DEVELOPMENT OF LETHAL AUTONOMOUS WEAPON SYSTEMS AND THEIR IMPLICATIONS

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INTRODUCTION

Modern warfare is increasingly witnessing the use of covert swarms of miniature spy drones, unmanned ground and seaborne vehicles, sentry robots and missiles with decision-making powers. Though currently most of these weapons are being controlled by human operators, evolving penetration of Artificial Intelligence (AI) in weapon systems is making the paradigm shift to Lethal Autonomous Weapon Systems (LAWS), which would have their decision-making capabilities in the processes of scanning the environment, detecting threats, identifying targets and launching attacks on their own.

AI-driven autonomy has already become the new reality of warfare. As Artificial Intelligence, machine learning, and deep learning evolve, the rapid acceleration in computing power, memory, big data, and high-speed communication is not only creating innovation, but it appears that the weaponisation of AI is inevitable. "Autonomous weapons select and engage targets with hardly any human intervention. *Though fully autonomous weapons do not exist as yet*, an increasing number of countries are now engaged in developing or deploying near-autonomous systems."[1] In contrast to nuclear

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1. "Worried about the autonomous weapons of the Future?", at https://thebulletin.org/2021/04/worried-about-the-autonomous-weapons-of-the-future-look-at-whats-already-gone-wrong/. Accessed on October 15, 2021.

'Autonomous' systems are much more advanced and complicated than the conventional 'automatic' or 'automated' systems because they can operate in dynamic, unstructured and open environmental circumstances.

weapons, where governments lead in discovery, development and deployment, AI advancements and related technologies are driven by private firms and university researchers. Moreover, unlike in Nuclear Warfare, where second-strike capability has resulted in a stalemate, we have not been able to identify an analogous plateau in AI so far.

'Autonomous' systems are much more advanced and complicated than the conventional 'automatic' or 'automated' systems because they can operate in dynamic, unstructured and open environmental circumstances. Autonomous weapons could be armed with anything between the conventional payloads like tanks, guns, bombs, submarines, electronic warfare jammers, and strategic payloads like missiles capable of carrying chemical weapons agents and biological and even nuclear weapons. More autonomous weapons would mean more opportunities for failure. AI systems require huge amounts of labelled data to train the system. Moreover, the AI algorithms need to be exposed to different environments, as, unlike humans, they cannot learn just from a few instances.

Autonomous systems are divided into three sub-categories based on human involvement: Human-*in*-the-Loop Weapons, where the weapons identify targets and attack them only with a human command. Human-*on*-the-Loop Weapons, where the weapons identify targets and launch attacks force under the manual supervision of an operator who can override the weapons' actions; and Human-*out-of*-the-Loop Weapons, in which weapons are capable of identifying targets and launching attacks force without any human input or interaction.

The morality of using these weapons under international humanitarian law has generated a fierce global debate, primarily because such weapons are vulnerable to errors and hackers. Moreover, the legality of autonomous

weapons is critical because their deployment would change how we fight a war. This debate centres on whether these weapons, as independent actors, can adhere to the ethical and moral laws that govern modern conflicts.

The first section of this paper examines the emerging threats from unmanned aerial combat vehicles, which have been currently used in conflicts with incidents worldwide, highlighting their developments and use trajectory. The second section discusses the challenges for air defence systems that will be used to defend the territories. The third section looks at the emerging threat of Lethal Autonomous Weapons Systems, wherein AI has the opportunity of being integrated into many legacy weapon systems. The subsequent section discusses the legal implications confronting the challenges for the formulation of treaties for those weapons systems where the integration of AI is being implemented with reduced human involvement. The fifth section carries out an environment scan for India. The final section suggests the development of weapons for non-contact warfare for India.

Integrating AI technology into weapon systems makes the paradigm shift to use smaller and cheaper but faster and more precise weapons assuring higher kill probabilities without endangering own troops.

DAWN OF DRONE WARS—THE NEW BATTLEFIELD

As weapons technology advances, humans are moving further and further away from the battlefield. An AI-equipped drone can spot, validate and destroy a target at far distances in a few hundredths of a second. The 1980s revolutionary convergence of technologies brought communications, high-resolution cameras, video and image processing, high-speed computing power, complex algorithms and higher memory capacity into lightweight payloads of UCAVs, thereby significantly compressing the OODA loop. Integrating AI technology into weapon systems makes the paradigm shift to use smaller and cheaper but faster and more precise weapons assuring higher kill probabilities without endangering own troops. Missile equipped

drones are the mainstay of most anti-terrorist operations. Non-state actors are increasingly using these platforms. As a result, air defence systems are increasingly being developed to shoot them down.

