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TECHNOLOGY NEEDS OF THE INDIAN ARMY: BUSINESS ENVIRONMENT & OPPORTUNITY

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Abstract

The Indian Army has recently declassified its Long Term Perspective Plan for weaponizing and equipping over the next 15 years, in the form of its Technology Perspective and Capability Roadmap 2013. In conjunction with the government's Make in India initiative, this presents a business opportunity to all stakeholders ranging from government run manufacturing agencies to private industry and academia, both domestic and international. This paper comprehensively covers the near and long-term technology requirements of the Indian Army, and outlines the prevalent business environment and opportunity afforded.

Keywords: Indian Army Technology, business opportunity

"If we desire to avoid insult, we must be able to repel it; if we desire to secure peace, one of the most powerful instruments of our rising prosperity, it must be known, that we are at all times ready for War."

George Washington,

Introduction

Military capability of a country is built on two basic tenets – firstly, the existing and perspective security threats envisaged and secondly, on the aspirations of its policy for military power projection in its neighbourhood or globally (Campose Philip, Feb 2015). India faces land security threats arising out of territorial disputes with its neighbours Pakistan and China. The Indian Army (IA), mandated to ensure the territorial integrity of India, often finds itself embroiled in faceoffs with the Chinese on the Line of Actual Control, and with the Pakistani regular or irregular forces on the Line of Control. Internal security threats arising from insurgencies, and wars by proxies, keep the pot boiling for the Army in the hinterland. General Bipin Rawat, Chief of the Army Staff, stated at a seminar that in a worst case scenario, the Army is essentially required to fight on two and a half fronts i.e. on its western and northern borders while handling internal security in some parts of the country (Firstpost India, 08Sep 2017). The global and regional arena has witnessed a change in the form and nature of warfare – a distinct reduction in full scale state vs state wars, to various forms of hybrid wars flags the new normal. Thus, the Indian Army must equip and weaponize itself to deal with all forms of warfare and combinations of these forms. Conventional wars are now expected in the backdrop of the nuclear overhang, irregular warfare involving well trained combatants not belonging to the adversary's military, terrorism, conflicts like water wars,

economic wars, currency wars – something India lately dealt with its own countermeasure in the form of note- bandi, legal wars etc; and technological/ informational warfare – in the realms of cyber space, electronic and print media, or social media. Success of the IA lies in physical contact battles coupled with battles of the mind, which will emanate from superior training and technological edge over the enemy.

How then must we define the perimeter to successfully work out an equipping and weaponization philosophy for the land warrior to be sure of success? Perspective plans determine the capability sought by the Army. Gaps identified in the required capability drive the procurement of platforms and equipment, and thereby the technology required to attain this capability. The Armed Forces Long Term Integrated Perspective Plan (LTIPP) covers a period of 15 years (Chakraborty PK, 2012). Part of the LTIPP was declassified in the form of the Technology Perspective and Capability Roadmap (TPCR) in 2013. From the LTPP of the IA flow the 5year plans, and the Annual Acquisition Plans (AAP). The TPCR 2013 document also legislates for itself a periodic review of the Long-Term Perspective Plans to facilitate mid-course corrections. The TPCR also describes Technological Capabilities at three levels: the basic, intermediate and advanced levels. At the basic level we are able to operate and maintain a new production plant based on imported technology as we currently stand with the Ordnance Factories (OFs) working on assembly lines for the T-72 or T 90 tanks and BMPs with some transfer of technology (Shukla Vinay, 09 Apr 2017). The intermediate level includes the ability to duplicate and adapt the design for an imported plant and technology unique elsewhere in the country or abroad. Finally the advanced level is defined by the capability to undertake new designs and develop new production systems and components (Gupta A K , Dec 2015).

Objectives of the Paper.

- To address the immediate to near term technology requirements of the Army over three to five years.
- To outline the technology needs over a perspective of 15 to 25 year period.
- To touch upon the business environment for implementing this technology roadmap.

Review of Literature.

