



**MINISTÈRE
DES ARMÉES**

*Liberté
Égalité
Fraternité*

DEFENCE ETHICS COMMITTEE

OPINION ON THE INTEGRATION OF AUTONOMY INTO LETHAL WEAPON SYSTEMS

April 29th 2021

April 29th 2021

OPINION ON THE INTEGRATION OF AUTONOMY INTO LETHAL WEAPON SYSTEMS

Executive Summary

A dual technological and ethical disruption

- (1) Automated devices have long been used in weapon systems employed in military operations on land, at sea or in the air. However, the concept of "autonomous weapon systems", currently used in civil society to condemn the very principle or, in certain international fora, to restrict their use, evokes, in all cases, the idea of a clear disruption in both technology and ethics.
- (2) Due to the prospects offered by the development of robotics, use of lethal weapon systems described as "autonomous" is a source of ethical questions linked to the very foundations of the military function:
 - How can the operational superiority of our armed forces be maintained without losing our values?
 - What role should be reserved for humans in warfare?
 - How do we preserve the moral integrity of combatants?
 - To what extent will humans be responsible in the conduct of war?

Autonomy in lethal or non-lethal weapon systems

- (3) The Committee initially focused on identifying what **autonomy in lethal or non-lethal weapon systems actually means**, and on assessing current developments in this field.
- (4) In this respect, the Committee considers it essential to emphasise that an "autonomous" system does not define its own rules. To understand autonomy, we should stress that behind autonomy, there is automation; behind automation, there is software; and behind software, there are human beings who define the system's rules, including the rules that authorise the system to disregard those rules.
- (5) The Committee therefore notes that terms such as "*autonomy*", "*autonomous*" or "*intelligent system*" are ambiguous when applied to machines. Anthropomorphic words are misleading when they are used to describe things, weapons or weapon systems.
- (6) The very concept of lethal weapon systems must be clarified. In this regard, the Committee believes that the concept does not, by definition, include either non-lethal decision support systems, even if they play a role in the conduct of military operations and combat action, or devices forming the digital environment of soldiers. While such systems are likely to raise ethical questions on which further studies could focus, they can be delinked from questions relating to autonomy in lethal weapon systems. Studying these different topics together would be of no benefit and the Committee has therefore focused solely on issues relating to the integration of autonomy into lethal weapon systems.
- (7) **Some distinctions must be made as regards lethal weapon systems.**
- (8) First, a distinction must be made between automated weapon systems, in which automation performs non-critical "low level" functions, and lethal weapon systems in which critical "high-level" decision-making functions are automated. Decision-making and command functions allocated to automation represent the factors of disruption.
- (9) Secondly, in higher-level weapon systems, **there is a difference between lethal autonomous weapon systems, referred to as LAWS, and partially autonomous lethal weapon systems which remain under human control, hereinafter referred to as PALWS.**

- (10) **LAWS** are lethal weapon systems programmed to be capable of changing their rules of operation and therefore are likely to depart from the employment framework initially defined. Their software may compute decisions in order to perform actions without any assessment of the situation¹ by the command.
- (11) **PALWS** are lethal weapon systems integrating automation and software:
- to which, after assessing the situation and under their responsibility, the military command can assign the computation and execution of tasks related to critical functions such as identification, classification, interception and engagement within time and space limits and under conditions;
 - which include technical safeguards or intrinsic characteristics to prevent failures, misuse and relinquishment by the command of two essential duties, namely situation assessment and reporting.
- (12) In other words, a PALWS is a lethal weapon system whose decision-making functions are defined according to the robotics meaning of decision-making autonomy, i.e. within a specific framework of action. A PALWS cannot take lethal initiatives that would result in it altering its functional scope.

Reasons for renouncing the use of LAWS

- (13) The French government has declared that it renounces the use of LAWS. The Committee regards this decision as unquestionably sound in light of the ethical, legal and operational principles governing the action of the French armed forces. Indeed, use of LAWS would:
- break the chain of command;
 - run counter to the constitutional principle of having liberty of action to dispose of the armed forces;
 - not provide any assurance as to compliance with the principles of international humanitarian law (IHL);
 - be contrary to our military ethics and the fundamental commitments made by French soldiers, i.e. honour, dignity, controlled use of force and humanity.

Conditions for using PALWS

- (14) The refusal of LAWS should not be extended to the integration of automation into low-level functions of certain lethal weapon systems. Neither should it concern partially autonomous lethal weapon systems (PALWS) embedding higher-level automated functions or automated decision-making functions provided that human command is maintained in a manner ensuring compliance with the constitutional principle of having liberty of action to dispose of the armed forces, continuity in the chain of command and the principles of IHL. It is therefore vital to develop an operating analysis grid to enable French political and military leaders to **make informed choices concerning the development of autonomy in lethal weapon systems**.
- (15) **The use of PALWS can have operational benefits** in all conflict environments (land, air, sea, outer space, cyber space) in terms of performance, precision, pertinence, protection and permanence:
- performance (faster pace of operations, attack by saturation, area control, interoperability in coalition operations);
 - pertinence (processing masses of data; very high level defence penetration);
 - precision (strike capacity and reduced risk of error);
 - protection (protecting soldier life and health in hostile environments, defending military bases);
 - permanence (ability to take long-term action in all environments).

¹ Logical reasoning through which the commander takes into consideration all the factors influencing the military situation and decides on the conduct to be adopted to accomplish the mission.

(16) These benefits, namely the "5 Ps", must be **balanced with risks** that are equally very real:

- risks relating to public opinion regarding our operations and their legitimacy;
- the same risks among the armed forces themselves;
- operating risks (operator ability to understand and manage the systems, blurred responsibility, vulnerability to cyber attacks);
- risks of use (alteration of discernment and distancing, faster pace of actions and risks of escalation, temptation to make systematic and excessive use of systems because they reduce dangers for our soldiers).

(17) The design and implementation of PALWS should therefore only be contemplated if all **the guarantees of their correct use are met** (namely the "5 Cs"):

- command (maintain a chain of responsibility, command and internal control);
- risk control (risk analysis, technical and operational validation process, systematic feedback);
- compliance (correctly phased legality checks throughout the system's life cycle);
- competence (soldier instruction and training, raising awareness among authorities);
- confidence (qualification of critical automated functions, control over PALWS hardware and software, formal chain of responsibilities).

(18) Throughout the analysis, the Committee has identified six guiding principles and set out 25 guidelines relating to methodology, research, use, design and training.

List of principles and guidelines²

Guiding principles

P1 The issue of "autonomy in lethal weapon systems" should be examined solely from the perspective of its uniqueness stemming from the constitutional nature of the armed forces' mission, military status and ethics, and the strict national and international legal framework governing combat action.

P2 The principle of human responsibility in the design, deployment and use of decision-making autonomy in lethal weapon systems, whether or not they are described as autonomous, must not be breached. The highest values of our civilisation and our constitutional order require human responsibility in all circumstances.

P3 Use of LAWS by the French armed forces would be absolutely contrary to the French constitutional principle of having liberty of action to dispose of the armed forces and the principle of continuity in the chain of command. It would also jeopardise compliance by our forces with the principles of necessity, proportionality, humanity and discrimination between combatants and non-combatants, forming the foundations of international humanitarian law to which France adheres. Lastly, it would undermine the dignity of French soldiers and contradict military ethics. Such use, as well as manufacturing and exporting, should be refused.

P4 France should continue research in the fields of defence artificial intelligence and weapon systems automation for several reasons. First to avoid the country losing ground in the scientific and technological fields; second to counter enemy development of LAWS; and finally, to be able to defend ourselves against this type of weapon in the likely event of their use by an enemy State or

² The principles and guidelines are numbered in the rest of the document with these references (P1, P2., etc. G1, G2, etc.).

terrorist group against our troops or population. Such research must be governed by a strict ethical and legal framework and be conducted in compliance with legal review mechanisms.

P5 The difference between lethal autonomous weapon systems (LAWS) and partially lethal autonomous weapon systems (PALWS) lies in their nature, i.e. the human involvement in certain critical functions. However, the LAWS/PALWS distinction cannot hinge solely on proper human use of the system and should also be based on technical and organisational safeguards, such as devices, technical qualification and technical certification measures, or intrinsic design measures to prevent failures, misuse, and relinquishment of human prerogatives.

P6 Refusals of LAWS in the future, whether under French or international law, should not be extended to the integration of automation into low-level functions of certain lethal weapon systems. Neither should they concern partially autonomous lethal weapon systems (PALWS) embedding automated decision-making functions or higher level automated functions provided that human command is maintained in a manner ensuring compliance with the constitutional principle of having liberty of action to dispose of the armed forces, continuity in the chain of command and the principles of IHL.

Methodology guidelines

G1 This opinion should be regularly analysed and updated to take technological developments and changes in operational doctrine and reflection on capacity planning into account whenever necessary.

Research guidelines

G2 Strategic monitoring of autonomy in weapon systems should be carried on with a particular focus on definitions, stands adopted by governments and other entities, and emerging technologies, in order to compare them with the French view. This should lead to drawing conclusions about potential threats, the French armed forces' operational superiority and their interoperability in coalition.

G3 Research into autonomy in weapon systems should be continued, especially to preserve the operational superiority of our armed forces and be able, in particular, to neutralise enemy LAWS and PALWS, without using LAWS ourselves. This should include risk analyses and ethical reflection, focusing on the scope and possible developments of results.

Guidelines for use

G4 The risks of alteration in human control and the acceptability of assigning use of force to a machine should be systematically assessed during research, design, development and use of PALWS.

G5 The consequences of lethal actions carried out by a PALWS must be systematically evaluated by the command. In particular, only the chain of command shall have authority to change the targets of a mission in progress or to cancel the mission.

G6 The command should define a framework to transpose doctrine, i.e. target to be reached, space and time limits, constraints, engagement rules, for each mission performed by a PALWS. A PALWS should never be operated without an employment framework and should never have the capacity to depart from it without intervention by the chain of command.

G7 In any urgent operational situation, the chain of command must be alerted and must explicitly validate any new PALWS employment framework.

- G8** A PALWS should not be enabled to assign to another PALWS a mission that departs from the initial framework without prior validation by the chain of command.
- G9** The conditions under which continuous machine learning during a mission can be implemented for on-line computation of new tasks should be clearly specified.
- G10** When drafting doctrine on the use of weapon systems, appropriate information on automated decision-making functions should be provided. The conditions and limits of use should be clarified relying on technical and operational performance criteria and relevant ethical considerations.
- G11** The chain of responsibility involved in the definition, design, development, qualification and use of a PALWS should be formally defined in order to clearly identify the respective responsibilities of all the parties involved.

