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Integration of Artificial Intelligence in Indian Military Operations: An Overview (2024)

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Abstract

Contemporary research and development are accelerating the proliferation of Disruptive Technologies and Artificial Intelligence (AI) in an unprecedented manner into our geo-politics, society and more disruptively in war fighting. The Indian Military is at turning point of technology revolution, wherein, the war will be fought with autonomous, unmanned platforms with AI technology. Today, the commercial sector is driving the AI in the world. This article looks at the state of art of AI, Machine Learning, and other technologies with their potential application in the military operations. It specifically analyses opportunities and challenges of AI application on National Security, Warfare and Autonomy in Military Operations. Today, geo-politics is already being dominated by the AI and instruments of disruptive technology in the field of Intelligence, Situational-Awareness, Surveillance, Autonomous Weapons and Logistics. The article shall also suggest transformational steps to be taken by India, in general and Military establishments, in particular, to seamlessly harness AI. This article aims to discuss integration and application of AI in Military Operations.

Keywords: Artificial Intelligence, Machine Learning, Deep Learning, Autonomous Weapons, Robotics, Military Operations, AI Strategy, Data Strategy.

Introduction

Artificial Intelligence (AI) has assumed substantial importance for all countries, specifically in Military domain. In US, the DoD spending of $600 m in 2016 has reportedly increased to $100 billion in 2024, which is indicative of US focus and importance being allocated to the field of AI. On the other hand, according to the open-source information it is stated that China is going to invest upto $150 to $200 billion on AI and associated technologies and will lead the technology race of AI by 2030.[1] India has not specifically announced budgetary allocation for AI development, however, Task Force report of Jun 2018 recommended earmarking AI budget from yearly Defence Budget with corpus of Rs 1000 crores to be provided every year and for next 5 years. Evidently, the figures above suggest the importance and seriousness of US and China, vis-à-vis India, which has enormous disparity in the investments. Notwithstanding that, baby steps have been taken by the government and policymakers to energise the AI eco-system. The automation and digitisation riding on AI will have a substantial impact on the economy globally. Individually, each country will benefit due to higher productivity and resultant jump in GDP. It is predicted by the think tanks that by 2035 AI would boost the world economic growth to double of present levels.

AI is acknowledged globally as the game changing technology, which will impact every sphere of human lives, private or public. It is changing all spheres and spaces across the world with global spending of $

118 billion in 2022, which is projected to surpass $300 billion by 2026[2]. Resilient national security to face an on-coming technological storm can only be endured by a robust geo-political vision and well strengthened and advanced military. Consequently, the strength to the military can be drawn from a well-endowed strategy and doctrine which would ride on the AI and associated technologies. As we harness the AI into our system, the operational concepts will start emerging and reshaping to adapt new technologies. Accordingly, the tactical functions i.e. Reconnaissance, Situational Awareness, Intelligence gathering and Analysis, Command & Control and Logistics will start transforming and improving. AI will change the way we manage our borders and conduct CI operations in J&K and North East. The complex domains of Cyber and Space will be completely managed and supported by AI, which will automatically detect and mitigate threats emerging in these domains. Therefore, the time is now for our Military to adapt, be acquainted with AI in all its forms and reap benefits in all domains to survive in the future scenarios.

Methodology & Research Approach: Qualitative Research

Considering the perceptions and assumptions on integration of AI into military operations, qualitative study has been conducted with inductive approach. Many of the factors considered i.e. transparency, trust, culture, ethos, transparency, and perceptions are not measurable, therefore qualitative approach was found more appropriate method, which allows detailed exploration of facts and concerns then quantitative methods. The descriptions, feelings, and emotions attached to the organization and change of culture is best justified through a qualitative method with better precision. Moreover, this method is best suited to research intricate topics related to military issues and settings.

The aim of the current research is to understand current state of AI readiness and opinions about the integration of AI in the military with the acceptable recommendations. The focus of the research is on the AI adoption strategy and a way forward for the Nation in general, and Military Forces in particular.

To collect effective qualitative data and address all research questions, review of literature and selective interviews with subject experts and military leaders was adopted. This methods of multi approach provided and all rounded insight into the complex issues being faced by all stakeholders for AI adoption. It also provides an overview of the environment and cognitive levels in which the AI tools are going to be implemented. Data collected through literature review and interviews with military leaders facilitated the correct analysis and identify the problem statement and recommendations thereof. It provided a pragmatic and workable and pragmatic framework to work on for AI integration

What is Artificial Intelligence?