Campose (2015) brought out the future challenges likely to be faced by the Army with emerging threats' scenarios. Behera (2016) makes a case for meeting the Army's technology needs through indigenisation, in the back drop of the Make in India initiative. Greater transparency in the technology perspective of the Army in the form of the TPCR 2013, and a breakdown of technology components of various programmes encapsulated in the Army Design Bureau's release of 150 Problem Statements, has given a lead to development and production agencies including the private sector and MSMEs to align their focus with futuristic modernisation programs. Cowshish (2017) dwelt on opportunities and challenges in implementation of the recently unveiled Strategic Partnership Model, impacting participation by private enterprises. The Defence Procurement

Procedure amended in 2016, and various reports of GoI on defence production, smart border management and role of private sector and MSMEs, contributed to the study of the defence manufacturing environment and opportunities presented.

The research design is descriptive research, in analysis of textual data from secondary sources, in view of the nature of the topic.

Immediate to Near Term Requirements for Modernisation

Whether in conventional or unconventional warfare, the foot soldier need to be empowered with Light weight assault rifles, bulletproof jackets and helmets, Hand Held Thermal Imagers and a host of modern weapon like carbines, machine guns, rocket launchers, anti tank guided missiles, mortars, radio sets with better battery packs etc, to replace older generation weapons and eqpt. The Future Infantry Soldier as a System (F-INSAS) program strives to meet these requirements, similar to programs in the US, UK, Russia and China. (Refer Figure 1) However, a reality check reveals acquisition from developed countries is yet to fructify and indigenous develop is still a far cry (Chauhan BS, 11 Nov 2015).

The programme has been now divided into two parts to enable meeting immediate requirements in terms of the weapons and protection features, while future requirements in terms of battlefield management systems to improve situational awareness (which will take some more time for development) in the second part. These weapons and equipment really do not demand very high levels of technology in materials and design (Bhattacharya P, 14 Jan 2015) Their requirement being in vast numbers make it an attractive business proposition. Needless to say, quality remains the underlying most important factor in their development and production.

Figure 1: The Future Indian Soldier (Indian Defence Review 2015)

Mechanised Forces operate with Main Battle Tanks (MBT) and Infantry Combat Vehicles (ICV). Light Armoured Vehicles are employed for swift recces, patrols, liaison, exercising command and control; and are handy during internal security operations as well. The T 90 tanks imported from Russia are of current technology. However, their assembly and production of parts indigenously is yet to reach desired levels. The ability to absorb the technology and skill quotient of our technicians at the Ordnance Factories needs to be ramped up at the earliest. Older generation T 72 and BMPs need to be refurbished and technologically upgraded ("The Evolution of Modern Indian Tanks", 08 Apr 2015). Programs for a Future Ready Combat Vehicle (FRCV) and Future Infantry Combat Vehicle (FICV) are being pursued as the next generation state of the art replacements.

The 155 mm medium Bofors guns have outlived their technology and the indigenously produced 105 mm Indian Field Gun and Light Field Gun need technology upgradations. In the current Five-Year Plan ending 2017, the IA plans to upgrade to 155 mm towed gun system as a universal inventory. Standardisation of calibre would streamline logistics, maintenance and repair including standardisation of ammunition. The indigenously developed Dhanush is claimed 87% indigenous, less the Auxiliary Power unit and Sighting System. Meanwhile M777 Light Howitzer are currently undergoing much hyped trials in Pokharan. The DRDO's Advanced Towed Artillery Gun (ATAG) being develop with private participation is scheduled to be ready for production in 2019. While precision guided missiles appear to be a success story by the DRDO, their productionisation and quality control will remain an issue. Long range vectors like Smerch and Pinaka rocket systems are yet to be fully productionised ("Field Artillery Modernisation Program of the Indian Army", Indian Defence Update December 2016). The aviation component of the IA consisting of the indigenously developed Advanced Light Helicopter is now in the induction phase - an achievement by our Defence R&D Organisation (DRDO) establishment and Defence PSUs. These however will soon need to be upgraded and successfully weaponised. Unmanned Aerial Vehicles (UAVs) with longer endurance, low signatures and higher resolution will need to be inducted to improve battlefield transparency ("Make in India – An Overview of Defence Manufacturing in India", Indian Defence News, 12 December 2015). The air defence missile systems both static and mobile, are of unacceptably low vintage, and need urgent replacement by newer technology system.

