

Conflicted intelligence

How universities can help prevent the development of lethal autonomous weapons



www.paxforpeace.nl

Reprogramming War

This report is part of a PAX research project on the development of lethal autonomous weapons. Previous reports looked at the role of states, tech companies and arms producers in contributing to the development of weapons with increasing levels of autonomy. Lethal autonomous weapons, which would be able to kill people without any direct human involvement, are highly controversial. Many experts warn that they would violate fundamental legal and ethical principles and would be a destabilising threat to international peace and security.

The present report focuses on universities. Its goal is to inform the ongoing debate with illustrations of where and how university collaboration with the military could be controversial, and potentially could run the risk of contributing to the development of lethal autonomous weapons systems. This report also aims to raise awareness of the issue more generally among students, university staff and the universities themselves. It is crucial that universities and their staff take steps to prevent any (unintentional) contribution to the development of lethal autonomous weapons.

If you have any questions regarding this project, please contact Daan Kayser (kayser@paxforpeace.nl).

Colophon

February 2020

ISBN: 978-94-92487-48-3

NUR: 689

PAX/2020/01

Authors: Alice Beck, Maaïke Beenes and Daan Kayser

Thanks to: Frank Slijper

Cover illustration: 'Vector' by Kran Kanthawong

Graphic design: Het IJzeren Gordijn

© PAX

This work is available under the Creative Commons Attribution 4.0 license (CC BY 4.0) <https://creativecommons.org/licenses/by/4.0/deed.en> We encourage people to share this information widely and ask that it be correctly cited when shared.

About PAX

PAX works with committed citizens and partners to protect civilians against acts of war, to end armed violence and to build peace. PAX operates independently of political interests. PAX is a co-founder of the Campaign to Stop Killer Robots.

PO Box 19318

3501 DH Utrecht

The Netherlands

www.paxforpeace.nl

info@paxforpeace.nl

Table of Contents

Introduction	4
Fundamental research, fundamental questions	4
Responsible science	5
Designing the future of war	7
United States of America	8
United Kingdom	9
China	10
Risky research	12
University of Queensland and University of New South Wales Canberra (Australia)	12
Carnegie Mellon University (US)	12
Imperial College London (UK)	13
Academic resistance	14
Student activism	14
Protesting military involvement with universities	14
Science for good	15
A need for due diligence	16
What can universities do?	17
Notes	20

Introduction

In February 2018, it was announced that the Korean Advanced Institute of Science and Technology (KAIST) had started a collaboration with arms producer Hanwha Systems. The goal was to “co-develop artificial intelligence (AI) technologies to be applied to military weapons, joining the global competition to develop autonomous arms”.¹ This collaboration immediately led to an outcry among scientists and a call to boycott the university.² Faced with the boycott, KAIST gave public reassurances that it would not develop such weapons, nor did it have plans to develop lethal autonomous weapon systems.³

The KAIST example demonstrates two important points. On the one hand, universities play an important role in the development of new technologies that can have significant implications for international security. This includes technologies that could play a key role in lethal autonomous weapons. On the other hand, the KAIST example shows that scientists can play an important part in preventing this from happening.

AI and related technologies are progressing rapidly and have enormous potential for helping humanity in countless ways, from improving healthcare to lifting people out of poverty and helping achieve the United Nations Sustainable Development Goals—if deployed wisely.⁴

In recent years, there has been increasing debate within the private sector about the impact of AI on our societies, and where to draw the line between acceptable and unacceptable uses. Concerns related to privacy, human rights and other issues have been raised. The issue of weapon systems with increasing levels of autonomy, which could lead to lethal autonomous weapons, has also led to heated debate.

Fundamental research, fundamental questions

Universities are hugely important in shaping society. They train future generations, pass on knowledge and play a key role in driving innovation. Many important innovations used in everyday life, from seatbelts to touchscreens, come from university research, illustrating the many positive impacts and applications university research can have.⁵

University research is not only financed by the state but also receives external, commercial, funding. Over the last decade, research and development (R&D) at universities has seen increases in funding from industry by over 5,5 per cent per year in the US.⁶ These partnerships exist not only for civilian products and sectors, but also with both ministries of defence and the arms industry.

Collaboration with the military sector is not necessarily problematic in itself. There are applications of new technologies in the military which are less controversial, for example when used for autonomous take-off and landing, navigation or refuelling of military systems. However, it is crucial for universities to be aware of how the technology they develop could be used in the future. Cutting

edge research in for example computer science, artificial intelligence and robotics is a key influence for developments in the defence industry that are rapidly changing the nature of warfare and can come to pose threats to international peace and security. And as the experience with the KAIST university shows, particular concern arises in relation to the development of lethal autonomous weapon systems, also commonly known as 'killer robots'.

Responsible science

Given that research undertaken by universities may end up being used in military applications, with particular concerns relating to autonomous weapon systems, academia has a role to play in preventing the development of such weapon systems. It is crucial that universities take a stand against any contribution to the development of lethal autonomous weapon systems. Awareness of this issue is all the more important given the increasing blurring of the lines separating knowledge development for civilian purposes and knowledge development for military purposes.⁷

This report therefore gives a brief insight into various involvements of universities in military projects, highlighting some specific profiles that demonstrate why it is essential that staff and students are well aware of what they are working on as well as the possible end uses.

The main aim of this report is to raise awareness of the issue of lethal autonomous weapons among students, university staff and faculty and anyone else interested in the issue, particularly within a university context. Indeed, there is concern that unless universities develop proper policies, some technologies not intended for battlefield use may ultimately end up being used in weapon systems.

This is an important debate in which universities play an important role. To ensure that this debate is as fact-based and productive as possible, it is valuable for universities to articulate and publish clear policies on their stance, clarifying where they draw the line between what AI technology they will and will not develop.

LETHAL AUTONOMY

Collaborations with the military sector are not always problematic, but do point to areas of concern. Such collaborations are potentially problematic because of the impact on a range of societal issues they may have, ranging from the compatibility of disruptive military technologies with the laws of war, to digital human rights such as freedom of speech and the right to privacy. Of particular concern to this report is the potential development of lethal autonomous weapon systems.

Lethal autonomous weapon systems are weapons that can select and attack individual targets without meaningful human control.⁸ This means that the decision to use lethal force is delegated to a machine, and that an algorithm can decide to kill humans. The function of autonomously selecting and attacking targets could be applied to various autonomous platforms, for instance drones, tanks, fighter jets or ships. The development of such weapons would have an enormous effect on the way war is conducted and it has been called the third revolution in warfare, after gunpowder and the atomic bomb.⁹

Militaries are developing these weapons so that they can react more rapidly, and thus gain an advantage over the enemy. Another reason to develop unmanned and increasingly autonomous systems is to reduce the direct exposure of troops to hostilities. Furthermore, these systems can operate for long periods in contested environments where even remote control by a human would not be possible.