Design guidelines

- G12** Develop risk analyses based on compliance with French constitutional and military ethical principles.
- G13** Develop a process for the technical (performance, etc.) and operational (use, doctrine) validation of autonomous decision-making capacities, prior to operational commissioning and throughout the life cycle, and based on our ethical principles.
- G14** Ensure that operational feedback on the use of PALWS is provided and disseminated to all operational spheres, and to competent technical and legal authorities.
- G15** Define appropriate methods for monitoring legality in light of the new challenges induced by embedding automated decision-making functions in PALWS.
- G16** A risk, functional and value analysis method dedicated to the expected level of decision-making autonomy should be set up from the very beginning of the military requirement specification. This method should cover every stage in the process of meeting the requirements, including off-the-shelf devices and software, support functions and operational readiness services.
- G17** Mechanisms should be implemented to ensure human control is retained over the use of PALWS, including emergency deactivation systems if necessary.
- G18** Ensure that clearly defined qualification processes are designed for PALWS critical functions based on autonomous decision-making. These qualifications should enable control over the use of force and post-incident investigation/inspections. In particular, while the command may legitimately modify an assigned mission, a regulated technical and operational process must apply when changing the field of employment of a PALWS. Operational feedback will be systematically taken into account.
- G19** Particular attention should be paid to retaining national sovereignty over the technology used in PALWS critical functions and software as far as design, production, maintenance, etc. are concerned.
- G20** In order to develop trustworthy technologies, ensure that specification and qualification documents relating to artificial intelligence in weapon systems reflect the state of the art. Also ensure that such documents are fully adopted by all parties involved in the design and development of a weapon system. Additionally, the position of France as regards these new technologies should be made explicit at international level.

Training guidelines

- G21** Provide continuous operational preparation for strategic leaders, theatre commanders, tactical leaders and operators.
- G22** Pursue training and operational preparation efforts and adapt them, as necessary, to the growing complexity of PALWS, in order to master weapon systems and the full spectrum of their use, and understand the risks and limits in light of our ethical principles.
- G23** Ensure that personnel involved in the design, development and promotion of autonomy in lethal weapon systems are aware of the various risks and issues. Therefore, diplomats, researchers and engineers should also be made aware of these questions.
- G24** Provide training for all levels in command and operation, including during initial military training, in the use of autonomous decision-making technologies.
- G25** Inform public authorities of the ethical issues inherent in the use of PALWS.

Preamble	10
A. Ethics of the French Armed Forces	10
B. Purpose and Scope of our Opinion	12
C. Method	12
I. Lethal, Automated, Autonomous and Partially Autonomous Weapon systems	14
A. Weapon systems Characterisation and Differentiation	14
a) Lethal Weapon systems	14
b) Weapon system Automation	14
c) Lethal Autonomous Weapon systems (LAWS)	14
d) The necessary clarification between LAWS and partially autonomous lethal weapon systems	15
B. LAWS: Weapon systems renounced by France but possibly developed elsewhere	17
C. PALWS: systems that may prove necessary and legitimate in certain circumstances	18
II. Why and When Use PALWS?	20
A. Constitutional Requirements and Mission Success	20
B. A Strategic Context requiring Anticipation	20
C. Expected benefits: performance, precision, pertinence, protection and permanence: the "5 Ps"	21
D. Risks to be managed	23
a) Moral acceptability of using force without human intervention	23
b) Risks of Machine Learning	24
c) Risk of blurring responsibility in the event of an incident	24
d) Vulnerabilities induced by Digital Technology	25
e) Risks relating to the Use of these Weapon systems	25
f) Risks of Altering Human Control Mechanisms	25
g) Exogenous Risks	26
III. Which Safeguards and Framework?	27
A. Reaffirm the central role of humans and the principle of human responsibility	27
B. Design and implementation of PALWS must be subject to guarantees of proper use: command, control of risks), compliance, competence and confidence (the "5 Cs")	27
a) Command: maintain a chain of responsibility, command and control	27
b) Risk Control: Reasoning must be guided by ethical principles rather than technological progress ..	29
c) Compliance: ensure legality is correctly monitored throughout the life cycle of weapon systems ..	30
d) Competence: pay particular attention to the human factor and training	30
e) Confidence: pursue the initiative to develop and qualify "trusted" and strategic autonomy technologies	32
Mission and Members of the Defence Ethics Committee	34
APPENDIX 1: Reference Standards taken into account	35
APPENDIX 2: Rome Statute of the International Criminal Court and French Penal Code	36
APPENDIX 3: Definitions adopted by the CICDE	41
APPENDIX 4: The 11 guiding principles affirmed by the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapon system	43
APPENDIX 5: Questions for the Test of Legality	44

Preamble

(19) On 10 January 2020, the French Minister of the Armed Forces addressed a request to the Defence Ethics Committee seeking an opinion on "autonomous lethal weapon systems".

A. Ethics of the French Armed Forces

(20) On both a historical and cultural level, military ethics is a system of values and questions, underpinned by service to the country and the relationship with death inflicted, ordered or suffered to defend France.

(21) This system of values and questions is rooted in our nation's military tradition and forms, not only for soldiers, but also for our citizens, a marker of military identity, based on mission culture, honour, companionship, commitment and self-sacrifice, through to the ultimate sacrifice if necessary.

(22) We did not build this capital overnight. In "The Edge of the Sword", General de Gaulle wrote: *"the French Army has a long history"* and he talked, in this regard, of a *"philosophy specific to the profession"*, underlining *"the abnegation of individuals for the benefit of the group, the glorified suffering that correspond to our aesthetic and moral concepts; the highest philosophical and religious doctrines have not chosen another ideal."*

(23) This system of values specific to military status is upheld within the military community, taught in schools and training centres, and cultivated in the institution's organisations and think tanks and the many publications they directly or indirectly produce.

(24) These values are also recognised by French society; they are honoured, valued and serve as a model in public opinion.

(25) Military ethics is also rooted in military status, i.e. the unique legal system governing the general status of soldiers and the resulting obligations, and in the normative framework of domestic or international law governing the use of armed force.

(26) The uniqueness stems firstly from the role of the armed forces and the resulting obligations, i.e.:

- The constitutional nature of our armed forces' mission to contribute to safeguarding the Nation's fundamental interests, particularly national independence and territorial integrity;
- The constitutional principle of having liberty of action to dispose of the armed forces resulting from Articles 5, 15, 20 and 21 of the French Constitution;
- Military status and the general statute of the military³ that govern the military function, forming a unique legal system based on primacy of the mission and exceptional constraints, particularly articles:
 - L 4111-1 of the French Defence Code: *"The armed forces of the Republic serve the Nation. Their mission is to prepare and ensure the defence of the homeland and its best interests by armed force. Status as a member of the armed forces requires*

³ As a reminder, military statute, which is both legislative and regulatory, stems from the constitutional foundations of military status. These foundations govern the military function consisting of the men and women governed by this status and statute.

under all circumstances a spirit of sacrifice, which may include the ultimate sacrifice, discipline, availability, loyalty and neutrality."

- L 4122-1: Soldiers have a duty to obey the orders of their superiors and are responsible for the execution of missions with which they are entrusted.

(27) Secondly, this uniqueness is expressed in the armed forces' general rules of discipline, codified in Articles D.4122-1 to D.4122-11 and focusing entirely on excellence and exemplary behaviour and action. They particularly set forth:

- on the one hand, the obligations attaching to military duty, namely:
 - honour and dignity,
 - obedience to orders received,
 - full responsibility of the command for orders given,
 - primacy of the mission and the engagement of all in action against the enemy, conducted with energy and self-sacrifice, including risking one's life, until success is achieved or all means of action are exhausted;
- on the other hand, rules governing the use of armed force and combat actions, including in particular:
 - the prohibition placed on superiors or subordinates to give or execute orders that are contrary to French or international laws,
 - the subjection of soldiers to the obligations arising under international law applicable to armed conflict and the obligation to train them in understanding and complying with such law: the distinction between combatant and non-combatant, proportionality, precaution, the prohibition to cause superfluous injury or unnecessary suffering and the principle of humanity,
 - the obligation to direct attacks exclusively against military targets or targets of military significance and the requirement of proportionality between the violent action and the expected military advantage,
 - the sole use of force required for the mission,
 - the duty placed on a military leader to ensure their subordinates are trained and prepared for active service,
 - the legitimacy of means employed, stemming from exemplary behaviour, discipline and rigorous execution.

(28) Military status is also unique in that the general rules of discipline directly refer to the principles of necessity, proportionality, humanity and distinction between combatants and non-combatants laid down by international humanitarian law (IHL) and international law of armed conflicts, both of which are incorporated into French military conduct guidelines.

(29) Lastly, while the mission of soldiers is to defend France by armed force and therefore represents "legislative permission" to inflict death on our enemies in combat actions carried out by our forces, this special immunity from criminal liability does not carry immunity from the provisions of the French Penal Code punishing war crimes and offences committed during an international or non-international armed conflict (Articles 461-1 to 462-11 of the Penal Code) no more than, and unlike other countries, from Articles 25, 28, 30, 31, 32 and 33 of the Rome Statute of the International Criminal Court. These provisions are reproduced in Appendix 2.

(30) In all these cases, military leaders and those executing their decisions may incur liability. This principle is a cornerstone of military ethics and is therefore fully enshrined in substantive law.

B. Purpose and Scope of our Opinion

(31) Today, due to the prospects offered by the development of robotics, use of weapon systems described as "autonomous" is a source of ethical questions linked to the very foundations of the military function:

- How can operational superiority be maintained without losing our values?
- What role should be reserved for humans in warfare?
- How do we preserve the moral integrity of combatants?
- To what extent will humans be responsible in the conduct of war?

(32) Three points immediately call for clarification. First, the Committee considers that the concept of lethal weapon systems should be limited and **cannot, by construction, include non-lethal decision support systems or devices forming the digital environmental of troops**. These systems also involve ethical issues, which could be the topic of subsequent work by the Committee.

(33) Secondly, the Committee notes that, having regard to the terms of its assignment, the scope of this opinion concerns the armed forces (French army, air force and navy), the formations linked to them and joint organisations (cyberdefence command for example), within the meaning and for the application of Articles L 3211-1 and L 3211-1-1 of the Defence Code, to the exclusion of the national gendarmerie.

(34) Thirdly, the Committee underlines the pitfalls of using certain terms such as "autonomy", "autonomous" or "intelligent system" in relation to machines and, more generally, all terms in the lexical field of anthropomorphism⁴ when they are used to describe objects or systems.

(35) Therefore, the Committee has paid special attention to removing anthropomorphic words from this opinion. Consequently the terms "autonomy" and "autonomous" will be used according to their meanings in robotics, i.e., "decision-making autonomy", when they apply to weapon systems, machines and robots. Indeed those systems do not determine their own rules and therefore are not "autonomous" in the philosophical sense. This good practice, which has already been adopted in certain areas of defence, should become standard practice.

C. Method

(36) To draft the opinion below, the Committee:

- analysed the reference standards of domestic and international law establishing the framework within which considerations relating to autonomy in weapon systems should be discussed. These standards are set out in Appendix 1;
- reviewed publications and communications addressing the topic of lethal autonomous weapon systems. They present the prospects opened up by scientific and technological developments, which allow or should allow the future use of partially autonomous lethal systems and raise ethical or legal questions. The Committee also notes that the military profession and Defence think tanks have often been a source of highly relevant contributions on the topic;
- met with experts and competent authorities who fuelled the Committee's reflection.

(37) Thus informed, the Committee decided not to examine weapon systems on a case-by-case basis, but to define a methodological analysis grid based on the following structure:

- lethal, automated, autonomous and partially autonomous weapon systems;

⁴ Universalis.fr: erroneous and illegitimate process by which insufficiently critical thinking attributes human predicates to objects for explanatory or representative purposes.