The drone is typically a "Quad-Copter" with four propellers fitted vertically and made up of composite plastics and fabrics. They are highly manoeuvrable and carry flexible payloads. They are capable of tree-top flying and can be pre-programmed to hit a target remotely. However, winds and weather affect their flight. Their potential advantages of inherent stealthy operation (in terms of noises, radar and visual signatures) make them ideal for military operations in urban terrain. On the other hand, UCAVs typically have the structure of an aeroplane with wings and fuselage and do not hover.

Currently, a drone-based weapon usually requires several people to operate it. However, advances in artificial intelligence and autonomy would invert that relationship, where one human would supervise many robotic vehicles while they work cooperatively to accomplish a task. Hence, the shift to drone swarms made up of cooperative, autonomous robots that react to the battlefield at machine speed will allow militaries to field forces that are larger in number, faster and better-coordinated than would be possible with humans alone.

Nations do not always showcase their advanced technology. Therefore, given the recent incidents cited below, there is a need to review whether autonomous weapons can be relied upon to decide (on their own) when and whom to kill, as state and non-state actors are increasingly using the weapons.

ISRAEL

Israel demonstrated the first use of UCAV capability during the 1982 Bekaa Valley conflict with Syria. Syrian radars were activated to intercept Israeli drone's probe attack, which gave away their locations. Consequently, Israeli fighter aircraft destroyed them. Moreover, the Syrian aircraft that gave the fight was rendered defunct by electronic jamming. As a result, Syria lost 82 fighters, while Israel lost only one.

INDIA

The drone attack on the IAF base at Jammu in the wee hours of June 27, 2021, has highlighted that the drones made with Commercial-Off-The-Shelf (COTS) components can be easily weaponised and are now readily available in the country,[2] prompting the induction of a robust counter-drone capability.[3]

LIBYA

According to a report by the Libya expert panel of the UN, in 2020, a Turkish autonomous weapon—the STM Kargu-2 drone "hunted down and remotely engaged" retreating soldiers loyal to the Libyan General Khalifa Haftar. The Kargu-2 is a "loitering" drone that can use an autonomous mode with swarming capabilities, using machine learning-based object classification to select and engage targets. The UN report hints, though not explicitly, that the drones were used autonomously using their artificial intelligence capabilities. The use of such drones highlights the need to define the so-called lethal autonomous weapons. It was a challenge for the experts to investigate and ascertain the verification mode used by the STM Kargu-2 drone.

AZERBAIJAN

"The destruction by armed Unmanned Combat Aerial Vehicles (UCAVs) in Azerbaijan-Armenia conflict last year has brought these systems to the centre stage of threat analysis. Both sides have made extensive use of UCAVs. Armenia used UCAVs for intelligence and surveillance, whereas Azerbaijan used Turkish supplied Baykar Makina Bayraktar TB2 tactical UCAVs. Like the 1982 Israeli approach, Azerbaijan also used an old AN-2 aircraft as a feint by converting it into a drone as bait for the Armenians in this South Caucasian

2. Air Vice Marshal Manmohan Bahadur VM (Retd), "UAVs: India's Weak Link In Modern Warfare?", June 12, 2021, at http://www.indiandefensenews.in/2021/06/uavs-indias-weak-link-in-modern-warfare.html. Accessed on November 11, 2021.
3. Air Chief Marshal S Krishnaswamy (Retd), "India needs drone detection systems", June 29, 2021, at https://indianexpress.com/article/opinion/columns/drone-detection-system-jammu-airfield-bomb-attack-7380116/?utm_source=newzmate&utm_medium=email&utm_campaign=opinion&tqid=1_O7Mng4EV8ByENgIw5PSrqwPXpVJC5KPqXBa3qzxA. Accessed on November 15, 2021.

If a developed nation deploys a 'manned-unmanned team—where manned fighter aircraft remain afar and control a swarm of tied UCAVs called 'loyal wingmen'—a tactical advantage can be created deep inside enemy territory, thereby changing the air supremacy paradigm.

conflict." Azerbaijan's Turkish-made Bayraktar TB2 armed UCAVs and Israeli AI-enabled loitering 'suicide drones' could identify and then destroy targets by hard kill using small munitions to attack the weakest point armoured infantry vehicles, artillery pieces and surface-to-air missiles with impunity. These weapons outweighed the Armenian Air Defence mainly due to their small radar cross-section. It had an overwhelming psychological impact and forced Armenia to settle for peace on humiliating terms. Armenian ground soldiers were seen bewildered by UCAV strikes in the Azerbaijanian released videos. For the first time, perhaps, UCAVs had helped a country defeat conventional enemy forces and armour. Unlike manned fighter aircraft, drones are regulated under the Missile Technology Control Regulations, attempting to limit their proliferation.[4] Therefore, Azerbaijan utilised a loophole in the regime by using AN-2, where the rules do not explicitly prohibit the conversion of inhabited aircraft into drones.

