples include strict liability, which was referred to the context of state responsibility, and ordinary and gross negligence, which were mentioned in the context of individual criminal liability.

In addition to exploring the likelihood of support for an Additional Protocol, efforts can be made to exchange best practices under existing Article 36 of Additional Protocol I to the Geneva Conventions. It is also possible to start developing codes of conduct for the various actors that are involved in the development or use of autonomous weapon systems at some point, including actors from the private sector.

Like MP Salima Belhaj, the AIV and the CAVV believe that the Dutch government should work at international level towards the transposition of Article 36 of Additional Protocol I to the Geneva Conventions into national law. This would apply to semi-autonomous weapon systems and the underlying technology, since the AIV and the CAVV are pushing for the introduction of a prohibition on the development and use of fully autonomous weapon systems.

Furthermore, states should work to promote and ensure compliance with their obligations in the development or procurement stage, i.e. prior to implementation. In order to facilitate this, it would be useful to develop, at international level, an interpretative guide that explains how to operationalise meaningful human control in the various stages of development and procurement, as well as in connection with the actual use of autonomous weapon systems in different situations. This will provide states and companies with greater insight into the legal implications and responsibilities arising from certain innovations.

Chapter 6

Synopsis and conclusions

summary

The convergence of two tracks

The present advisory report by the AIV and the CAVV takes a two-track approach. On the one hand, it points out that recent technological and geopolitical developments have fuelled growing concerns about the abuse and erosion of legal and ethical frameworks. The report mentions several obvious objections to autonomous weapon systems, such as the lowering of the threshold for the use of force, the lack of clarity as to who exercises control and bears responsibility for the deployment of autonomous weapon systems and the growing uncertainty with regard to the legal frameworks. There is an increasing need for greater clarity on how the current legal framework applies to the various types of *semi-autonomous* weapon systems. At the same time, the government should more actively promote the implicit ban on *fully* autonomous weapon systems that arises from existing international humanitarian law, and push for the adoption of an explicit ban.

On the other hand, from a security perspective, the AIV and the CAVV consider it necessary (precisely because of the above-mentioned alarming technological and geopolitical developments) for the Dutch government to invest more in new technologies and the development, procurement and use of *semi-autonomous* weapon systems, provided they are better regulated. In this context, the Netherlands should work closely with international partners, research institutes, the private sector and non-governmental organisations.

I. The need to regulate

Dutch parliament has rightly expressed concern about the development and use of autonomous weapon systems on a number of occasions. Members of parliament have highlighted an important problem: the lack of explicit rules for the use of autonomous weapon systems. This is also what scientists and non-governmental organisations are warning the Dutch government about when they point to the dangers of lethal autonomous weapon systems in which humans are no longer in control and the system can independently make life-or-death decisions. The overly generic rules of contemporary international humanitarian law offer little in the way of a specific framework for the regulation of new weapon systems.

In order to address these alarming reports, the AIV and the CAVV make a clear distinction in this advisory report – more so than in their 2015 report – between *semi-autonomous* weapon systems, which include a certain degree of human control, and *fully autonomous* weapon systems, in which such control is absent.

International humanitarian law prescribes that the principles of distinction, proportionality and precaution must always be respected when weapon systems are deployed. Because the deployment of fully autonomous weapon systems does not involve human control – and because such systems cannot independently apply the principles of distinction, proportionality and precaution – the AIV and the CAVV are opposed to their deployment. The AIV and the CAVV call on the Dutch government to take a clearer position against the development and use of fully autonomous weapon systems.

With regard to semi-autonomous weapon systems, the AIV and the CAVV note that their development, procurement and use in conflict situations is permitted, provided there is meaningful human control that guarantees that the international humanitarian law principles of distinction, proportionality and precaution are respected.

In this advisory report, the AIV and the CAVV focus principally on the question of how and when meaningful human control is exercised over semi-autonomous weapon systems. In order to understand how human control can be ensured, a broader definition of 'autonomy' is needed. That is why the AIV and the CAVV focus on a model developed by Noel Sharkey, as expanded by Daniele Amoroso and Guglielmo Tamburrini. This model differentiates among five levels of autonomy within a weapon system, depending on the operational context. In practice, this scale encompasses all forms of autonomy currently conceivable in connection with the development and deployment of autonomous weapon systems.

The AIV and the CAVV recommend making the concept of meaningful human control an integral part of the different stages of the decision-making process. For example, there are various legal, policy and ethical decision points throughout the entire chain of command. Moreover, even *before* a decision is made concerning a specific attack, individuals in positions of political responsibility will have already made decisions about the development, procurement and general use of semi-autonomous weapon systems in a given conflict.

