Atmanirbharta in Critical and Emerging Defence Technologies

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The Russia–Ukraine war is now in its third year, and it has already been an year since the Israel–Hamas conflict started. Both have seen bloody spurts of high-level violence between malignant long pauses with no end in sight. One thing is certain. The battlespace has changed in nature and character. Two Generals were interviewed by *The Washington Post*[1]—one Russian and the other Ukrainian. As per them, 'tanks, manned aircraft and traditional manoeuvre forces are sitting ducks, while advanced drones and digital battle-management systems can have a decisive impact in the current battlespaces'.[2] Their discussion indicates that wars will be driven by algorithms where battlefield transparency has cleared the fog of war. They go on to say that air defences have triumphed over conventional military aviation and that superior artillery is a priority requirement with a radical rearmament. An important point they make is that the best weapons are small and cheap.[3]

It would be fair to surmise that the future of battlespace will be shaped by technology. Technological superiority will determine the outcome of future battles. It is therefore essential that technological self-reliance remains

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the mantra for the future. A collective national effort needs to be initiated to achieve this in the quickest possible time ensuring that technological developments are commensurate with our desired military capability. This is not some original thinking or prophecy. This is precisely what is contained in the Technology Perspective and Capability Roadmap of HQ IDS of April 2013.[4] Yet we are where we are. Bereft of the technologies we need for today, leave alone tomorrow. There is an added caveat. Nations must be prepared to fight in the technology-driven battlespaces for the long haul on their own. A rising India, therefore, needs to be adept at utilising home-grown technology to achieve its ends. The name of the new game is long-term Atmanirbharta in Critical and Emerging Defence Technologies. How do we get anywhere near that? That is the challenge.

The first step is to identify the technologies we need. Two articles in the recent past inform us about emerging technologies which have dominated the battlefield. The first article by Eric Schmidt, ex-CEO Google explains as to 'Why Technology Will Define the Future of Geopolitics'.[5] He cites the case of Ukraine (outgunned and outmanned), turning to an area in which it held an advantage over the enemy—Technology. He amplifies that 'Ukraine protected its critical data by uploading it to the cloud, repurposed its e-government mobile app for open-source intelligence collection through crowd participation and used Starlink satellites and ground stations provided by SpaceX to stay connected'.[6]

Further Ukraine acquired its own drones, which were specially designed to intercept Russian attacks. All this was innovated during the course of battle. He also defines innovation power as the ability to invent, adopt and adapt new technologies. He also talks of Artificial Intelligence (AI) having the ability to supercharge the ability of scientists and engineers to contribute to capability development. The second article by David Zikusoka talks of 'How a Surge in Satellites Will Revolutionize Intelligence'.[7] He highlights the ubiquity of space in the terrestrial battle. The author elucidates that a convergence of advanced technologies—reusable rockets, printed rockets, miniaturised semiconductors and high-powered AI is making it possible to obtain 'constant-stare' capability.

In times when the cost of rocket launches has fallen dramatically and satellites with advanced intelligence-gathering capabilities can be as small as a breadbox or a backpack, 'constant stare capability' is a reality. The article also explains that AI has enabled the teaming of humans and machines, with computer algorithms rapidly sifting through data and identifying relevant pieces of information for analysts.[8]

However, these are not the only technologies which are needed. There are more. For instance, energy is a scarce commodity in Himalayan battlespaces. New horizons have to be explored. Interminable burning of fossil fuels is no longer an option. There is a need to think of fuel cell or thorium powered small reactor systems for widespread usage. If China can think of designing merchant ships with thorium power,[9] India can think of using thorium power in high altitudes.

This is especially significant with the core loading of the critical second stage in the three-step thorium cycle.[10] Alternately, if India can design Air Independent Propulsion in submarines, why can it not deploy such technology in high altitudes?[11] There is also a need to counter the humongous cyber capabilities of China. Not in defensive terms but also to be in offensive mode. Add to this mix, the over-the-horizon technologies of quantum computing and synthetic biology. A holistic picture emerges of a bouquet of military technologies which will dominate battlespaces in this century. These are represented in Figure 1 below.