- why and when use partially autonomous lethal weapon systems, or PALWS;
- which safeguards and framework are required.

(38) The Committee does not believe that the study should be limited to a given period in time since the field of new technologies evolves fast whereas that of weapon systems spans several decades.

(39) The Committee considers that this opinion should be regularly reviewed to take account of technological developments and changes in operational doctrine and reflection on capacity planning when necessary.

G1: This opinion should be regularly analysed and updated to take technological developments and changes in operational doctrine and reflection on capacity planning into account whenever necessary.

I. Lethal, Automated, Autonomous and Partially Autonomous Weapon systems

A. Weapon systems Characterisation and Differentiation

a) Lethal Weapon systems

(40) Weapon systems means all mechanical, electronic and/or software systems used to achieve military effect⁵ on an enemy system or target, by means of action in any of the environments (land, air, sea, cyberspace, outer space). Such systems are:

- comprehensive, i.e. they integrate the full spectrum of identification, tracking, target-spotting, firing preparation, firing and guiding functions;
- coordinated, by being integrated into a system of systems via communications means and data links.

(41) These systems may particularly comprise:

- carriers (aircraft, tanks, vessels, IT networks, etc.);
- sensors (radar, optronics, electromagnetics, etc.);
- means of communication (radio, tactical data links, satellite, etc.);
- computers and related software;
- ammunition (in the very broad sense of load capacity: bombs, shells, missiles, software, etc.) and related triggering devices;
- countermeasures (against electromagnetic jamming for instance).

b) Weapon system Automation

(42) The CICDE (French Joint Centre for Concepts, Doctrine and Experimentation) provides definitions in this area organised according to a gradual classification distinguishing "remotely operated", "supervised", "semi-autonomous" and "fully autonomous" systems. The definitions of these terms are given in Appendix 3.

c) Lethal Autonomous Weapon systems (LAWS)

(43) The definition of LAWS is still a subject of debate. The positions adopted by France in the Convention on Certain Conventional Weapons and the definitions provided in the 2020 report on the parliamentary fact-finding mission are given below.

Position of France in the Convention on Certain Conventional Weapons (CCWC)

(44) The positions defended by France at the CCWC meeting on 20-21 August 2019 in Geneva are as follows:

⁵ An effect is described as a "change to the behaviour or physical state of a system or its components brought about by one or more actions or other causes". Examples of military effects include: defence, intelligence, hindrance, neutralisation and destruction.

- Avoid confusion between LAWS and current weapon systems that are merely remotely operated, automated, or use artificial intelligence⁶ to support human decision-making.
- LAWS should be considered as fully autonomous systems, i.e. systems capable of defining or altering the framework of their mission, without human validation, and using lethal force without any form of human control or oversight.

(45) The other definitions adopted at the CCW and the guiding principles promoted by France are detailed in Appendix 4.

(46) The CICDE definitions and those used in the French position at the CCW are very similar and use the term "fully autonomous" for systems that "do not yet exist" and are rejected by France. It is noted that these definitions refer to an extreme level where there would be no subordination or human control. The system would be capable of "modifying its own programming"⁷ or "altering the mission framework", and could become completely out of control.

Parliamentary fact-finding mission on LAWS report, July 2020

(47) French parliamentarians and rapporteurs Messrs Gouttefarde and Ganay note the use of both broad and restrictive definitions⁸.

(48) They adopt the following definition: *"LAWS are weapon systems capable of choosing and engaging a target on their own without human intervention and in a changing environment."*

d) The necessary clarification between LAWS and partially autonomous lethal weapon systems

(49) When applied to a weapon, especially a lethal weapon, the term "autonomous" sparks off debate, no doubt due to the anxiety-provoking anthropomorphic lexical field surrounding it.

(50) In the philosophical sense, autonomy is the human ability to define their own rules. In medicine, autonomy refers to the ability to carry out acts of everyday life independently.

(51) However, these definitions do not match the definition of autonomy in robotics. In robotics, an "autonomous object" is equipped with "decision-making autonomy": it is able to operate independently of any other agent, whether a human or another device, by computing and then performing non-trivial actions in changing – physical or operational – environments, in compliance

6 Official Journal of 09 December 2019: Interdisciplinary field of theory and practice aiming to understand cognitive and thought processes, and their imitation by hardware and software for the purpose of assisting or substituting for human activities.

7 This ability to "modify its own programming" is regarded as an oxymoron by certain experts since it would be made possible by a human and therefore programmed.

8 [Excerpt from the fact-finding mission report] On the one hand, the broad definitions encompass under the acronym "LAWS" all robotised weapon systems with a capacity to kill, regardless of their degree of autonomy. Under these broad definitions, the term LAWS includes remotely operated systems such as UAVs employed by French troops in the Sahel, and automatic or automated systems that the forces have used for decades. This kind of definition is favoured by most actors in civil society, particularly NGOs pushing the "Stop Killer Robots" campaign. On the other hand, a more restrictive definition focuses on the concept of autonomy, meaning a robot's ability to define its own rules and function independently of another agent, whether human or machine. This definition is preferred by major military powers, including France.

with requirements and specifications meeting a need. The object's designer and user have therefore decided to allocate certain tasks to the object. The object's computations particularly relate to recognition functions and situation assessment (perception in the broad sense), decision functions based on the situation assessed, integrating different constraints and meeting the defined objective, as well as communication between humans or objects.

(52) **The Committee's rationale is based on the definition used in robotics (i.e. decision-making autonomy).** The following definitions are therefore adopted:

LAWS (lethal autonomous weapon system): a lethal weapon system programmed to be capable of changing its own rules of operation particularly as regards target engagement, beyond a determined framework of use, and capable of computing decisions to perform actions without any assessment of the situation by human military command.

PALWS (partially autonomous lethal weapon system): a lethal weapon system integrating automation and software:

- to which, after assessing the situation and under their responsibility, the military command can assign the computation and execution of tasks related to critical functions such as identification, classification, interception and engagement within time and space limits and under conditions;
- which include technical safeguards or intrinsic characteristics to prevent failures misuse and relinquishment by the command of two vital duties, namely situation assessment and reporting.

(53) Consequently, a PALWS is a system whose decision-making functions are defined **according to the robotic meaning of decision-making autonomy**, i.e., within a specific framework of action. A PALWS cannot compute lethal decisions that would modify its field of operation.

(54) Unlike a PALWS, an automated weapon system:

- does not rely on decision-making mechanisms as defined above: an underwater mine that detects a warship or a proximity fuze installed on an air-to-air missile is a simple mechanism implementing a main object-detecting sensor and a principal reaction designed to destroy the object; therefore, it is not a PALWS;
- performs non-critical "low level" functions such as altitude hold, observation, camouflage and maintaining contact, which do not raise any particular ethical issues;
- can support humans in higher-level and more critical functions such as identification, classification, pathway selection and reporting intended to give rise to a critical human decision such as engagement; it is therefore a decision support system that it not lethal *per se*, and as indicated above (cf. preamble on non-lethal decision support systems), is outside the scope of this opinion.

(55) Unlike a PALWS, a LAWS is likely to embed software that by construction can change its own decision-making rules, and go beyond the space-time framework of the mission (i.e. the specifications). However, it is not possible to rule out exceptional cases in which overriding the specifications could create an operational advantage and thus be an acceptable option to military command in certain circumstances. The dividing line between a PALWS and a LAWS must therefore be based on technical or organisational safeguards such as devices, technical qualification and technical certification measures, or intrinsic design measures to prevent failures, misuse, and relinquishment of human prerogatives.

P5: The difference between lethal autonomous weapon systems (LAWS) and partially lethal autonomous weapon systems (PALWS) lies in their nature, i.e. the human involvement in certain critical functions. However, the LAWS/PALWS distinction cannot hinge solely on proper human use of the

system and should also be based on technical and organisational safeguards, such as devices, technical qualification and technical certification measures, or intrinsic design measures to prevent failures, misuse, and relinquishment of human prerogatives.

(56) The concepts of command (i.e., the authority allowing a decision to be made), situation assessment, delegation of authority⁹ and assignment of tasks are therefore of higher importance.

B. LAWS: Weapon systems renounced by France but possibly developed elsewhere

(57) While the 2020 parliamentary fact-finding report states that LAWS do not yet exist, the design, manufacturing and use of such machines are nonetheless possible in the medium term.

(58) There is indeed no reason to think that terrorist groups or certain countries which do not share our values will not seek to acquire and use them, irrespective of the potential effects on targets, populations, or even, in certain circumstances, their own troops.

(59) For its part, the French government has declared that it renounces the use of LAWS¹⁰.

(60) The Committee regards this decision as unquestionably sound in light of the ethical, legal and operational principles governing the action of the French armed forces.

(61) Indeed, use of LAWS would:

- break the chain of command;
- directly contradict the constitutional principle of having liberty of action to dispose of the armed forces;
- not provide any assurance as to compliance with the principles of international humanitarian law (IHL)¹¹ and the risk of proliferation.

(62) Lastly, the use of LAWS would be directly contrary to our military ethics and the fundamental commitments made by French soldiers, i.e. honour, dignity, controlled use of force and humanity. It would definitely raise questions about tasking a machine to open fire, and could subsequently trigger an identity crisis or cohesion meltdown within our armed forces.

P3: Use of LAWS by the French armed forces would be absolutely contrary to the French constitutional principle of having liberty of action to dispose of the armed forces and the principle of continuity in the chain of command. It would also jeopardise compliance by our forces with the principles of necessity, proportionality, humanity and discrimination between combatants and non-combatants, forming the foundations of international humanitarian law to which France adheres. Lastly, it would undermine the dignity of French soldiers and contradict military ethics. Such use, as well as manufacturing and exporting, should be refused.

⁹ Delegation of authority: action whereby a commander assigns to a lower commander a clearly determined part of his authority (Joint Terminology Glossary)

¹⁰ Saclay address on 5 April 2019: "Terminator will not parade on Bastille Day".

¹¹ Programming complex situations that even a soldier does not currently know how to solve in the same way every time is a technological challenge. For example, a soldier threatened by a weapon carried by a person who is built like an adult but has child-like features always poses a dilemma. The decision taken in such a situation depends on the context, the rules of engagement, and knowledge of all the weak signals from the environment.

(63) Beyond the military realm, operations carried out in serving the Republic could be regarded as unacceptable by French people, thereby undermining their support.

(64) Similarly, the refusal to employ LAWS should be extended to manufacturing and export and imply preventing their use.

(65) However, the Committee considers it legitimate and vital to continue research in the area of autonomy in lethal weapons, in order to design weapons and weapon systems integrating autonomy which, while ensuring our operational superiority, are or would be fully aligned with our principles and values. Such research should also legitimately focus on ways and means of enabling French forces to counter the use of LAWS by states or other enemies, but without using LAWS ourselves.

(66) Naturally, such research should:

- first, be governed by a strict ethical framework and compliance control procedures to prevent a gradual shift towards the development of lethal weapon systems that could ultimately escape human control,
- secondly, be supported by ethical reflection on resulting uses.