The AI is classified into Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Artificial Super Intelligence (ASI).

Artificial Narrow Intelligence: It represents all existing AI technology which can only perform a specific task autonomously using human-like capabilities. These machines can do on what they are programmed to do, and have limited or narrow range of actions. Even the most complex AI that uses ML and DL to teach itself falls under ANI.

Artificial General Intelligence: It is ability of an AI machine to learn, understand and function like human mind. These systems can independently build multiple competencies and generate solutions by learning from past data.

Artificial Super Intelligence: It will be the pinnacle of AI research and may takeover human intelligence. It will be able to replicate and perform better then human beings, process data, analyses and make faster decisions.

AI also has subsets like Machine Learning (ML), Deep Learning (DL) and Neural Networks.

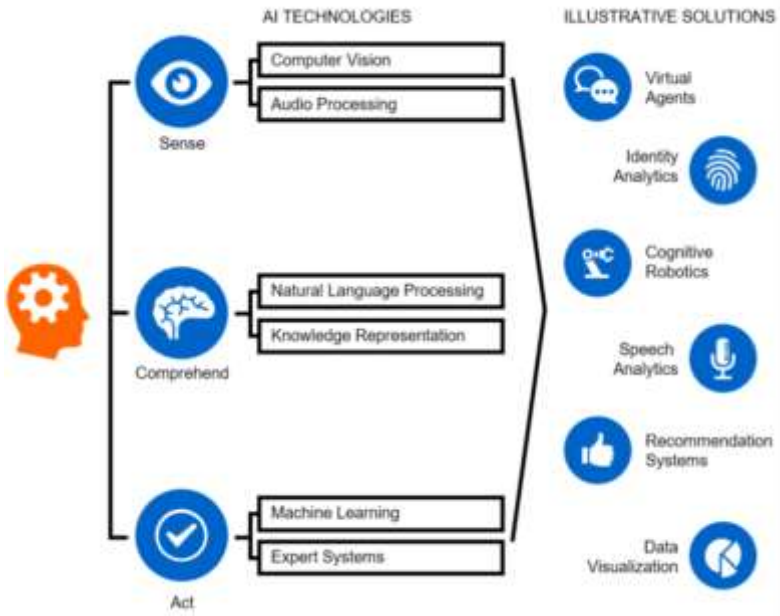

Figure 1: What is Artificial Intelligence[3]

AI Enablers: Spiralling Advancements

The state-of-art hardware which can store and process big data are the mother entity of AI. The niche advancement in nano technology, semi-conductors, Graphic Processing Units (GPU) and Tensor Processing Units (TPU) constitute a hardware for AI architecture. Big Data constitute structured or un-structured/ semi-structured data sets which are stored into the caches/stacks to provide pool of information for AI generation and develop models and patterns. The other associated technologies of AI are Machine Learning (ML), Computer Vision (CV), Natural Language Processing (NLP), Robotics etc.

Machine Learning is the foundational technology of AI which enables the programs to self-learn and generate logical solutions/options. The data cache store information in form of data sets based on experiences and proven solutions which are fed into the programme to learn and arrive at logical outcomes. The machine can also adapt by identifying patterns within the data sets.[4]

Deep Learning is far superior technology formed by fusion of ML with Neural Network. The neural networks are the human neurons cloned model of functioning and processing huge data and allowing high computational capability.

Computer Vision analyses, adapts, extracts, and learns from the images, photos, and videos.

NLP enhances the AI capability by understanding and interpreting human language (Alexa, Siri etc). It allows machines to understand, process and respond to the human speech or text.

Brain Machine Interface (**BMI**) allows link between human brain and the machine. It enables performing intended functions by transforming signals from human brain through neural network to machine.

The exploitation of these technologies by the military will enhance the operation efficiency and transform the strategic approach to warfighting.