However, many experts warn that lethal autonomous weapons would violate fundamental legal and ethical principles and would be a destabilising threat to international peace and security. Moral and ethical concerns have centred on the delegation of the kill decision to an algorithm. Legal concerns are related to whether lethal autonomous weapons could comply with International Humanitarian Law (also known as the law of war). Military and legal scholars have pointed out an accountability vacuum regarding who would be held responsible in the case of an unlawful act.¹⁰ Experts have also voiced various security concerns. For example, by enabling risk-free and untraceable attacks, they could lower the threshold to war and weaken norms regulating the use of force. Delegating decisions to algorithms could result in the pace of combat exceeding human response times, creating the danger of rapid conflict escalation. Lethal autonomous weapons might trigger a global arms race in which they become mass-produced, cheap and ubiquitous since, unlike nuclear weapons, they do not require any hard-to-obtain raw materials. They might therefore proliferate, spread to a large number of states and end up in the hands of criminals, terrorists and warlords.

Designing the future of war

Historically, universities and research institutes have played a key role in developing new technologies. With new technologies, however, also come new risks. This is especially true when research is used for military purposes.

During the Second World War and later the Cold War, innovation was one of the areas where states competed for dominance. Collaborations between universities and the military became commonplace.¹¹ In the US, for instance, the Defense Research Committee was founded in 1940. This committee funded research such as the Manhattan Project and established the current model of federal funding for university research.¹²

THE MANHATTAN PROJECT: THE SCIENCE OF DESTRUCTION

The Manhattan Project is an important illustration of academic contribution to military research. Back then, several US universities (including all those within the University of California) carried out academic research which was crucial to the aim of the Manhattan Project: the development of a nuclear weapon.¹³

The development of the nuclear weapon also made other countries realise that both fundamental and applied physics research had become a crucial part of conflict. For example, in the Netherlands the rise in interest for physics research cannot be seen separately from the nuclear bombing of Hiroshima and Nagasaki, which led to the realization that science and war were now permanently connected to one another.¹⁴

Once developed, the nuclear bombs that were then dropped on Hiroshima and Nagasaki led to the death of over 200.000 people. When the news of the attacks became clear, various scientists working on the project shared their regrets in developing the technology. The nuclear bomb is a clear example of the horrific consequences that academic research, without proper moral reflection on the effects, may lead to.

SOCIETAL IMPACT OF NEW TECHNOLOGIES

In the current geopolitical environment, with rising tensions and high military and economic competition, innovation is still seen as an important source of power. There are, however, some

important differences with the Cold War period.

Most importantly, the difference between innovation for civilian and military purposes is increasingly blurry.¹⁵ This is because emerging technologies are often dual-use in nature. This raises new questions about the responsibility of research communities for the potential end-uses of their research. In many cases, the ultimate end-uses will not be known when a technology is first developed. However, in the case of close collaborations between universities and military organisations and arms producers, it is clear some level of responsibility lies with the university.

This is particularly relevant because worldwide the trend of military funding into academic research has continued. Defence departments look to universities to help them in their research and development.

This chapter will provide some examples of involvement between the military sector and universities, focusing on the US, UK and China. It is not meant to be exhaustive, but to give an idea of the various types of collaborations. As mentioned the examples of collaborations with the military sector are not always problematic, but do point to areas of concern where it is important for universities to articulate and publish clear policies on their stance, clarifying where they draw the line between what AI technology they will and will not develop.

United States of America

The US Department of Defense's (DoD) overall spending on R&D has nearly doubled in the past two decades, increasing from USD 35.5 billion in 1996 to USD 68.3 billion in 2017, according to the National Science Foundation.¹⁶ A part of this R&D funding goes to universities in all 50 US states. Although such funding is mostly not for research into weaponry, an MIT researcher argues that "there is no such thing as free lunch, and the Pentagon is not handing out money just to do good science".¹⁷

In the US, the Pentagon is the third largest sponsor of all academic research. Only the National Institutes of Health and the National Science Foundation invest more.¹⁸ Furthermore the Pentagon is the leading sponsor in the physical sciences and engineering, for example in electrical engineering, mechanical engineering, mathematics and computer science. The DoD Joint Artificial Intelligence Centre (JAIC) fosters cooperation with academy and industry and is aimed at "accelerating the delivery of AI-enabled capabilities, scaling the Departmentwide impact of AI, and synchronizing DoD AI activities to expand Joint Force advantages [...] and adapt AI technologies for DoD missions".¹⁹

Carnegie Mellon University (CMU) is one of the many US universities benefitting from funds from the DoD. Its long-standing collaborative relationship with the Pentagon goes back more than 70 years.²⁰ For the fiscal year ending 30 June 2017, the university stated that it had spent USD 172 million in direct funding from the DoD.²¹ CMU notably works with the Defense Advanced Research Projects Agency (DARPA) on the OFFSET programme (OFFensive Swarm-Enabled Tactics), which aims to use swarms "to accomplish diverse missions in complex urban environments";²² in collaboration with other universities and start-ups such as Corenova Technologies Inc.²³

In general, most funding from government typically goes to university-affiliated research centres. One example is the Applied Physics Laboratory at John Hopkins University, which was established

by the DoD in 1942 and “accounted for USD 1.3 billion of the university’s USD 2.3 billion R&D expenditure in 2015”.²⁴ The lab works on various projects including robot swarms and is “helping to solve one of the Defense Department’s most significant challenges: the test and evaluation of autonomous unmanned aerial systems”.²⁵

Another example is the Lincoln Laboratory, part of MIT. The laboratory researches and develops technology in support of national security. It is a DoD, federally funded R&D centre.²⁶ It runs a 17,000-square-foot indoor test facility at the Hanscom Air Force Base used for “prototyping and testing of ground-based, aerial, and undersea autonomous systems”.²⁷

United Kingdom

Along with the United States, the United Kingdom is one of the largest funders of overall military R&D. Investments are currently increasing following a period of decline.²⁸ The UK spends around 17 per cent of total public R&D on the military – a large proportion but these numbers are still overshadowed by the figure of 52 per cent for the US. The majority of this funding goes to the arms industry, but (an unknown) part of this funding goes into universities.