P4: France should continue research in the fields of defence artificial intelligence and weapon systems automation for several reasons. First to avoid the country losing ground in the scientific and technological fields; second to counter enemy development of LAWS; and finally, to be able to defend ourselves against this type of weapon in the likely event of their use by an enemy State or terrorist group against our troops or population. Such research must be governed by a strict ethical and legal framework and be conducted in compliance with legal review mechanisms.

C. PALWS: systems that may prove necessary and legitimate in certain circumstances

(67) While LAWS must be refused completely, this is not true of partially autonomous lethal weapons since their autonomy is limited and their use remains under control by the chain of command.

P6: Refusals of LAWS in the future, whether under French or international law, should not be extended to the integration of automation into low-level functions of certain lethal weapon systems. Neither should they concern partially autonomous lethal weapon systems (PALWS) embedding automated decision-making functions or higher level automated functions provided that human command is maintained in a manner ensuring compliance with the constitutional principle of having liberty of action to dispose of the armed forces, continuity in the chain of command and the principles of IHL.

(68) The Committee therefore considered it appropriate to develop an operating analysis grid to enable French political and military leaders to:

- make informed choices concerning the development of autonomy in lethal weapon systems;
- take stands on the international scene in order to share this view and secure as much support as possible.

(69) The trickiest issues currently raised by the question of "autonomy" in lethal weapon systems relate to the fact that they could directly or indirectly inflict death. In line with the definition given in the

preamble, the Committee focused on the criticality of the relevant functions taking account of their potential impact, exclusively from the perspective of using armed force.

(70) The Committee emphasises that this scope includes cyber weapon systems which can have lethal effects, for example in the case of an attack on a power plant or a hospital, or diversion of a lethal weapon system by computer-based attack.

(71) As "remotely operated systems" defined by the CICDE are remotely controlled by troops via telecommunications means, they are outside the scope of the opinion and are not therefore mentioned in the rest of this document.

II. Why and When Use PALWS?

P1: The issue of "autonomy in lethal weapon systems" should be examined solely from the perspective of its uniqueness stemming from the constitutional nature of the armed forces' mission, military status and ethics, and the strict national and international legal framework governing combat action.

A. Constitutional Requirements and Mission Success

(72) Use of PALWS and the assignment of certain functions to these machines are not in themselves contrary to military honour and soldier dignity. The design, development and use of PALWS requires a framework to:

- ensure prevention of production, implementation and sale of LAWS;
- preserve our operational superiority while upholding our values and the constitutional requirements applicable to our forces' action, namely safeguarding the Nation's fundamental interests, particularly national independence and territorial integrity;
- research in order to avoid losing technological ground and be capable of neutralising hostile action employing partially autonomous systems.

G2: Strategic monitoring of autonomy in weapon systems should be carried on with a particular focus on definitions, stands adopted by governments and other entities, and emerging technologies, in order to compare them with the French view. This should lead to drawing conclusions about potential threats, the French armed forces' operational superiority and their interoperability in coalition.

G3: Research into autonomy in weapon systems should be continued, especially to preserve the operational superiority of our armed forces and be able, in particular, to neutralise enemy LAWS and PALWS, without using LAWS ourselves. This should include risk analyses and ethical reflection, focusing on the scope and possible developments of results.

B. A Strategic Context requiring Anticipation

(73) The 2017 Revue stratégique de défense et de sécurité nationale (Strategic Review of Defence and National Security) reports on a context of increasingly serious conflicts with increasingly sophisticated threats. The strategic environment is therefore dominated by unpredictability more than ever before since the end of the Cold War. Both government and other players now have a considerably broader set of solutions at their disposal to achieve their political aims, without needing to engage their forces in direct confrontations. Growing arsenals, the dissemination of contemporary conventional equipment and technological progress provide them with advanced military resources. In parallel, the dissemination of new technologies from the commercial world now facilitates access to capacities which, until recently, were available solely to governments.

(74) Combined with innovative modes of action, these developments can challenge the operational and technological superiority of all armed forces in the West and in all environments – land, sea and air – but also in cyber space and outer space that are becoming fully-fledged areas of conflict. They also systematically render French military engagements more complex, as current conflicts have already shown. Conflicts "below the threshold" such as hybrid wars¹² (Crimea, information warfare)

¹² An ambiguous form of confrontation, combining conventional and non-conventional military actions and non-military action, based on a strategy of destabilising the enemy by using various complementary levers. Note: Influence operations play a significant role in this kind of conflict in all areas, particularly by using psychological

are one example. At the same time, some governments are stepping up their efforts in very high-tech systems, with the risk of European military powers being left behind.

(75) Faced with these threats and aggravating factors of crises, the 2017 Strategic Review underlines national cohesion and the resilience of functions essential to state continuity and life of the Nation as the vital bases of our freedom of action. Resilience of armed forces and services is again becoming an operational challenge.

(76) In this context, which places our soldiers in great demand, tools must be found to preserve or improve the operational capacity of the armed forces. The concept of employment of forces identifies nine factors of operational superiority applied to the art of war, which, when achieved and combined, allow the upper hand to be gained over the enemy:

- command performance, representing the driving force underpinned by the principle of subsidiarity;
- individual and collective morale, a prerequisite of resilience and dominating the enemy;
- understanding, for optimal anticipation and pertinent action;
- agility, the permanent ability to manage the action, including in exceptional conditions;
- influence, which is critical in the current and future information environment;
- endurance, requiring control of pace, patience and perseverance;
- strike, with force, speed and suddenness to take by surprise;
- credibility, which contributes to deterrence and supports the conduct of action;
- mass, to build positive power relationships and respond to simultaneous crises.

C. Expected benefits: performance, precision, pertinence, protection and permanence: the "5 Ps"

(77) In this strategic context, PALWS represent a lever in several respects because, depending on the configuration, they combine performance, precision, pertinence, protection and permanence.

(78) Regarding **performance**, PALWS provide a means to:

- **respond to the faster pace of military operations:** the OODA Loop (observe / orient / decide / act) is gaining speed in operational engagements; the time elapsing between the detection of a threat (by satellites, drones, lookouts, etc.) and its neutralisation by the armed forces is becoming substantially shorter. A key success factor therefore consists in implementing this loop faster than the enemy. Hypervelocity missiles, capable of being propelled at more than Mach 5, or more than five times the speed of sound, represent a concrete example of this accelerating operational pace. In the forward-looking document "Chocs futurs", the French Secretariat General for National Defence and Security (SGDSN) considers that these weapons, expected to be mature by 2030, will represent a major change in strategy and an immediate threat, at any time and distance, of a conventional or nuclear strike. The emergence of such delivery systems will require developments in anti-missile, anti-aircraft and even anti-satellite defence technologies, and an acceleration in our own OODA loop. Without highly sophisticated technology, space

tools and the possibilities offered by cyber space, to achieve the ultimate aim through the effects of synergy, making use of asymmetry and undermining the enemy's resistance until it is completely destroyed.

threats such as "intrusive" satellites¹³, i.e. outer space objects travelling at several kilometres per second, would be extremely difficult to tackle. The same is true of certain computer-based attacks that can occur in a flash, and thus require extremely responsive defence capacities.

- **defend ourselves against multiple players:** concerns are again emerging over the strategic principle of mass. It is becoming necessary to have sufficient forces on the ground, at sea and in the air to operate in vast conflict areas like the Sahel, whilst also raising a defence against attacks by saturation, such as a swarm of small armed drones on a strategic position, possibly by a terrorist group. Such attacks by saturation are also encountered in cyberspace and could emerge in outer space. Integrating decision-making autonomy into certain combat systems is a means of responding to such fast-paced operational situations arising in complex environments with a large amount of targets. Future technological developments in weapon systems could allow our troops to steer a swarm of armed platforms and defend themselves against an enemy swarm.
- **multiply capacities and ensure resilience in hostile environments:** as mentioned above, some operations require armed forces to manoeuvre in vast expanses. Deploying PALWS could support the use of force in order to monitor an area over time, and benefit from redundancy in all environments (land, air, sea, cyber, space).
- **maintain the rank of the French armed forces** and their interoperability in coalition operations: French defence development must continue at a pace that guarantees interoperability and the country's role among its allies, while avoiding, by excessive irenicism, the risk of a capability loss compared to potential enemies. Furthermore, while France, to its credit, adopts a cautious approach to the topic of autonomy in weapon systems, other countries could show less concern. In "Chocs futurs", the SGDSN considers that by 2030, *"robots and autonomous systems will be standard players in military operations. Either remotely operated or entirely autonomous, they will be active in physical and virtual battlefields. All configurations will be possible: alone, in homogeneous groups or within mixed units of humans and robots. [...] Some countries (USA, China, etc.) have great ambitions for the development and acquisition of autonomous systems. Progress made in artificial intelligence renders these aspirations all the more plausible."*

(79) The **pertinence** of PALWS allows forces to:

- **adapt to a tremendous mass of data:** sensors, such as those producing images, electromagnetic signals, acoustic signatures and computer attack detection information, have developed to such a point that there is now talk of a "data deluge". This mass of information represents a real challenge for intelligence and operational decision-making in a command centre. It also has a direct impact on soldiers engaged in operations, whether at sea, on the ground or in a cockpit, where the environment is increasingly digital and interconnected with the whole chain of command by instant messaging or tactical data link. The terms "connected combat" and "tactical cloud" are already in use. Weapon systems deployed in a theatre of operations are interconnected via these means and such systems must and will have to process a growing amount of data to avoid soldiers suffering a cognitive overload.

¹³ For example the "Luch-Olymp satellite with big ears" mentioned by the French Minister of the Armed Forces during her Space and Defence speech on 7 September 2018.

- **penetrate very high level defence systems:** the capabilities of new technologies will facilitate entry into the defence systems of certain enemies equipped with A2/AD¹⁴ capacities, in all physical and virtual environments, and will therefore help reinforce the “Initial entry” capability¹⁵.

(80) PALWS also improve strike **precision**: integrating decision-making autonomy into identification or classification functions could improve the precision of strikes on a target and prior estimates of potential collateral damage, thanks to the possibility of including more parameters. It also eliminates the fatigue and stress caused by harsh environments, thus allowing soldiers to focus their cognitive abilities on the most critical aspects of their mission. Other technologies embedded in weapon systems could avoid soldiers having to face adverse weather conditions (wind, rain, snow, fog, etc.), thereby improving the conditions of their mission and reducing the risk of error.

(81) In terms of **protection**, PALWS help protect the life and health of soldiers: by 2030, the army could include robots capable of "teaming up" with and supporting soldiers, particularly to clear routes. They could be used against the threat of improvised explosive devices (IEDs), or in degraded bacteriological or chemical environments for example. In terms of sustainability, decision-making autonomy could be very useful in systems used to defend strategic bases, by functioning non-stop with all sorts of sensors capable of detecting multiple threats (a sniper hidden at a distance, commando intrusion, explosive-laden vehicles, etc.).

(82) Lastly, PALWS allow greater **permanence** in a zone. The physical limits of machines exceed those of a soldier. Thanks to technological developments, PALWS can now be adapted to both heterogeneous and homogeneous environments. They can therefore last at sea (self-protected vessel) and in the air (drone orbit) or withstand conditions faced by squads on the ground. They are therefore particularly convenient for tedious, dangerous or dirty (in the literal sense) tasks.