An AI-enabled drone would have the capability to decide whether or not to kill a human. Thus, cheap and expendable UCAVs could detect and destroy land forces. If a developed nation deploys a 'manned-unmanned team—where manned fighter aircraft remain afar and control a swarm of tied UCAVs called 'loyal wingmen'—a tactical advantage can be created deep inside enemy territory, thereby changing the air supremacy paradigm.

AFGHANISTAN

The US retaliation to the ISIS-K suicide bomber attack at Kabul Airport, which claimed the lives of 13 American soldiers, highlights the lethality of

4. Benzamin Fogel, Andrew Mathewson, "The next frontier in drone warfare? A Soviet-era crop duster", February 10, 2021, at https://thebulletin.org/2021/02/the-next-frontier-in-drone-warfare-a-soviet-era-crop-duster/ Accessed on November 15, 2021.

automated weapons and how things could go wrong, causing international embarrassment to even superpowers. On August 29, 2021, US intelligence identified a car as a potential attack vehicle carrying explosives to Kabul airport. The car was tracked using Reaper drones and eliminated by a Hellfire Missile, both remotely controlled. Since video feeds have to ricochet among military commanders spread out worldwide, they are often delayed by several seconds. The car stopped at a secluded spot, but few civilians had gathered around it by then. However, the intelligence assessment that the encounter was to take place at a secluded spot went awry, probably due to communication transmission delays, and the missile eventually struck the car, killing ten Afghan civilians as collateral damage.[5] In the future, Reaper and other drones will be equipped with advanced AI, which will let the machine decide when and perhaps whom to kill.

AI-enabled drones are now being used to kill civilian targets also. The November 27, 2020, killing of Iran's top nuclear scientist Mohsen Fakhrizadeh has demonstrated the brazen use of AI weapons by Israeli Mossad.

PALESTINE, NIGERIA AND MEXICO

So far, drones do not appear to impact the conflict dynamics in Israel and Palestine drastically. However, its use by non-state actors points out how hard it will be to put the unmanned aerial genie back in the bottle. Over the past two decades, several non-state forces from Boko Haram in Nigeria to drug cartels in Mexico have also acquired drones.[6]

5. David H Freedman, "US Is Only Nation with Ethical Standards for AI Weapons. Should We Be Afraid?", September 15, 2021, at https://www.newsweek.com/2021/09/24/us-only-nation-ethical-standards-ai-weapons-should-we-afraid-1628986.html. Accessed on November 15, 2021.
6. Thomas Gaulkin, "Drones add little to rocket-filled Israel-Palestine skies, but represent growing global threat", May 20, 2021, at https://thebulletin.org/2021/05/drones-add-little-to-rocket-filled-israel-palestine-skies-but-represent-growing-global-threat/. Accessed on November 1, 2021.

IRAN AND IRAQ

AI-enabled drones are now being used to kill civilian targets also. The November 27, 2020, killing of Iran's top nuclear scientist Mohsen Fakhrizadeh has demonstrated the brazen use of AI weapons by Israeli Mossad, wherein an AI-assisted gun was mounted on a Nissan pickup vehicle that was remotely controlled from 1000 miles away**.** The precision of AI-based tools is demonstrated by facial recognition technology, ensuring that only the scientist was eliminated and his wife and guards remained unharmed. In contrast to an aerial drone, the robotic machine gun using scan, identification and targeting algorithms can be deployed anywhere without drawing any attention. Recently, three explosive-laden quadcopters were used to target the residence of Iraqi Prime Minister's Mustafa al-Kadhimi in an assassination attempt. Kadhimi narrowly survived, but photos released of his home revealed the destructive capabilities of such devices.[7] AI has enormous potential in perceiving images, speech or patterns by churning big data that humans may not perceive.

TAKEAWAYS FOR INDIA

The first important takeaway for India is that small forces/nations can develop asymmetric advantages with low-cost UCAVs.

The second important takeaway for India is that the drones and UCAVs will expand the battlespace, forcing the adversary to commit additional air defence resources.

The third important takeaway is that time becomes critical for the warring side under attack from UCAVs.

"The future drone war would be won by the best algorithm and ability to anticipate and respond quickly to a threat, not just by whoever could put a bird in the air".[8] Drones are not tomorrow's weapons, but today and the country that achieves the technological edge in AI will win.

7. Tom O'Connor and Naveed Jamali, "Could the Next 9/11 Be Caused By Drones?", September 11, 2021, at https://www.newsweek.com/could-next-9-11-caused-drones-1647249. Accessed on September 12, 2021.
8. Seth J. Frantzman, "Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future", June 22, 2021, at https://www.amazon.in/Drone-Wars-Pioneers-Artificial-Intelligence/dp/1642936758/ref=sr_1_1?dchild=1&keywords=the+drone+wars&qid=1625555275&sr=8-1. Accessed on November 2, 2021.