The MoD has various programmes and projects that relate to artificial intelligence and autonomy. One of these is the ‘Autonomy programme’. The programme seeks to collaborate with academia, industry and international partners, with the aim of drawing on “external civil and military scientific and technological developments and capabilities”. Activities include algorithm development, artificial intelligence, machine learning, “developing underpinning technologies to enable next generation autonomous military systems” and optimisation of human autonomy teaming.²⁹ A survey undertaken by Drone Wars UK shows that 14 UK universities received funding for autonomous systems and drone technology from Defence Science and Technology Laboratory (Dstl), an MoD agency.³⁰

An example of this is the Autonomous Systems Underpinning Research (ASUR) programme, led by BAE Systems with support from e.g. Cranfield and Loughborough universities. ASUR supports the development of technologies for unmanned systems, including with regard to “engineering autonomous systems”, “operator system decision-making partnership” and “reasoning about metadata in a distributed autonomous environment in order to exploit, prioritise and adapt”.³¹

UNIVERSITY	AREA OF COLLABORATION
Cranfield University	Autonomous systems
Imperial College London	Sensors and data analytics
Loughborough University	Autonomous systems
University College London	Imaging and sensors
University of Cambridge	Control and performance
University of Liverpool	Ship launched drones

Image 1: Examples of cooperation between universities and MoD / arms producers (source: Drone Wars UK)³²

UK university funding does not only stem from the Ministry of Defence and its associated laboratories. Arms producers themselves pour large amounts of money into the academic sector as well. There are collaborations with several arms producers, including BAE Systems, Thales, and QinetiQ. Drone Wars UK notes that “universities appear usually to undertake applied research of this nature in collaboration with private sector contractors, often as part of a broad industry-academia consortium involving several partners from each sector, with projects specifically focused on defined outputs”.³³ According to an article from 2018, “in the past three years alone, 15 universities with renowned engineering departments have received almost £40m in grants from the contractors”.³⁴ Examples include Boeing’s funding of scholarships and internships for students working on a drone project at Bristol University, as well as BAE Systems sponsoring the Centre for Ethics and Law at University College London.³⁵ BAE Systems also supports a professorship at Cranfield University in autonomous systems and artificial Intelligence.³⁶

These collaborations in the UK have sparked debate in the past. Already in 2010, a group of 20 professors asked that public spending cuts be made in military R&D rather than into research in healthcare and environmental issues.³⁷

China

Traditionally there have been strong links in China between defence and educational institutions. This is also the case in the development of artificial intelligence and related technologies. Tsinghua University, for instance, has launched the Military-Civil Fusion National Defence Peak Technologies Laboratory to create a “platform for the pursuit of dual-use applications of emerging technologies, particularly artificial intelligence”.³⁸ In a speech the Vice President of Tsinghua University stated that “Applied basic research is mainly focused on major national needs, especially military needs, research and development of key core technologies, and promote military-civilian integration in the field of artificial intelligence in China”.³⁹ The university received CNY 100 million (around EUR 13 million) for research into “AI Theories and Crux Technologies for Future Human-Machine Cooperative (Combat) Operations”.⁴⁰

A number of Chinese universities participate in the China Innovation Challenge Competition, including the Chinese Academy of Sciences, Peking University, Tsinghua University, Shanghai Jiaotong University and Fudan University. The event is co-organised by the Zhongguancun Civil-Military Integration Industrial Alliance. Ji Huixian, general secretary of the Alliance stated: “Some of the latest scientific achievements have been applied to meet the needs of users, which contributed a lot to promoting national defense”.⁴¹ Another example is the Tianjin Artificial Intelligence Innovation Centre (TAIIC) which was established by the Academy of Military Sciences. The centre does various research projects for the People’s Liberation Army (PLA) and collaborates with several Chinese universities.⁴² These links are also seen at Harbin Engineering University (HEU), which traces its origins to the PLA Military Engineering Institute and is mainly aimed at research for the navy. In 2018 the university co-organised the “civil-military integration of artificial intelligence Industry Development Summit”. One of the technologies currently being developed at the university is autonomous underwater vehicles.⁴³

Interestingly some Chinese scholars have argued that the development of artificial intelligence should not be without limits. Indeed, Xu Nengwu and Ge Hongchang of China’s National University of Defence Technology state that “the international community maintains that the control of

autonomous lethal weapons systems is difficult, but necessary” and recommend a framework that emphasises both transparency and legal principles.⁴⁴

The next section will look more closely at some examples of university–military cooperation that potentially risks contributing to the development of lethal autonomous weapons and therefore raises particular concerns.

Risky research

The sections below aim to highlight specific universities that are involved with defence departments and/or arms producers. The aim is to give some insight into a number of ongoing projects that could run the risk of (unintentionally) contributing to the development of lethal autonomous weapons. Projects are considered concerning if they involve technology (and associated hardware) relevant to the development of lethal autonomous weapon systems as well as close military collaboration. Examples of technologies include:

- ◆ Sensors, notably: radar, camera, lidar, inertial measurement unit (IMU).
- ◆ Software for object detection, identification and classification and target tracking
- ◆ Related hardware, notably chips and semiconductors
- ◆ Key components for robotics and unmanned systems

In these cases, there is potential for the research carried out within the framework of universities to be used by the military. It is also possible that militaries reconfigure academic research for purposes not foreseen by the institutions.

University of Queensland and University of New South Wales Canberra (Australia)

In February 2019, the University of Queensland and the University of New South Wales (UNSW) announced a joint collaboration with the aim of embedding ethics into autonomous weapons. The five-year, AUD 9 million (around USD 6 million) project is funded by the Australian Defence Department and is the world's largest study "into how to make autonomous weapons such as future armed drones behave ethically in warfare".⁴⁵ The research will also involve the establishment of an advisory board "for organisations to consult with on ethical matters".⁴⁶

Despite the proclaimed aim of this research to embed ethics in autonomous weapons, the project is a worrying one and has sparked controversy, as the research appears to legitimise lethal autonomous weapons. Indeed the lead researcher stated that the project "aims to shape international policy by convincing people that autonomous weapons are a force for good".⁴⁷ The idea that programming ethics and the laws of war into machines would solve the concerns related to lethal autonomous weapons has been critiqued by various AI experts.⁴⁸

Carnegie Mellon University (US)

Similarly, Carnegie Mellon University is involved in research that raises questions. In February 2019, it was announced that the university was further expanding its defence collaboration with the launch of the United States Army's Artificial Intelligence Task Force, which will be based in the National Robotics Engineering Centre in Lawrenceville. Although the broad

mission of this task force has not yet been decided, it is likely that the Task Force will be at the forefront of applying AI technologies to weapons systems.⁴⁹ Apparently, the task force will delve into ethics and codes of conduct for AI systems, despite the President of CMU, the Army Secretary and the commander of Army Futures Command all declining “to endorse a full ban on autonomous weapons systems”.⁵⁰ More recently, the AI Army Task Force head Col. Matty said that they were “able to leverage existing relationships between Carnegie Mellon and DOD through Army Research Lab [...] to create an Army task force that could tap into the artificial intelligence ecosystem”.⁵¹