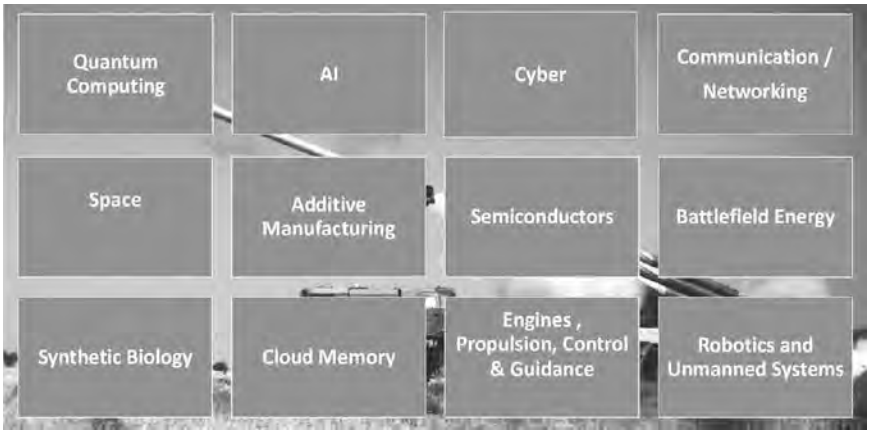

Figure 1 Military Technologies in this Century

Source: 'A Perspective on the Defence Budget', *Financial Express*, 8 February 2023, available at https://www.financialexpress.com/business/defence-a-perspective-on-the-defense-budget-2974379/

It also needs to be clarified that many of these technologies by themselves have no direct application on the battlefield. These technologies must be incorporated/integrated into specific systems/weapons, which can then be deployed/employed in battle. For instance, if these technologies are to

be utilised in high altitudes, a broad capability matrix with constituent technologies will emerge as indicated in Figure 2. However, it must be noted that such matrices will emerge for different terrain and environment conditions. Notwithstanding this, the necessity of developing basic technologies suiting multiple environments will remain relevant, as highlighted earlier.

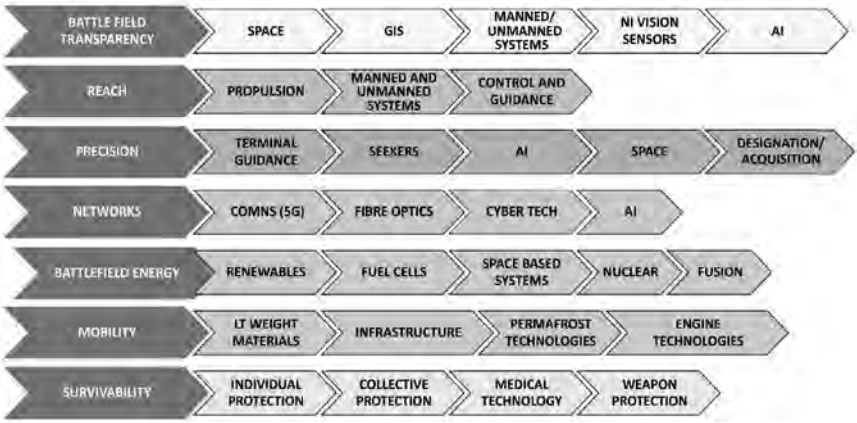

Figure 2 Technologies for High Altitudes

Source: P.R. Shankar, 'Civil Military Fusion: A Model for India', Synergy, February 2023, pp. 52–67, available at https://cenjows.in/pdf-view/?url=2023/03/3.-Civil-Military-Fusion-A-Model-for-India-By-Lt-Gen-PR-Shankar-Retd.pdf&pID=19302&pg=1

While there is no doubt that these technologies will be required in future battles, it is important to understand that they need to be purpose-oriented. The purpose orientation comes from a military doctrine, which delineates how future battles are to be fought. In this context, there is a yawning gap in our quest for Atmanirbharta in Critical and Emerging Defence Technologies. Presently, the Indian Armed Forces are in a catch-up mode where technology is outstripping doctrine. India is in this stage since it does not have a National Security Strategy,[12] a clear Military Doctrine or a roadmap tuned to these technologies. The existing technology roadmap of the Armed Forces is a leftover of the erstwhile Technology Perspective and Capability Roadmap with very little clairvoyance into the future. The earlier 15-year Long Term Integrated Perspective Plan has been converted into the 10-year Integrated Capability Development Plan.[13] However, the details are hazy and all stakeholders have no clarity on the long-term roadmap for technology

absorption or implementation in the Armed Forces. In the absence of such a base policy document, attaining 'atmanirbharta' in critical and emerging technologies will be a challenging proposition.

