Disruptive Technologies and Future Warfare

BY DR AJEY LELE

Technology development is a continuing process. Technological developments are known to impact the advancements taking place in various sectors. The modern world is found getting driven mostly by technologies. From health to agriculture to education to human development to truism to critical infrastructure, almost every part of human life is found increasingly getting dependent on technologies. Apart from these sectors, technology is known to be influencing the security sector for long.

Historically, it has been witnessed that different technological innovations used to originate in the defence arena and were found subsequently making inroads in the civilian domain (e.g. Computers, Internet, GPSetc). Particularly, during the period of world wars and cold war, much of the government funding used to go to defence sector for technology research, development and innovation. This is because owing to the strategic challenges, the military leadership always used to be hunting for new technologies. These technologies were meant for replacing the existing fighting systems or for juxtaposing on their existing military structures in order to improve the performance. All in all, the level of technological expertise used to dictates the warfighting strategies of a country or a power block. However, the post-Cold War period is witnessing a societal change in many parts of the world. The process of globalisation and economic liberalisation made a huge impact on way the global economy used to function. The process of technology development is no longer been governed exclusively by the military needs. At present, market needs are found mostly driving the innovation cycle. In the present era, new technologies are found frequently making inroads into the commercial sector and subsequently the defence sector is found consuming them.

Today, for any state, it is extremely important to watch the progress made in the domain of civilian technology, which could possibly have an impact (direct or indirect) on defence. At the same time, it is also important to mention that idea of demonstration of technological superiority of a state continues to remain an important aspect in modern-day power politics too. Innovation allows both development of new technologies and finding alternatives to the existing technologies. The need and process for finding alternatives depend on various factors like environmental requirements for avoidance of pollution, to find alternatives to critical metals/materials which are in short supply, need for superior technology or owing to financial aspects or for some social reasons. On occasions, the market witnesses an entry of altogether a new form of technology, which upsets the existing structures of technology diffusion. A simple working example could be about the arrival of digital photography and its availability in the mobile phones. This has altogether stopped the requirement of photography using films (remember....now Kodak films are out of business). This phenomenon is known as technology disruption.

Literature defines disruption as the displacement of existing technology or market. This leads to systemic changes, whereas innovation typically has more positive connotations and is correlated with upgradation. Innovation is seen as a rational process, while disruption is reflected as unpredictable event which mostly could be irrational and damaging. However, disruption is not always a negative thing, in fact, there is a view that disruption is actually a higher form of innovation.

Today, various new technologies are getting developed, which are known to be disrupting the some existing technologies. Also, all of a sudden some new technologies are getting introduced which are found bringing a major change in the lifestyle. Most of these technologies are also found significantly impacting the defence sector and on occasions are forcing the defence establishments to bring in the doctrinal changes. Ultimately, all this is leading to bringing in a major change in the nature of warfighting itself.

Presently, the world is standing at the cusp of the fourth Industrial Revolution (Industry 4.0). This has been characterised by the widespread application of cyber-physical systems. A new era in intelligent network systems, big data analytics, internet of things (IoT), cloud computing, additive manufacturing (3D printing), hypersonic weapons, biotechnologies, energy technologies and new materials is found impacting equally, both civilian and military domains. The fundamental aspect of Industry 4.0 has been the development of digital, physical and biological technologies. The Covid-19 crisis have actually pushed the world to leapfrog in the arena of information technologies.

MOST OF THE DISRUPTIVE TECHNOLOGIES ARE STILL EVOLVING. HOWEVER, THEY ARE EXPECTED TO PROVIDE INNOVATIVE, REAL-TIME, AND MORE GRANULAR INSIGHTS FOR MANY DEFENCE APPLICATIONS. OBVIOUSLY, SUCH DISRUPTION IS EXPECTED TO CHANGE THE METHODS OF WARFIGHTING AND ALSO EVEN REVOLUTIONISE THE CONCEPT OF FUTURE WARFARE. LOOKING AT THE GLOBAL STATUS OF MILITARY RELATED DISRUPTIVE TECHNOLOGIES, IT IS EXPECTED THAT IT WOULD TAKE SOME MORE TIME TO COMPLETELY ASSIMILATE THESE TECHNOLOGIES IN THE DEFENCE ARCHITECTURES OF NATION STATES.

The future battlefield is expected to be driven by various disruptive technologies. The troops would be assessed by these new technologies and actually some of these technologies could even impact the process of warfighting itself. On occasions it is expected that the troops on ground could even be replaced by machines. The militaries would hire equipment which is intelligent and capable of performing a broad range of tasks like sensing, communicating and coordinating amongst agencies and human warfighters. Some of these devices could also be taking the decisions on the battlefield for their human masters. Man-machine interphase is expected to dominate the process of formulation of war tactics of tomorrow. Various devices like sensors, smart-munitions, state-of-art weapon delivery platforms, robotic systems and human-wearable equipment would be the part of warfighting architecture.

The most debated disruptive technology at present is Artificial Intelligence (AI). This technology brings up to the ability to make machines act intelligently. AI could be seen more as an umbrella term incorporating smart sensors, intelligent robotics, ambient intelligence, machine automation, autonomous weapons, reactive and hybrid behaviour-based systems and big and small data products. The distinctive feature of AI is that it is self-adaptive and uses advanced algorithms, which permits self-programing by recognizing structure and regularities. The strength of AI is determined by the availability of data and it is extremely important to have accurate data. In 21st century, data gets regarded as a new oil and armed forces are required to collect and share the data with concerned agencies if they want an effective AI system to assist them.