In addition to the importance of meaningful human control as a guarantee for compliance with the criteria of international humanitarian law, it is also necessary – from the point of view of legitimacy and political and public accountability – that those who hold political office and positions of responsibility are able to show how diligent and informed decision-making on the development, procurement and use of semi-autonomous weapon systems takes place.

The AIV and the CAVV are of the opinion that the Dutch government should enhance its efforts to make the implicit ban on fully autonomous weapon systems that arises from existing international humanitarian law more explicit. At the same time, the government will have to push for the adoption of further ethical and international rules and/or guidelines for semi-autonomous weapon systems.

At international but also at national level, consultations on these issues between government bodies, the private sector, civil society organisations and research institutes need to be intensified. The Netherlands' position should be prepared in a broad-based and open manner. To this end, structured consultations should be set up between government bodies, the private sector, civil society organisations and research institutes. Limiting development to semi-autonomous weapon systems must be central to this effort.

In addition to examining the lawfulness of the use of semi-autonomous weapon systems, it is important to carefully identify how responsibility for unlawful use is allocated. Different forms and levels of responsibility can be complementary, meaning that different actors can be held responsible for the same actions of a system.

Under general international law states can be held responsible for unlawful actions in the international arena of autonomous weapon systems whose use can be attributed to them. In addition, they can incur responsibility if they do not fulfil their duty of care, for example if they develop or commission systems whose use is unlawful. States are obliged to provide full legal redress for any damage resulting from the unlawful use of such systems. Given the relatively risky nature of the use of autonomous weapon systems in conflict situations, consideration should be given to the application of a principle of strict liability in the context of state responsibility, especially in the case of technical defects. Strict liability is based solely on damage caused and does not require fault or illegality.

In addition to states, individuals and companies can in principle be held criminally or civilly liable for violations of international law caused by autonomous weapon systems. In this context, the focus is chiefly on the role of the operator, the commander and the developer. However, it is not self-evident that these persons can be held criminally liable for the consequences of using autonomous systems if they did not want or accept these consequences and are therefore not at fault.

Given the potential for abuse by certain states and non-state entities, the speed of technological developments and the fact that private companies will be playing an increasingly important role in the standardisation of norms, the AIV and the CAVV believe that it is necessary to develop regulation that goes further than the Guiding Principles of the CCW. This concerns regulation with regard to the development, procurement and use of fully autonomous and semi-autonomous weapon systems and the responsibilities of actors in the various stages of the life cycle of such systems.

A moratorium on the development and use of fully autonomous or semi-autonomous weapon systems, as advocated by some countries within the CCW, cannot count on sufficient international support at present. A moratorium is a political tool that can be used to compel states not to develop or use autonomous weapon systems. The problem is that technological developments in this area have a strong civilian component. Putting a stop to technological developments in the civilian domain in order to prevent their military application is a complicated matter. Pushing for a moratorium is therefore not deemed appropriate at this time.

The AIV and the CAVV emphasise that there are various options for creating further regulation for both fully autonomous and semi-autonomous weapon systems. This is not so much about developing entirely new legal rules but rather about putting the existing rules described in this chapter into practice. The AIV and the CAVV see possibilities in drawing up an Additional Protocol to the CCW. This protocol could explicitly codify a prohibition of the development and use of fully autonomous weapon systems (even though such a prohibition already follows implicitly from the consideration that such systems cannot independently apply the humanitarian law principles of distinction, proportionality and precaution).

Efforts can also be made to exchange best practices under existing Article 36 of Additional Protocol I to the Geneva Conventions. In this context, efforts could focus on developing codes of conduct for the various actors involved at some point in the development or use of autonomous weapon systems, including actors from the private sector.

II. The need to invest

The AIV and the CAVV note that there has been a significant expansion of geopolitical and technological activity and investment since the publication of their previous advisory report in 2015. Around the world, many state and non-state actors are working on the development of semi-autonomous weapon systems, but in an uncoordinated manner. It is very important that the Netherlands pay constant and rigorous attention to these developments in the political, diplomatic, technical and financial fields.

Looking at technological developments and geopolitical threats, the AIV and the CAVV observe that a shift is taking place in the way conflicts are conducted. Technology is expected to increasingly influence the nature of warfare. According to NATO, this will occur mainly through the development of data (including big data), robotics, artificial intelligence, biotechnology, nanotechnology and quantum computing.

