What is the impact of technological progress on modern warfare? How should national (or international) defence strategies be altered in light of these changes?

"Armies that could reach further, hit harder, and get there faster usually won, while the range-restricted, less well-armed, and slower armies lost. For this reason, a vast amount of human creative effort has been poured into extending the range, increasing the fire power, and accelerating the speed of weapons and of armies."[1]

Modern warfare is going through a revolution in response to technological progress. It is impossible to assuredly predict what the outcome of the revolution in warfare will be and what the future of modern warfare holds. However, we can identify some of the current moving patterns and suggest where technologically advanced warfare is heading. Long-term, think cyborg soldiers, quantum computing, cyberwarfare, and stealth reaching the point of true invisibility. Think nanotech, the weaponisation of space, true autonomous and non-contact conflict, and the potential of biotech. The possibilities of future warfare are endless. All the possibilities of future warfare, however, can be traced to technology's role in modern warfare. As the extent of the impact of technological progress on modern warfare is extensive, this essay will take a focus. This essay will explore the rise of unmanned vehicles and the increasing reliance on satellites in modern warfare. It will be suggested that the fundamental impact of technological progress on modern warfare is that now, more than ever, warfare is an information-based affair. Previously, the winner of warfare was predominately determined on who had the most manpower and mass. Now, modern warfare is undergoing a transformation: intelligence is the key to victory.

Modern warfare appears to be following a path towards unmanned vehicles dominating. Especially since the Vietnam War, there has been a shift in values regarding warfare. The public will no longer tolerate casualties – be it on their side, or their foe's. As such, the use of unmanned combat aerial vehicles (UCAVs) has grown considerably – as a 2013 study conducted by the Brookings Institution confirms. The study revealed that, from 2008 to 2013, the number of remote aircraft pilots who graduated training with the US Air Force (USAF) went from about 500 personnel to 1300.[2] As of 2009 onwards, impacted by the

[1] Alvin Toffler and Heidi Toffler. *War and Anti-war: Survival at the Dawn of the 21st Century* (London: Little, Brown, 1994)
[2] Matthew Williams. (2021). *Life in 2050: A Glimpse at Warfare in the Future.* Available: https://interestingengineering.com/warfare-in-2050-what-to-expect. Last accessed 6th March

rise in drone technology, the USAF trains more remote pilots than fighter and bomber pilots combined.[3] Writing on the subject, Michael Boyle justifies that the trend is likely to continue due to increased drone development: "with growing popular scientific and commercial interest in drones and a deep commercial base for their development, it is inevitable that drone technology will continue to develop."[4] UCAV developers are constantly looking to make their products smaller, stealthier, and capable of taking on more roles. Future UCAVs will thus conduct a wider array of strike missions, such as aerial refuelling, carrier-based operations, high-altitude aerial reconnaissance, and transport. As a result, it is likely that UCAVs will replace onboard human-piloted vehicles altogether by 2050.[5]

Whilst national and international defence strategies will prioritise physical anti-drone technology, I suggest that the next best defence strategy will need to be increased regulation and legal restriction. As the trend of drone development continues, "the technology itself will outpace the contemporary legal and ethical frameworks associated with its use and bring up new dilemmas that are yet imagined for political decision-making."[6] We therefore must enact laws that aim at preventing any foreseen and predicted risks. The main defence we need is ultimately a defence from ourselves. For example, we do not understand what the impact of drone technology is on human behaviour and the decisions that we make. Whilst unmanned vehicles appear to save human lives, this accomplishment may still come with a cost. As drone technology falls into the hands of more people, it enables an increased risk. Does operating a drone from the safety of a pod make a government, organisation, or individual trigger happy? Drones that are unmanned are ultimately less risky in terms of human life, and thus this makes them seductive; what would once be considered too risky is now feasible. The best defence is thus ultimately to restrict ourselves from technology's full potential. We must take preventative measures.

