Use Of Technology Including Artificial Intelligence (AI) and Robotics to Enhance War Winning Capability

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Abstract

The paper starts with a section which briefly outlines the operating environment the Army is likely to operate in, emphasising the aspects of enhanced mobility, lethality and small enemy fighting groups of a nation state or trans-border terrorists or hybrid of the two.

In the next section, there is a brief expose on the evolution of network centricity and a listing of the military relevant new age technologies that are emerging.

The paper goes on to examine the objective and capability enhancements that will be required to thwart the enemy designs on the battlefield, counter use of emerging technologies, present adversaries with multiple dilemmas and beat the enemy. The five capability enhancement areas are - situational awareness, physical and cognitive load, sustainability, mobility and manoeuvre, protection of the force and common control.

The next section identifies relevant segments of technology, formed by combination of earlier listed technologies, to achieve the identified enhancements required. These segments are – Artificial Intelligence, Autonomous Robotics, common controls and secure data communications. The need for evolving a simultaneous conceptual framework is also covered briefly.

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*The paper lays down short, medium and long term
time lines and spells out some of the recommended
activities in each phase. A cycle of ideate, research,
test, accept / reject, centre of excellence (CoE),
productise is introduced that obliquely refers to Make
in India. Importance of innovation and creative
thinking leading to productisation is emphasised.*

*In the last section, an attempt is made to identify
major stake holders from army, academia and
industry to take the concept forward in a
collaborative, inclusive and adaptive manner by
instituting regulation, control and execution layers.
A recommendation to set up multi domain joint
interest groups under this mandate is made.*

Crystal Gazing

Future operations, in the Indian context, will be titrated not only
by the environmental realities and disruptive technologies but
also by national aspirations of becoming a global super power -
both economically as well as militarily. Therefore, the current
typically linear battlefield will be replaced by a 360 degree view
with heavy information overloads. Strategic military aims will be
achieved by Joint Operations, with increasing emphasis on Air
Force and Navy for long range strategic effect with consequent
decrease in probability of large scale traditional ground operations.

We will see army employed in swift, highly mobile and
extremely lethal battles / operations for territorial integrity and force
projection - both against traditional enemies and increasingly
against cross border terrorists in operations other than war. Army
is likely to restructure and employ modular, but dispersed, highly
mobile and extremely lethal groups using technology to the hilt,
while still being prepared for large size formation operations. Anti-
cross border terrorist operations and Special Forces operations
will be the flavour even in peace time. We will witness weaponised
Information Communication Technology Electronics and Cyber
(ICTEC) increasingly being employed in battle. A new dimension
of communication networks becoming platforms of delivery using
information as ammunition will quickly emerge. Data, information
and derived cognitive wisdom therefrom, will become synonymous
with military terminologies and will be increasingly used by war

fighters to beat the enemy in ever shortening time dimension and expanding space dimension. Consequentially there will be concerted efforts to increase the teeth elements and decrease the tail to the extent possible, retaining / enhancing operational efficiencies by use of technology. Increasing sensitivity to keep human casualties to the minimum will be discernible and technology will provide a better assurance than what is currently available.

New Age Technologies that will affect the Military

The importance and relevance of ICTEC technology and its derivatives was understood almost a decade ago when military started espousing Net Centric Warfare (NCW). However, the prerequisites of a connected environment has taken time to fructify and it is only now since the last few years that a canopy cover of standards-based networks / combination of interoperable networks and compatible devices are increasingly making an advent into the war fighters domain. Structured and unstructured data being generated by connected devices, platforms and organisations is now being made available for processing. No doubt NCW will follow once doctrines, policies, common platforms are clearly defined and implemented. In any case we are now not only getting digitized but also digitalised, which sets the space for rapid induction of new technologies for effect.

In the current context, there is a plethora of technologies that have emerged on the academic, commercial and industrial scenario that hold great potential for the military. We do find islands of use within military even now, but need to look at their utilisation more holistically so that the disruption caused by these technologies is positive rather than negative. Some of the relevant new age disruptive technologies / applications are listed below :

(a) Artificial Intelligence (AI).

(b) Deep Learning (DL).

(c) Machine Learning (ML).

(d) Augmented Reality (AR).

(e) Virtual Reality (VR).

(f) Deep Fakes.

(g) Facial Recognition, Image Enhancement and other Digital Signal Processing applications (DSP).

(h) Robotics. One major task will be to conduct dangerous and dirty tasks.

(i) Internet of Things (IOT) / Internet of Everything (IOE).

(j) Autonomous Systems / Vehicles and Automation.

(k) Drones.

(l) Cloud Technologies and Virtualisation.

(m) Social Media.

(n) Big Data, Data Analytics and Data Visualisation.

(o) Swarm Technologies.

(p) Smart Ammunitions.

Each of the above technology can be easily explained standalone one at a time and applications in military will be clearly discernible. However, the permutations and combinations of these have deadly and far reaching implications which require detailed in depth deliberations to fathom. These combinations, if integrated by our military into future organisations in a well thought out roadmap to overmatch the enemy's / adversary's capabilities, may well provide multiple options that become the instruments that will prevail greatly for the supremacy of our war fighters in the emerging multi domain battle environment.