The parallels with the above example are self-evident, and this announcement has also raised concerns. On campus, “critics say they wish they had more information on this new work with the Army”.⁵² These developments come at a time when Silicon Valley and the tech sector are toeing the line between useful innovations (for defence and civilian protection), and producing autonomous weapons.⁵³ An op-ed in the student newspaper, the Tartan, protested clearly and strongly against the presence of the US Army on campus. This op-ed argued that “even our very own university president, Farnam Jahanian, is committed to war over diplomacy and negotiations. [...] This is unacceptable. The President did not seek the input of students, faculty, or staff before proffering this view on our behalf – or indeed, before committing Carnegie Mellon to the Army AI Task Force itself”.⁵⁴

On top of this, one of the Task Force’s projects has been tied to (the much controversial) Project Maven. The US Army has been developing surveillance technology within CMU’s Army AI Task Force, where it seeks to develop algorithms able to analyse drone footage in order to identify targets.⁵⁵ Allegedly, the pursuit of this Project Maven initiative by the university “went without any notice or publications”.⁵⁶

Imperial College London (UK)

Imperial College London provides another example of a university with strong defence links and collaborations. The university is among those receiving the highest levels of military funding, according to Scientists for Global Responsibility (SGR), a UK-based organisation that has undertaken research into military funding of UK universities.⁵⁷

In July 2018 it was reported that Imperial’s White City Campus “is providing a new hub for DASA [the Defence and Security Accelerator]”. This new hub was arranged at the same time as both institutions agree to explore research collaboration opportunities that “could provide advantages to the UK’s defence and security”. According to the head of DASA, “Our presence at I-HUB gives us access to innovative start-ups and world class academics across a wide range of disciplines, and promotes collaborative working between the Government, academia and the private sector”.⁵⁸ Indeed, the aim of DASA is to help the UK DoD maintain strategic advantage over its adversaries.⁵⁹

Imperial College had also previously developed flight control algorithms for the Demon drone, which displayed a certain amount of autonomy.⁶⁰ According to NGO Drone Wars UK, it is likely that Imperial College works on sensor networks and visualisation in projects funded by DSTL; however when conducting research on this topic, they were unable to get more information as Imperial College turned down requests to provide more details.⁶¹

Academic resistance

Student activism

Traditionally, universities have been fertile ground for activism and protests. This was particularly evident during the Vietnam war, where student unrest spread across the US. A nationwide strike took place on 5 May 1970, in reaction to the deaths of students at a protest rally in Kent State University following president Nixon's extension of the war into Cambodia.⁶² The week-long protest that ensued involved some of the largest protest movements around the country.

In recent years, universities have been host to student protests in relation to climate change, particularly with the aim of getting universities to divest from fossil fuel companies. In February 2018, the University of Edinburgh declared that it was fully divesting from all fossil fuels, following a long student campaign.⁶³ In November 2019, the University of Manchester announced that it was reviewing its GBP 12 million investment into fossil fuel companies. This came after a week of protests involving the occupation of one of the university's buildings.⁶⁴

Similar activism has also been linked to university shares in arms producers. In September 2019, an investigation by the Glasgow Guardian found that the University of Glasgow had a total of GBP 3 million invested in weapons producers as of 30 June 2019.⁶⁵ Following this, six University societies have formed a coalition protesting for full divestment and they aim to pursue a long-term campaign.⁶⁶ The Glasgow University Arms Divestment Coalition states: "The campaign has such a broad base of societies due to the very nature of the arms trade. It is damaging in so many ways, from furthering the climate crisis to violation of human rights. We hope that the University will hear loud and clear that the student population does not accept this use of money now, nor ever".⁶⁷ These examples illustrate the influence that students may have over universities and their policies.

Protesting military involvement with universities

University collaboration with the military sector is contentious and has raised questions for many years. Below are some more recent examples of resistance in accepting research funding from defence organisations.

JAPAN

In Japan, it was reported back in 2017 that there was a big divide among academics over MoD grants to universities for defence-related research.⁶⁸ Indeed, the years 2015 to 2017 were marked by a big increase in subsidies for such research, from JPY 300 million (approx. EUR 2,5 million) in 2015 to JPY 11 billion (approx. EUR 92 million⁶⁹) for the fiscal year 2017. What is more, for Japan 2015

marked the first year since World War II that direct research funding was provided to universities from the defence ministry.⁷⁰ Since the end of World War II, Japanese academics have consistently renounced military research “based on the bitter lessons of the war, in which Japanese scientists contributed”.⁷¹ Worries pertain primarily to the risks posed by defence funding to academic freedom, as the results would not be available to the public without permission from the military, according to the Japanese Coalition Against Military Research in Academia. In March 2018, Kyoto University announced it was adopting a policy of not conducting any military-related research.

GERMANY

In Germany, some 20 universities have signed a clause (the ‘Civil Clause’) where they promise to only conduct civilian, not military research.⁷² Civil clauses were first introduced at the University of Bremen in 1986, with multiple other German universities following suit.⁷³ In 2013, revelations about US defence funding research at German universities and research institutions caused quite a stir, raising questions about the relationship between the Pentagon and Germany’s institutes of higher education and research.⁷⁴ However, in July 2019 the German state of North Rhine-Westphalia adopted a new law allowing universities there to conduct military research in the future through abolishing the so-called ‘civilian clause’, despite many groups protesting the bill.⁷⁵

EUROPEAN UNION

The European Union itself is now also focusing on military R&D, allocating EUR 13 billion for the new European Defence Fund in the period 2021 to 2027. For now though, universities have received just 2 per cent of the EUR 44 million allocated so far, while 26 per cent went to research and technology organisations – such as TNO, the Netherlands Organisation for Applied Scientific Research.⁷⁶ However, in the future projects might be tailored more “towards fundamental science and universities”.⁷⁷ These developments have led some researchers to actively avoid the scheme. A campaign group named Researchers for Peace gathered more than 1,000 signatures against the fund, with the largest share of signatures coming from Germany.⁷⁸ The campaigners warn that the “establishment of an EU military research programme points towards an unprecedented acceleration of the militarisation of the EU”.⁷⁹

Science for good

There are several organisations that work to ensure that research is done for the benefit of humanity. Such groups include previously-mentioned *Scientists for Global Responsibility*, a UK membership organisation promoting responsible science and technology.⁸⁰ SGR have listed the various justifications that universities may provide for accepting military funding, which include arguing that the amount may only be a small percentage of the university’s total funding and so “it has little effect on its overall research agenda” and that “military-funded projects benefit Britain’s national security”.⁸¹ SGR refute these points, arguing that funding may represent a large proportion of the budget for a particular department, and thus can shape the research priorities of that department – “gearing them towards a more militaristic agenda”.⁸² Another example is *Pugwash Conferences on Science and World Affairs*, an international organisation which focuses on the issues that lie at the intersection between science and global affairs.⁸³ Its goal is to seek the elimination of all weapons of mass destruction and to reduce the risks of war, among others.