We must develop strong legal standards for the use and sale of unmanned vehicles. Boyle reveals that, in the past, attempts have been made: "the Obama administration developed tight export standards and launched a joint declaration with fifty other countries on

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[3]Edward Helmore. (2009). *US now trains more drone operators than pilots.* Available: https://www.theguardian.com/world/2009/aug/23/drones-air-force-robot-planes. Last accessed 16th March

[4] Michael J. Boyle. *The Drone Age* (New York: Oxford UP, 2020)

[5] Matthew Williams. (2021). *Life in 2050: A Glimpse at Warfare in the Future.* Available: https://interestingengineering.com/warfare-in-2050-what-to-expect. Last accessed 6th March

[6] Michael J. Boyle. *The Drone Age* (New York: Oxford UP, 2020): 291

the import and export of drones."[7] Donald Trump swept much of this away, however, loosening the standards for drone use and enabling exports to a wider variety of countries. Increasing the risk of drone technology falling into the wrong hands, the best defence strategy would thus highly regulate and trace drone sales and their use. Legal standards are already in place with the likes of the Federal Aviation Administration's regulations for domestic use in the United States. However, the political constraints around drone use are considerably weaker, let alone the international regulations of what is considered ethical and legal. Within the US, although drone pilots are constrained by the rules of engagement, those authorising targeted killings are much less constrained in making decisions. Superpowers have little transparency or accountability for how their unmanned technology is used. Allowing countries to regulate themselves will thus be insufficient. Instead, the United Nations or other international organisations will need to regulate technology through the development of an international regulatory board that would establish global laws for how drones are used and sold.

As unmanned technology has developed, modern warfare has benefited from increased surveillance. UCAV's and unmanned surveillance and reconnaissance aerial vehicles (UAVs) are used for battlefield intelligence – providing a cheap, easy, risk-free omniscient birds-eye view of what the enemy is doing. As Vinod Anand states, "technology has changed the traditional thought processes on military effectiveness. Increasingly, modern armed forces are endeavouring to obtain superiority over the enemy by qualitative means by deploying advanced technologies."[8] A shift has thus occurred from mass and mobility to non-traditional methods of enhancing combat efficiency. With the help of technological progress, modern warfare is seeing armed forces conducting knowledge-based warfare. The future fundamentally thus lies in digital technologies and communications. What better way to win warfare, then, than by taking out an enemy's eyes in the sky? If you want to fight smart war, aim at the satellite; take out an enemy's communications and their army will go blind. With countries taking their space-based assets for granted, relying on the advanced communication they provide, it leaves countries vulnerable to any adversary who can successfully disable or sabotage them. With the rise of anti-satellite technology, national and international space strategy thus needs to be reconceptualised.

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[7] Michael J. Boyle. *The Drone Age* (New York: Oxford UP, 2020): 291
[8] Vinod Anand. 'Impact of Technology on Conduct of Warfare.' *Strategic Analysis* 23.1 (1999): 148

Benjamin Sutherland, editing a collection of The Economist articles, helps reveal that "in a hushed, dimmed hall in the nerve centre that controls America's air operations, giant video screens tracking aircraft dominate. Blue dots show the location of ground forces, with 'troops in contact' highlighted for priority air support. Smaller screens show live black-and-white footage, relayed by satellite from unmanned drones which, in their turn, are remotely controlled by pilots [elsewhere]."[9] It is from locations like these that commanders supervise tens of thousands of sorties a year. Through aircraft surveillance pods, countries receive a God's eye view of all operations. In modern warfare, superpowers do not fight in a fog of war, but in a "huge cloud of electrons."[10] Large amounts of information such as surveillance videos can be shown globally in real-time; battlefield intelligence is gathered and communicated in these sites through satellites. This kind of network centric warfare is revolutionary. As recently as the Vietnam War, destroying a bridge or building could take hundreds of bombing runs. Now, a plane with 'smart' bombs can blast several targets in a single attack – all thanks to the satellite. The revolution in modern military technology is undoubtedly a revolution in the use of space. However, satellites are not untouchable; satellites are unprotected systems. The advanced technology on Earth would be inadequate without the satellite. As such, countries and their technological advantage are vulnerable. Why attack a single plane when you can blind the whole fleet? With satellites being perhaps the most important piece of technology to modern warfare, it is likely that countries will no longer leave them vulnerable and defenceless as they are susceptible to attack. Modern warfare is heading in the direction of the militarisation of space.