Combat Engineers are direly in need of new generation bridging equipment, a new family of mines, and minelaying and mine breaching eqpt. Self-neutralizing attack mines still under development by the DRDO since the last fifteen years now need to be acquired from global sources besides continuing efforts to develop indigenously. High speed mine laying or scattering systems will be needed to create obstacles in the face of the advancing enemy. Development of an Armoured Vehicle Engineers equipped with a multitude of capabilities including dozing, trench digging tools and a demolition gun needs to be urgently addressed. It is also intended for heavy duty explosive ordnance disposal (EOD) operations. Armed with sensors / ground penetrating radars with a

complex system of ruggedized cameras it should identify Improvised Explosive Devices (IEDs) and mines. Current technology of Remotely Piloted Vehicles for stand-off disposal of IEDs has been a long standing requirement (Annual Reports 2014-15 and 2015-16, Ministry of Defence).

The Static Communication Network (ka ASCON) is in place, as also the indigenous radio network system for communications in the field. However, these now need a generational change to leap into Network Centric Warfare capability. CIDSS (Communication and Intelligence Decision Support System) under development since a few years, needs to fructify and match current technology levels.

Link with Academia – IMPRINT and ADB.

Immediate technology requirements are sought to be met by the Army Design Bureau (ADB) recently raised in May 17. It intends to create the final linkage with academia, research and production agencies. It has outlined some 150 problem statements specifying assemblies and components to be develop in projects (Army Design Bureau: Future Core Technology and Problem Statements, Booklet by Indian Army and CII, 2017) The Impacting Research Innovation and Technology (IMPRINT) initiative of GoI intends to adopt engineering and technology as the vehicle to address societal needs. This Pan IIT and IISC initiative is now expanding to the NITs, and will possibly include private universities if funded by govt, over currently 17 institutions covering seven technological domains ("IMPRINT Overview", Ministry of Human Resource Development, India). IIT Madras has been selected as the coordinator for Defence and Security ("IIT Madras signs MoU with Indian Army", Economic Times, March 2017). However, the IA, industry and DRDO will also interact with IIT Karagpur in the information and communication domain, IIT Bombay for the nano technology domain and IIT Kanpur for Advance Materials ("IIT-Gandhinagar and Indian Army sign MoU to set up R&D cell", India Today December 2016 . The Defence and Security domain covers wearable and portable devices for human health monitoring in field treatment; materials and structures for blast mitigation, armoury, ballistics, self-healing fibre composites, materials with integrated stealth characteristics ultra high temp ceramics, carbon nose for explosive detection etc. In armaments, it includes the rail gun system, electromagnetic guns; and protection systems will range from bullet proof jackets to infra red protection optics and exoskeletons. The entire gamut of electronics will cover guidance system, high energy laser system, human movement sensors in concrete bldgs., multi terrain robots. Cyber security, anti-jamming capability and a number of software based system frameworks.

The creation of Defence Innovation Organisation to foster technology develop and innovative products with commercial potential for the defence sector is a step in the right direction. In Dec 16, the Defence Minister had approved the creation of a Defence Innovation Fund under which the DIO has been formed, to provide the ideas and topics for innovation. The DIO is formed collaboratively with BEL and HAL and can be exploited by the IA for aviation requirements and UAV technology develop ("Defence Innovation Organisation", GoI Press Release, Business Standard)

Future Technology Perspective

The LTIPP/TPCR 2013 enable the country's R&D establishments to focus on specific capability requirements and appropriate technologies (Technological Perspective and Capability Roadmap – 2013, Booklet, Ministry of Defence). The capabilities sought to be built up are enhanced operational effectiveness of manoeuvre forces, a wired and net-connected infantry soldier integrated with a battle field management system and equipped with state-of-the-art weapons, comprehensive fire power, battlefield transparency and night fighting capability, control over cyber space, enhanced sensor-to-shooter synergy, effective combat aviation fleet based on helicopters and air defence, enhance mobility of own forces and deny/retard that of the adversary. In addition, chemical biological radiological & nuclear (CBRN) capabilities, protected operations in built up urban/ semi urban rural areas, amphibious capabilities of designated forces over riverine terrain, and an agile logistics system in synergy with the national industrial base are required.