D. Risks to be managed

(83) While there are definite advantages, the development of PALWS also comes with a number of different risks.

a) Moral acceptability of using force without human intervention

(84) The legitimacy of using PALWS may be perceived differently or even trigger objections: for example among the local population where the hostilities take place, by French society, or by French soldiers themselves due to a conflict with their own ethics. Confidence in our armed actions could be undermined by the feeling of being watched by weapons, fear for safety, and concerns about the absence of humans in the loop or risks of a technological error.

(85) In addition, the moral acceptability of using force by means of a PALWS would no doubt vary with different operational situations, for example:

- target neutralisation;
- reprisals against an attack on our armed forces or civilians might be more acceptable;

14 Anti-Access / Area Denial

15 "First entry" is a military ability to be strengthened according to the 2017 Strategic Review Of Defence and National Security.

- neutralisation of a possibly manned vehicle that has violated a keep-out zone (demilitarized zone, no-fly or no-sail zone, etc.) could be considered legitimate provided there are sufficient guarantees that no collateral damage will be caused.

b) Risks of Machine Learning¹⁶

- (86) Confidence in a system hinges on its qualification, certification and the assurance that it only does what it is designed to do. If the system includes algorithms based on machine learning, the data used for that learning and its qualification must be characterised. Nonetheless, the correlations calculated by these algorithms are mainly semantics-free, i.e. meaningless to a human being, so the result obtained can be difficult to explain. A system designed to identify, designate or even neutralise targets without being able to provide intelligible explanations for its proposals or choices could be regarded with mistrust.
- (87) Systems could also be designed with on-line learning capacities during a mission, so as to adapt to each environment or situation. Without appropriate control over what the system "learns", it could lead to unexpected and unwanted behaviour outside the intended framework of use.
- (88) Lastly, and more generally, machine learning systems whose behaviour is likely change during operational employment not only raise the issue of the management of their configuration, but also the issue of the control of their reliability and use over time. The emergence of new capacities that are currently being considered by the ministry could create a discrepancy between what the weapon system can do, the way the chain of command intends to use it and the abilities of the armed forces, which might not yet be trained in the operational use of such a system.

c) Risk of blurring responsibility in the event of an incident

- (89) In the event of an incident involving a PALWS causing unacceptable damage or unwanted firing, establishing responsibilities by means of an ex-post investigation could prove difficult.
- (90) Today, within a pre-determined and limited framework, some weapon systems can select (i.e. look for or detect, identify, follow and select) and neutralise (by using force, damaging or destroying) targets without human intervention. This is the case, for example, of the PHALANX CIWS¹⁷ used by the US Marine. After commissioning, it defends a combat vessel – detection, classification and engagement – without human intervention.
- (91) This system has served as a model to develop similar systems for combating site attacks by CENTURION C-RAM rockets, as well as systems in the same family (Russian AK-630, GOALKEEPER CIWS, etc.).
- (92) During an incident causing the destruction of a non-hostile aircraft, identifying the different responsibilities involved is more complex than with other systems that require a prior decision to open fire: *Is it the operational chain of command, from the decision-maker to the soldier who used the system? Who decided to use this system in this environment? Were they aware of the potential*

¹⁶ Machine learning is a statistical approach that can discover significant correlations in large masses of data, in order to build a predictive model when it would be difficult to construct an explanatory model. http://cerna-ethics-allistene.org/digitalAssets/53/53991_cerna_thique_apprentissage.pdf

¹⁷ Close-In Weapon system.

error? Was this deployment compliant with doctrine? Were the risks known? Were the risks documented during design?

d) Vulnerabilities induced by Digital Technology

(93) Today, all weapon systems feature digital technology. It is an asset in so far as it improves what is generally known as information management. However, it also gives the opportunity to ill-intentioned actors, whether governments or other, to carry out attacks that would have a "systemic" effect.

(94) Like other weapon systems, governments and other actors are acquiring offensive cyber capacities with which they could take control of or alter the integrity of a system and change the targeting functions. The lack of ultimate human control over open fire functions could facilitate such diversion.

(95) Furthermore, mechanisms based on machine learning can have intrinsic vulnerabilities; a computer-based attack can deceive a weapon system or even remotely take control of it. Examples of identified modes of action include learning data poisoning, backdoor attacks and deception.

e) Risks relating to the Use of these Weapon systems

(96) More extensive use of PALWS must enable soldiers to cope with increasingly complex operational environments at an ever faster speed. This could, however, facilitate the rise to extremes.

(97) Moreover, widespread integration of automation and decision-making autonomy into critical functions can distance the soldier from the operation, and alter their judgement and perception of the operational situation.

(98) Indeed if humans are excluded from certain functions of the system, particularly decision-making, or are no longer able to perform them, doubts arise as to their ability to fully comprehend what the system is doing. Coordination could therefore be lost between computed actions and human actions. If the human being's sense of control is altered, whether consciously or not, they would be distanced from the operation and may feel less involved in open fire procedures, causing detachment and loss of humanity in combat actions.

(99) The question of human control over weapon systems is therefore crucial: on the one hand the use of PALWS seeks to automate functions, lighten the cognitive load of soldiers and speed up their decisions, but on the other hand, it could result in losing control of the situation. A risk of excessive use of technology in warfare could also arise.

(100) Lastly, because they do not put the lives of soldiers at risk, political leaders and commanders could be tempted to use PALWS in situations in which they are not fully justified and which therefore involve ethical or legal risks.

f) Risks of Altering Human Control Mechanisms

(101) Development of PALWS could alter soldier control of the system in several respects:

- Automation alters the control mechanisms traditionally used by a soldier, such as error detection mechanisms, and can increase attention wandering. These changes could create a "legitimization risk", leading them to trust the machine blindly and to fail to question suggestions made by the weapon system;
- Human tendency to develop an addiction to automation could result in them refusing to take control or losing confidence in their ability to deal with a highly complex situation;
- A lack of information or, conversely, an excessive amount of information, the plans the human being has in mind, and the various cognitive biases (confirmation bias, attention tunnelling, etc.) can cause a misunderstanding of the system's behaviour, and a wrong prediction, which could result in incidents, potentially with serious consequences;
- Decisions for which humans remain responsible are such that humans must be capable of exercising this control: therefore they must not be considered as a last resort to take over control in any situation or when automated functions "don't know what to do";
- The gradual extraction of human beings brought about by the increasing speed of response.

(102) The International Committee of the Red Cross (ICRC) has studied these different risks and deduced the potential consequences of:

- growing use of machine learning to adapt to operational uses: bias, lack of foreseeability and lack of explainability can cause a loss of confidence;
- the diminishing role of humans which causes distancing, attention loss and difficulty to take over control in fast decision-making processes.

G4: The risks of alteration in human control and the acceptability of assigning use of force to a machine should be systematically assessed during research, design, development and use of PALWS.

g) Exogenous Risks

(103) There is a risk of civil society refusing the PALWS employment framework, for philosophical or religious reasons. Autonomy in lethal weapon systems sometimes sparks off heated debate. Information on the issue may also be manipulated with a view to influencing public opinion and preventing or delaying the development of new military capacities in France or, conversely, lending credit to a new technology embedded in a weapon system which runs counter to the values upheld by France. In any event, information and transparency vis-à-vis French citizens will be necessary.

(104) Furthermore, there is a permanent risk of proliferation for this type of weapon like all others, requiring control and regulation. Export control should therefore be examined by national review boards (particularly CIEEMG¹⁸ and also, for example, the Parliamentary Office for Assessment of Scientific and Technological Choices (OPECST)¹⁹ or the Defence Innovation Agency (AID)).

¹⁸ Inter-Ministerial Commission for War Material Export Studies

¹⁹ OPECST was established by law as an information entity common to the French National Assembly and the Senate. Comprising 18 parliamentarians and 18 senators, its mission, according to the law, is to "inform Parliament on the consequences of scientific and technological choices in order to enlighten decisions." It therefore provides Parliament with expert knowledge to inform long-term political choices.

III. Which Safeguards and Framework?

A. Reaffirm the central role of humans and the principle of human responsibility

(105) Behind "autonomy" there is automation, in this case software, and behind software there are the people who have designed, developed or implemented them.

(106) As a PALWS is a thing, no responsibility can be attributed to it.

(107) In other words, like any weapon system, implementing decision-making autonomy must not, under any circumstances, relieve soldiers or other people authorising the use of such machines from their responsibility, when such use violates the law of armed conflict or constitutes an offence under French criminal law. The applicable legal rules are set out in Appendix 1.

P2: The principle of human responsibility in the design, deployment and use of decision-making autonomy in lethal weapon systems, whether or not they are described as autonomous, must not be breached. The highest values of our civilisation and our constitutional order require human responsibility in all circumstances.

B. Design and implementation of PALWS must be subject to guarantees of proper use: command, control of risks), compliance, competence and confidence (the "5 Cs")

a) Command: maintain a chain of responsibility, command and control

(108) Different levels of responsibility can be distinguished based on the life cycle of a weapon system:

- The sequence of defence procurement operations clarifies the process and each individual role in the various stages of developing a weapon system, which involves the project owner, the armed forces and industry;
- Prior to the decision to commission the system²⁰, employment doctrine defines the principles of integration into the chain of command, the players and the conditions of system readiness support;
- Each operation order sets out the chain of responsibility for opening fire according to the theatre of operations, the missions to be accomplished and the operational environment.

(109) When a lethal weapon system features decision-making autonomy in critical functions as defined in the preamble, a map of the various players and their respective responsibilities is a necessary safeguard. It must be prepared without predicting what a court could decide in the event of post-incident proceedings.

(110) As a result of these responsibilities, internal audit and control units working under these responsible individuals will have more oversight over the impact of these new technologies and a better understanding of the new risks they involve.

(111) In addition, despite the precautions taken, misuse of a weapon system is always possible, whether it is a PALWS or not.

²⁰ Decided by each chief of staff pursuant to Article D. 3121-29 of the French Defence Code, after seeking the opinion of the Chief of Defence Staff.

(112) Moreover, the causes of an incident can be difficult to identify when the weapon system is packed with technologies and is equipped with automated decision-making functions.

(113) Therefore, the Committee considers it vital for the armed forces to be able to deal with accidents or incidents²¹ involving such weapon systems, in order to identify the causes and draw all the operational, human and technology-related conclusions.

(114) In any event, and this is a key point, pursuant to Articles 15, 20 and 21 of the Constitution and the constitutional principal of having liberty of action to dispose of the armed forces, military leaders are accountable for armed force engagements under the authority of the French President and the government.

G5: The consequences of lethal actions carried out by a PALWS must be systematically evaluated by the command. In particular, only the chain of command shall have authority to change the targets of a mission in progress or to cancel the mission.

(115) In this way, respect for chains of command, doctrines and rules governing employment of PALWS will be ensured.

G6: The command should define a framework to transpose doctrine, i.e., target to be reached, space and time limits, constraints, engagement rules, for each mission performed by a PALWS. A PALWS should never be operated without an employment framework and should never have the capacity to depart from it without intervention by the chain of command.

