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Impact of Disruptive Technologies on Warfare

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Introduction

New technologies are emerging rapidly on varied fronts. Quite a few technological advancements are considered as a breakthrough yet not every new technology will alter the way wars are fought. There are some which have a disruptive impact on modern-day warfare, in terms of bringing in new paradigms, opening up new challenges, creating new domains of war-fighting, making operational concepts and doctrines redundant, and most importantly having an exponential and dramatic impact. The aim of this paper is to understand the use of current and futuristic Disruptive Technologies and their impact on modern-day warfare.

Disruptive Technology refers to a new age technology which invariably makes the existing technology obsolete. It is an innovative technology that triggers sudden and unexpected effects. In military domain, a disruptive technology will provide decisive

Key Points

1. New technologies are rapidly emerging on varied fronts, e.g., artificial intelligence, robotics, space, drones, social media, nanotechnology, etc.
2. These technologies will provide decisive and exponential advantage in modern warfare, and would aid a definite victory.
3. Some key aspects of military warfare which will get impacted are engagement, force posturing, mobility, protection, communications, sustenance, surveillance and intelligence collection, strategy and doctrine.
4. India needs to put its focus on these new age technologies if it wants to be counted on the global platform; as someone rightly said— Global aspirations are to be backed by military superiority.

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and exponential advantage to the owner and would aid a definite victory; its impact could be as described as below:[1]

- Creates a paradigm shift in the nature and conduct of military operations.
- Renders obsolete or irrelevant one or more core competencies.
- Creates new core competencies, in existing and new dimensions of warfare.

Today, there are a plethora of technologies, matured and emerging both, which have the potential to impact the modern-day war in a dramatic way. Rapid advances in these new age technologies could potentially destabilise fragile balances of power and alter the international security landscape, creating disparities between countries or heralding chaos. Some emerging technologies on the horizon are:

- Artificial Intelligence (AI)
- Robotics
- Satellite
- Drones/UAVs (Unmanned Aerial Vehicles)
- Social Media
- Nanotechnology (NT)

Disruptive Technologies

The hyper-connected and super collaborative world of today has contributed to the exponential rise in innovations witnessed in the fields of AI, cognitive sciences, robotics, drones, NT, 3D printing, bio-weapons, directed energy weapons, satellite, telecom, Information Technology (IT), etc. These disruptive technologies have become ubiquitous and the skills required to learn about many of them are now freely available on the Internet. Let's review some of the important disruptive technologies, and their broad impact on warfare.

AI and Robotics. AI can be defined as intelligence demonstrated by machines, i.e., when a machine mimics cognitive functions of a human brain, such as learning, problem solving, etc. A good amount of progress has been made in this field, e.g., if we consider the combined developments in the field of AI and robotics, we realise that they are slowly replacing humans. This could be a great game changer for future wars as they could replace soldiers in high-risk missions and thus save precious human lives. The concept of an ideal soldier of the future who knows no fear or fatigue, who can adopt the best course of action after considering all alternatives in real time, and who can survive the battlefield chaos and explosions, is bound to be very attractive.

Satellites. The Soviet Union pioneered the first ever launch of a satellite in 1957, called the Sputnik 1. Since then, more than 40 countries have acquired this capability, and almost 6,600 satellites have been launched in space. Satellites provide a different dimension of warfare, i.e., *Space*, are influential over vast geographical areas covering multiple nations in their beat, and provide a plethora of varied services, which is what qualifies it as a disruptive technology.

UAV. Commonly known as drone, UAV is an aircraft without a human pilot. UAVs are typically used for missions that are dirty or dangerous for human beings. While they originated mostly in military applications, their use is rapidly expanding to agriculture, policing, peacekeeping, surveillance, product deliveries, aerial photography, agriculture, etc. Important military applications include reconnaissance, surveillance, imagery, weapons delivery, target acquisition, laser designation, missile attack, post-strike damage assessment, targets for military training, search and rescue, communication relay, decoy, etc. The science of UAV along with other fields like NT is now paving the way for miniaturisation of drones. Technological developments and improved capabilities in the field of drones are now stealing a march over manned aircraft or even space-based systems.

Social Media. The immense impact that social media could create in swinging opinions, and the larger issue of data privacy have been only too convincingly brought out by the recent incidents of US President Trump's election campaign being influenced by the Russians, and the public data of Facebook users

exploited by political consulting firm Cambridge Analytica. Social media can play a very significant role in military warfare to conduct psychological operations (as part of Information Warfare, IW) to mislead the enemy soldiers, the civilian population, or even tilt the opinion of neutral forces in own favour. It is widely speculated that Russian forces used Facebook and Twitter for false propaganda in Ukraine.[2] Social media is also being used very effectively by terrorist organisations; as per an estimate there are almost 6,000 terrorist related websites and most of them are the preferred method for dissemination of jihadist propaganda. An Al-Qaeda publication lists 39 principles of jihad of which one very important one is *performing electronic jihad*.[3] Conversely, state forces may exploit social media and the power of the Internet to counter the jihadist propaganda, by creating counter-narratives, gaining the sympathy and favour of local population, changing public opinion and so on.