The principle of Collaborative, Adaptive and Inclusive (CIA) will need to be applied for not only jointness but also Human Machine combinations. This will reduce the number of soldiers in harm's way, increase decision making speed in critical operations and in performing tasks / undertaking options considered impossible or too risky for humans to undertake.

Capability Enhancements

Our adversaries will tend to avoid our strong points, disrupt our capabilities, utilise technical advantages and expand the battlefield beyond the physical domain. We will have to modify our doctrines and concepts duly incorporating technology to face emerging challenges. The broad improvements / enhancements that will be

desirable are listed below:-

(a)   Accelerated speed of action on the battlefield (including joint operations as against coordinated operations).

(b)   Means to counter increased use of emerging technologies by the adversary, particularly cross border terrorist groups.

(c)   Present adversaries with multiple dilemmas in complex contested environments resulting in multiple options to operate across multiple domains and to beat the enemy in the required dimensions.

There will be a complex interplay of humans and technology to improve our war winning potential in the future. Therefore, insertion and use of technology should be with a clear aim towards this objective. It would, therefore, be incumbent on us to judiciously identify military parameters in the light of emerging technologies and then study how military parameters can be enhanced / augmented to refine and improve military operations against our adversaries in the envisaged operating environment. Therefore, there is a need to look at some of the military capability objectives that need to be augmented by emerging technology. These capability objectives are listed below.

(a)   **Increase Situational Awareness.** By providing a persistent and deep look over wide areas including those where manned systems cannot go. This will increase standoff distances, survivability and reaction times.

(b)   **Reduce the Soldiers Physical and Cognitive Load.** Reduction in physical load can be achieved by using autonomous ground and air systems, thereby improving endurance, speed and effectiveness. Sensor based collection, processing and disseminating prioritized information reduces information overload, mental fatigue and improves decision making. These measures also reduce signatures of all types thus improving effectiveness.

(c)   **Improve Sustainability.** By enhancing logistic re-distribution, throughput and efficiency. Use of unmanned autonomous vehicles, air unmanned systems which do not rely on helicopters or ac and other autonomous blended and modular capabilities will not only reduce use of personnel but

are capable of moving logistics to most remote but urgent points and create logistic distribution options. However, lead vehicle, communication vehicle and recovery vehicle may not be autonomous and may continue to be manned in a convoy of autonomous vehicles.

(d) **Facilitate Mobility and Manoeuvre**. The enemy's aim will always be to impede and thwart movement and reach of our surveillance elements and fighting forces by placing obstacles and area denial tactics / systems. The enemy will also attempt to engage our ground forces early and at longer distances. Use of effective new age technology combinations can not only extend own depth of operations and overcome obstacles, but also provide kinetic and non-kinetic responses to the enemy.

(e) **Increase Protection of the Force**. These technologies in suitable combinations will provide greater standoff distances from enemy forces, long range weapons and hazardous situations, thus reducing risk to soldiers.

(f) **Common Control**. A single software platform to control multiple formulas of technologies like robots, Decision Support System (DSS) etc. This will be discussed in succeeding paragraphs.

Relevant Segments of Technology

To achieve capability enhancements mentioned above, four major segments of technology can be identified. Each segment may contain multiple basic blocks of the technologies listed earlier. These segments are – autonomous systems, artificial intelligence – and common control and their induction will have to be suitably spread / phased out over the entire spectrum of the induction roadmap. These technical segments are amplified in greater detail in the following paragraphs.

(a) **Autonomous Systems.** This will be a combination of robotic hardware empowered by AI, ML, DL, IOT and automation. The degree of automation given will depend on the operating environment, mission and risks involved. Level of autonomy will dictate mission duration, increased depth of operations and stand off distances. The sequential introduction

may start from remote controlled systems, smart systems, semi-autonomous and finally fully autonomous systems with optional human manning and /or human insertion before permitting decision making and human veto.

(b) **AI.** It is the ability of machines to take near human logical decisions / perform tasks based on patterns, learnings (like ML, DL), fuzzy logic. It will, along with robotics and IOT, take over or aid in many data intensive tasks thus leading to simplified human decision making. Operationally AI will aid in defining mission parameters, terrain analysis, identifying indications / warnings, countering enemy narratives / propaganda, supporting DSS, enabling blended use of manned and unmanned systems and simplify any function where speed, information overload and synchronisation may impede human decision making.

(c) **Common Control.** It is a software-based system of systems that controls and maximises multiple systems employed in the operating environment. It is primarily a controller that reduces deployment of soldiers and reduces the physical and cognitive load on the controller by reducing need for data sharing, encryption, multiple displays, communication equipment etc. It will necessarily require to be standards based with common protocols and converged technology. Publication and adherence to the laid down standards will be mandatory for operational / technical / interoperability / financial reasons, innovation integration, and to support modularity for diverse applications, payloads and scenarios.

(d) **Critical Aspects.** Those that can hamper or enhance resilience of mission critical communications, secure data links across the electromagnetic spectrum as well as cyberspace and ensure deep cyber protection under all conditions and situations.