(116) The principle of subsidiarity in command remains applicable, including in the use of PALWS. While a dialectic, specific to PALWS, would appear to remain between supervision and subsidiarity (the higher levels wanting greater control due to the technical complexity of PALWS), the command continues to define the degree of control in the use of weapon systems for each piece of equipment and each context, in line with practices applicable to current weapon systems.

(117) The ability of PALWS to adapt to urgent situations also has a tactical advantage when taking urgent decisions. However, it comes with a risk of deviating from the doctrine and this risk must be managed.

G7: In any urgent operational situation, the chain of command must be alerted and must explicitly validate any new PALWS employment framework.

(118) PALWS may be equipped with software based on machine learning that is capable of changing their own or another PALWS' rules during a mission, based on machine-learned parameters. The chain of command also prevails in this situation.

G8: A PALWS should not be enabled to assign to another PALWS a mission that departs from the initial framework without prior validation by the chain of command.

(119) The dialectic of combat does not rule out the possibility of studying the use of new tactical concepts during a battle. However, machine learning must be regulated according to the weapon's possibilities and in order to comply with the general framework for its use. In particular some specification and qualification guidelines governing the development of artificial intelligence

21 The provisions defined by military authorities for accidents or incidents caused by weapons or ammunition in service in the French armed forces, excluding storage and transport, provide a robust framework.

systems must be respected. For instance, machine learning should be kept for off-line use, in order to retain control over the data that are used and over the system changes.

G9: The conditions under which continuous machine learning during a mission can be implemented for on-line computation of new tasks should be clearly specified.

b) Risk Control: Reasoning must be guided by ethical principles rather than technological progress

(120) Given the very strong link between PALWS and progress in digital technology, there is a tendency for reasoning to be dictated by technology, rather than concept definition. Now, the dialectic of war does not prohibit progress. Therefore, in defence, PALWS have a decisive advantage in the dialectic of war, allowing the self-protection of systems such as ship combat systems. The only real limits identified by an ethical study like this opinion are ethical principles. Because the dialectic of war prevails over technological progress, possible acceptable departures from set principles can be outlined if we study PALWS under the scope of their functions – which are of varying criticality.

G12: Develop risk analyses based on compliance with French constitutional and military ethical principles.

(121) Scientific advances in artificial intelligence and machine learning in particular allow images to be better interpreted and human cognitive saturation to be reduced. Continuous on-line machine learning is possible. Whether they are assigned to command or support tasks, all these functions should be regularly reviewed and reassessed in relation to ethical principles.

(122) It is therefore fair to wonder whether targeting and opening fire are particular functions and whether they may or may not be assigned to PALWS. In any event and whatever technology is chosen, the following ethical question will arise: can this function be legitimately assigned to the machine and on what basis? This will lead to a risk analysis, integrating ethical principles, with no a priori exclusion of scientific and technological advances.

G13: Develop a process for the technical (performances, etc.) and operational (use, doctrine) validation of autonomous decision-making capacities, prior to operational commissioning and throughout the life cycle, based on our ethical principles.

(123) The capacity-building process that leads to the development of a weapon system currently follows strict rules governing defence procurement operations. It appears, at this stage, that certain risks should systematically be included in the phases of this process, i.e. risks of distancing, alteration of human control, acceptability of assigning use of force to a machine, and retaining sovereign control over the use of PALWS. A set of questions that should be examined during the acquisition of a PALWS is given in Appendix 5.

(124) This approach could include integrating these risks into employment doctrines – as is the case already with doctrine relating to use of UAVs in operations – but also, upstream, in the military requirement specification phase (followed by the various tasks of the integrated programmes team) and during experimentation activities.

(125) Given the highly changing nature of this kind of weapon system and the emergence of new features, doctrine should be regularly reviewed to guarantee optimal use of the system at all times.

Therefore operational feedback should be provided and disseminated, in all operational, technical and legal spheres.

G14: Ensure operational feedback on the use of PALWS is escalated and disseminated to all operational spheres, and to competent technical and legal authorities.

c) Compliance: ensure legality is correctly monitored throughout the life cycle of weapon systems

(126) Article 36 of Additional Protocol I to the Geneva Conventions of 12 August 1949 relating to the protection of victims of international armed conflicts of 8 June 1977 (Protocol I) stipulates that *"In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation 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 to the High Contracting Party."*

(127) While International Humanitarian Law is important, the Committee stresses that French law is extremely righteous and can even be more restrictive.

(128) Fulfilling its commitments, France transposed the conditions of this legal review and specified how this analysis of compliance with international law is applied at every stage in defence procurement. It particularly emphasises that the review is conducted, as required, during the various phases of a weapon system's life cycle: preparation, production and operational use. During this last and often longest phase, it is required whenever *"obsolescence or integration of innovations into the weapon, means or doctrine contribute to changing the functions in a manner that could challenge the previous legality opinion."*

(129) In light of the abovementioned risks, the Committee stresses the importance and pertinence of conducting a complete legal review whenever decision-making autonomy, according to the robotics meaning as defined in the preamble, is developed in a lethal weapon system, especially as far as identification, classification and opening fire functions are concerned.

G15: Define appropriate methods for monitoring legality in light of the new challenges induced by integrating decision-making autonomy into functions assigned to PALWS.

(130) A risk analysis method dedicated to partially autonomous systems could be added to the existing regulatory corpus applicable to the acquisition of PALWS. This method would be provided to capacity-building experts during the requirement specification phase. It would cover every stage in the process of meeting the operational requirement and detail the ethical risks associated with each function.

G16: A risk, functional and value analysis method dedicated to the expected level of decision-making autonomy should be set up from the very beginning of the military requirement specification. This method should cover every stage of the process of meeting the requirements, including off-the-shelf devices and software, support functions and operational readiness services.

d) Competence: pay particular attention to the human factor and training

(131) For each weapon system to which this report applies, the Committee considers that special attention should be paid to human factors. In light of the abovementioned risks, all soldiers must be aware of:

- human-machine interaction and the blind trust in automated systems that can gradually arise;
- the required degree of involvement to avoid becoming distanced from operations;
- the need to correctly judge suggestions made by the weapon system and to understand the system's limits.
- the responsibility involved in firing actions and decision-making in the most critical combat situations, with a certain level of uncertainty.

(132) Even though human control consists of supervising high-level goals rather than directly monitoring the weapon system's combat actions, soldiers must have relevant information to oversee and understand the mission progress, predict the states the system is seeking to reach, so as to remain agents and take over control whenever necessary. The concept of a system-inhibiting device in the event of an incident is of major importance, but is merely one solution among all the possible organisational or technical safeguards. Such a device and its operating procedures must be chosen based on solid grounds.

(133) Whenever human intervention is necessary to take control of the weapon system, the human should be enabled to do so with means such as:

- self-destruction mechanisms in the event of machine-command communication loss (to be adapted to speed and environment);
- constant communication between machine and command;
- geographical tracking of the machine or machines forming the system²²;
- a device for aborting the manoeuvre in progress (return to base, interruption);
- organisational methods (order confirmed by two different means).

G17: Implement mechanisms to ensure human control is retained over the use of the PALWS, including emergency deactivation systems if necessary.

(134) Instruction and training, today known as operational preparation, are vital for the armed forces to adopt a new combat system and manage force in most extreme situations, by validating individual and collective knowledge.

G21: Provide continuous operational preparation for strategic leaders, theatre commanders, tactical leaders and operators.

(135) The Committee believes that efforts made in training and operational preparation must be maintained and adequately adapted to the growing complexity of PALWS, to ensure that the system and all its uses are fully managed and their limits are known. Soldiers must also fully comprehend the risk of the human factor.

G22: Pursue training and operational preparation efforts and adapt them, as necessary, to the growing complexity of PALWS, in order to master weapon systems and the full spectrum of their uses, and understand the risks and limits in light of our ethical principles.

²² It should be noted that the lack of geographical tracking of objects during the first half of the 20th century is still a problem addressed by the armed forces which search for underwater mines and regularly uncover shells from the first world wars.

(136) This effort not only concerns individuals but also their entire chain of command. Personnel involved in defence procurement programmes should also be made aware of the issues and risks involved in using PALWS.

G23: Ensure that personnel involved in the design, development and promotion of autonomy in lethal weapon systems are aware of the various risks and issues. Therefore, diplomats, researchers and engineers must also be made aware of these questions.

(137) While PALWS awareness must apply to diplomats, politicians, commanders, engineers and researchers, it must also apply to every rank in the chain of command, decision-making and implementation. This would erase generation gaps and ensure that the specific features of PALWS are consistently considered at every level.

G24: Provide training for all levels in command and operation, including during initial military training, in the use of technologies featuring decision-making autonomy.

G25: Inform public authorities of the ethical issues inherent in the use of PALWS.

(138) Work done on drafting employment doctrines shall ensure that military personnel are informed and educated in the direct or indirect use of PALWS. The resulting dialectics of combat and subsidiarity shall also be documented.

G10: When drafting doctrine on the use of weapon systems, include appropriate information on functions featuring decision-making autonomy. Specify the conditions and limits of use, based on technical and operational performance criteria and the relevant ethical considerations.

e) Confidence: pursue the initiative to develop and qualify "trusted" and strategic autonomy technologies

(139) The Ministry for the Armed Forces has been studying the risks associated with by some artificial intelligence technologies since 2019.

(140) One suggested approach consists of taking into account the level of impact and supervision of each function jointly. There is a particular need to extensively qualify artificial intelligence-based functions that have a potentially strong impact and a low level of supervision. Notions of "interpretability", "auditability" and "guarantee" of results must also be taken into account. Moreover some cyber vulnerabilities mentioned above should also be taken into account along with methods for reducing the risk of computer-based attacks.

(141) Such methods are undoubtedly a key to developing trusted technologies in this area.

G18: Ensure that clearly defined qualification processes are designed for PALWS critical functions based on autonomous decision-making. These qualifications should enable control over the use of force and post-incident investigation/inspections. In particular, while the command may legitimately modify an assigned mission, a regulated technical and operational process must apply when changing the field of employment of a PALWS. Operational feedback will be systematically taken into account.

(142) Consequently and in light of technological developments in this area, everyone involved in the design and production of a PALWS should regularly refresh their knowledge.

(143) Lastly, retaining sovereignty over hardware and software integrated into PALWS is vital to preserve the country's strategic autonomy.

G19: Pay particular attention to retaining national control over the technology (design, production, maintenance, etc.) used in critical functions and programmes integrated into PALWS.

(144) Specification of trustworthy technologies should benefit from our partners' work whenever a development is made in cooperation.

G20: In order to develop trustworthy technologies, ensure that specification and qualification documents relating to artificial intelligence in weapon systems reflect the state of the art. Also ensure that such documents are fully adopted by all parties involved in the design and development of a weapon system. Additionally, the position of France as regards these new technologies should be made explicit at international level.

(145) The highly sophisticated nature of PALWS can cause confusion, loss of expertise and loss of control over the technologies by project managers, contracting authorities and operators. Avoiding this loss is vital in order to maintain control over the core technology of critical functions. The related responsibilities must therefore be known.

G11: Formally define the chain of responsibility involved in the definition, design, development, qualification and use of a PALWS in order to clearly identify the respective responsibilities of all the parties involved.