Artificial intelligence and robotics are vital to the development of autonomous weapon systems. Artificial intelligence consists of algorithms (software). These are mathematical formulas and models that – once they have been fed with available data – enable a system to function. Robotics (hardware)

describes the physical components of a machine that enable it to take action in the physical world. By interacting with the software and the environment in which it operates, a robot is able to simulate complex movements. Besides artificial intelligence, new technologies such as quantum computing and data will most likely play a decisive role in the development of autonomous weapon systems.

For now, artificial intelligence and robotics appear to be especially useful in controlled environments, where algorithms are able to apply machine learning using large quantities of data. In the operational domain, the use of artificial intelligence and robotics is still proving complicated. The land domain is by far the most complex setting for the development of intelligent robots, because in this chaotic environment the large number of variables and the simulation of movement create technical hurdles. Since the air domain is a relatively predictable environment, developments there are occurring at the fastest pace. Autonomous action in the underwater domain and the cyber domain remains a major challenge at this time.

When it comes to exercising control over the deployment of semi-autonomous weapon systems, it is important to distinguish between autonomy in making a decision and autonomy in implementing that decision. Central to this is 'human-machine interaction', which is based on the premise that humans and machines understand and are able to respond to each other's context, needs, capabilities and limitations. In order to develop semi-autonomous weapon systems characterised by intensive interaction between human and machine, consideration should be given to the application of concepts such as machine ethics and transfer of control.

The AIV and the CAVV recommend taking the concept of explainable AI as the starting point for the development of semi-autonomous weapon systems. This implies that the artificial intelligence and the underlying mathematical models and data must be explainable at all times. It should also be clear which parts of the decision-making process are subject to human control and what responsibilities this entails. The Dutch armed forces must be trained to work within these parameters.

Even more so than in 2015, when the previous advisory report was published, there appears to be an international race for technological supremacy. In investment terms, the US, China and Russia are leading the way, investing tens of billions of euros in the development of disruptive technologies for military use. States are increasingly suspicious of each other and are less willing to submit to international regulation. In the meantime, many of them are expanding their own networked, semi-autonomous military capabilities as quickly as possible.

In addition to the above-mentioned three powers, there are smaller countries which, while less significant in quantitative terms, are nevertheless at the forefront of technological development. Examples include South Korea and Israel, which are both scoring high in terms of investment and the creation of a high-tech innovation climate. The role of Turkey, which is making remarkable progress in the field of autonomous weapon systems, also deserves attention. In addition, various non-state actors, such as terrorist groups, are also developing autonomous systems.

The EU member states jointly have the second-highest defence budget in the world – after the US – and the knowledge and capabilities to develop advanced hardware for autonomous weapon systems. The problem, however, is that the EU is too divided internally. Moreover, many investments in key technologies primarily target the civilian domain. The EU needs to assume a clearer role when it comes to investing in knowledge and skills in the military domain, but also in the formulation of legal and ethical standards and the pursuit of arms control. NATO is more active in setting standards and regulating responsible use. In addition, it is developing an ethical framework for the use of artificial intelligence in military systems that will help ensure both individual and state responsibility. The Netherlands should make a significant contribution to these efforts.

It is important for the Netherlands to keep participating in the field of knowledge and innovation. In light of the return of fierce competition between major powers – at higher levels than in 2015 – it is important that the Netherlands does not lag behind. The use of semi-autonomous weapon systems has important military-operational advantages. In recent years, the Dutch armed forces have therefore worked and experimented with semi-autonomous systems in various domains. The Netherlands should not only have such systems at its disposal – and therefore be willing to invest the necessary funds – but should also commit to exchanging advanced technological knowledge with NATO Allies and EU partners through an ambitious innovation programme. However, the AIV and the CAVV emphasise that these investments should be assigned a clear direction and purpose. This can be achieved by linking them to government supervision.

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Appendix I

Advisory request

Ministerie van Buitenlandse Zaken

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Date 30 June 2020
Re Request for updated advisory report on autonomous weapon systems

Dear Mr Chair and Madam Chair,

In October 2015 the AIV and the CAVV presented the government with their joint advisory report, 'Autonomous Weapon Systems: The Need for Meaningful Human Control'. The insights and guidelines contained in that report have since formed the basis of the development of Dutch policy on autonomous weapon systems. The AIV/CAVV recommended reviewing the relevance of the advisory report after five years to assess the extent to which its insights and guidelines are still applicable. The government therefore requests that the AIV and the CAVV update the 2015 report.