Therefore, **the fourth vital takeaway** is that "artificial intelligence (AI) and autonomy would increasingly play a crucial role for both the attacker and the defender. The challenge for the defender is the extremely short lead time to engage the armed drones, and for the attacker, to avoid collateral damage by accurately distinguishing between warfighters and civilians. In this fast decision-making cycle, a man in the loop would delay the response, resulting in unnecessary killings or the target escaping." Under these circumstances, human control is increasingly becoming compromised in human-machine interactions.

CHALLENGES FOR THE AIR DEFENCE WEAPONS SYSTEMS

Militaries have used air defence systems for decades against missile and airborne threats. It is estimated that at least 89 countries operate air defence systems. Modern air defence systems can handle a large number of threats simultaneously, which cannot be done manually. Hence, over a period of time, the character of human-machine interaction in it has rapidly decreased the quality of human supervision in specific targeting decisions. Moreover, with cognitive functions increasingly delegated to machines, the human operators find it challenging to understand the targeting decisions made by complex computer systems. Many policymakers have indicated that they favour humans to remain in control over the lethal force. However, when things go wrong, the individual human operators at the bottom of the chain of command frequently bear responsibility for structural failures—focussing on "human error" diverts attention away from a critical review of how the automated and autonomous technology structure the application of force.

Appropriate human control needs to be ensured over specific targeting decisions, as they play an important role in the international discussion on regulating autonomous weapons systems. Under the international humanitarian law stipulated by Geneva Conventions, the military obligations apply specifically to the battlefield decisions rather than weapon systems development.

A study of current air defence systems sheds light on three significant real-life challenges to human-machine interaction, which have arisen due to the automated and autonomous features. The following three challenges will determine how well humans can effectively control the specific situations that rely on autonomous targeting in the existing air defence systems.

- *Targeting decisions are opaque.* The sheer complexity of the internal working of the systems has resulted in a situation where only a few users can understand the algorithms behind the software they use. Nevertheless, failures of high-profile air defence systems also suggest that human operators are not always aware of known system weaknesses. Another difficulty that operators face is automation bias and over-trust. Human operators may blindly trust the reliability and accuracy of the information they see on their screens and may not question the machine's algorithmic targeting parameters.

  This trust resulted in the shooting down of a Royal Air Force Tornado fighter jet over Kuwait in 2003 by Allied Forces. The human operators need a more balanced approach; that they must have the ability to know when to trust the systems and when to question their outputs.
- *Operators can lose situational awareness.* As more automated and autonomous features are integrated into the critical functions of air defence systems, the role of human operators has changed. Rather than actively controlling the weapons systems, they have now shifted to just monitoring their operations. Effectively, the machines now perform the bulk of the decision making involved in operating an air defence system, not just the motor and sensory tasks. As a result, human operators are increasingly either overloaded or underloaded with tasks vis-à-vis those delegated to the machine, as they have sometimes lost situational awareness, particularly in high-stress combat situations where human operators are unable to question system outputs and to make logical deliberations about whether specific targets are appropriately chosen.

  The 1988 downing of an Iranian Air Fight with 290 passengers and crew by a US Navy warship, Vincennes, illustrates how the human

operators amid combat can misinterpret computer outputs and make fatal mistakes. A 1992 Newsweek investigation revealed that senior personnel on the ship were unfamiliar with or uncomfortable operating the AEGIS's combat system.

- *War is already too fast.* Improvements in the speed and manoeuvrability of modern weaponry continue to reduce the time available to the human operators to decide when to authorise the use of force. A recent example is the misfortune of a Ukraine International Airlines jet. A civilian plane carrying 176 passengers and crew members was shot down near Tehran's airport in January 2020, just minutes after it took off. Iran attributed the incident to human error, citing that the missile defence system had not been re-calibrated and operated after being repositioned at a new site. Operating without complete situational awareness of Iranian airspace at the time, the plane was wrongly identified as an incoming American cruise missile. As a result, the operators of the Tor-M1 had only 10 seconds to decide whether or not to fire. The issue highlights the almost impossible demands imposed by the shortage of time for critical deliberation in high-stress combat scenarios.

EMERGING CHALLENGES TO AIR DEFENCE SYSTEMS

Two important issues need to be addressed while evaluating an air defence system.