Key Technology Requirements.

These should provide Indian Industry with an overview, to drive research and development.

Movement and Manoeuvre. The future combat systems including main battle tanks (MBTs) and infantry combat vehicles (ICVs) must be highly maneuverable protected against anti-tank missiles, attack helicopters and mines (Figgures Andrew, March 2008).

Mobility concerns will demand compact light weight power packs capable of hyperbar engines with extraordinary acceleration from 0 to full power at 1500 hp in 2.58 seconds, electro mechanical drives and advanced suspension systems. Amphibious capability will be required in specific cases.

Lethality will be enhanced by electronic guns exceeding muzzle velocities of conventional tubes; high velocity kinetic energy ammunition with chemical and heavy metal penetrators, and thermo-baric munitions/missiles; trajectory correction munitions systems and advanced fire control systems.

Survivability will improve with smaller and more compact armoured vehicles with effective signature management measures and multi spectral camouflage. In urban environment reactive armour will enhance survivability. (TPCR 2013)

Figure2: BMP 2 (Infantry Combat Vehicle) in action (personal source of the author)

Close-In Combat. The F-INSAS program will need to enhance the capability of the infantry soldier in terms of lethality, survivability, sustainability, mobility, communication and situational awareness. It therefore demands light and compact systems, consistent performance in all-weather all terrain day and night configuration, and low power consumption to improve sustainability. A robust assault rifle with attachments like UBGL and latest weapon sights, modular bulletproof jackets including hydration pack and a survival kit. Target acquisition will be enhanced by Night Vision (NVD) and hand held devices. Wearable radio and situational awareness modules will make the system complete. ("Report of Working Group on Defence Equipment", 2012, GoI)

Non - Lethal Weapons Sub-lethal or disabling military technology suitable in an urban or complex environment will include Stun Grenades to immobilise, Optical Weapons to cripple sensors and dazzle, and Acoustic Weapons to disorient and cause dizziness. (TPCR-2013)

Combat Engineers will require robots for surveillance, reconnaissance, anti mine and anti IED systems in urban area combat; mechanical bridging systems with modular design (load class 60 tons), and manual launch floating bridges to be assembled in short timeframes (TPCR-2013). Aerial cableways and heliportable bridges for mountains with 20 m span 60 tonne capacity will be essential. Influence mine breaching and mine laying will be based on mechanical means and mine scattering / dispensing system to enable reactive capability. Air Cushioned Vehicles for recce and troop carriage in riverine terrain for Inland Water Transportation Units will enhance riverine op capability.

Long Range Engagement Guns, Rockets and Missile Systems need long range Terminally Guided Munitions and Sensor Fuzed Munitions to improve accuracy. Bi-Modular Charge System will

achieve longer ranges and increase barrel life. Radar based Trajectory Correction Systems with inertial navigation systems remain essential features. Microsystem technology will miniaturise navigation systems and warhead guidance in missiles. Ammunition in future would need to be based on indigenous GPS for guidance. Adaptive Warheads should be capability of selecting and directing themselves for optimum lethality combining a range of different capabilities. Light/Medium utility helicopters and weaponised systems with advanced man machine interfaces and stealth technology will raise the effectiveness and lethality of the aviation component. Stealth design features will be lent by absorbent materials, noise suppressors etc.

Protection, Robotics and Sensors Critical sensor technologies would be emerging multi-mode radar with AESA (Active Electronically Scanned Array) and Non-Cooperative Target Recognition (NCTR) facility; Synthetic Aperture Radar (SAR) and Inverse SAR (ISAR) capabilities with enhanced processing capabilities, LASER based systems for detection and imaging, state-of-the-art thermal imaging and ground based sensors, both attended and unattended. With a plethora of sensors available and providing information, there is a need for proper sensor fusion, to provide a clear picture to the operator and a centralised agency for decision making.