Nanotechnology (NT). NT broadly involves the manipulation and application of functional materials and systems through control of matter at the atomic and molecular levels, and is emerging as the major focus of scientific and technological innovation for the twenty-first century. NT is expected to advance weaponry, clothing, light-weight metallurgy, miniature robotics, surveillance devices, drones, medical diagnostics, therapeutics, vaccines, and computing. These micro- and nanotechnologies are being used to develop miniature flying and crawling systems capable of performing a wide variety of battlefield missions, especially in the domain of surveillance. In addition, there are other military applications such as armour like fibre, smart helmets, ultra-light material for aircraft, artificial muscles, etc.; all this, coupled with robotics and AI, could lead to innovation of devices and applications for military warfare, which one could never imagine to be possible.

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The spurt in technologies would excite the military commanders to think and employ these at the operational and tactical level of warfare, and probably the political leadership would exercise options at the strategic level. However, the disruptive potential of these technologies requires an understanding of how they might fundamentally affect the nature of warfare. Some of the important aspects are as under:[4]

- **Balance of Power.** As time goes on, advancements in technology may shake up balance of international power by making it easier for smaller nations, non-state actors, and even individuals to threaten the big boys like the US and China. The entry cost of some of the disruptive digital technologies like the AI or cyberwarfare is very low, and new entrants could well surprise the traditional superpowers. Exploitation of social media can certainly tilt the balance of power as was aptly proved by Russians during the Ukraine war,[5] or by the ISIS in their fight against al-Nusra[6] or during attack on Mosul.[7] A well-coordinated and targeted social media campaign can have devastating psychological effects not only on soldiers, but on civilian population as well. As costs drop, militaries may produce vast swarms of small, cheap, artificially intelligent attack drones/robots; for the price of a single fighter aircraft, a military could acquire a few thousand drones. The future of warfare is in space and cyber. There is thus a direct bearing of space capabilities of a nation to its international standing and creation of credible deterrence—a Star Wars kind of scenario is no more in the realm of fiction, but slowly becoming a reality.
- **Engagement.** With disruptive technologies like robotics, satellites, drones, UCAVs, NT, etc., becoming mature, the rules of engagement in war are bound to change; for example, physical contact battles may become folklore and stand-off operations/non-contact warfare may become a norm in future, reducing drastically the risk to soldiers; other than conventional warfare, robots may also be used to engage with terrorists in hideouts, inside buildings, etc., thus reducing casualties. UAVs define new rules of engagement

for military warfare; the biggest dramatic shift that drones provide is the capability to carry out stand-off missions; new concepts like the drone-swarm tactics will give new avenues of engagement with the adversary. New warfare domains will open up, namely, space warfare and the virtual domain of cyber world, including social media. Engagement in the realm of Space and to enemy areas in depth, across thousands of kilometres has also been made possible by space-based assets. Setting up of manned space stations will probably open up new possibilities.

- **Movement.** AI tools may enhance mobility by automatically suggesting ideal routes considering traffic congestion, road conditions, destroyed bridges and so on. Unmanned, intelligent vehicles on ground, in air, and under the sea, may enhance reach of surveillance and weapons systems. Technologies like NT may lead to miniaturisation and thereby making possible light-weight vehicles, weaponry, personal kits and so on. Space assets enhance military mobility by providing accurate navigational and positioning services in enemy territory.
- **Protection.** Protection of equipment and human beings will certainly get a boost. Nano-fibre based soldier uniforms would be able to change the colour and texture to merge with surroundings thereby reducing the visual signature; nano-coatings can be used to enhance camouflaging, stealth features and thus reduce the visual, thermal, infrared and electro-magnetic signatures of many military vehicles, systems and soldiers; light-weight nano armour can provide better protection compared to traditional materials; NT can be used for protection against chemical/biological attack—it could be in the form of better sensors, and blocking of molecules by plugging pores in clothing. Inventions like intelligent robots, drones, UCAVs, etc., will reduce the involvement of soldiers/pilots in risky situations and therefore reduce battlefield casualties. Robots could be employed in hazardous environments like NBC radiations, thereby preventing exposure to soldiers. Space-based missile defence systems can give early warning of missile launch by the enemy, and provide adequate reaction time to launch countermeasures.
- **Communication.** A robust, high capacity and fail safe communication network is a prerequisite for smooth and efficient conduct of military operations. Expeditionary forces need to communicate across the globe to their parent nation. New age technologies like satellites, AI, drones, and social media can effectively contribute towards an efficient military communications network. AI can make communications more efficient by using machine learning to predict traffic patterns and accordingly adjusting the link parameters. It could also be used to defeat enemy EW (Electronic Warfare) attack by using cognitive tools for frequency hopping, adaptive digital modulation and spread spectrum techniques. Miniature packaging and increased density of nanomaterials can provide smaller devices, better communications, faster data processing, low power consumption and higher data storage density.
- **Sustainment.** Sustainment of a fighting force in the battlefield is a major planning factor for any military commander. The endurance of soldiers, vehicles, flying machines are all critical. New-age technologies can effectively contribute in this domain, e.g., robotic surgery in field, improved logistics through drone delivery, and so on. AI based logistics management systems could assist in inventory assessment and future predictions, based on past consumption and wastage patterns. Locations of units and supply echelons can be tracked on real-time basis. Information regarding critical stores can be relayed through satellites back to the base despite large geographical separation and inclement weather. Long-range patrols or