Role of a human operator: Autonomous weapons design should ideally allow commanders and operators to exercise human judgment over using force appropriately. As stated in an August 2018 US government white paper, "'*appropriate*' is a flexible term that expresses the fact that there is no fixed, one-size-fits-all level of human judgment that can apply to every context. The definition of what is 'appropriate' can differ across weapon systems, domains of warfare, types of warfare, operational contexts, and even across varied weapon system functions." Further, "human judgement over the use of force" doesn't require manual human "control" but somewhat broader human engagement in decisions regarding the use of a weapon, including

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how, when, where, and why. This employment includes a human decision that the weapon will be used "with appropriate care and as per the law of war, applicable treaties, weapon system safety rules, and applicable rules of engagement."[9] The training, tactics, techniques, procedures and doctrine need to be available, periodically revised and used by the system operators and commanders to correctly understand the functioning, capabilities and limitations of the system's autonomy in realistic operational situations. It is also required that the weapon's human-machine interface be "ready to understand for the trained operators" for enabling them to make informed decisions in using these weapons.

Weapons review process: There is a need to test the software and hardware of all systems, including lethal autonomous weapons. This effort ensures they function as designed against adaptive adversaries, engage near-real-time, and conform to the commander and operator intentions. However, if it cannot do so, additional human operator inputs may be sought before continuing the engagement or termination. In addition, the system must be robust enough against the loss of control of the system to unauthorised parties.[10] In addition, any changes to the system's operating after the system has been fielded would need re-testing and re-evaluation to ensure that its safety features and ability to operate as intended have been retained."[11]

Therefore, **the fifth takeaway** is the need to establish a review and refine the process for weapon utilisation so that the human-machine interface

9 Ingvild Bode and Tom Watts, "Bulletin of the Atomic Scientists—Worried about the autonomous weapons of the Future? Look, at what is already gone wrong", April 21, 2021, at https://thebulletin.org/2021/04/worried-about-the-autonomous-weapons-of-the-future-look-at-whats-already-gone-wrong/. Accessed on October 15, 2021.

10. Ibid.

11. Ibid.

is in perfect synchronism with the operator's capabilities.

The development of autonomous weapons technology and current international discussions of LAWS impact military budgets, operational concepts, treaty-making and the future of war.

LETHAL AUTONOMOUS WEAPON SYSTEMS (LAWS)

This section highlights the Lethal Automated Weapons System's definition and the legal implications that hamper the imposition of control treaties and regulations of these weapon systems.

"LAWS are a particular class of weapon systems that use sensor suites and computer algorithms to independently identify a target and employ an onboard weapon system to engage and destroy the target without manual human control of the system". Although these systems are not yet in widespread deployment, it is believed they would enable military operations in communications-degraded or denied environments in which traditional systems may not be able to operate.

There is no universally agreed definition of lethal autonomous weapon systems in international fora. However, the US Department of Defense Directive (DODD) 3000.09 document primarily discusses the role of the human operator concerning target selection and engagement decisions rather than in the technological sophistication of the weapon system.[12] "DODD 3000.09 defines LAWS as "weapon system(s) that, once activated, can select and engage targets without further intervention by a human operator. The directive does not cover "autonomous or semi-autonomous systems for cyberspace operations; unarmed, unmanned platforms; unguided munitions; munitions manually guided by the operator (e.g., laser- or wire-guided munitions); mines; and unexploded explosive ordnance", nor does it subject them to its guidelines."[13]

12. Jeffery S Thurnher, "The Law that applies to Autonomous Weapon Systems", January 18, 2013, at https://www.asil.org/insights/volume/17/issue/4/law-applies-autonomous-weapon-systems. Accessed on October 17, 2021.
13. Ibid.

The development of autonomous weapons technology and current international discussions of LAWS impact military budgets, operational concepts, treaty-making and the future of war. Thus, the perception of threats, the economic situation, the priorities on the society level, and technology can become the drivers or the inhibitors of defence spending.

INTERNATIONAL DISCUSSIONS OF LETHAL AUTOMATIC WEAPON SYSTEM

No nation is allowed to choose methods and means of warfare with unlimited freedom. Article 36 of the 1977 Additional Protocol to the 1949 Geneva Conventions—colloquially referred to as a 'weapon review', 'legal review' or 'Article 36 review'.[14] The conduct of Article 36 review is essential to determine whether the adoption of new technologies might cause any significant concern from a humanitarian perspective and ensure that states' armed forces can conduct hostilities according to their international obligations. These existing laws of armed conflict generally focus on traditional weapons and regulate certain objectionable weapons such as poisonous gases, blinding lasers, chemical, nuclear and biological weapons and landmines, etc.; still, these regulations currently do not cover autonomous weapons, particularly with the ability to kill humans. Several years after Article 36, which highlighted meaningful human control, was introduced, there has been no consensus on what makes human control meaningful.

