The Future of Peace and War: Warfare at the Technological Edge

Technological innovations have always shaped conflict and war. In the 20th century, technological developments in the military realm mainly concerned conventional weapons, such as fighter jets, missiles, and tanks, as well as nuclear, biological and chemical weapons. The end of the last century brought through cutting-edge technologies such as satellite communication and digital tools. The beginning of the 21st century has accentuated the developments in these fields and continues to produce the technologies of the future, such as artificial intelligence (AI), nanotechnology, and human augmentation. Given these technologies' novel features, their military use will most likely have considerable influence on future conflict and war.

New technologies in conflict and warfare

Several new technologies on the horizon are likely to impact future conflict and warfare. Armed forces and other actors already rely heavily on digital tools. These technologies have enhanced the speed, quantity and quality of information, thereby enabling a connected battlefield. Cyber-operations further allow states and non-state actors to attack military forces and critical infrastructure, as well as retrieve sensitive information from the adversary. While cyber-operations have thus become a full feature of warfare, they also tend to precede the outbreak of conflict. In the future, it is possible that with the increased sophistication of digital tools, cyber-operations will take on dynamics of their own --- dynamics that are different from those in the other military domains. To date, offensive cyber-operations have not led to the outbreak of war in the physical world, for instance. The damage that cyber-operations create tends to be very real, however, as prominent attacks against oil, healthcare and nuclear facilities have shown.

New technological developments also impact the militarisation of outer space. Armed forces have used outer space for several decades now, but both civilian and military use of outer space has significantly increased recently, making outer space congested, contested and competitive. This increases the risk of confrontation, inadvertent incidents and escalation. Yet modern societies' strong reliance on space technologies also implies significant vulnerabilities. From a military perspective, outer space assets are crucial for the conduct of modern military operations, thereby making them potential targets. A challenge in this regard is "dual-use" of civilian assets for military purposes, as this makes civilian assets legitimate targets with potentially serious consequences for societies. Given the military value of outer space technology, it is very likely that states will conduct cyber-operations against others' assets in outer space to hamper them without causing damage to their proper assets. While no placement of kinetic weapons in outer space has been confirmed so far, several states have operational anti-satellite weapons that they can launch from the ground or air. As such, these states have the ability to disrupt the space technologies on which modern societies rely. Recent tests of anti-satellite weapons have caused problematic debris, for instance.

Artificial intelligence is another emerging technology that is likely to be increasingly used in warfare. AI applications can be used to produce and disseminate "deepfakes" for the purpose of subversion, for instance. In addition, AI enables increasingly autonomous systems, allowing ever more delegation of tasks to algorithms and machines. This reduces the need for human soldiers and increases the speed and complexity of warfare. Already today, armed forces use AI applications in the context of reconnaissance and communication. Other applications that are likely to see further development are AI systems that guide drones with limited human interaction, including their coordination in swarms. Early applications of AI-enabled swarming and autonomous drones have already been used in recent military operations, such as in Palestine and Libya. Technologically advanced states' recent decisions to enhance their investments for developing, procuring and integrating military AI applications makes the wider and more substantial use of such technologies in all military domains and levels very likely. This competition for developing military AI may require the dynamics, costs, and risks of traditional arms races.

Quantum computing, nanotechnologies, human augmentation and synthetic biology are further technologies that may be used in future warfare. To date, publicly available information on the development of these technologies for military purposes, and on their sophistication and readiness for operationalisation, is scarce. Therefore, anticipating how they will affect the future of warfare remains very difficult. It is thus necessary to monitor the civilian development of these technologies very closely in order to infer potential military uses from their defining features and their concrete advantages for military operations. If these technologies are to be properly developed for military purposes, it can be assumed that they will lead to better-performing armed forces and combatants, which will further increase the speed and complexity of the battlefield. As with all technological developments in the military realm, any such progress will likely increase modern armed forces' dependence on technology; this may become a vulnerability of its own.

Outlook and broader implications

Today's and tomorrow's rapid technological developments will impact the future of conflict and warfare. A general trend is that technological innovation is usually driven by civilian research and development. Civilian technologies are then oftentimes adapted and integrated for military purposes. This poses challenges to civilian developers, who may not wish that their products are used for warfare. This also poses challenges for states' procurement processes, which tend to be complex and slow, because the technologies may be outdated by the time they are acquired. Hence, it is very likely that states will further increase their investments in research and development specifically for military purposes and in close co-operation with civilian partners.

A further trend is that new technologies enable states to be engaged in warfare, conflict and military confrontation less directly. Technologies and non-state actors --- there is often no clear distinction between military and civilian tools and actors --- are increasingly used by states as surrogates. Hybrid warfare, surrogate warfare and remote warfare conceptualise such modern forms of warfare that are likely to be employed in the future, notably in the context of tensions and confrontation between great powers. Yet, private actors may also access and use new technologies for their own objectives --- hacktivists and terrorist organisations using civilian drones being obvious examples.

As new technologies emerge and are used for military purposes, their impact on the future of peace and warfare needs to be closely observed and evaluated. This also requires exploration and debate on how international law, norms and standardsapply and need to be developed, since the military use of new technologies brings numerous ethical challenges. As such, the future is now.

Reference: https://radar.gesda.global/trends/invited-contributions/the-future-of-peace-and-war-warfare-at-the-technological-edge

Note: **The VIIMES would like to expressly emphasise that it has no influence on the content of the scientific article.**