Air Defence will be based on self guided missiles and Directed Energy Weapons (DEWS) employing laser technology to kill soft system on satellites and other weapon system including UAVs. An Anti-Missile Shield to protect from sub and supersonic cruise missiles is in the works with Russian help (S-400). Directed Energy Weapons will be required to target UAVs/Drones, missiles and stand off armaments at 8-10 km ranges. The use of Electro Magnetic Pulse weapons will also demand consideration. The High Power Microwave weapon could be used against an opponent's network and knock out electrical equipment, rather than people. ("Report of Working Group on Defence Equipment", 2012, GoI)

Artificial Intelligence will introduce parallel soft computing methods to carry out image interpretation for target identification and classification; diagnosis and maintenance of sophisticated weapon systems and for robotic equipment

Battlefield Transparency A combatant must have the ability to continuously look deep to gain information about his adversary to enhance situational awareness. Communication systems need integrated platforms to support voice, data, image, multi-media applications and networking. Network centricity will need a defence communication system with encryption and adequate band width to include data linking facilities. In Electronic Warfare (EW) the problem of jamming and avoiding disruption of one's own systems will need space based EW Unmanned Aerial Vehicles.

Info and Communication Technology. ICT will involve data analytics, cloud computing, optical fibre networks and social media analytics, along with cryptography and AI technology.

Nano-Technology/MEMS Nano-technology would usher in light weight, strong, multifunctional advanced materials. Carbon composites, metal matrix composites, stealth coatings, self healing materials, adaptive camouflage materials and structures, and smart skin materials shall be the main structural materials for the future combat and support systems. Capability for development

of Micro Electro Mechanical System (MEMS) based sensors, actuators, RF devices and focal plane arrays would also need to be developed.

Bio-Technology. We should develop biodegradable ammunition, lighter food and fuel for carriage, allowing for extended operation in remote areas.

Simulators. These low cost high performances generating technologies will be essential components in training soldiers. These will involve Adaptive Tutoring to optimize learning efficiency, and to monitor the emotions of trainees. It will also assist generate realistic War Gaming Models. (TPCR-2013)

Infrastructure Requirements Low cost high speed construction technology and light building materials are imperative for meeting the infrastructure requirements of the IA, esp in remote and border areas. Internal capability for energy generation through renewable sources of like wind and solar; and technologies for water generation, purification and conservation will be required. Tunnelling technology and caverns for mountains for protection from enemy fire, lateral movement of troops and logistics storage facilities need to be incorporated. Speedy track and road construction in mountains to keep up with and generate viable options for high intensity operations are also needed, besides new paving materials and laying technologies for construction of helipads/Advanced Landing Grounds in mountains and deserts.

Smart Technologies for Homeland Security Border Mgt on LC/LAC Boomerang Warrior-X is a device worn in the vest which can pinpoint sniper positions from the enemy side up to about 1,000 yards. We need explosive detection kits (EDK), suitcase SATCOM terminals, and other portable technology to be used near the borders with China and Bangladesh. Also required are unattended ground sensors, advanced medical equipment, mine-protected vehicles, bullet-resistant vehicles/ boats, designed to help movement in tough terrains like deserts, no man's land and mountainous regions etc (FICCI Report September 2016.).

Business Environment and Opportunity

The Defence Procurement Procedure 2016 has ushered in indigenous technology development through various Make categories like Buy (Indian IDDM), Buy (Indian), and Buy and Make (Indian). Entry of the private sector in defence R&D and production will complement the role of DRDO and DPSUs (Defence Procurement Procedure – 2016, Ministry of Defence, Government of India).