Autonomous Weaponry and Warfare

In the recent times, from Ukraine to Gaza strip, militaries are applying technology in the manner never presented. While from outside the Russo-Ukraine war may seem conventional warfare, but on ground the conflict is of new character all-together. Similarly, Israel is also using AI enabled military force against Hamas in Gaza Strip. AI tools are enhancing the capacity of fighting and gaining advantage over the other. Most fundamental application in intelligence operations and surveillance are UAVs, armed with AI enabled devices are being extensively used, providing real-time data and imagery (figure 1). The ML and DL enable these drones/UAVs to identify military deployment and distinguish between military equipment and troops apart from civilians. In addition, both conflicts are witnessing extensive use of Loiter Munition (LMs) and Kamakazi Drones which can navigate using AI and attack pre-programmed targets.

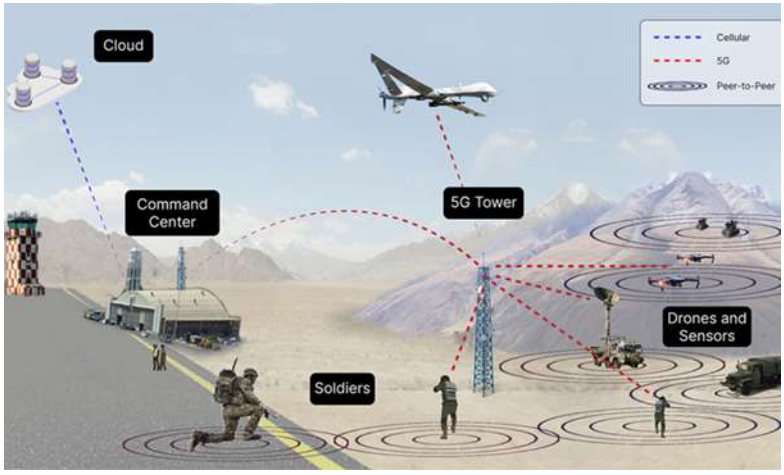

Figure 2: Future Battlefield Mosaic

In both the conflicts, AI has played a significant role in Cyber Warfare. Russia has extensively and offensively attacked Ukraine's defence systems and infrastructure. Conversely, Ukraine has also used AI enabled programmes to defend itself from many of these attacks. Israel has demonstrated a very high level of AI capability in the field of surveillance and targeting by employing its new system "The Gospel" which identifies enemy and military equipment for precision targeting by using large amount of data on that specific target or individual. Israel is also using AI to identify and map the underground tunnel system in Gaza Strip.[5] Prior to Russo-Ukraine conflict Armed Drones were first used offensively and in large number in Azerbaijan- Armenia conflict in 2021 where technology and drones were shared by Israel and Turkey. Therefore, it can be concluded that a new trend in warfighting has emerged.

Warfare is set to be transformed across entire spectrum of conflict and in every domain. The glimpse of AI domination can be seen extensively in the ongoing conflicts and skirmishes. It is evident that the force with more AI-enabled inventory has an advantage on the battlefield. It is also seen that by using Brain Machine Interface (BMI), the human-machine teaming can be considerably improved and evolved into decision making ability. Military's possessing the capability to integrate AI into all its systems and weapons will out manoeuvre their adversaries with ease.[6]

Intelligence Operation with AI

The intelligence organisations in India will be the biggest beneficiary of AI. Once integrated into a robust architecture, the entire intelligence grid will generate immense amount of high value data. Today, large amount of data in form of mis-information and fake news/deep fakes are being generated by the social media platforms. Once AI is integrated with suitable algorithm and filters, all noise and unwanted data

will be sifted out and discarded automatically by the system. The final picture on the table will be clean and authentic. Automation of AI with Quantum Computing will process and deliver information/intelligence in quick time and in efficient manner.

Surveillance operations will also see a transformation change, where in, AI will be able to predict patterns and recognise targets through concrete walls in built up areas. The AI will be able to auto track targets and their actions with help of ML/DL And interfacing all surveillance gadgets deployed in the country. Same technology will also be a game changer for border management, infiltration along loc and monitor movement pattern along lac on northern borders with China. In conventional domain, it will be able to predict enemy actions and generate a response strategy for pre-empting with own military.

Data Security

The core of any AI system is its data. In civil domain and social media platforms, every detail of an individual profile and corporate data is being monitored through AI tools. This Data is being curated through ML to influence individual on personal religious health etc.[7] This data is also being misused for political and financial benefits. Data security is a key component of any AI framework and needs to be taken seriously. AI adoption in military, would entail a very robust data strategy. In addition, AI can also be used to address internal security issues such as terrorism, Population Control Mechanisms, environmental security etc. The Indian military should be equipped with the requisite security apparatus prior to adoption of AI into its decision-making architecture.

