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EMERGING TECHNOLOGIES: INDUCTION CHALLENGES FOR WARFARE

DINESH KUMAR PANDEY

A technological revolution is currently taking place inside the world's armed forces in order to better prepare themselves for future conflicts. With the assistance of cutting-edge technology such as quantum computing, artificial intelligence, and digital surveillance, it is possible that combat might be made substantially more rapid, accurate, stealthy, and intelligent. It is possible that the successful completion of this objective will need the application of more than one of these technological approaches.

Because of the complexity of military operations, it is easy to fall into the trap of assuming that every advancement in technological capability also delivers a similar gain in the quality of life. This is a misconception that can have serious consequences. All breakthroughs in science and technology are not necessarily beneficial, safe, or productive all of the time. As a result, some form of control is necessary to restrict the adverse implications, and this especially holds true for technological advancements. Firstly, a substantial amount of it pertains to domains where the advantages and risks are largely unknown. There should be a reasonable

Dr **Dinesh Kumar Pandey** is Senior Fellow at the Centre for Air Power Studies, New Delhi.

amount of government regulation. If there is an excessive amount of it, it may hinder all forms of creativity and development. If not adequately prepared, the new findings may result in physical or economic devastation and even the loss of human lives. More than 40 per cent of the professionals interviewed responded that artificial intelligence (AI), robots, and biotechnologies are at the top of the list of technologies that demand better regulation. The combination of AI and robotics creates a new field with enormous potential advantages and dangers.¹

WHAT ARE EMERGING CHALLENGES?

Emerging technologies for military operations are either newly developed or significantly enhanced, and they have the potential to increase the capabilities and performance of military forces across various domains and scenarios. However, they can also generate new problems and dangers for the military's stability and security. The following are some examples of new technology that can be used in military operations:²

Artificial Intelligence (AI): This technology enables machines to accomplish activities that generally require human intelligence, such as reasoning, learning, planning, and decision-making. AI has the potential to assist armed forces in improving their situational awareness, command and control, target detection, weapon guidance, cyber defence, and logistics.

Lethal Autonomous Weapons (LAWs): These weapons can choose and engage targets without the assistance of a human being. LAWs can be lethal. Although LAWs can potentially improve military operations' speed, accuracy, and overall effectiveness, they also present ethical and legal considerations around accountability, responsibility, and human dignity.

Hypersonic Weapons: These weapons can fly at speeds greater than five times the speed of sound (Mach 5) and behave

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1. Jurica Dujmovic, "Opinion: What risks do we face from emerging technology?", *MarketWatch*, February 22, 2017, at <https://www.marketwatch.com/story/what-risks-do-we-face-from-emerging-technology-2017-02-22>. Accessed on May 6, 2023.
 2. "Report to Congress on Emerging Military Technologies", USNI News, November 2, 2022, at <https://news.usni.org/2022/11/02/report-to-congress-on-emerging-military-technologies-5>. Accessed on May 9, 2023.

unpredictably while operating in the atmosphere. As a result, hypersonic weapons can potentially present a significant risk to conventional air and missile defence systems and the stability and deterrence of strategic operations.

Directed Energy Weapons (DEWs): These weapons use highly concentrated forms of energy to hurt or destroy their targets. Examples of such weapons include lasers, microwaves, and particle beams. DEWs can potentially deliver several benefits, including precision, rapidity, a cheap cost per shot, and scalability.

Biotechnology: It refers to a type of technology that creates or modifies goods or processes by using living creatures or portions of living organisms. Biotechnology applications can be found in military medicine, bioengineering, biosecurity, and biowarfare.

Quantum Technology: It refers to a type of technology that uses the phenomena associated with quantum physics, such as entanglement and superposition, to carry out operations that are either not conceivable or not viable using classical physics. For example, the military can benefit from the deployment of quantum technology in communication, processing, encryption, sensing, and navigation.

Blockchain: Blockchain technology ensures data privacy while enabling secure data exchange with all parties involved. This is why entrepreneurs in the defence industry are developing solutions based on blockchain technology to safeguard classified military data and combat cyberattacks. Other applications of blockchain technology in the sector include streamlining and simplifying the procurement process, protecting supply chains, and tracking devices. Furthermore, when interacting with defence contractors, using intelligent contracts dramatically lowers the possibility of fraud or corruption.³

Cyber Warfare: The military's computer networks are notoriously susceptible to cyberattacks, which can compromise sensitive military data and cause physical harm to the networks. Both the frequency of cyberattacks and the severity of those attacks have progressively

3. "Top 10 Military Technology Trends & Innovations for 2023", *StartUs Insights*, at <https://www.startus-insights.com/innovators-guide/top-10-military-technology-trends-2022/>. Accessed on May 10, 2023.