Broadly speaking, priority should be given to aspects that can help in situational awareness and reduce the soldier's physical and cognitive load. This can be followed by logistic sustainment and automated semi-autonomous convoys. This autonomy technology can then be modularly introduced to unmanned combat vehicles.

Needless to say, simultaneously there must be an evolution in concepts, doctrines and policies to adopt these technologies optimally. Logically the low hanging fruit can be catered for in ensuing annual budgets while the midterm and long-term insertions will require R&D efforts and hence separate budgets.

Recommended Time Lines and Action

The above-mentioned enhancements / capabilities will take time to develop / procure and introduce. These require significant resources and must, therefore, be prioritised. In the interim, once a road map is clearly defined and accepted, there will be a need to seize and utilize technological opportunities leading to the identified goal.

The entire road map can be divided into three phases – Short Term (first to fifth year), Mid Term (sixth to fifteenth year) and Long Term (sixteenth to twenty fifth year). Some of the actions that can be undertaken in each phase are listed below:

(a) **Short Term.**

o   Improve tactical situational awareness for foot soldiers at tactical levels.

o   Reduce physical payload carried manpack.

o   Improve logistic resupply with automated ground supply.

o   Improve route clearance and IED destruction using semi-autonomous robots.

o   Introduce soldier borne sensors.

o   Integrate autonomous systems into combined arms manoeuvre.

o   Convoys will be composed of autonomous vehicles interspersed with manned critical vehicles.

o   This period will also be used to mature concepts, doctrines, policies, procedures and to lay down a clear roadmap with defined budgets.

(b) **Mid Term.**

o   Focus on human machine collaboration.

o   Advancements to what was done in the Short term phase.

o   Introduce swarming.

o   Introduction of unmanned combat vehicle into mechanised units.

o   Automated convoy operations.

o   Advanced but light payloads.

o   Deep persistent stare to improve real time situational awareness at the next level.

o   Will require soldiers to be trained in new data management techniques, tactics and procedures to improve semi-autonomous / autonomous ISR.

o   Swarming robots with AI insertions will provide redundant communications, navigation and a collaborative small mobile robot based sensor network.

o   Medium sized autonomous robots will be introduced to take on the soldier loads.

o   The robots will be interchangeably used to deliver different payloads like sensors, communication base stations and munitions.

o   Introduction of lighter exoskeletal personnel protection armour and innovative firepower.

o   Robotic systems will be introduced for medium level cargo handling as well as casualty evacuation, thus reducing use of manned helicopters.

o   Optionally manned semi-automated combat vehicles with advanced features will be another area of introduction.

o   Research in AI and new age technologies / applications will achieve better autonomous robots, both in air and on ground and firmly integrated into the common control, though they may not yet be fully autonomous.

(c) **Long Term.**

o   By now research efforts, duly incorporating lessons learnt during previous phases, would be maturing. Those

items accepted for introduction post trials in Centres of Excellence would be productised. These would replace the short term and midterm insertions.

o   Human manipulations of autonomous systems may now reduce to a trickle thus freeing soldiers to do actions where human decisions and actions are required utilising the multiple options now being thrown up by the AI engines and robots.

o   Entire mission logistics and situational awareness will by now be automated on a common control.

o   Technologies will enable manned and autonomous system teaming using sensors, communications, AI and data handling to ensure dominance over the enemy in time and space as per operational plans.

o   Options considered unviable by humans alone will now be possible using these constructs.

o   Secure and redundant communications at all times will, however, be a prerequisite.

In all phases as a continuum, there obviously will be a premium on innovation, creative thinking and conversion of new ideas into valued outcomes. Technology will be an enabler to innovative problem solving of operational and tactical issues which will lead to development of new doctrines and concepts. The cycle of ideate, R&D in (DRDO) laboratories / DST / Commercial laboratories, try out in a CoE, discard or take on for productization and introduction will be very prominent in ensuing years, especially with emphasis on Make in India.

Stake Holders

It is, therefore, critical that agencies like Army Training Command (ARTRAC), Director General Perspective Planning (DGPP), Director General of Military Operations (DGMO), Director General of Signals (DGSIGS), Defence Research and Development Organisation (DRDO) / other labs (including private) and academia work in tandem to understand emerging operational concepts, technologies and lay down a collaborative, inclusive and adaptive roadmap for gainfully laying down a prioritised roadmap, governing and regulating it to ensure that each component delivers what it is

best in delivering. There will be a need to set up regulated and governed Joint Interest Groups (JIGs) between military, academia and industry at appropriate technical levels to help user requirements draw maximum benefit of emerging technologies and be a win – win situation for all concerned. This approach will help productise and deliver Indianised physical elements (AI based Robots) as discussed and also ensure simultaneous and inclusive introduction of new doctrines, concepts and policies. Human Capital Management (HCM) policy changes and constructs will have to ensure that appropriately skilled manpower is concurrently available to the Army in the envisaged time frame to effectively use the constructs of new doctrines and technologies effectively and gainfully. Simultaneously, appropriate inputs can be obtained / given to Air Force and Navy so that Tri Service joint operations can also be facilitated.