AI and Geo-politics

The global Political fraternity is already expressing concern over AI exploitation for political gains and overturning power. Russian president Vladimir Putin in a speech, had pre-empted the threat oblique concern emerging from AI. He announced “Artificial intelligence is the future not only for Russia but for all humankind. While AI comes with colossal opportunities, but also threats which are difficult to predict. Whoever becomes the leader in this sphere will become ruler of the world”[8]This statement became famous for being the harbinger for global ai race and lead to series of announcements by global leaders on ai namely China and USA among others. The testimony to the political ramification of AI may be drawn from US presidential elections in 2016, when President Trump was elected. The global media and US experts indicated Russian intervention by way of influencing public opinion through AI. Hence, country which has advanced AI technology can secure their national interest by influencing the geopolitics in own favour. Consequently, the military will also get influenced by AI driven power politics. Every domain of military will get affected and will have to adapt to the AI as early as possible to remain relevant. In forceable future, the real military strength of our country will be defined by AI Robustness, hence, it must become a new dimension of warfare, which implies that the Indian Army Doctrine and Joint Doctrines will have to be revised to incorporate AI in every domain and spectrum of warfare.

AI Readiness in India

The government of India has prioritised the development of niche technologies and AI capabilities in all domains and spectrum. Study of AI strategies across the globe suggest that AI roadmap must be inclusive and take into consideration all key components and factors without making it too monolithic. Issues of ethics, regulations, transparency, explainability, liability, accountability, privacy, and oversight are some of the key issues which need to be addressed while formulating a comprehensive strategy. The support

mechanism is most important for any strategy to be inclusive and robust. Issues of infrastructure, skilled workforce, institutional framework, education, R&D capacity, Innovation, eco-system have to be concurrently addressed in the strategy as the technology is being developed. Therefore, it is important to underline the challenges and gaps in the current system, environment and military establishments which become the start point for the roadmap. It is also important to identify key areas which need to be supported by AI, backed by legal framework.

NITI AAYOG'S National Strategy (#AI for All)

The government Think Tanks conceptualised an Artificial Intelligence Strategy for India viz **#AI for All.**[9] In formulation of this strategy the processes of collaborating with experts and all stakeholders were achieved. It articulates AI projects in all fields and need for vibrant ecosystem in India for implementation. The strategy aims to leverage AI for economic growth, social development and basically an all-inclusive growth. It mainly focuses on Healthcare, Agriculture, Education, Smart Cities, Infrastructure and Transportation. The Niti Aayog paper lays out present and proposed eco-system for AI development in India and prospective sectors where AI needs to proliferate. It systematically discusses the research and development capabilities and way forward.

The strategy is derived to mainly for socio-economic growth of the country. While it discusses all fields in general which are associated with growth, the mention of National Security or Armed Forces in specific has not been discussed in the stated strategy. However, it provides over 30 policy recommendations for investments in research, skill development, training, adoption of value chain and promotion of ethics, privacy, and security. Notable initiative has been establishing the Centres of Research Excellence (COREs). These COREs are to become the technology feeders to International Centres for Transformational AI (ICTAIs), which in turn will create AI based applications in specific domains. Some of the identified COREs are

Centre for Artificial Intelligence, IIT Kharagpur.
Centre for Artificial Intelligence & Robotics (CAIR), DRDO.
Robert Bosch Centre for Data Science and Artificial Intelligence, IITM.
The Artificial Intelligence Group (AI@IISc).
Department of AI @IITH.
Academia-Industry Collaboration on Artificial Intelligence.
Laboratory of Statistical AI and Machine Learning (LSAIML), IITR.

Consequent to the National Strategy, Ministry of Electronics, and IT (MEITY) also released four committee reports in July 2019 articulating individual framework i.e. A- Platforms and Data on Artificial Intelligence, B- Leveraging AI For Identifying National Missions in Key Sectors, C- Mapping Technology Capabilities, Key Policy Enablers Required Across Sectors, Skilling and Reskill, and D-Cyber Security, Safety, Legal and Ethical Issues. The Government also launched a National Artificial Intelligence Portal viz www.ai.gov.in on 30 May 2020. This portal is intended to be a single point digital platform for all AI related information, developments, resources, articles, industry start-ups, educational institutes etc. It is also a platform for posting AI related job opportunities and learning. In addition, government has also launched National Programme for Youth "**Responsible AI for Youth**." It is aimed at empowering Indian youth towards new age mindset and access to relevant skills to be relevant in future.