risen throughout the past few years. Prescriptive security technology employs cybersecurity, artificial intelligence, and automation to identify prospective threats and neutralise them before they affect defensive cyberwarfare capabilities. The protection of connected military equipment, the cyber defence of essential organisations, and the safeguarding of nuclear materials are primary areas of concentration. In addition, militaries are developing offensive cyberwarfare capabilities, such as malware, ransomware, and phishing assaults.⁴

Immersive Technologies: Simplification of creating the experiences that can be replicated and adapted to various contexts, such as flying or combat training is possible by Immersive Technologies. For example, new businesses use virtual reality (VR) to construct synthetic training environments (STE). These experiences enhance the preparedness of individual soldiers and entire units by complementing traditional training and mission rehearsal. In addition to the options it provides for training, augmented reality (AR) makes it possible for soldiers to perform their tasks more efficiently. Through augmented reality headsets or glasses, soldiers are equipped with mapping information, movement markers, and other data. This improves the ground forces' ability to make real-time decisions based on the current circumstances.⁵

The United States of America is currently in the driver's seat when developing several technologies. Nevertheless, China and Russia, two of the most critical strategic competitors, are making consistent headway in developing cutting-edge military technologies.

IMPLICATIONS OF EMERGING CHALLENGES

Emerging technologies can affect military operations in numerous ways other than just through disruption. For example, the workforce is impacted by new technologies, which creates a demand for different supervisors and engineers. However, before armies can adapt to these changes, there will be an increase in unemployment, which will, in turn, impact overall organisational stability.

4. Ibid.

5. Ibid.

The consensus among professionals is cautious optimism regarding each upcoming technology's risk and reward profiles. It was determined that artificial intelligence and robotics were the most dangerous, even though they offered substantial rewards.

The most significant advantages would result from AI's decision-making powers, which would draw on massive data and its ability to process various factors. Artificial intelligence may help governments and military commanders come to conclusions, but it could also reveal insights that could help solve some of the most pressing problems of modern times. These challenges range from complicated shifts in how conflict scenarios are played out. So it should come as no surprise that military weapon manufacturers have already invested billions of dollars in companies developing uses for artificial intelligence.

Another significant domain in which artificial intelligence has the potential to demonstrate its advantages over traditional data processing methods is machine learning. For example, Stanford's work on artificial intelligence has contributed to advancing breast cancer research by analysing millions of cellular characteristics and tumour photos. This has been made possible due to the discovery of useful signs that scientists have neglected.

However, artificial intelligence and robots also present several obstacles. The development of artificial intelligence (AI) and robotics, which are becoming more entwined with one another, makes it feasible to picture autonomous factories of the future run by complicated AI algorithms that supervise and operate manufacturing machines. The study of manning dynamics would require a significant number of people working in relevant sectors. Artificial intelligence will discover a method to automate and improve what workers do now, and it will do it at a fraction of the cost, which will cause this trend to expand to other professions.

The accuracy and morality of decisions made by autonomous systems could likewise be called into question by artificial intelligence. For example, imagine an AI deciding between putting a pilot's life in jeopardy and striking a target; this is a situation where even a human would have difficulty making the right choice.

THE CHALLENGES TO COMBAT EFFECTIVENESS

The theatre and field commanders must be cautious to ensure the efficient and effective introduction of new technologies. The salient factors that may need attention. Unfortunately, despite the fact that technological developments have the potential to have far-reaching positive benefits, they also hold the potential for substantial threats, particularly when they occur rapidly and in military operations. Emerging technologies expose their users to a number of dangers, including the following:⁶

- *Risks related to Cybersecurity:* The number of cyberattacks is expected to continue to rise. As more and more organisations migrate their network-centric operations through the internet, they will begin to collect more data, which increases the risk that it could be lost, stolen, or kidnapped for ransom. In addition, given that quantum computers can decipher encrypted data, the current security protocols may need to be revised.
- *Risks related to Effectiveness:* The environment for risk is transforming due to developing technology. The increased rate at which new technologies are being tested and used can amplify even minor problems and present unanticipated roadblocks that have far-reaching consequences for organisations.
- *Risks related to cost:* Difficulties in investing in new technologies demand considerable investments in research and development (R&D), infrastructure, skill, and regulation, all of which present challenges for investors. Nevertheless, many unknowns exist when investing in deep technological projects, such as high failure rates, complex challenges with intellectual property, and a need for more standardisation.⁷
- *The possibility that developing technology might not live up to the anticipation of planners:* Whenever an organisation implements an unconventional way of carrying out operations, there is the potential for quality control management concerns to surface. As a consequence of this, workers could feel uneasy about adapting to new circumstances. The elimination of bottlenecks like these

6. Dujmovic, n. 1.

7. "Meeting the Challenges of Deep Tech Investing", CSIS, May 17, 2021, at <https://www.bcg.com/publications/2021/overcoming-challenges-investing-in-digital-technology>. Accessed on April 9, 2023.

could be made possible by better training and more streamlined switching procedures.