The exponential growth of robotic technologies, and autonomous technologies, notably presents some challenges to the international community, which needs to adopt the International Humanitarian Law (IHL) for automated weapons. "Since 2014, the US, through the United Nations Convention on Certain Conventional Weapons (UN CCW), has held international discussions on LAWS."[15] Many countries agree in

14. Vincent Boulanin and Maaike Verbruggen, "SIPRI —Article 36 Reviews Dealing with the Challenges posed by Emerging Technologies" July 15, 2021, at https://www.sipri.org/sites/default/files/2017-12/article_36_report_1712.pdf. Accessed on October 20, 2021.
15. Office for Disarmament Affairs, United Nations, "The Convention on Certain Conventional Weapons" December 21, 2001, at https://www.un.org/disarmament/the-convention-on-certain-conventional-weapons/. Accessed on November 19, 2021.

principle to retain human responsibility in using weapon systems to ensure the use of autonomous weapons systems in compliance with International Humanitarian Law, with two main concerns. First, how to define human control over the use of force, and second, how to measure such control to ensure that humans, not the machines, ultimately control the use of force. "In 2017, these discussions progressed from an informal 'meeting of experts' to a formal 'Group of Governmental Experts (GGE) tasked with examining technological, military, ethical, and legal dimensions of LAWS. In 2018 and 2019, the GGE has considered proposals by states parties to issue political declarations about LAWS and proposals to regulate them."[16]

"In addition, approximately 30 countries and 165 non-governmental organisations have called for a pre-emptive ban on LAWS due to ethical concerns, including concerns about operational risk, accountability for use, and compliance with the proportionality and distinction requirements of the law of war".

Policymakers should analyse the precedents set by the use of highly automated air defence systems and other existing weapons systems with automated or autonomous features in their targeting functions (such as active protection systems, counter-drone systems, and loitering munitions) and how these weapons are altering the equations between humans and technology. Much too often, incrementally integrating more and more autonomous features into weapon systems is presented as either an inevitable development of technological progress or a reaction to what the adversaries are doing.

Therefore, **the sixth takeaway** for India is to take the lead in formulating treaties and international laws to regulate the development, use, and trade of these systems.

16. Office for Disarmament Affairs, United Nations, "Background on LAWS in the CCW", December 21, 2001, at https://www.un.org/disarmament/the-convention-on-certain-conventional-weapons/background-on-laws-in-the-ccw/. Accessed on November 20, 2021.

CHALLENGES IN THE FORMULATION OF A TREATY

"The US was one of thirty-five signatories to the Missile Technology Control Regime (MTCR), which controls exports of missiles or drones that could carry 500-kilogram payloads more than 300-kilometre."[17] Later, the US began to re-examine the self-imposed exile the MTCR was placing it in, as China and others sought to sell to US customers. In addition, Iran, China, and some other countries were not signatories of the agreement and could skirt it.

Three reasons make it challenging to formulate an AI treaty, similar to those that ban biological and chemical weapons and anti-personnel landmines.

First, it is no easy task to identify the risks of AI in the Military.

Second, it might take a long time for governments to formulate an AI arms control treaty. By the time a treaty is put into effect, any international negotiation eventual outcomes may become obsolete and out of tune with technological reality due to rapid advancements in AI technology. Additionally, since AI has military and commercial applications, the private sector may resist regulatory efforts on military AI.

Third, a new arms control agreement is unlikely in the near future given the current political order, which is marked by heightened tensions among China, the United States, Russia and the EU over a range of many issues.

THREATS IN THE NEIGHBOURHOOD

This section discusses the changing threat perception and stages of development to carry out an environment scan in our neighbourhood.

China

China's capability development. China's modernisation has been underway since the 1980s. Modernisation would turn PLA into a world-class military by 2035. The 'active defence' strategic guideline approved by Deng Xiaoping

17. Seth J. Frantzman, "Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future", June 22, 2021 at https://www.amazon.in/Drone-Wars-Pioneers-Artificial-Intelligence/dp/1642936758/ref=sr_1_1?dchild=1&keywords=the+drone+wars&qid=1625555275&sr=8-1

has been picked up by Xi Jinping and given slightly adjusted goals. China has initiated National Security Law (2015),[18] National Intelligence Law (2017), the New Generation Artificial Intelligence Development Plan and Civil-Military Fusion to enable compliance and synchronisation across all agencies.

China had planned that her AI industry be "inline" with the most advanced countries by 2020. By 2025, China aims to reach a "world-leading" level in some AI fields. Finally, by 2030, China seeks to become the world's "primary" AI innovation centre.[19] These benchmarks map three strategic phases of AI development. Moreover, the progress in AI will lead to a shift from today's informative warfare to future intelligentised warfare using AI. The key development areas are as follows:

- Informatisation. This is essentially digitisation wherein PLA will control the flow of information. Also, disrupting the enemy's access to information can change the course of the conflict.
- Intelligentisation. This builds upon informatisation using artificial intelligence and machine learning. AI can help PLA SSF reduce the time taken to decide and improve the response times during the pre-war and early conflict phases using space, cyber, electronic and psychological warfare. PLA Army (PLAA) has concentrated on military robotics and unmanned ground vehicles, which could be used for logistics. The PLA Navy (PLAN) is experimenting with unmanned surface vessels that may operate with some autonomy and is reportedly developing autonomous submarines. The PLA Air Force (PLAAF) operates advanced unmanned systems with limited autonomy that could be upgraded to include greater autonomy while exploring options for manned-unmanned teaming. The PLA Rocket Force (PLARF) may leverage use cases in remote sensing,