In this quest for being technologically 'atmanirbhar', certain issues must be factored in. India is still struggling with mastering the old brick and mortar technology associated with guns, missiles, tanks, aircraft and ships as new technologies are emerging. In such an environment of change, do our planners know which are the technologies that need focus? At this stage, it will be pertinent to understand certain fundamentals before we dive headlong into acquiring defence technology. It has been long the conviction of this author that the best technology is the one which wins you a war. For that to happen one does not need the latest technology. The best or latest technology might not actually help you win the war. The American defeat in Afghanistan by Taliban is a great example. The armed force with the best technology in the world bit the dust in front of a low-tech force called Taliban. The reason being that Taliban played whatever technology it had, skilfully to its advantage. There is an adjunct factor to this. Every battlefield has a level of technology it can absorb. Some battlefields need more of one technology than the other. For example, in permanently snowbound and super high-altitude areas, technologies related to habitation and survivability are critical. In the Siachen Glacier, it is more important to survive first than to go gung-ho about fighting. It is therefore important to define the optimum technological levels one must achieve in each battlespace.

A major factor of consideration is that defence technology is a costly game. The cheapest technology is what one owns through development and the costliest is the one imported. India has been in a trap of paying through its nose for imported weapons with the latest technology for far too long. In an age of limited budgets, costs assume importance. Unless defence planners can break the mould, India will continue to pay a heavy price while being technologically backward and vulnerable. The bottom-line is that there is no choice but to make our own technology. However, development and adoption of technology needs vision and knowledge combined with the ability to take risks and accept failure. This must be backed by investment into research and development (R&D). To this end, a pragmatic national technology roadmap/plan is mandatory.

Another factor which few people understand is that being a technologically savvy force does not mean owning new shiny weapons with the latest technologies. The major characteristic about the new emerging technologies is that they are adaptable to being slapped onto old systems.

Hence, upgradation of dated/legacy weapons systems is an important factor in the overall technology game-plan. Upgradation/life extension is a cheaper and quicker process if such technology is sought and made. For example, latest propulsion technologies will enhance the life of many missile/rocket systems in our inventory. It provides time cushion to effect a new development or postpone an investment to a later date. It circumvents budget constraints. It also saves on sunk costs.

Alongside upgradation, there is also a need to master technologies by reverse engineering and also explore and adopt alternate strategies. For instance, many surveillance/night fighting systems are based on prohibitively costly thermal imaging technologies, which need extensive cooling and are bulky. India pays heavily for such technology since it is entirely imported. Such technology will not be imparted for a price also. It is also costly to deploy such systems in battle since their losses are, many times, irreplaceable—cost , capability and availability wise.

However, alternate systems based on digital image processing and computer vision technologies exist. These are far cheaper, lighter and simpler. However, to develop, adopt and steer such strategies there is a requirement of people with vision, adequate knowledge of war fighting and being technologically sound. They need to be co-opted in the larger system at apex level. For many reasons India has not invested in knowledge-based options or built a human resource base for this approach. This is important since knowledge gained through upgradation, substitution, reverse engineering and adopting alternate strategies will eventually lead to 'evolution' of indigenous home-grown systems. It is far better than adopting a revolutionary approach to acquire the latest. The failure of the Arjun MBT or the inability of DRDO to come up with an UAV after decades of promising a revolution are cases in point.

When one considers being 'atmanirbhar' in critical and emerging technologies, one must also consider the likely operational environment which India has. As India rises, the chances of a conventional conflict with either China or Pakistan are receding. In any case, extended conventional conflict between nuclear armed nations with huge populations is really not on the cards. Look at how quickly Israel and Iran avoided direct combat in April 2024.[14] On the other hand, the likelihood of a 24x7x365 hybrid/grey zone/asymmetric contestation is a certainty. In fact, it would not be out of place to state that hybrid approaches in a multi-domain environment[15] will be the new normal in all likelihood. Hence, military technologies need to be tuned to this new reality. It should enable India to project power in

the region rather than aim to win wars it is unlikely to wage. Space/cyber/EW technologies, which underpin information/influence/narrative/legal/cartographic/industrial/economic/diplomatic contestation in cognitive domains are at the forefront of hybrid wars. They need greater focus. There is rarely a thought given to it.