A need for due diligence

The examples given above demonstrate existing tensions concerning military funding in higher education institutions, despite not all defence collaborations with universities being necessarily unwanted. As this report focuses on concerns related to the development of lethal autonomous weapon systems, many components that could be used for such systems may be in the research and development phase. It is therefore crucial that universities are fully aware of the purpose and possible applications of the technologies they are working on, especially if the research is pursued in collaboration with Ministries of Defence and the arms industry.

What can universities do?

This report has presented several potentially concerning examples of university collaboration with the military. However, there have also been examples of universities taking positive steps to prevent any future contribution to the development of lethal autonomous weapons systems. The present chapter will present some examples of such action as well as provide other measures that universities and their staff can take to ensure none of their work ends up leading to the development of weapons systems without meaningful human control.

In spring 2018, the Korean Advanced Institute of Science and Technology's collaboration with an arms producer led to a huge public outcry. In February of that year, the institute had opened a joint research centre along with Hanwha Systems, with the aim of carrying out studies into how Fourth Industrial revolution technologies can be utilised on future battlefields.⁸⁴ This announcement led to a boycott organised by Professor Toby Walsh. More than 50 leading AI and robotics researchers stated that "they will boycott South Korea's KAIST university over the institute's plans to help develop AI-powered weapons."⁸⁵ The boycott would "forbid all contact and academic collaboration with KAIST until the university makes assurances that the weaponry it develops will have 'meaningful human control'".⁸⁶ In response, the university indeed gave public reassurances that it would not develop such weapons, nor did it have plans to develop them,⁸⁷ and the boycott was ended.

Later, in June, KAIST launched an ethics subcommittee within the KAIST Institute for Artificial Intelligence, "in a bid to cope with a series of challenging ethical questions being posed by AI-powered systems worldwide".⁸⁸ As a result, KAIST now has a code of ethics for artificial intelligence:

Artificial Intelligence (AI), researched and developed at KAIST, is required to have the following codes of ethics:

1. AI should contribute to improving the quality of life and human society as well as individual people. In this process, artificial intelligence must cooperate with people, follow the directions of people, learn the values of human society, protect the law and morality, and improve its own abilities.
2. AI in any events should not injure people.
3. Unless violating codes 1 and 2 above, AI shall follow both explicit and implicit human intention. However, before the execution, AI should ask people to confirm the implicit intention. (If several people are involved and their intentions are different, AI should follow a person with the highest priority or the closest relationship.)

4. Unless violating codes 1 to 3 above, AI may autonomously perform functions delegated by people. However, for the cases of either a low confidence or a high risk, AI should always advise to people and confirm the final decision before the execution".⁸⁹

The KAIST controversy demonstrates the important role that academia can play in preventing any developments that could lead to lethal autonomous weapon systems. The following section will provide an overview of what else universities can do, as well as some examples of other commitments already made by academic staff.

The KAIST example is not the only time that academics have played a role impeding the development of lethal autonomous weapon systems. There have been a number of scientists' letters, i.e. open letters signed by prominent AI and robotics researchers, some of which have been submitted to national parliaments or to the UN.

Stuart Russell, a computer science professor at the University of California in Berkeley has warned that "because they do not require individual human supervision, autonomous weapons are potentially scalable weapons of mass destruction; an essentially unlimited number of such weapons can be launched by a small number of people. This is an inescapable logical consequence of autonomy".⁹⁰ Therefore "pursuing the development of lethal autonomous weapons would drastically reduce international, national, local, and personal security", according to Russell.⁹¹ Decades ago, scientists used a similar argument to convince presidents Lyndon Johnson and Richard Nixon to renounce the US biological weapons programme and ultimately bring about the Biological Weapons Convention.⁹²

In Belgium, an open letter was published in December 2017 by 116 scientists working in fields such as AI and robotics. The letter expressed "serious concern at the development of weapon systems lacking meaningful human control over the critical functions of targeting and engagement in every attack". Many of the signatories were university professors or researchers.⁹³ The letter was released on the same day that the Belgium parliament held its first hearing on autonomous weapons.⁹⁴ The attention and coverage was instrumental in leading to a resolution unanimously adopted by the Belgian parliament in July 2018 calling for a ban. The resolution calls on the government "to forbid the Belgian military from using lethal autonomous weapons and to work toward an international treaty banning the weapons".⁹⁵ Another letter was published in Norway in June 2019. At the time of writing, it has received over 750 signatures.⁹⁶ Signatories include numerous rectors of Norwegian universities, professors and heads of departments.

As shown above, these letters can have a significant impact on debates in national parliaments. We encourage university faculty staff, researchers and students to sign any such national open letter. Similarly, they can make a commitment by signing the Future of Life's "Lethal Autonomous Weapons Pledge".⁹⁷

Students and faculty members can take other steps to raise awareness too, in the aim that their institutions take action to prevent the development of killer robots. Actions such as events and workshops on the issue are helpful, as well as encouraging dialogue and questions on (military) research conducted within universities.

“Pursuing the development of lethal autonomous weapons would drastically reduce international, national, local, and personal security” – Stuart Russell.⁹⁸

Besides steps taken by students and staff, there are measures that universities themselves can take to prevent their collaborations leading to the development of lethal autonomous weapons.

- ◆ Commit publicly to not contributing to the development of lethal autonomous weapons.⁹⁹
- ◆ Establish a clear policy stating that the university will not contribute to the development or production of lethal autonomous weapon systems, and including implementation measures such as:
 - ◆ Ensuring each new project is assessed by an ethics committee;
 - ◆ Assessing all technology the university develops and its potential uses and implications;
 - ◆ Adding a clause in contracts, especially in collaborations with ministries of defence and arms producers, stating that the technology developed may not be used in lethal autonomous weapon systems.
- ◆ Ensure university staff and researchers are fully aware of what precisely their technology is being used for and understand the possible implications of their work, and allow open discussions about any related concerns.