- *Intended implications of technological advances like robotics and artificial intelligence:* The vulnerability of the “Internet of Things” (IoT) to cyberattacks, data breaches, and privacy violations. The term “IoT” describes the interconnection and data-sharing capabilities of various machines, vehicles, and structures. While this can enhance productivity, comfort, and security, it also can jeopardise privacy, vital infrastructure, and national safety.
- *The difficulty in determining the degree of risk posed by the implementation of newly developed technology:* As a result of the emergence of cutting-edge technologies, organisations are confronted with new challenges in the realm of information technology. These challenges include the following: how to integrate new systems with existing ones; how to manage data quality and security; how to automate mundane tasks; how to make use of cloud computing and artificial intelligence; and how to facilitate a culture of “Bring-Your-Own-Device” (BYOD).⁸
- *Supply chain challenges:* The COVID-19 epidemic and the crisis in Russia and Ukraine have both disrupted supply lines around the world, which has led to a shortage of semiconductors (chips) and other important materials. These two factors are to blame for the problems that have arisen in the supply chain. There are many new technologies that can’t advance without these components. These execution gaps may result in defects in coverage brought about by the evolution of products and services.⁹
- *Overlooked potential global risks:* Emerging technologies can have positive effects on the speed, quality, and cost of products and services. Still, they can also displace many employees, pose moral dilemmas, and generate new security and cyber threats.¹⁰

8. Matt Dixon, “Top 5 IT Challenges with Emerging Technology”, Front Range Systems, November 29, 2019, at <https://frontrangesystems.com/blog/top-5-it-challenges-with-emerging-technology>. Accessed on April 9, 2023.

9. Shirshendu Halder, “Ethical Challenges of Emerging Technologies”, Enterprise Tech Management, June 22, 2021, at <https://www.enterprisetechgmt.com/2021/06/22/ethical-challenges-of-emerging-technologies/>. Accessed on April 9, 2023.

10. Darrell M. West, “Technological Progress and Potential Future Risks”, BBVA, 2023, at <https://www.bbvaopenmind.com/en/articles/technological-progress-and-potential-future-risks/>. Accessed on April 29, 2023.

IMPACT OF TECHNOLOGICAL ADVANCEMENTS ON INDIAN OPERATIONAL READINESS

To get a competitive advantage in the technical arms race, the Indian military intends to be the first to adopt both disruptive and emerging technology. Therefore, the induction of emerging technologies for enhancements of capabilities to effectively conduct military operations on the multidomain, technology-dominated battlefield of the future will be essential. Regarding conventional warfare, the Indian military is extremely well-prepared regarding organisation, equipment, and training. But, on the other hand, it desires to adopt innovation, technology, and disruptive and emerging technologies to tilt the technological asymmetry in its favour. For our Armed Forces to be in a dominating position to confront the challenges of the future, the government needs to provide the necessary support on a priority basis, before it becomes too late.

IMPLEMENTING EMERGING TECHNOLOGIES

The aviation units of the army and the navy cannot all be brought up to date at the same time due to a lack of funds for the purchase of new jets, which is one of the reasons why the aircraft is still in use. Analysts say this is one of the reasons why the aircraft is still in service. The Indian Air Force and the Indian Navy are taking advantage of a number of cutting-edge technologies, including the following:

- *Unmanned Combat Aerial Vehicle (UCAV)*. IAF and the Indian Navy commissioned the Defence Research and Development Organisation (DRDO) to design and build the AURA UCAV, which is capable of operating in stealth mode. AURA is going to be the primary long-range strike platform, and it will be able to carry missiles, precision-guided bombs, and other types of munitions.¹¹
- *Innovation for Defence Excellence (iDEX)*: iDEX is an effort that was launched by the Department of Defence Production to stimulate innovation and technological development in the defence and aerospace industries. This was accomplished by engaging start-

11. Dharvi Vaid, "How India is ramping up military modernization efforts", DW, January 5, 2022, at <https://www.dw.com/en/how-india-is-ramping-up-efforts-to-bolster-military-capability/a-60336292>. Accessed on April 9, 2023.

ups, MSMEs, individual innovators, R&D institutes, and academic institutions in the project. Innovators have the opportunity to receive cash support, mentoring, technical guidance, and handholding from iDEX, as well as opportunities to develop prototypes.¹²

- *Amphibious Warfare Capabilities*: The Indian Navy has to place a primary emphasis on the acquisition of amphibious ships in order to establish an amphibious task force with dedicated amphibious warfare doctrines as a reaction to the Anti-Access/Area Denial (A2/AD) strategy employed by the Chinese government.¹³
- *Global Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Capability*: In view of developing threat in Indo-Pacific, maintaining dominance at sea in the Indian Ocean will be a crucial future capacity for the Indian Navy to develop. The Indian Navy will need to use cutting-edge weaponry and defence technology to project power and deter adversaries. Creation of a global C4ISR capacity by IN is vital, in order to ensure that its maritime strike operations are successful.¹⁴
- *Military Modernisation Programme*: In light of the shifting geopolitical environment and security landscape, the Indian government has been stepping up its efforts to strengthen the country's armed forces as part of its Military Modernisation Programme. The Defence Acquisition Council has given its blessings for the purchase of a total of 14 products to be made within thirty months of the contract for the creation of prototypes under the iDEX programme.