Mission and Members of the Defence Ethics Committee

The Defence Ethics Committee was established on 10 January 2020 by the French Minister for the Armed Forces. It is tasked with issuing opinions and recommendations to inform political and military authorities of the ethical issues raised by changes in the military function and scientific and technological innovations in defence. It comprises 18 qualified persons nominated by the Minister.

The Committee's members are:

Bernard PECHEUR	Section President (h), Conseil d'État
Henri BENTEGEAT	Army General (2S), former Chief of Defence Staff (CEMA)
Rose-Marie ANTOINE	Honorary Chief Executive and former President of ONACVG
Christine BALAGUE	Professor at IMT-BS, holder of the Good in Tech Chair
Marie-Germaine BOUSSER	Professor emeritus of neurology, member of the Académie nationale de médecine
Frédéric DOUZET	Professor at the French Institute of Geopolitics (Paris VIII University)
Hervé DREVILLON	History Professor, Paris I University (Panthéon-Sorbonne)
Michel GOSTIAUX	Chief Defence Procurement Engineer
Laurent HERMANN	Rear-Admiral
Jean-Baptiste JEANGENE-VILMER	Director of the Strategic Research Institute of the Ecole Militaire (IRSEM)
Aurélie LECAM	Commissioner for the Armed Forces, legal advisor
Bruno PAUPY	French Air and Space Force Colonel
Philippe ROUANET de BERCHOUX	General Medical Officer of the Armed Forces, head of the Armed Forces health department
Guillaume SCHLUMBERGER	Director, Directorate for Defence Strategy, Counter-Proliferation, and Strategic Foresight , Directorate General for International Relations and Strategy (DGRIS)
Catherine TESSIER	Expert engineer at the French national aerospace research centre (Office national d'études et de recherches aérospatiales - ONERA), research integrity and research ethics officer
Nicolas THERY	President of the Confédération Nationale du Crédit Mutuel (CNCM)
Cathy THILLY-SOUSSAN	Financial, legal and ethics advisor, Direction Générale de l'Armement (DGA)
Bernard THORETTE	Army General (2S), former Army Chief of Staff (CEMAT)

APPENDIX 1: Reference Standards taken into account

Above and beyond ethical considerations, this appendix lists the provisions establishing the normative framework within which the topic of autonomy in lethal weapon systems has been studied:

- The French Constitution, particularly the preamble and Articles 5, 15, 20, 21 and 55 establishing the constitutional principles of national independence, safeguarding the fundamental interests of the nation, liberty of action to dispose of the armed forces²³ and the superior authority of treaties.
- Obligations arising from international law applicable to armed conflicts, particularly the four Geneva Conventions, and the two additional protocols mentioned in Article D.4122-7 of the French Defence Code.
- Articles 461-1 to 31 of the French Penal Code on war crimes and offences.
- Article D.4122-8 of the Defence Code on respect for protected persons by servicemen in combat.
- The following articles of the Defence Code:
 - o L.3211-2²⁴, L.4111-1 *et seq.* and Articles D.4122-1 to 4122-11 establishing the general rules of discipline of the armed forces.
 - o L.4123-12 specifying the legal protection and criminal liability of a member of the armed forces when using force in self-defence or during a military operation outside French territory.
 - o Article R.3111-1 and Decree No. 2009-870 of 15 July 2009 on the duties of the Head of the DGA and the secretary general for Defence Ministry administration.
 - o Articles R.3111-1, R.3121-1 to 20 on the duties of the Chief of Defence Staff.
 - o Articles R.3121-25 to 32 on the duties of the Chiefs of Staff of the army, navy and air force.
- Military Planning Act No. 2018-607 of 13 July 2018 for the years 2019 to 2025 and particularly the strategy review appended thereto²⁵.
- The order of the Minister of the Armed Forces of 17 July 2019 establishing the Defence Ethics Committee.

23 And decisions QPC no. 2014-450 of 27 February 2015 and 2014-432 QPC of 28 November 2014.

24 Which stipulates that "The Armed Forces of the Republic serve the Nation. Their mission is to prepare and ensure the defence of the homeland and its best interests by armed force."

25 Available on the website of the Ministry for the Armed Forces at <https://www.defense.gouv.fr/dgris/politique-de-defense/revue-strategique/revue-strategique>

APPENDIX 2: Rome Statute of the International Criminal Court and French Penal Code

Rome Statute

➤ Article 25: Individual Criminal Responsibility:

1. The Court shall have jurisdiction over natural persons pursuant to this Statute.
2. A person who commits a crime within the jurisdiction of the Court shall be individually responsible and liable for punishment in accordance with this Statute.
3. In accordance with this Statute, a person shall be criminally responsible and liable for punishment for a crime within the jurisdiction of the Court if that person:
 - a. Commits such a crime, whether as an individual, jointly with another or through another person, regardless of whether that other person is criminally responsible;
 - b. Orders, solicits or induces the commission of such a crime which in fact occurs or is attempted;
 - c. For the purpose of facilitating the commission of such a crime, aids, abets or otherwise assists in its commission or its attempted commission, including providing the means for its commission;
 - d. In any other way contributes to the commission or attempted commission of such a crime by a group of persons acting with a common purpose. Such contribution shall be intentional and shall either:
 - i. Be made with the aim of furthering the criminal activity or criminal purpose of the group, where such activity or purpose involves the commission of a crime within the jurisdiction of the Court; or
 - ii. Be made in the knowledge of the intention of the group to commit the crime;
 - e. In respect of the crime of genocide, directly and publicly incites others to commit genocide;
 - f. Attempts to commit such a crime by taking action that commences its execution by means of a substantial step, but the crime does not occur because of circumstances independent of the person's intentions. However, a person who abandons the effort to commit the crime or otherwise prevents the completion of the crime shall not be liable for punishment under this Statute for the attempt to commit that crime if that person completely and voluntarily gave up the criminal purpose.
- 3 *bis*. In respect of the crime of aggression, the provisions of this article shall apply only to persons in a position effectively to exercise control over or to direct the political or military action of a State.
4. No provision in this Statute relating to individual criminal responsibility shall affect the responsibility of States under international law.

➤ Article 28: Responsibility of commanders and other superiors

In addition to other grounds of criminal responsibility under this Statute for crimes within the jurisdiction of the Court:

1. A military commander or person effectively acting as a military commander shall be criminally responsible for crimes within the jurisdiction of the Court committed by forces under his or her effective command and control, or effective authority and control as the case may be, as a result of his or her failure to exercise control properly over such forces, where:
 - a. That military commander or person either knew or, owing to the circumstances at the time, should have known that the forces were committing or about to commit such crimes; and

- b. That military commander or person failed to take all necessary and reasonable measures within his or her power to prevent or repress their commission or to submit the matter to the competent authorities for investigation and prosecution;
2. With respect to superior and subordinate relationships not described in paragraph (a), a superior shall be criminally responsible for crimes within the jurisdiction of the Court committed by subordinates under his or her effective authority and control, as a result of his or her failure to exercise control properly over such subordinates, where:
 - a. The superior either knew, or consciously disregarded information which clearly indicated, that the subordinates were committing or about to commit such crimes;
 - b. The crimes concerned activities that were within the effective responsibility and control of the superior; and
 - c. The superior failed to take all necessary and reasonable measures within his or her power to prevent or repress their commission or to submit the matter to the competent authorities for investigation and prosecution.

➤ Article 30: Mental Element

1. Unless otherwise provided, a person shall be criminally responsible and liable for punishment for a crime within the jurisdiction of the Court only if the material elements are committed with intent and knowledge.
2. For the purposes of this article, a person has intent where:
 - a. In relation to conduct, that person means to engage in the conduct;
 - b. In relation to a consequence, that person means to cause that consequence or is aware that it will occur in the ordinary course of events.
3. For the purposes of this article, "knowledge" means awareness that a circumstance exists or a consequence will occur in the ordinary course of events. "Know" and "knowingly" shall be construed accordingly.

➤ Article 31: Grounds for excluding criminal responsibility

1. In addition to other grounds for excluding criminal responsibility provided for in this Statute, a person shall not be criminally responsible if, at the time of that person's conduct:
 - a. The person suffers from a mental disease or defect that destroys that person's capacity to appreciate the unlawfulness or nature of his or her conduct, or capacity to control his or her conduct to conform to the requirements of law;
 - b. The person is in a state of intoxication that destroys that person's capacity to appreciate the unlawfulness or nature of his or her conduct, or capacity to control his or her conduct to conform to the requirements of law, unless the person has become voluntarily intoxicated under such circumstances that the person knew, or disregarded the risk, that, as a result of the intoxication, he or she was likely to engage in conduct constituting a crime within the jurisdiction of the Court;
 - c. The person acts reasonably to defend himself or herself or another person or, in the case of war crimes, property which is essential for the survival of the person or another person or property which is essential for accomplishing a military mission, against an imminent and unlawful use of force in a manner proportionate to the degree of danger to the person or the other person or property protected. The fact that the person was involved in a defensive operation conducted by forces shall not in itself constitute a ground for excluding criminal responsibility under this subparagraph;

- d. The conduct which is alleged to constitute a crime within the jurisdiction of the Court has been caused by duress resulting from a threat of imminent death or of continuing or imminent serious bodily harm against that person or another person, and the person acts necessarily and reasonably to avoid this threat, provided that the person does not intend to cause a greater harm than the one sought to be avoided. Such a threat may either be:
 - i. Made by other persons; or
 - ii. Constituted by other circumstances beyond that person's control.
 2. The Court shall determine the applicability of the grounds for excluding criminal responsibility provided for in this Statute to the case before it.
 3. At trial, the Court may consider a ground for excluding criminal responsibility other than those referred to in paragraph 1 where such a ground is derived from applicable law as set forth in article 21. The procedures relating to the consideration of such a ground shall be provided for in the Rules of Procedure and Evidence.
 - Article 32: Mistake of fact or mistake of law.
 1. A mistake of fact shall be a ground for excluding criminal responsibility only if it negates the mental element required by the crime.
 2. A mistake of law as to whether a particular type of conduct is a crime within the jurisdiction of the Court shall not be a ground for excluding criminal responsibility. A mistake of law may, however, be a ground for excluding criminal responsibility if it negates the mental element required by such a crime, or as provided for in article 33.
 - Article 33: Superior orders and prescription of law
 1. The fact that a crime within the jurisdiction of the Court has been committed by a person pursuant to an order of a Government or of a superior, whether military or civilian, shall not relieve that person of criminal responsibility unless:
 - a. The person was under a legal obligation to obey orders of the Government or the superior in question;
 - b. The person did not know that the order was unlawful; and
 - c. The order was not manifestly unlawful.
 2. For the purposes of this article, orders to commit genocide or crimes against humanity are manifestly unlawful.