Department of Telecom (DOT) and AI standardisation has also taken numerous initiatives under a committee formed in September 2019 for standardisation of AI technology for all stakeholders. Most

notable outcome of the committee reports is that it has addressed functional aspects of AI i.e. Network Architecture and Data Structures. It also articulates the need for a **Data Stack** for interoperability within all stakeholders.

While all government initiatives where focused towards social empowerment, the national security was one domain which remained to be addressed as an outcome of overall strategy. Therefore, to study the strategic implications of AI with respect to National Security, MoD and DDP concurrently established a Task Force in Mar 2018 under the chairman ship of Sh. N Chandrasekran, Chairman, Tata Sons. The first report of the TF was submitted in Jun 2018 with following recommendations:

Integrating and embedding AI strategy for Defence with Defence strategy.

Establish a high-level Defence AI Council (DAIC) and a Defence AI Project Agency (DAIPA).

Development of Data Management framework, establishing Data Management Office and appointing a Data Management Officer.

Scaling the existing capability of Data Centres and establishing a centrally facilitating networks of Test Beds.

Framework incorporating industry and development of AI capability for Defence and IP Management.

Training of Defence personnel in AI at training Centre's.

Earmarking AI budget from yearly Defence Budget with corpus of Rs 1000 crores to be provided every year and next 5 years.

Consequent to the Task Force study recommendations, DAIC under Raksha Mantri and DAIPA under Secretary DP has been created to guide and enable development of the framework for AI adoption and policy formulation. The services have also established organizational Institutional Mechanism through AI Sub Committee and Joint Working Group on AI in Tri-Services. Besides this, the services have also formulated data policy and appointed Data Management Officers and have identified key AI domains for development of AI projects. In addition, an AI roadmap has been finalized for each DPSU under which 61 defence specific AI projects have been identified for development, of which more than 26 projects have been completed by the DPSUs.[10] The services are also engaging in development of AI projects from start-ups through the Innovations for Defence Excellence (iDEX) and academia.

Defence AI Council (DAIC).

It is a high -level council created under Defence Minister with the following mandate:

Provide Strategic direction to harnessing AI in Defence.

Address issues related to Data Sharing.

Establish synergy between Defence and Industry for a collaborative approach.

Address issues regarding start-ups and technology acquisitions.

Formulate and review ethical, safe and secure use of AI in the country.

Formulate policies in concert with industry, defence government agencies which are robust for future adoption, yet deterrent for any misuse.

Defence AI Project Agency (DAIPA).

Established under Chairmanship (ex-officio) of Secretary (Defence Production) with the following mandate:

Adopt/Evolve a technology stack within defence establishment.

Adopt/Evolve technology development standards and delivery of AI projects.

Formulate and promulgate IPR policy for AI projects.

Ensure timely development and delivery of AI projects.
Interface between Defence and Industry for policy formulation and contractual obligations
The Task Force recommendations also outline instructions and directions for integration and adoption of AI by all organisations under MoD by formulating their respective strategies. These would include the three services, the coast guard, DRDO and DPSUs. It also articulates capacity building with defence forces through AI training in respective training centres and institutions. The report emphasises on HR issues with focus on empowering the personnel of defence forces with AI skills i.e. data analysts, data scientist and AI specialists.

Centre of Artificial Intelligence and Robotics (CAIR)