The context today is different from that of five years ago. The fields of robotics and artificial intelligence (AI) are advancing rapidly. Stanford University's AI Index 2019 Report shows, for example, that the speed of AI computational capacity is doubling every three months.[1] At the same time, talks on this subject in the framework of the Group of Governmental Experts on Lethal Autonomous Weapons Systems (GGE LAWS), mandated by the States Parties to the Convention on Certain Conventional Weapons (CCW), have yielded new insights. There is agreement on 11 'Guiding Principles' concerning the development and use of autonomous weapon systems. Under these principles, there must always be a certain degree of human involvement in the use of autonomous weapon systems in order to meet the requirements of international law. With these principles the participating countries emphasise that humans will always retain responsibility for the use of weapon systems, as machines cannot render account for their actions. The practical

[1] https://hai.stanford.edu/sites/g/files/sbiybj10986/f/ai_index_2019_report.pdf.

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application of these and other principles – as has been government policy in recent years – nevertheless needs to be elaborated in more detail in the run-up to the five-yearly CCW Review Conference, to be held in 2021.

Given the above developments, the government would like to have an update to the 2015 AIV/CAVV advisory report. Although the questions the government posed in 2015 can be used again, in part, to structure the report, the government has also identified a number of additional issues that are relevant in the current context. The government therefore presents the AIV and the CAVV with the following questions to be addressed in the advisory report:

1. The 2015 advisory report concluded that if the Dutch armed forces are to remain technologically advanced, autonomous weapons will have a role to play, now and in the future. The government shares this view. Moreover, the investments being made by a large number of countries in the development of autonomous military applications show that autonomous weapon systems and technologies are increasingly set to be a part of the military toolkit. At present, China, Israel, Russia and the United States are the leading players in the development of this technology. Given the predicted strategic impact of autonomous weapon systems and technologies, the government believes that arms control initiatives make sense only if all the relevant players take part.

How, in the view of the AIV and the CAVV, do potential arms control initiatives relate to national and allied security perspectives on the development of autonomous weapons? What role do the AIV and the CAVV see for Dutch efforts at NATO level with a view to the defence of the Alliance, and for defence cooperation at EU level?

2. In the 2015 report the AIV and CAVV concluded that the deployment of autonomous weapons must always involve meaningful human control in order to meet the requirements of international law. The government agrees with this view. There is also agreement at international level that there is a link between human involvement and the requirements of international law. The substance of this human role, however, needs to be elaborated in more detail. How do the AIV and the CAVV believe the substance of that role should be shaped?

3. While the Netherlands is committed to the concept of 'meaningful human control', other countries are opting for concepts such as 'supervision' or 'intervention' to express the interaction between humans and machines. Do the AIV and the CAVV see scope for reaching international agreement on a concept that is supported by a majority of countries but is at the same time sufficiently comprehensive to safeguard the underlying principles inherent to 'meaningful human control'?

4. In its response to the 2015 advisory report, the government rejected out of hand the development and use of fully autonomous weapon systems because, in accordance with the advisory report, it took the view that the use of such systems is incompatible with the

requirements of international law. Do the AIV and the CAVV still maintain this position, and if so, can they explain which provisions of international law this position is based on?

5. In 2015 the AIV and the CAVV argued that a moratorium on the development and use of fully autonomous weapon systems was neither expedient nor feasible. Five years on, do they still maintain this position, or do they see grounds for revising this view?

6. In the public debate on autonomous weapon systems there have been loud calls for a legally binding ban on such systems. In the 2015 advisory report the AIV and the CAVV argued that such a ban was neither necessary nor expedient, because the current international legal framework was adequate to regulate the development and use of autonomous systems. Is this still the position of the AIV and the CAVV?

7. Since its establishment the GGE LAWS has made progress towards achieving an international consensus on the principles underlying the development and use of autonomous weapons. The 11 Guiding Principles are the most visible example of this. What is the AIV and the CAVV's assessment of these principles, bearing in mind the Netherlands' need to define its position in the debate on the further elaboration of the Guiding Principles in the run-up to the CCW Review Conference?

8. Developments relating to artificial intelligence and autonomy are largely taking place within the private sector. In the view of the AIV and the CAVV, do government authorities have sufficient insight into these developments? Could Dutch government authorities play more of a steering/supervisory role in this regard?

9. In the context of autonomous weapon systems, concerns are sometimes expressed about the risk of non-state actors, particularly terrorist groups, acquiring such systems. To what extent do the AIV and the CAVV consider this risk likely, and if so what should government authorities do to address it?

The government would be grateful if the AIV and the CAVV could submit their advisory report well in advance of the CCW Review Conference in 2021.