Article 121-1 *et seq.* to 122-8 of the French Penal Code provide input for this opinion. They particularly stipulate as follows:

- Article 121-1: No one is criminally liable except for his own conduct.
- Article 121-2: Legal persons, with the exception of the State, are criminally liable for the offences committed on their account by their organs or representatives, according to the distinctions set out in articles 121-4 and 121-7. However, local public authorities and their associations incur criminal liability only for offences committed in the course of their activities which may be exercised through public service delegation conventions. The criminal liability of legal persons does not exclude that of any natural persons who are perpetrators or accomplices to the same act, subject to the provisions of the fourth paragraph of article 121-3.
- Article 121-3: There is no felony or misdemeanour in the absence of intent to commit it. However, the deliberate endangering of others is a misdemeanour where the law so provides. A misdemeanour also exists, where the law so provides, in cases of recklessness, negligence, or failure to observe an obligation of due care or precaution imposed by any statute or regulation, where it is established that the offender has failed to show normal diligence, taking into consideration where appropriate the nature of his role or functions, of his capacities and powers and of the means then available to him. In the case as referred to in the above paragraph, natural

persons who have not directly contributed to causing the damage, but who have created or contributed to create the situation which allowed the damage to happen or who failed to take steps enabling it to be avoided, are criminally liable where it is shown that they have broken a duty of care or precaution laid down by statute or regulation in a manifestly deliberate manner, or have committed a specified piece of misconduct which exposed another person to a particularly serious risk of which they must have been aware. There is no petty offence in the event of force majeure.

- Article 121-4: The perpetrator of an offence is the person who:
 1. commits the criminally prohibited act;
 2. attempts to commit a felony or, in the cases provided for by Statute, a misdemeanour.
- Article 121-5: An attempt is committed where, being demonstrated by a beginning of execution, it was suspended or failed to achieve the desired effect solely through circumstances independent of the perpetrator's will.
- Article 121-6: The accomplice to the offence, in the meaning of article 121-7, is punishable as a perpetrator.
- Article 121-7: The accomplice to a felony or a misdemeanour is the person who knowingly, by aiding and abetting, facilitates its preparation or commission. Any person who, by means of a gift, promise, threat, order, or an abuse of authority or powers, provokes the commission of an offence or gives instructions to commit it, is also an accomplice.
- Article 122-1: A person is not criminally liable who, when the act was committed, was suffering from a psychological or neuropsychological disorder which destroyed his discernment or his ability to control his actions. A person who, at the time he acted, was suffering from a psychological or neuropsychological disorder which reduced his discernment or impeded his ability to control his actions, remains punishable; however, the court shall take this into account when it decides the penalty and determines its regime.
- Article 122-2: A person is not criminally liable who acted under the influence of a force or constraint which he could not resist.
- Article 122-3: A person is not criminally liable who establishes that he believed he could legitimately perform the action because of a mistake of law that he was not in a position to avoid.
- Article 122-4: A person is not criminally liable who performs an act prescribed or authorised by legislative or regulatory provisions. A person is not criminally liable who performs an action commanded by a lawful authority, unless the action is manifestly unlawful.
- Article 122-5: A person is not criminally liable if, confronted with an unjustified attack upon himself or upon another, he performs at that moment an action compelled by the necessity of self-defence or the defence of another person, except where the means of defence used are not proportionate to the seriousness of the attack. A person is not criminally liable if, to interrupt the commission of a felony or a misdemeanour against property, he performs an act of defence other than wilful murder, where the act is strictly necessary for the intended objective and the means used are proportionate to the seriousness of the offence.
- Article 122-6: A person is presumed to have acted in self-defence if he performs an action:
 1. to repulse at night an entry to an inhabited place committed by breaking in, violence or deception;
 2. to defend himself against the perpetrators of theft or pillage carried out with violence.

- Article 122-7: A person is not criminally liable if, confronted with a present or imminent danger to himself, another person or property, he performs an act necessary to ensure the safety of the person or property, except where the means used are disproportionate to the seriousness of the threat.
- Article 122-8: Minors found guilty of criminal offences are subject to measures of protection, assistance, supervision and education according to the conditions laid down by specific legislation. This legislation also determines the conditions in which penalties may be imposed upon minors over thirteen years of age.

APPENDIX 3: Definitions adopted by the CICDE

Remotely operated system

A remotely operated system is a system with no crew on board that is operated remotely by a crew via telecommunications means. All the tasks ordinarily performed by a system's crew are executed remotely. The system's status is piloted (e.g. Reaper drone).

A remotely operated system is functionally employed like a conventional carrier. It features automation like any other commercial or military carrier. Humans continue to intervene in every aspect of using remotely operated delivery systems.

This type of system does not preclude the presence of certain particular automated functions (flight commands, automatic return to base in specific situations such as a communication breakdown).

Supervised system

A supervised system is one whose basic tasks²⁶ are automated²⁷. A human operator constantly monitors the situation, provided by the system, and decides on the high-level tasks²⁸ it is to perform. Aircraft automatic pilots are an example of a supervised system.

Semi-autonomous system

A semi-autonomous system executes its tasks without human intervention according to its initial programming which cannot be altered without human intervention.

The system's ultimate status depends exclusively on the rules of operation, use and engagement, its mission (very high-level tasks) and its environment. The system executes high-level tasks assigned, in general, prior to its mission. Its high and low level tasks are automated. The system may report all or part of the signals and information processed during the mission.

This system does not modify its programming, tactical libraries, operating, use and engagement rules, or its mission without human intervention; it merely unwinds its automatic controls.

Humans retain control over the system: they manage the design and programming and define the rules of operation, use, engagement and the mission.

Use of the system is strictly limited in space and time for each mission.

For mobile systems, there are communication and control links between the system and the military chain of command to define, modify or halt the mission framework. Execution of the mission, possibly through to completion, may cause a breakdown or voluntary interruption in communication (stealth, change of environment). Any unintentional break in these links requires strict compliance with the last mission framework received from the command, which may include the return of the system or a switch to stand-by mode pending restoration of the links after completion of the mission.

²⁶ Basic tasks: system navigation, observation, situational awareness and aiming.

²⁷ Automata are systems whose operation and statuses are predefined, overall or specifically. Their autonomy depends on the type of programming (algorithm, artificial intelligence, etc.). Their start-up is generally triggered under control by an event or series of events.

²⁸ High level tasks: Time and space management of the system, sensor control, target designation and weapon engagement.

Fully autonomous system

A fully autonomous system executes its mission after activation, potentially outside the initial programming which may be modified without human intervention.

The system has no relationship of subordination with the chain of command, and cannot therefore be controlled or deactivated.

A fully autonomous system can increase its ability to respond to new situations by integrating new data generated by its perception of the environment in which it acts: this adaptation to the complexity and diversity of situations and environments could rely on unsupervised autonomous machine self-learning capabilities (and therefore self-modification of the programming).

If fully autonomous systems are faced with situations not initially programmed, machine self-learning would be based on models of forms of awareness, environmental interaction and understanding the behaviour of external elements. In the real world, where it would face "elements unforeseeable at the time of programming", a fully autonomous system could spontaneously adopt "abnormal" behaviour developed through its unsupervised machine self-learning.

Fully autonomous systems or functions, whose use is physically or functionally restricted to protecting life and property are conceptually possible but are yet to be invented.

We will note that part of the CICDE's definition of "semi-autonomous" systems is considered "autonomous" by the ICRC. An "autonomous" weapon system as defined by the ICRC could be identified as "semi-autonomous" without any communication links, according to the CICDE definition, and inserted beneath "fully autonomous". Furthermore, this difference is significant in terms of characterising certain weapon systems in service.

APPENDIX 4: The 11 guiding principles affirmed by the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapon system

- 1) International humanitarian law continues to apply fully to all weapon systems, including the potential development and use of lethal autonomous weapon systems;
- 2) Human responsibility for decisions on the use of weapon systems must be retained since accountability cannot be transferred to machines. This should be considered across the entire life cycle of the weapon system;
- 3) Human-machine interaction, which may take various forms and be implemented at various stages of the life cycle of a weapon, should ensure that the potential use of weapon systems based on emerging technologies in the area of lethal autonomous weapon systems is in compliance with applicable international law, in particular international humanitarian law. In determining the quality and extent of human-machine interaction, a range of factors should be considered including the operational context, and the characteristics and capabilities of the weapon system as a whole;
- 4) Accountability for developing, deploying and using any emerging weapon system in the framework of the CCW must be ensured in accordance with applicable international law, including through the operation of such systems within a responsible chain of human command and control;
- 5) In accordance with States' obligations under international law, in the study, development, acquisition, or adoption of a new weapon, means or method of warfare, determination must be made whether its employment would, in some or all circumstances, be prohibited by international law;
- 6) When developing or acquiring new weapon systems based on emerging technologies in the area of lethal autonomous weapon systems, physical security, appropriate non-physical safeguards (including cyber-security against hacking or data spoofing), the risk of acquisition by terrorist groups and the risk of proliferation should be considered;
- 7) Risk assessments and mitigation measures should be part of the design, development, testing and deployment cycle of emerging technologies in any weapon systems;
- 8) Consideration should be given to the use of emerging technologies in the area of lethal autonomous weapon systems in upholding compliance with IHL and other applicable international legal obligations;
- 9) In crafting potential policy measures, emerging technologies in the area of lethal autonomous weapon systems should not be anthropomorphized;
- 10) Discussions and any potential policy measures taken within the context of the CCW should not hamper progress in or access to peaceful uses of intelligent autonomous technologies;
- 11) The CCW offers an appropriate framework for dealing with the issue of emerging technologies in the area of lethal autonomous weapon systems within the context of the objectives and purposes of the Convention, which seeks to strike a balance between military necessity and humanitarian considerations.

APPENDIX 5: Questions for the legal review

The following questions have been drafted in parallel to this interim report to illustrate the main focus areas in the preparation of a weapon system featuring autonomous functions within the robotics meaning of decision-making autonomy:

- **Targeting:**
 1. How will targets at which the system is liable to fire be designated?
 2. Does the system have target recognition, classification or recognition assistance functions? Based on which criteria?
 3. Is the system capable of estimating potential collateral damage (fallout, weapon range, etc.)?
- **Opening fire:**
 1. Should the system be capable of opening fire without human intervention? On enemies? On enemy systems?
 2. Is the system intended to take over from soldiers, for example if the human being's attention is saturated or in physically demanding situations?
 3. What is the expected level of reversibility of missions assigned to the weapon system? Up to which point or operational stage should it be possible for the chain of command to cancel the system's action?
 4. What procedure must the system apply in the event of uncertainty over attaining targets or collateral damage?
 5. Are there any imperative points of interaction with soldiers, regarding the framework passed on from the chain of command to the machine (intention, restrictions, engagement rules), and "reporting" from the machine to the soldier to notify or question non-conforming situations, unexpected events, uncertainty and risks?
- **Human Factors:**
 1. What level of understanding must the system be able to provide to humans to avoid any ambiguity?
 2. What cognitive load will the system bring to bear on the people who operate it?
 3. What instruction and training is planned for use of the system?
- **Upgradability:**
 1. Will and should the system integrate databases and how will they be updated?
 2. Do any functions rely on machine learning? Does the learning continue during missions?
- **Reliability and Resilience:**
 1. How should the system behave in the event of a communication breakdown with its operators or chain of command in the broad sense?
 2. How reliable and resilient are the various automated functions?
 3. Should provision be made for "degraded mode" procedures (e.g. loss of tracking signal, sensor loss, etc.)?