The CAIR was formed in October 1986 as a nodal agency for research and development in artificial intelligence and robotics for the defense services. The centre is functioning under DRDO. Since beginning CAIR has contributed immensely towards various defense projects in image processing, Various intelligent systems, human machine interface design, automation, and Robotics. CAIR has also been involved in development of various user-friendly artificial intelligence applications for real life problems. It has also developed capabilities in machine vision, intelligent systems, robotics, and automatic target recognition (ATR).[11]
The vision of CAIR is to develop cutting edge technologies in AI, robotics and allied areas of AI and Robotics, develop advanced software technologies for defense forces and provide technical consultancy, support, and training for the users. The organization has team of scientists and engineers from various domains working on R&D, production Support quality assurance, training, and consultancies at various level. The focus of research in CAIR include
Intelligence systems
Machine learning
Robotics
Software engineering
The centre has also established a strong collaboration with ISRO, IITs, National Law Schools, National Aerospace Laboratories, Electronic Corporation of India Limited etc.
The primary aim of CAIR is to develop state of art technologies in AI robotics and intelligent systems that are relevant to the defense forces. The centre has acquired expertise in various areas of AI which include
Knowledge based systems
Highly reliable real time embedded systems
Robotics for hazardous and space applications
Learning techniques for industrial automation
Machine vision and Image processing
Speech recognition and synthesis
India has made significant progress in the field of AI. It would be prudent to mention that private/public sector has fully adopted ai technology and are evolving at a fast pace. However, AI maturity levels in the military domain are still lagging. While baby steps have been taken within the armed forces by taking initiatives i.e. National AI forums, establishing Centre of Excellences and engagement of Academia and industry to facilitate the ai adoption. However, a concrete framework is yet to be formulated which points towards creation of required architecture for AI enablement in the military. First and foremost, most

crucial step would be to create an architecture within the military establishment having robust data security stacking infrastructure which would become the foundation of the AI ready force.

AI Integration Challenges

While AI offers unlimited opportunities for the military adoption into our framework, but it has some notable challenges, in its application ranging from ethical, operational to strategic. While ethical challenges and concerns of AI are profound and need to be addressed adequately while formulating the national AI strategy. However, the scope of this research is primarily to suggest integration of AI into our military operations, and would not address the ethical and legal issues. Suffice to say that ethical concerns emerging from AI would need to be embedded in their overall strategy of war fighting. Data security would remain main challenge for AI integration.

Data Management

Machine learning requires large cache of data from all sources deployed by the military, including past practices, war games, operations which makes it a complex exercise. The collation, evaluation, and cleaning of data itself is a difficult step. AI is also prone to infiltration of spurious data, hacking, fake data, etc which is a major challenge. The challenges at tactical and operation level have strategic ramifications. Hence a robust and pragmatic Data Strategy needs to be formulated by the Military.

Budget Allocation

Nation needs to allocate adequate budget towards AI R&D and implementation. Parallel for budget allocation for development and adoption of AI can be drawn from other nations ie US, China etc (figure 3). The figure below is a clear indicator of budget allocation vs aspirations of the country to compete for third largest economy and power in the world. Evidently much larger effort and seriousness is mandated.

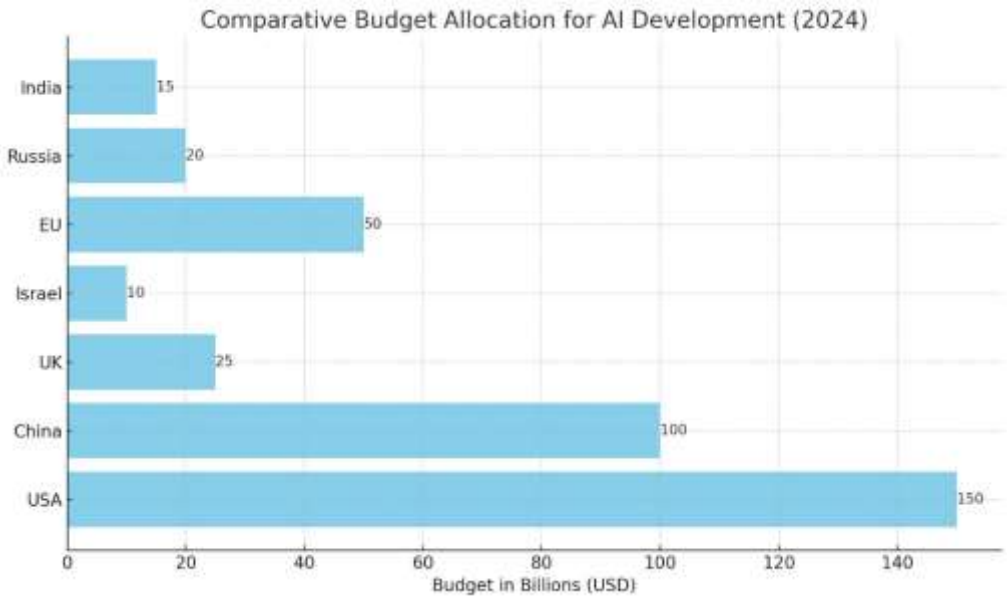

Figure 3: Comparative Budget Allocation for AI

Military-Private Partnership

Conceptualizing and initial establishment of AI infrastructure in military is a challenge due to non-avail-