Notes

- 1 Jun Ji-hye, 'Hanwha, KAIST to develop AI weapons', Korea Times, 25 February 2018, https://www.koreatimes.co.kr/www/tech/2018/12/133_244641.html.
- 2 James Vincent, 'Leading AI researchers threaten Korean university with boycott over its work on "killer robots"', The Verge, 4 April 2018, <https://www.theverge.com/2018/4/4/17196818/ai-boycot-killer-robots-kaist-university-hanwha>.
- 3 Cyclical Consumer Goods, 'AI researchers end ban after S. Korean university says no to "killer robots"', Reuters, 9 April 2018, <https://www.reuters.com/article/tech-korea-boycott/ai-researchers-end-ban-after-s-korean-university-says-no-to-killer-robots-idUSL8N1RM2HN>.
- 4 R. Vinuesa et al., 'The role of artificial intelligence in achieving the Sustainable Development Goals', 2019, <https://arxiv.org/ftp/arxiv/papers/1905/1905.00501.pdf>.
- 5 See '100 Important Innovations That Came From University Research', Online Universities, 27 August 2012, <https://www.onlineuniversities.com/blog/2012/08/100-important-innovations-that-came-from-university-research/>.
- 6 Farnam Jahanian, '4 ways universities are driving innovation', World Economic Forum, 17 January 2018, <https://www.weforum.org/agenda/2018/01/4-ways-universities-are-driving-innovation/>.
- 7 See Rathenau Instituut, 'Kennis in het vizier', Rathenau Instituut, 1 July 2019, <https://www.rathenau.nl/vitale-kennisecosystemen/kennis-het-vizier> (Google translation).
- 8 Within the UN and elsewhere, lethal autonomous weapon systems are often referred to as LAWS or as fully autonomous weapon systems, and more popularly as killer robots. In this report we will use the terms 'lethal autonomous weapons' and 'autonomous weapons' interchangeably. For more information on the UN process, see: [https://www.unog.ch/80256EE600585943/\(httpPages\)/8FA3C2562A60FF81C1257CE600393DF6?OpenDocument](https://www.unog.ch/80256EE600585943/(httpPages)/8FA3C2562A60FF81C1257CE600393DF6?OpenDocument). For a brief general introduction to this topic, see: <https://www.paxforpeace.nl/media/files/pax-booklet-killer-robots-what-are-they-and-what-are-the-concerns.pdf>.
- 9 Future of Life Institute, 'Autonomous Weapons: An Open Letter From AI & Robotics Researchers', 28 July 2015, <https://futureoflife.org/open-letter-autonomous-weapons/>.
- 10 Bonnie Docherty, 'Mind the Gap: the Lack of Accountability for Killer Robots', Human Rights Watch, 9 April 2015, <https://www.hrw.org/report/2015/04/09/mind-gap/lack-accountability-killer-robots>; Thomas Chengeta, 'Accountability Gap, Autonomous Weapon Systems and Modes of Responsibility in International Law', SSRN, 30 September 2015, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2755211.
- 11 Evan Comen, '10 universities spending billions on R&D', MSN, 4 April 2017, <https://www.msn.com/en-us/money/careersandeducation/10-universities-spending-billions-on-randd/ar-BBzjbN7>.
- 12 Ibid.
- 13 Nate Van Duzer, 'Schools of Mass Destruction: American Universities in the U.S. Nuclear Weapons Complex', ICAN, November 2019, <https://universities.icanw.org/>.
- 14 Rathenau Instituut, 'Kennis in het vizier', Rathenau Instituut, 1 July 2019, <https://www.rathenau.nl/vitale-kennisecosystemen/kennis-het-vizier> (Google translation).
- 15 Ibid.
- 16 Brian Conway, 'Carnegie Mellon University is helping to shape the future of war. What do we really know about it?', Public Source, 30 April 2018, <https://www.publicsource.org/carnegie-mellon-university-is-helping-to-shape-the-future-of-war-what-do-we-really-know-about-it/>.
- 17 Ibid.
- 18 Subrata Ghoshroy, 'Fact Sheet: The Pentagon and the Universities', Global Campaign on Military Spending, 14 January 2011, <http://demilitarize.org/enfact-sheet-pentagon-universities/>.
- 19 Deputy Secretary of Defense, 'Memorandum: Establishment of the Joint Artificial Intelligence Center', 27 June 2018, https://admin.govexec.com/media/establishment_of_the_joint_artificial_intelligence_center_osd008412-18_r....pdf.
- 20 Bill O'Toole, 'U.S. Army launches AI Task Force at CMU, stirring concerns about lethal machines', Next Pittsburgh, 4 February 2019, <https://www.nextpittsburgh.com/latest-news/u-s-army-launches-ai-task-force-at-cmu-stirring-concerns-about-lethal-machines/>.
- 21 Brian Conway, 'Carnegie Mellon University is helping to shape the future of war. What do we really know about it?', Public Source, 30 April 2018, <https://www.publicsource.org/carnegie-mellon-university-is-helping-to-shape-the-future-of-war-what-do-we-really-know-about-it/>.
- 22 DARPA, 'OFFensive Swarm-Enabled Tactics (OFFSET)', <https://www.darpa.mil/program/offensive-swarm-enabled-tactics>.
- 23 PAX, 'State of AI', May 2019, <https://www.paxforpeace.nl/publications/all-publications/the-state-of-ai>.
- 24 Evan Comen, '10 universities spending billions on R&D', MSN, 4 April 2017, <https://www.msn.com/en-us/money/careersandeducation/10-universities-spending-billions-on-randd/ar-BBzjbN7>.
- 25 John Hopkins Applied Physics Laboratory, 'Intelligent Systems Center', <https://www.jhuapl.edu/isc>.