Satellites move in predictable orbits and anybody who can reach space can thus destroy a satellite – especially as space architecture is very fragile. A major superpower could intercept space assets with missiles and space mines, and disable them with lasers and electronic jammers. On January 11th, 2007, China launched an anti-satellite test (ASAT), intercepting one of its ageing weather satellites 500 miles above Earth.[11] The world was taken by surprise. No one knew that China was working on anti-satellite technology. More recently,

[9] Benjamin Sutherland. *Modern Warfare, Intelligence and Deterrence: The Technology That Is Transforming Them* (London: Profile, 2011): 128
[10] Benjamin Sutherland. *Modern Warfare, Intelligence and Deterrence: The Technology That Is Transforming Them* (London: Profile, 2011): 128
[11] Benjamin Sutherland. *Modern Warfare, Intelligence and Deterrence: The Technology That Is Transforming Them* (London: Profile, 2011): 125

Russia conducted its own anti-satellite test in November 2021.[12] It is clear to see the impact that technology is having on modern warfare. In 2015, Russian Defence Minister Sergei Shoigu announced the creation of a new branch of the armed forces – the Aerospace Forces, combining the air force with Aerospace Defence. Shoigu stated that the restructuring was in response to "a shift in the combat centre of gravity toward the aerospace theatre."[13] The move by Russia indicated that space will play an increasing role in modern warfare, and that space will perhaps eventualise in hosting conflict itself.

In an ideal world, space would be a global common. To date, international law treats outer space as a global common, akin to the high seas. Countries are free to use space for "peaceful purposes"[14] but may not stake territorial claims to celestial bodies or place nuclear weapons in space. With an increasingly globalised world where activities in space are becoming more frequent, it is likely that space will become contested. After all, under international law, the North Pole and the region of the Arctic Ocean surrounding it are not owned by any country. That has not stopped countries such as Russia disputing and challenging Arctic demarcation, however. The idealisation of space as a peaceful space for all may not hold longevity. ASAT testing highlights the impact of technology on modern warfare, the direction modern warfare is heading, and thus the need for defence.

In 2002, China and Russia proposed a treaty banning the deployment of weapons in space or attacks against space-based objects. The Americans were sceptical and refused to negotiate, saying that a treaty would be unenforceable and would only give an advantage to countries that are trying to hide their efforts to develop weapons for use in space.[15] Verifying compliance of technological development through an international body would indeed be very difficult. The best defence, then, is one that prepares for the worst case of scenario. A

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[12] Juliana Suess. (2021). *Space and the Future of War According to Russia.* Available: https://rusi.org/explore-our-research/publications/commentary/space-and-future-war-according-russia. Last accessed 7th March

[13] Juliana Suess. (2021). *Space and the Future of War According to Russia.* Available: https://rusi.org/explore-our-research/publications/commentary/space-and-future-war-according-russia. Last accessed 7th March

[14] United Nations. *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.* Available: https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html. Last accessed March 17th

[15] Benjamin Sutherland. *Modern Warfare, Intelligence and Deterrence: The Technology That Is Transforming Them* (London: Profile, 2011): 126

government's fundamental role is to protect its people, and thus the best defence strategy is *defence*. The American air force has adopted a doctrine of 'counterspace operations' that envisages either destroying enemy satellites in a future war or temporarily disabling them. Currently, superpowers' space defence strategies rely on passive measures: sidestepping an attacker by moving out of the way of possible strikes; shielding the organs of satellites by 'hardening' them against laser or electromagnetic attack; and replacing any damaged satellites. Few of these options are cost-free. More manoeuvrable satellites are heavier as they must carry more fuel; protective equipment makes satellites cumbrous and more expensive; placing a satellite further away from Earth, where it is more difficult to attack, means it will broadcast a weaker signal or require more costly sensors and antennae. Nevertheless, precautionary and passive defences are needed—no matter the cost—when so much is at stake. Satellites are the key to modern warfare, and going forward, national and international strategy will need to focus on defending them through fully committing to bulking up satellite armour and investing in their manoeuvrable structure.

The main impact of technological progress on modern warfare is that warfare is becoming increasingly knowledge-based. As communication and intelligence is fundamental to victory, warfare is likely to be directed towards the satellite. Modern warfare is thus resulting in the militarisation of space, laying the foundations for the future where space may host future warfare. It is also via unmanned vehicles that armies gather their intelligence. Along with unmanned technology comes legal and ethical concern. To stop technology such as drones getting into the wrong hands, and to defend the rights of the enemy, an international framework must be put in place. The industry requires more regulation to be deemed safe. Our biggest enemy is ourselves, and without laws in place to restrict the use of increasingly developed technologies, they will be exploited, and unnecessary death will follow as a result. As with drones as a source of information gathering, satellites will become a target for one's enemy. Countries will have to invest in improving satellite structure to make them more defensible, or they will risk affecting their whole nation – leaving them vulnerable – if their communication signal, which is so vital to the war effort, goes offline.

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