ability of expertise. Military needs to collaborate with private entities and academia to conceptualize, integrate and even manage the AI architecture till complete AI-Maturity is achieved within the organization. Today smaller companies (MSMEs) and start-ups are driving the AI innovations, which can be adopted as dual use for military purpose in many general fields i.e. Logistics, Medical, Training, Financial Planning, HR, Surveillance, Intelligence etc.

Acquisition Processes

The existing acquisition process is too slow and lengthy for technology adoption. The pace of AI and contemporary technologies is outpacing our efforts due to acquisition processes and bureaucratic hurdles. Therefore, **Fast Track Procedures** will have to be adopted for AI adoption for them to remain relevant, with larger delegated financial powers to the military offices i.e. VCOAS and Theatre Commanders.

Cultural and Organisational Barriers

There is an ongoing debate on Evolutionary vs Revolutionary approach to AI development in the military. Apparently, the time for debate has passed and the status quo culture needs a revolutionary change, lest AI technology overtakes our efforts and impacts our readiness against future threats and overall national security.

Trained Workforce

AI adoption would require advanced skills in the military and expert talent from private industry. HR and training policies would require change to enhance AI skills of existing personnel and alter recruitment criteria for larger intake of technical and qualified workforce. Intake and retention of AI talent in the military and government establishment would require larger incentives which are competitive with commercial sector. In future perspective, a special technical cadre may have to be introduced for the military with special status and incentives. While the permanent solution may take few years to mature, an alternate and temporary option of hiring contractual workforce from private sector can be explored.

Computing Power

AI generation and algorithm coding requires high speed computing power to stack and process data. This would involve high **performance** computing, not only in static establishments, but also in forward military echelons for faster decision-making by military commanders. Therefore, the hardware requirement is unique and would need upgrading and secured. The future lies in Quantum Computing technology, which must be developed at a fast pace to sustain and handle large scale data processing and transmission at larger distances in real time frame.

Technology Gaps

Existing technology gaps in the field of AI and other disruptive technologies can only be filled by alliance strategy with global partnerships. The government should seek core technologies through existing alliances. Concurrently, own tech companies should be given mission mode projects to develop these technologies in a time bound manner.

Discussion and Result

AI is a technology which has revolutionary potential in all fields of military. Hence it is not possible to

ignore or delay its adoption. We need to prepare for it, first to embrace it, and two to catch up with the global North and West. Currently, we have an advantage of AI talent, private entities ready to innovate and integrate with start up initiatives. AI could complement the current security framework with support of these startups and academia in a collaborative manner. To exploit this advantage, military and MoD should, firstly make larger investments towards R&D and secondly, incentivise the players who are ready to partner with the military. The recommendations made in this study is a result of extensive research of the current capabilities of military establishment of AI technologies and what needs to be done to integrate full potential of AI. The recommendations are being made after due considerations of existing policies, various reports published by the government, Task Force on AI and National Strategy including Meity Reports.

AI's ability to function with data analytics is the inseparable function, which along with ML and DL tools will drive the future military operations. The main purpose of military operations is about influencing unwanted situations to reach political advantage. According to Von Clausewitz, military operations are won in the human mind. Only when the adversary is convinced that opposition is no longer opportune, the conflict can be terminated. Current Decision-Making approach only deals with situational awareness, that too in the physical realm. Big Data and AI will change the way decision support will be orchestrated to achieve operational advantage and success in battle. The decision-making OODA loop in future operations will be affected by all the landscapes i.e. physical, human and information.[12]

Conclusion

AI-Ready force would need larger initiatives by the government, while military leadership should drive this change. We cannot isolate ourself from this technological onslaught. Undoubtedly, the nation which transforms and realizes this change faster would have strategic advantage. The current state of AI-Maturity in the military suggests that the only way to implement AI is by adopting 'Revolutionary Approach' so that we catch up with the developed world by leaping forward.

Finally, military leadership should review service and joint service doctrines, which are laggard in acknowledging and giving importance to AI as a strategic capability and shift required for AI adoption.

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