- 26 Lincoln Laboratory, <https://www.ll.mit.edu/partner-us/government>.
- 27 Lincoln Laboratory, 'Autonomous Systems Development Facility', <https://www.ll.mit.edu/about/facilities/autonomous-systems-development-facility>.
- 28 Stuart Parkinson, 'Militarising academia: arms corporations and UK universities', SGR conference 'Universities for sale?', 19 November 2016, <https://www.sgr.org.uk/sites/default/files/SGRconf2016-Parkinson-Universities+arms-industry.pdf>.
- 29 Dstl, 'Autonomy Programme', 1 January 2018, <https://www.gov.uk/guidance/autonomy-programme>.
- 30 Peter Burt, 'Off the Leash: The development of autonomous military drones in the UK', Drone Wars UK, November 2018, <https://dronewarsuk.files.wordpress.com/2018/11/dw-leash-web.pdf>.
- 31 Innovate UK, 'Autonomous Systems Underpinning Research - ASUR 2013', https://sbri.innovateuk.org/competition-display-page/-/asset_publisher/E809e7RZ5ZTz/content/autonomous-systems-underpinning-research-asur-2013/1524978.
- 32 Peter Burt, 'Lethal and autonomous: coming soon to a sky near you', Responsible Science, 12 June 2019, https://www.sgr.org.uk/sites/default/files/2019-06/SGR-RS01_Lethal_autonomous_drones.pdf.
- 33 Peter Burt, 'Off the Leash: The development of autonomous military drones in the UK', Drone Wars UK, November 2018, <https://dronewarsuk.files.wordpress.com/2018/11/dw-leash-web.pdf>.
- 34 Jamie Doward and Greg Bennett, 'Defence contractors hand British universities £40m', The Guardian, 1 April 2018, <https://www.theguardian.com/world/2018/mar/31/defence-contractors-british-universities-funding>.
- 35 Ibid.
- 36 Cranfield University, 'Cranfield University reveals plans for leading research role in autonomous systems and AI', 3 October 2018, <https://www.cranfield.ac.uk/press/news-2018/cranfield-university-reveals-plans-for-leading-research-role-in-autonomous-systems-and-ai>.
- 37 Michael Atiyah, 'Cut military R&D, not science funding', The Guardian, 13 October 2010, <https://www.theguardian.com/commentisfree/2010/oct/13/cut-military-research-not-science-funding>.
- 38 Samuel Bendett and Elsa B. Kania, 'Innovation, with American Characteristics? Military Innovation, Commercial Technologies, and Great Power Competition', Strategy Bridge, 2 August 2018, <https://thestrategybridge.org/the-bridge/2018/8/2/chinese-and-russian-defense-innovation-with-american-characteristics-military-innovation-commercial-technologies-and-great-power-competition>; see also PAX, 'State of AI', May 2019, <https://www.paxforpeace.nl/publications/all-publications/the-state-of-ai>.
- 39 Ministry of Education, 'The Ministry of Education held a press conference to interpret the 'Action Plan for Artificial Intelligence Innovation in Higher Education Institutions'', Ministry of Education website, 8 June 2018, https://web.archive.org/save/http://www.gov.cn/xinwen/2018-06/08/content_5297021.htm#2 (Google translation).
- 40 Elsa B. Kania, 'Tsinghua's Approach to Military-Civil Fusion in Artificial Intelligence', Centre for New American Security, 12 July 2018, <https://www.cnas.org/publications/commentary/tsinghuas-approach-to-military-civil-fusion-in-artificial-intelligence>.
- 41 CCTV, 'China Innovation Challenge Competition boosts integration of civilian, military technologies', 17 June 2019, <http://www.cctvplus.com/news/20190617/8113481.shtml>.
- 42 Tianjin (Binhai) Artificial Intelligence Military-Civil Fusion Innovation Center, 14 November 2018, <http://www.yingjiesheng.com/job-004-024-366.html> (Google translation).
- 43 'The first civil-military integration of artificial intelligence Industry Development Summit', 709, 2018, http://www.jingpai7.com/ej/qdxq_hrbeu_edu_cn/2018/0415/c5162a185124/page.htm.
- 44 See Lyle J. Goldstein, 'China's Olive Branch to Save the World from AI Weapons', The National Interest, 1 February 2019, <https://nationalinterest.org/feature/chinas-olive-branch-save-world-ai-weapons-42972>.
- 45 David Wroe, "'Killer robots' to be taught ethics in world-topping Australian research project", The Sydney Morning Herald, 28 February 2019, <https://www.smh.com.au/politics/federal/killer-robots-to-be-taught-ethics-in-world-topping-australian-research-project-20190228-p510vz.html>.
- 46 George Nott, 'Killer robot campaign defector to "embed ethics" in autonomous weapons', Computerworld, 11 March 2019, <https://www.computerworld.com.au/article/658600/killer-robot-campaign-defector-embed-ethics-autonomous-weapons/>.
- 47 Charlie Moore, 'Australian Defence Force invests \$9million in researching "killer robots" to ensure artificially intelligent weapons are ethical and don't open fire on children', Daily Mail Australia, 1 March 2019, <https://www.dailymail.co.uk/news/article-6758051/Australian-Defence-Force-invests-9million-researching-killer-robots.html>.
- 48 See for example: Aimee van Wynsberghe & Scott Robbins, 'Critiquing the Reasons for Making Artificial Moral Agents', February 2018, <https://link.springer.com/article/10.1007/s11948-018-0030-8>; Noel Sharkey, 'The evitability of autonomous robot warfare', International Review of the Red Cross, June 2012, <https://international-review.icrc.org/sites/default/files/irrc-886-sharkey.pdf>; Professor P. Asaro 'On banning autonomous weapon systems: human rights, automation, and the dehumanization of lethal decision-making', International Review of the Red Cross, 2020, <https://e-brief.icrc.org/wp-content/uploads/2016/09/22-On-banning-autonomous-weapon-systems.pdf>.
- 49 Bill O'Toole, 'U.S. Army launches AI Task Force at CMU, stirring concerns about lethal machines', Next Pittsburgh, 4 February 2019, <https://www.nextpittsburgh.com/latest-news/u-s-army-launches-ai-task-force-at-cmu-stirring-concerns-about-lethal-machines/>.
- 50 Ibid.
- 51 Gary Sheftick, 'AI Task Force taking giant leaps forward', US Army, 13 August 2019, https://www.army.mil/article/225642/ai_task_force_taking_giant_leaps_forward.