It needs to be noted that all these technologies are largely dual-purpose. More importantly, the civilian application of such technologies is on a faster loop and is required in greater volumes. At the outset, it must be recognised that the realisation of most of these technologies will demand a great degree of civil–military fusion. Civil–military fusion demands a national level architecture and a whole-of-the-nation approach as highlighted in an earlier essay.[16] In fact, in India, any form of civil–military fusion must start with breaking down the rut of politico-military-bureaucratic 'diffusion' in which we are stuck. The PM's thought of 'shedding legacy systems and practices' and a 'holistic approach, focused on breaking down of civil-military silos and on expediting the speed of decision-making' needs to be given serious thought.[17]

The question that arises then is how do the forces develop and induct weapon systems and capabilities based on these critical technologies? One has to examine the agencies, which are involved in the circle of capability and technology development as shown in Figure 3. The government and the services are prime and permanent stakeholders in this cycle. They must drive the system. The DRDO, DPSUs and the erstwhile OFB (by design) are supposed to be the sheet anchors in developing technologies, designing and producing weapon systems.

However, all these entities are not well versed in emerging technologies and do not have the domain knowledge or expertise to undertake projects in transformative technologies. Moreover, they have consistently underperformed and not delivered to the nation. Further the DRDO is under overhaul[18] and the OFB has been restructured into seven corporate entities.[19] Under these conditions, both will underperform till the time they stabilise. They will not be able to handle the pace of change sweeping the newly emerging technology landscape. Hence, the services and the government will have to form new structures and mechanisms to induct most critical technology-driven weapon systems through academia, start-ups and private industry. There is no other choice.

Special provisions and procedures need to be drawn out to enable them to deliver what is needed. In this connection, it will be fair to point out that the academia in this country is highly underutilised/underleveraged. This is

in stark contrast to their being sought after by multinationals. The services need to carry out a great amount of introspection in this regard. There is also a case for seeding experienced armed forces professionals in the academia to bridge the divide between the two. Special effort must be made to utilise the technological expertise in DAE, ISRO and CSIR labs to contribute to the defence and strategic needs of the nation.

Figure 3 Defence Capability & Technology Development

Source: Author's own.

The DAC and its other subordinate structures are also presently not in tune with the pace of changes in battlefield technology. It can be clearly surmised that we need to think of new capability development structures or alternately strengthen existing ones with expert inputs as an additionality. In such a situation there is a need to have a Defence Technology Advisory Board that can advise and assist the current structures to handle the changes driven by the disruptive technologies. In this connection, a Defence Advisory Board[20] was envisaged by this author in 2020. This can be suitably tweaked to cater to the needs of the new technology paradigm we are in.

It is also being pointed out that it is not India alone, which is facing issues in induction of new technologies. Even an advanced country like USA faces similar problems when attempting a technology-driven transformation in warfighting/inducting new weapons systems. In this connection, the experience of Eric Schmidt, former CEO, Google is illuminative. He recounts that 'The U.S. military must also learn to integrate new technologies into its procurement process, battle plans, and warfighting. In the four years that I chaired the Defence Innovation Board, I was astounded by how difficult this was to do. A major bottleneck is the Pentagon's burdensome procurement process: major weapons systems take more than ten years to design, develop, and deploy. The Department of Defense should look for inspiration in the way the tech industry designs products. It should build missiles the way companies now build electric cars, using a design studio to develop and simulate software, looking for innovations ten times as fast and as cost-effective as current processes. The current procurement system is especially ill suited for a future in which software primacy proves decisive on the battlefield.'[21] There is a lot to learn from this thought process in our quest for Atmanirbharta in Critical and Emerging Defence Technologies.

A few months ago, Israel with the aid of USA was able to ward off a mass drone-cum-missile attack by Iran. It did so largely based on its technological capability. Now if a similar attack is launched by China against us, do we have the capability to ward it off singlehandedly? Singlehandedly we will have to, since USA in all probability will not interfere directly in a China–India missile exchange. Honest introspection will inform us that we might be found wanting. In such a situation, there is need for our defence planners to read this essay once again and develop the nascent ideas outlined in it to come up with concrete solutions in a time-bound manner to achieve Atmanirbharta in Critical and Emerging Defence Technologies, which can defend the nation effectively. There is a lot of soul searching we need to do.

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