The Defence Acquisition Council, 20 May this year (2017) finalised the policy to engage the Indian private sector with Strategic Partnership model (Cowshish Amit, 22 May 2017). Four segments opened now to private Indian companies are – single engine fighter aircraft, submarines, helicopters and MBTs/Armoured Fighting Vehicles (Gokhale Nitin, May 2017). The Strategic Partner will play the role of a system integrator by building an ecosystem comprising development partners, special vendors and suppliers esp from MSMEs (Rajat Pandit, May 2017). This will entail tie ups with Original Equipment Manufacturers to cover manufacture, Transfer of Technology (TOT), assistance in training skilled human resources etc. An imp aspect will be the depth of TOT

to achieve stipulated levels of indigenisation, creation of R&D facilities and skilling provisions

Technology Competitiveness. Factors that define it are-

Policy Factors: These include import substitution and export competitive capability, HRD for higher skill and education, facilitating quick replacement of foreign personnel and absorption of imported technology. Technology infrastructure in the form of DRDO labs does exist but lab-industry interaction for mkt orientation is essential. Similar backlinks from Labs to academia esp with IITs, NITs and selected private colleges for collaborative research need to be nurtured as in universities of developed countries, especially Germany, Taiwan and Korea. Quality of higher scientific education needs to become increasingly relevant to industry

Industry Specific Factors: The changing pace of technologies, availability of scientists and engineers, ability to acquire technology and not only absorb but also improve upon it, nature of global technology market for products and processes – all these determine technology competiveness. (UNIDO, n.d., "Indian manufacturing industry technology status and prospects").

Common Defence R&D Common ground for technology overlap between the Armed Forces lies in numerous fields; like the Ballistic Missile Defence Program currently undertaken by the DRDO to help form the shield from adversarial ballistic missiles, finds commonality with Air Defence systems of the Army and IAF. Similarly, autonomous weapons have common applications with both the Navy and the IA. DRDO's robotic program declared in 2013 also straddles common ground of Navy and IA. However, integrating systems on systems demands a major technology leap to ensure development of weapon systems common to all fighting services onto different platforms. The timeline for these projects may or may not be met, but the intent is clearly signalled (Annual Reports 2014-15 and 2015-16, Ministry of Defence.).

Technology Denial turned to Advantage. In a way, technology denial by way of sanctions on India could act as a spur for the indigenous development of defence systems and hardware. Technology embargoes helped the country develop many critical products hitherto imported, as in the case long range Agni missiles There are now around 300-400 industries working with strategic sectors—defence, nuclear and space. Another case is that of the Combat Vehicle Research Development Establishment (CVRDE) spearheading the MBT project, wherein it has adopted the public-private sector cooperation route co-opting domestic companies like Kirloskar Oil Engine, BEML (Bharat Earth Movers Limited), Mahindra and Mahindra, academic institutions like IIT and Pune based Automotive Research Association. "Our approach is not engine specific; we are looking at developing the complete range of technology needed to build engines. Not only design but also manufacturing, testing and evaluation," said CVRDE Director P Sivakumar (Radhakrishna Rao, February 2012). Rightly, the decision of the Ministry of Defence to bring the US$12-billion Future Infantry Combat Vehicle project under "Make (India)" category is a welcome step. The successful culmination of FICV project will hopefully transform the landscape of defence production in India radically (Kumar A, 16 Mar 2016)

Conclusion

The Ministry of Defence has brought a level of transparency as desired by various R&D and manufacturing agencies, by declassifying a major portion of the Long Term Perspective Plan of the IA in the form of the Technology Perspective and Capability Roadmap. There have been policy changes to encourage defence manufacturing, and ease of business facilitated for international joint ventures. The business environment has thus improved considerably, and PSUs and domestic private industry needs to take advantage of the improved climate, ensuring Make in India becomes a reality. India needs to ramp up its defence R&D spending from the meagre 0.9 per cent of GDP to at least 2% in the immediate term. Like US, Japan and China our R&D spending by the business sector needs to be raised to 60-75 per cent rather than the current 70% spending by the govt (Behera L K, 2016).

Finally, all stakeholders - DRDO, DPSUs, Academia and the private sector need to be pitched together to ensure that a conducive environment is created for defence innovation and research to harness the latest technology, for a battle ready and effective IA.

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