We look forward to receiving your report.

Yours sincerely,

Stef Blok
Minister of Foreign Affairs

Ank Bijleveld
Minister of Defence

Appendix II

List of experts consulted

Several external experts were consulted prior to the drafting of this advisory report. The AIV and the CAVV are grateful to them for their insights and contributions.

- Dr Hans Boddens Hosang – Ministry of Defence
- Patrick Bolder – Hague Centre for Strategic Studies
- Dr Berenice Boutin – Asser Institute
- Professor Philip Brey – University of Twente
- Anja Dahlmann – German Institute for International and Security Affairs
- Dr Jurriaan van Diggelen – Netherlands Organisation for Applied Scientific Research (TNO)
- Professor Paul Ducheine – University of Amsterdam / Netherlands Defence Academy
- Dr Merel Ekelhof – *in a personal capacity*
- Pieter Elands – Netherlands Organisation for Applied Scientific Research (TNO)
- Daan Kayser – Pax for Peace
- Geert Kuiper – Ministry of Defence
- Professor Frans Osinga – Leiden University / Netherlands Defence Academy
- Max van Rij – Ministry of Foreign Affairs
- Dr Jiří Šedivý – European Defence Agency (EU)
- Major General André Steur – Ministry of Defence
- Professor Stefano Stramigioli – University of Twente
- Dr Rogier Verberk – Netherlands Organisation for Applied Scientific Research (TNO)
- David van Weel – NATO

- Land Systems Analyst – Defence Intelligence and Security Service (MIVD)
- Military Technology Specialist – Defence Intelligence and Security Service (MIVD)
- Military Technology Team Leader – Defence Intelligence and Security Service (MIVD)

Appendix III

List of abbreviations and terms

AI	Artificial intelligence
AIRCW	Advisory Committee on International Law and the Use of Conventional Weapons
AIV	Advisory Council on International Affairs
AIVD	General Intelligence and Security Service
ARSIWA	Articles on Responsibility of States for Internationally Wrongful Acts
ASML	ASML Holding N.V. (Dutch high-tech company)
AUKUS	Defence pact between Australia, the UK and the US
CAAW	Advisory Committee on Autonomous Weapon Systems
CAVV	Advisory Committee on Issues of Public International Law
CCW	Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (Convention on Certain Conventional Weapons)
CSDB	Collaborative Small Diameter Bombs, US bombs that autonomously detect targets
D66	Democrats '66
EDT	Emerging disruptive technologies
EU	European Union
GGE	Group of Governmental Experts
Ghost Swimmer	Unmanned maritime system
Goalkeeper	Semi-autonomous anti-aircraft gun system used on frigates (close-in weapon system)
Harpy	Self-guided munition that autonomously detects and engages targets (Israel)
Hellfire missiles	US missiles that can be launched from drones
IBM	International Business Machines Corporation (multinational technology company)
ICRAC	International Committee for Robot Arms Control
ICRC	International Committee of the Red Cross
IISS	International Institute for Strategic Studies
ILC	International Law Commission
Knifefish	Unmanned maritime system
LAWS	Lethal autonomous weapon system
MHC	meaningful human control
MIVD	Defence Intelligence and Security Service
MQ-9 Reaper	Unmanned aerial vehicle
NATO	North Atlantic Treaty Organization
NCTV	Office of the National Coordinator for Counterterrorism and Security
NXP	NXP Semiconductors N.V. (Dutch high-tech company)
OODA	Observe–Orient–Decide–Act
Operation Haymaker	US drone mission in Afghanistan
PackBot	Semi-autonomous ground vehicle
PALWS	Partially autonomous lethal weapon system
Patriot	Unmanned air defence system
PAX	Pax for Peace
Remus	Unmanned underwater drone
Remus-600	Unmanned maritime system
Samsung SGR-A1	Semi-autonomous sentry gun (South Korea)
Sea Hunter	Unmanned warship (US)
SIPRI	Stockholm International Peace Research Institute
SkyStriker	Self-guided munition that autonomously detects and engages targets (Israel)
STM Kargu-2	Self-navigating drone with rotating wings (Turkey)

THeMIS	Unmanned ground vehicle
UAV	Unmanned aerial vehicle (drone)
UK	United Kingdom
UN	United Nations
UNIDIR	United Nations Institute for Disarmament Research
UNODA	United Nations Office for Disarmament Affairs
Uran-9	Unmanned tank (Russia)
US	United States
VVD	People's Party for Freedom and Democracy
WRR	Netherlands Scientific Council for Government Policy

List of figures