Modern-day warfare is very complex since there are various unknown variables. Also, the present-day geopolitics indicates that today it cannot be an all-out war as in the past and issues related to human rights, collateral damage and operating in urban warfare situation put much pressures on militaries to decide on their warfighting tactics. They are required to carter for various micro variables in their war planning and also during their actual operations. Here AI could help them to enhance their multi-layer capabilities to handle a range of indeterminate war circumstances or hostile environments. AI could help to improve and fasten the decision making process by providing various options in real time. This technology has much utility in various fields including training, net assessment, war gaming, logistics, determining on war tactics, command and control, intelligence assessmentand decision-making.

Apart from AI, one another technology, which could dictate the future of warfare is a hypersonic technology. Major state powers like the US and China are investing much in this technology. India has also its own hypersonic programme. Hypersonic missiles are expected to change the present notion of nuclear warfare and nuclear deterrence. When a missile travels with a speed more than 5 Mach (one Mach is

equal to the speed of sound) it enters in the zone of hypersonic. The performance of such missilealso depends on the properties of the medium of travel, ambient temperature and attitude. Presently, various military research labs are working towards developing hypersonic glide vehicles (HGVs), which are launched by a ballistic missile and glide to their targets. Also, there are hypersonic cruise missiles that are powered by high-speed, air-breathing jet engines called scramjets. The existing missile defence systems (like THAAD, S-400 etc) are not capable of intercepting such missiles. Hence, when such missiles become operational then it is expected to challenge the existing notion of nuclear deterrence. Owing such challenges already the work has begun to improve on the missile defence systems, which could even address the hypersonic threat. Alternatively, future technologies may also include lasers, high-powered microwaves, rail guns, or particle clouds designed to disrupt hypersonic flight. Largely, it may take few more years for induction of these missiles into the military edifice of major powers.

Future of warfare is expected to be impacted also by technologies like 3D printing. Actually, more than the process of warfighting could be viewed more as a backend technology, which would impact the military industrial complex significantly. This technology which is also known as additive manufacturing (AM) involves creating three-dimensional structures out of plastics, metals, polymers, and other materials. This technology challenges the conventional method of manufacturing. For last some decades, various industries both in civilian and defence sector are found using the computer numerical control (CNC) machines for manufacturing. Here there is a requirement of giving an order for the production of fixed number of units. This definitely is not a cost-effective option. However, 3D printing even permits to produce a single piece.

3D printing constructs are added layer by layer in real time based on digital design. Also, this technology helps todesign of very intricate and complex structures, which otherwise are not likely with traditional manufacturing methods. This is an attractive technology for process improvement within the armed forces as it is cost-effective and it is possible to product the parts at unit level which in turn reduces the pressure of logistics department. The process of 3D printing involves production of a product based on digital technology and the products are much lighter in weight and demand based production is possible. Presently, this technology is showing greatpotential and even the parts of aircraft and spacecraft are known to have been created (printed) by defence industries.

As discussed above most of the disruptive technologies are still evolving. However, they are expected to provide innovative, real-time, and more granular insights for many defence applications. Obviously, such disruption is expected to change the methods of warfighting and also even revolutionise the concept of future warfare. Looking at the global status of military- related disruptive technologies, it is expected that it would take some more time to completely assimilate these technologies in the defence architectures of nation states. Eventually, they are expected to impact all forms for warfare from conventional to nuclear to cyber to space. It is important for various military establishments to remain papered for this type of possible disruption.

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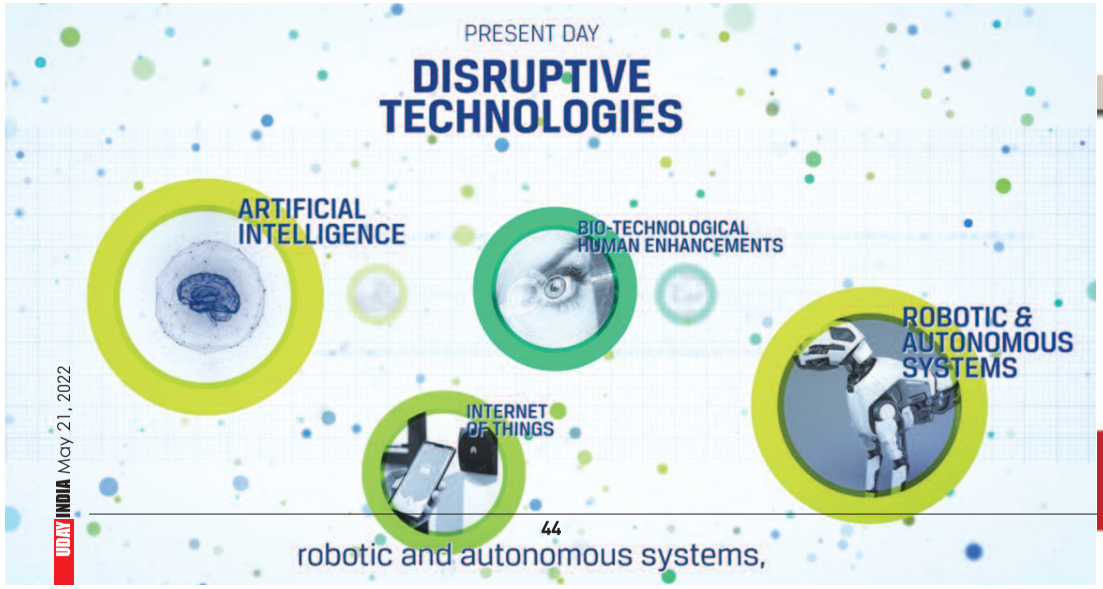

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