extended duration operations in inaccessible areas can be logistically sustained for larger durations by dropping supplies, ammunition through UAVs.

- **Surveillance and Intelligence Collection.** Surveillance and intelligence collection will get a tremendous boost through new technologies; satellites, drones, nano-sensors, cyber-espionage are all tools that will enhance the capability to get detailed information about enemy dispositions, future plans, movements, post-strike damage assessments, etc. Reconnaissance and surveillance space assets provide real-time information about enemy deployment, movements, location of weapon systems, reserves, terrain, rail/road network, etc. In addition, COMINT and ELINT satellites provide information about electronic transmitters of the enemy, including radars, missile control systems, communications transmitters. Intelligent tracking of social media usage by adversary troops and leaders can help in gathering critical intelligence. Miniature sensors with a wide range of advantages can be realised through NT; such sensors will be small, require very little power, and will be highly sensitive due to large sensing area.
- **Organisation and Human Resource.** Disruptive technologies have huge implications for military organisations, doctrines, and the human resource central to these organisations. New systems will demand new organisational structures, enhanced technical threshold, and so on. Absorption of intelligent robots/machines, drones, etc., as distinct resources in the overall structure, including their command and control, provisioning, repair and upgrade, has to be factored in. Soldiers will need to be trained to use these autonomous and intelligent devices, as also to exploit the AI based applications. Fleets of manned aircraft may gradually be replaced by drones. As more and more UAVs proliferate, there would be need to have new organisations, and skilled human resources to manage the new age systems. Dedicated organisations are required to handle a virtual weapon like the social media at all levels of war—strategic, operational and tactical.
- **Equipping.** Disruptive technologies may reduce the cost of equipping the forces, as also enable a nation to resize its forces towards a more lean structure. Robots may replace soldiers; UAV production costs are a fraction of manned fighter aircraft or helicopters. Thus, equipping the armed forces will be much less costly. Further, maintenance and storage costs are also low, and hence there is an impact on the overall life cycle cost of the system.
- **Posturing.** Force posturing may be impacted by technologies such as the drones, space-based systems, autonomous weapons, etc. These technologies will make traditional numerical force projection redundant across land, air and sea, and bring in a new era of warfare where long distance, human-less force projection is feasible through robots, drone swarms, space-based weapon systems, and virtual war in the cyber world.
- **Strategy and Doctrine.** This is probably the largest impact one can foresee. Nations will be forced to revise strategies and warfare doctrines to be able to exploit these new technologies to their full potential. A shift in focus from kinetics based warfare to technology enabled warfare will be required. The focus on R&D will need to be realigned and funding/procurement priorities will have to be reshuffled. A major doctrinal shift would be to accept use of space-based offensive capabilities as a credible deterrence tool. Another policy shift could be to place weapons in space, and their utilisation based on certain criteria. With advancements in drone technology, conventional aircraft may take a back seat, whether in numbers or in lethality. UCAVs may lead the attack wave, in addition to taking over other functions like visual and electronic surveillance. National strategy and military doctrine needs to undergo a revision to include cyber and social media as potential weapons of warfare. Today, these domains are,

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at best, treated as force multipliers in support of conventional warfare. However, we need to take a learning from reckonable militaries like the Chinese PLA (People's Liberation Army) who see cyberwarfare as a first-strike option (to preclude the requirement of kinetic operations), and not as a force multiplier to conventional operations.[8]

Conclusion

There is no denying the fact that disruptive technologies have a definite impact not only on the military warfare but also on the economic development and comprehensive national power. This further dictates the foreign policy choices that we can make. Future conflicts will be driven by these technologies, whether we like it or not, and rather than adopting an ostrich like attitude it would augur well for us as a nation to focus on building up capabilities and the arsenal of new age technologies. It's a long process to include not only identification and development/import of these capabilities, but also the associated policy, doctrinal, organisational changes and the mindsets that accompany. India needs to put its focus on these new age technologies if it wants to be counted on the global platform. Global aspirations are to be backed by military superiority, only then you get noticed, else be prepared to be overlooked. The political and military leadership would do well to realise this and initiate action plan to build up capabilities.

Notes

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