18. Javin Aryan, "How China aims to augment its military strength using AI" August 18, 2021, at https://www.orfonline.org/expert-speak/how-china-aims-to-augment-its-military-strength-using-ai/. Accessed on September 15, 2021.
19. Nicholas D Wright, "Artificial Intelligence, China, Russia, and the Global Order Technological, Political, Global, and Creative Perspectives", Air University Library Air University Press, October 2019, at https://www.airuniversity.af.edu/Portals/10/AUPress/Books/B_0161_WRIGHT_ARTIFICIAL_INTELLIGENCE_CHINA_RUSSIA_AND_THE_GLOBAL_ORDER.PDF. Accessed on November 29, 2021.

China is investing in the cyber domain using advances in the civilian domain, ranging from facial recognition to speech recognition software that uses AI for tracking individuals.

targeting, and decision support, and its missiles may be augmented to become more "intelligentised" in their capabilities, incorporating higher levels of automation to facilitate operations.[20]

- Military-Civil Fusion. This is a national development strategy initiated in the 1990s wherein technological developments in the civil sphere will be leveraged to help military developments. For example, China is investing in the cyber domain using advances in the civilian domain, ranging from facial recognition to speech recognition software that uses AI for tracking individuals.
- Information Superiority. With increased focus on developing and deploying advanced technologies for tactical and strategic advantage, the 5G rollout would cover a range of domains from telemedicine, military communications to UCAV swarms, border security and integration with Beidou. The 6G and beyond would cover the THz spectrum for applications such as communication, ISR, targeting, countermeasures and precision guidance. Trials are underway for quantum encryption in military communications, wherein a string of photons will be positioned ahead of the data, which allows the deceiver to decrypt. Still, it will be disrupted if communications are intercepted en route.
- China has been actively developing and producing UAV/UCAVs, primarily to gain air superiority in anti-access/area-denial strategies.

Pakistan

China and Pakistan mutually share their rivalry with India. Since the 1962 India-China War, China's strategy has been to keep Pakistan independent and powerful and thus to make India defensive on two fronts. Pakistan is in China's economic and military shadows. Notwithstanding the Turkish

20. Elsa B Kania, "'AI Weapons' in China's Military Innovation", April 2020, at https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_ai_weapons_kania_v2.pdf. Accessed on November 29, 2021.

supply of UCAVs to Pakistan, there is a possibility that these capabilities would soon find their way from China to Pakistan.

The seventh takeaway for the country is to innovate and develop counter weapons to tackle new threats. Though the Iraq war has demonstrated that missiles armed with conventional weapons were effective terror weapons, the induction of UAVs and UCAVs represents a significant step in the augmentation of manned flights. They are cheaper to mass-produce, eliminate some risk to humans, are generally more accurate, have helped reduce the sensor to shooter time and do not mind flying into a "no-win' situation. Hence, a suitable counter weapon system needs to be developed. The nature of the threat defines the type of forces that are needed. As threats evolve, they need to be reassessed.

India is strategically located in both continental Asia and the Indian Ocean region and with two nuclear-armed neighbours. With the prevailing conditions in our western and northern borders, the most critical security threat facing us emanates from missiles in our neighbourhood armed with WMD.

For this reason, military institutions and governments periodically re-evaluate their priorities and optimise assets to tackle those threats and support their strategic vision. Future threats to UCAV technology are most certainly being developed today. However, maintaining the full range of capabilities to tackle a threat might not always be an option due to the scarcity of resources. Therefore, governments and force planners have to establish a strategy and force that reflects the reality. Otherwise, the strategy might collapse when faced with the first challenge.

DEVELOPMENT OF WEAPONS TO COUNTER MODERN THREATS—NON-CONTACT WARFARE

India is strategically located in both continental Asia and the Indian Ocean region and with two nuclear-armed neighbours. With the prevailing conditions in our western and northern borders, the most critical security

threat facing us emanates from missiles in our neighbourhood armed with WMD.

The next challenge facing the country will be the conduct of non-contact warfare.[21] The changing character of warfare post the advent of informationisation and the ability to integrate surveillance and reconnaissance platform with the kill chain performing their tasks at standoff ranges will replace the concept of 'massing of force' to 'massing of effects'. Distance is no longer an obstacle on the battlefield. It meets the inherent requirement for non-contact joint firepower attacks in informatised war with the ability to avoid detection and attribution.