COUNTERING THE CHALLENGES FROM EMERGING TECHNOLOGIES

Our armed forces need to be up to date and proficient in technology to meet any potential threat to national security. Cyberattacks and arms races are two of the numerous emerging challenges and dangers that

12. "Defence India Startup Challenges", iDEX, May 10, 2023, at <https://idex.gov.in/>. Accessed on April 29, 2023.

13. Abhinav Dutta, "Emerging Technologies in Contemporary Ocean Warfare", *Indian Defence Review*, January 18, 2020, at <http://www.indiandefencereview.com/spotlights/emerging-technologies-in-contemporary-ocean-warfare/>.

14. Ibid.

have arisen due to the proliferation of new technology. For the military to make practical and moral use of technology in war and peace, it must adapt to the new realities and develop innovative doctrines, plans, and standards. The following measures may be initiated for countering the challenges of growing military technologies.

- *Investing in Technological Innovation:* To maintain its technological advantage over potential foes, the Indian military must develop technologies such as artificial intelligence, quantum computing, biotechnology, and hypersonic weaponry. In addition, it needs to gain the capability of regularly testing and auditing newly integrated systems. As a result, the current method of purchasing goods and services will be replaced with one that is more versatile and adaptive.¹⁵
- *Be Atmanirbhar in the Defence Sector:* One crucial takeaway from the Russia-Ukraine conflict is maintaining your independence in the defence sector. Being held as a prisoner by another nation during a war is equivalent to being dependent on that nation for supplies such as spare parts and ammunition. The government has already begun taking steps in that direction, and we can only hope that India will be “Atmanirbhar” in critical domains.¹⁶
- *Increasing the Strength of Diplomatic Alliances and Partnering Structures:* It is essential to keep our armed forces at the requisite level of operational readiness to deter or defeat potential adversaries. At the same time, developing our diplomatic and strategic alliances with nations that share their interests and values is vital. Capitalising on these countries’ combined resources and capabilities is also necessary. At the same time, it is essential to capitalise on these countries’ aggregate resources and capabilities. In addition, it must encourage collaboration and confidence among friends and partners on issues such as the

15. Sara Brown, “3 challenges to digital innovation and how to overcome them”, May 25, 2021, at <https://mitsloan.mit.edu/ideas-made-to-matter/3-challenges-to-digital-innovation-and-how-to-overcome-them>. Accessed on April 22, 2023.

16. “Atmanirbhar in Defence”, May 11, 2022, at <https://www.ibef.org/blogs/aatmanirbharta-in-defence#:~:text=Self%2Dreliance%20in%20the%20defence%20industry%20will%20enhance%20India's%20strategic,on%20import%20of%20various%20products>. Accessed on April 12, 2023.

division of responsibilities, interoperability, the interchange of information, and the transfer of technology.¹⁷

The nature of battle is constantly changing, and new technology brings new challenges, necessitating the development of new military doctrines and standards. Novel ideas and standards must be developed that will direct the application of these technologies in a manner compatible with our strategic goals. Our diplomatic discourse and confidence-building measures must continue with potential foes to decrease the probability of any misunderstanding, escalation, or confrontation. Although Indian diplomatic efforts to diffuse the tension at its borders have been praised globally, they need to continue.

CONCLUSION

Emerging technologies are rewriting the rules for modern conflict. Military operations have been completely transformed due to recent developments in areas such as autonomous systems, artificial intelligence, cyberwarfare, and space-based capabilities; these innovations bring advantages and challenges. However, ethical problems, vulnerabilities, and the potential for escalation also develop due to the use of these technologies, even though they offer enhanced precision, efficiency, and a reduction in the number of human casualties. It is essential for legislators, military strategists, and society as a whole to comprehend and manage this new period in order to assure security, ethical concerns, and stability in the face of rising technology. Warfare is continuously evolving, and this makes it all the more important to do so.

To address these issues, international cooperation, the creation of ethical frameworks, and decisive policy actions are required. Nevertheless, it will be possible for states to traverse the shifting landscape of conflict and protect international security in the coming years if they adopt a responsible approach to developing and using emerging technology.

17. "Military Technology", CSIS, 2023, at <https://www.csis.org/topics/technology/military-technology>. Accessed on April 9, 2023.