- 52 Courtney Linder, 'Some students, faculty remain uneasy about CMU's Army AI Task Force', Post-Gazette, 18 February 2019, <https://www.post-gazette.com/business/tech-news/2019/02/17/army-ai-task-force-pittsburgh-cmu-farnam-jahanian-military-google-project-maven/stories/201902150015>.
- 53 Ibid.
- 54 'CMU SDS opposes Army AI Task Force', The Tartan, 10 February 2019, http://thetartan.org/2019/2/11/forum/sds?fbclid=IwAR0kl7rNalFWZuU_nmrfYv0Fdn3MQ4DDKo5NztX8LLNsLP8iNOKk5MXLrMg.
- 55 Adam Tunnard, 'CMU Quietly Hosts Project Maven Offshoot Through Army AI Task Force', WESA, 3 September 2019, <https://www.wesa.fm/post/cmu-quietly-hosts-project-maven-offshoot-through-army-ai-task-force#stream/0>.
- 56 Ibid.
- 57 Stuart Parkinson, 'Military-university collaborations in the UK – an update', Scientists for Global Responsibility, 13 April 2015, <https://www.sgr.org.uk/resources/military-university-collaborations-uk-update>.
- 58 Imperial College London, 'New solution to defence and security challenges to be explored at White City', 10 July 2018, <https://www.imperial.ac.uk/news/187172/new-solutions-defence-security-challenges-explored/>.
- 59 DASA, 'About us', <https://www.gov.uk/government/organisations/defence-and-security-accelerator/about>.
- 60 Peter Burt, 'Off the Leash: The development of autonomous military drones in the UK', Drone Wars UK, November 2018, <https://dronewarsuk.files.wordpress.com/2018/11/dw-leash-web.pdf>, p.36.
- 61 Ibid.
- 62 Zoe Altaras, 'The May 1970 Strike at UW', Washington University, <https://depts.washington.edu/antiwar/may1970strike.shtml>.
- 63 Damian Carrington, 'Edinburgh University divests from all fossil fuels', The Guardian, 6 February 2018, <https://www.theguardian.com/environment/2018/feb/06/edinburgh-university-divests-from-all-fossil-fuels>.
- 64 Nicole Wootton-Cane, 'University of Manchester to review fossil fuel shares after student protest', The Guardian, 26 November 2019, <https://www.theguardian.com/education/2019/nov/26/university-of-manchester-to-review-fossil-fuel-shares-after-student-protest>.
- 65 Sam Doak, 'Glasgow University invests over £3m in arms trade and military service providers', Glasgow Guardian, 15 September 2019, <https://glasgowguardian.co.uk/2019/09/15/glasgow-university-invests-over-3m-in-arms-trade-and-military-services-providers/>.
- 66 Ibid.
- 67 Ibid.
- 68 Suvendrini Kakuchi, 'Rapid expansion of defence research divides academics', University World News, 10 January 2017, <https://www.universityworldnews.com/post.php?story=20170110132046209>.
- 69 Conversions based on current transfer rates (as per 2 February 2020).
- 70 Suvendrini Kakuchi, 'Rapid expansion of defence research divides academics', University World News, 10 January 2017, <https://www.universityworldnews.com/post.php?story=20170110132046209>.
- 71 Japanese Coalition Against Military Research in Academia, http://no-military-research.jp/?page_id=7.
- 72 Gijs Dierck, 'Universiteit moet beter gevaren van onderzoek zien', NRC, 8 July 2019, <https://www.nrc.nl/nieuws/2019/07/08/universiteit-moet-beter-gevaren-van-onderzoek-zien-a3966407>.
- 73 Sara A, 'New law abolishes "civil" German universities', News One, 12 July 2019, <https://www.newsone.news/2019/07/new-law-abolishes-civil-german.html>.
- 74 Lena Greiner, 'German Scientists Accused of Naivete', Spiegel, 26 November 2013, <https://www.spiegel.de/international/germany/german-universities-under-fire-for-taking-pentagon-contracts-a-935704.html>.
- 75 Sara A, 'New law abolishes "civil" German universities', News One, 12 July 2019, <https://www.newsone.news/2019/07/new-law-abolishes-civil-german.html>.
- 76 Elizabeth Gibney, 'Europe's controversial plans to expand defence research', Nature, 22 May 2019, <https://www.nature.com/articles/d41586-019-01567-y>.
- 77 Ibid.
- 78 Ibid.
- 79 Researchers for Peace, <https://researchersforpeace.eu/>.
- 80 Scientists for Global Responsibility, <https://www.sgr.org.uk/>.
- 81 Stuart Parkinson, 'Military-university collaborations in the UK – an update', Scientists for Global Responsibility, 13 April 2015, <https://www.sgr.org.uk/resources/military-university-collaborations-uk-update>.
- 82 Ibid.
- 83 Pugwash, <https://pugwash.org/about-pugwash/>.
- 84 Jun Ji-hye, 'Hanwha, KAIST to develop AI weapons', Korea Times, 25 February 2018, https://www.koreatimes.co.kr/www/tech/2018/12/133_244641.html.
- 85 James Vincent, 'Leading AI researchers threaten Korean university with boycott over its work on "killer robots"', The Verge, 4 April 2018, <https://www.theverge.com>.

com/2018/4/4/17196818/ai-boycot-killer-robots-kaist-university-hanwha.

86 Ibid.

87 AI researchers end ban after S. Korean university says no to "killer robots"; Reuters, 9 April 2018, <https://www.reuters.com/article/tech-korea-boycott/ai-researchers-end-ban-after-s-korean-university-says-no-to-killer-robots-idUSL8N1RM2HN>.

88 Jun Ji-hye, 'KAIST launches ethics subcommittee on AI', Korea Times, 7 June 2018, http://www.koreatimes.co.kr/www/tech/2018/06/133_250278.html.

89 KI for Artificial Intelligence, 'KAIST : Code of Ethics for Artificial Intelligence', https://kis.kaist.ac.kr/index.php?mid=KIAI_O.

90 Stuart Russell, 'The new weapons of mass destruction?', The Security Times, February 2018, https://www.securityconference.de/fileadmin/MSC_/2018/Dokumente/Security_Times_Feb2018.pdf.

91 Ian Sample, 'Ban on killer robots urgently needed, say scientists', The Guardian, 13 November 2017, <https://www.theguardian.com/science/2017/nov/13/ban-on-killer-robots-urgently-needed-say-scientists>.

92 Jean Guillemin, 'Scientists and the history of biological weapons: A brief historical overview of the development of biological weapons in the twentieth century', Science and Society, July 2006, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1490304/>.

93 'Belgian scientists letter on autonomous weapons', <https://docs.google.com/document/d/e/2PACX-1vQU8W-mpdjBqLHIA4Xgbe1BhK14scm2UyQg3cPpylpjnOVF810mPSE7QmzaXNdfqBelGrNFS4ozRL8-/pub>.

94 Stop Killer Robots, 'National campaigning against killer robots', 7 December 2017, <https://www.stopkillerrobots.org/2017/12/national-outreach/>.

95 PAX, 'Belgium votes to ban killer robots', 23 July 2018, <https://www.paxforpeace.nl/stay-informed/news/belgium-votes-to-ban-killer-robots>.

96 Call for action against Lethal Autonomous Weapons, <https://lytt-til-oss.no/en/>.

97 Future of Life, 'Lethal Autonomous Weapons Pledge', 2018, <https://futureoflife.org/lethal-autonomous-weapons-pledge/>.

98 Ian Sample, 'Ban on killer robots urgently needed, say scientists', The Guardian, 13 November 2017, <https://www.theguardian.com/science/2017/nov/13/ban-on-killer-robots-urgently-needed-say-scientists>.

99 See e.g. Ariel Conn, 'AI Companies, Researchers, Engineers, Scientists, Entrepreneurs, and Others Sign Pledge Promising Not to Develop Lethal Autonomous Weapons', Future of Life Institute, 18 July 2018, <https://futureoflife.org/2018/07/18/ai-companies-researchers-engineers-scientists-entrepreneurs-and-others-sign-pledge-promising-not-to-develop-lethal-autonomous-weapons/>.



Sint Jacobsstraat 12
3511 BS Utrecht
The Netherlands

www.paxforpeace.nl
info@paxforpeace.nl

+31 (0)30 233 33 46
P.O. Box 19318
3501 DH Utrecht
The Netherlands