Though missile defence does not guarantee fail-safe operations, a robust, effective missile defence system to cater for multiple target interception capabilities would help in buying time and blunt the political efforts of the adversary. India has to stretch its capabilities in multiple spheres to counter threats like short-range ballistic missiles (SRBM), Intermediate-Range Ballistic Missiles (IRBM), Intercontinental Ballistic Missiles (ICBM), hypersonic weapons, cruise missiles, manned aircraft, artillery shells, drones by achieving a triad of missile launch capability through the defence in depth. Multiple defensive layers, with system elements working together synergistically, are key to an effective defence. The layered approach provides multiple opportunities to engage the warheads from detection in the boost phase till re-entry phase, thus reducing the burden on any single layer of defence. In addition, the Anti-space ballistic missile capability will take care of space vulnerability. A system of systems enabling Exquisite ISR (Intelligence, Surveillance and Reconnaissance) is the key to multidomain awareness. AI-empowered ISR makes it possible to locate, track, and target various enemy weapons systems, raising the possibility of striking strategic targets. India's prowess in writing software in AI applications has come to the fore. In 2020, India overtook the US as the principal source by accounting for 30 per cent of

21. Vivek Verma, *Non-Contact Warfare—An Appraisal of China's Military Capabilities*. Delhi, India: Pentagon Press LLP, 2020, at https://usiofindia.org/publication/cs3/non-contact-warfare-an-appraisal-of-chinas-military-capabilities/. Accessed on November 1, 2021.

all 'commits' or contributions of AI codes in the public repository GitHub, the code-sharing platform owned by Microsoft.

The eighth takeaway is to develop own capability to produce Lethal Automated Weapon Systems. While new weapons are being developed, military history provides examples of classes of weapons having both a dramatic and lasting impact upon warfare.

Though air power has advantages in terms of precision and man in the loop, the guns, missiles and UCAVs offer the advantages of delivering destructive payload over distances even in the face of unfavourable air situations. Hence, the induction of Automated Lethal Weapons would improve the military effectiveness of our country and contribute immensely to our military power. Moreover, any country which takes the lead in the formulation of standards shall pave the way for indigenous development, reap associated economic interests and is in a strong position to negotiate.

Therefore, India needs to start developing standards for Lethal Automated Weapon Systems in consultation with academia, armed forces, certification agencies and manufacturing industries. Once the ecosystem has been formalised, such systems' development, testing, and fielding should be undertaken.[22]

CONCLUSION

The advances in artificial intelligence and machine autonomy are profoundly transforming the nature of warfare. The world is dynamic and is constantly changing. History confirms that man and his weapons are ever-evolving. Studies show that the growth of the world's population has resulted in rapid urbanisation. The growth of UAVs and UCAVs to augment manned aircraft to counter these threats is inevitable. Artificial Intelligence will help process a flood of information from various platforms resulting in two fundamental advantages: speed and range. "Lethal autonomous weapon systems (LAWS) use sensors and computer algorithms extensively

22. Subir Roy, "Writing artificial intelligence code for the world—out of India", November 26, 2021, at https://www.moneycontrol.com/news/opinion/writing-artificial-intelligence-code-for-the-world-out-of-india-7763641.html. Accessed on November 27, 2021.

to independently identify a target and autonomously deploy a weapon to engage and destroy the target without manual human intervention or control. Though not yet widely deployed, they would soon enable military operations in communications-degraded or denied environments where traditional systems are unable to operate."[23]

AI systems are vulnerable to flawed data inputs, which can cause unintended consequences. However, the battlefield advantages of AI-driven ISR and autonomous systems could shrink the time available for decision-makers to manage the crisis. "The current generation of more-or-less autonomous weapons has created demands for more human control over the lethal force."[24]

As yet, there are no concrete answers to the ethical and legal concerns surrounding autonomous weapons deployment. Nevertheless, politically and militarily, India must recognise the several advantages that autonomous weapon systems can bring, especially given the country's unique security situation. Therefore, they must face the challenges by keeping pace with these developments and developing such systems. Simultaneously, India should actively participate and contribute to the international debate on autonomous weapons.

23. "Defense Primer: US Policy on Lethal Autonomous Weapon Systems" December 01, 2020 at https://sgp.fas.org/crs/natsec/IF11150.pdf. Accessed on October 01, 2021.
24. Henry Brighton, "Introducing Artificial Intelligence: A Graphic Guide (Graphic Guides)", May 3, 2012, at https://www.amazon.in/Introducing-Artificial-Intelligence-Graphic-Guide/dp/1848312148/ref=sr_1_1?dchild=1&keywords=introducing+artificial+intelligence&qid=1625555444&sr=8-1 & Brighton, Henry (2015-09-02T22:58:59). Introducing Artificial Intelligence: A Graphic Guide (Introducing...). Icon Books Ltd. Kindle Edition. Accessed on October 15, 2021.