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FUSION AND INTEGRATION OF AI AND DATA ANALYTICS WITH MILITARY INTELLIGENCE IN INDIAN ARMED FORCES WITH AN EMPHASIS ON OPTIMISATION OF INTELLIGENCE CYCLE

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FUSION AND INTEGRATION OF AI AND DATA ANALYTICS WITH MILITARY INTELLIGENCE IN INDIAN ARMED FORCES, WITH AN EMPHASIS ON OPTIMISATION OF INTELLIGENCE CYCLE

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ABSTRACT

As the battlefield landscape transforms, the Indian Armed Forces face an imperative of harnessing the power of Artificial Intelligence (AI) to optimise Military Intelligence (MI) cycle. Embracing the AI Revolution and keeping pace with exponential technological advancements, topic of 'Fusion and Integration of AI and Data Analytics with Military Intelligence, in Indian Armed Forces, with an emphasis on optimisation of intelligence cycle' has been narrowed for research. The study dissects how AI can empower each stage of the intelligence cycle from collection of data till analysis and dissemination of information.

This research delves into the traditional intelligence cycle process, discusses how and in what form AI can augment the current process. An extensive literature review was carried out and is covered in chapter I. Examination of AI integration in field of MI by global power houses like the USA, Russia, China and the United Kingdom, enabled better understanding of the subject. In addition to above, the strides made by India in the said field at national level and by three services have been stated in chapter III and later evaluated through prism of objectivity.

The research goes beyond mere discussion, proposing concrete recommendations for a future proof MI cycle. Recommendations espoused, flows from the theoretical construct of chapter II & III as well as guided by analysis of both qualitative and quantitative analysis. The findings substantiate and prove the hypothesis leading to formulation of tangible recommendations at national and organisational level. An organogram, integrating AI in the organisation at HQ IDS is outlined. This research stands as a timely response to the evolving security landscape. By embracing AI, the Indian Armed Forces can unlock a significant competitive edge, ensuring battlefield effectiveness and safeguarding national security in the age of big data and intelligent warfare.

CHAPTER I : INTRODUCTION AND METHODOLOGY

MILITARY APPLICATIONS OF EMERGING TECHNOLOGIES LIKE ARTIFICIAL INTELLIGENCE AND DATA ANALYTICS THAT CAN BE HARNESSED BY INDIAN ARMED FORCES IN SPECIFIC AREAS TO IMPROVE OPERATIONAL EFFICIENCY AND OPERATIONAL LOGISTICS CAPABILITIES

"*Our intuition about the future is linear. But the reality of information technology is exponential and that makes a profound difference. If I take 30 steps linearly, I get to 30. If I take 30 steps exponentially, I get to a billion***".**

- Ray Kurzweil

Introduction

Artificial intelligence (AI) is a comprehensive name for information and computer systems that display intelligent behaviour or create new insights and information. This is a path breaking technological field that can be exploited in variety of applications with relative efficiency, at reasonable cost and on a vast scale. AI includes large number of sub domains including machine learning (ML), deep learning, computer vision, natural language processing (NLP) as well as interconnected technologies such as Internet of things. These and other domains are foundation for diverse applications in different fields including commerce, medicine, academia, transportation and defence sector.

In the big data era, the need for artificial intelligence (AI) tools and applications for intelligence uses has increased dramatically as armed forces focus on consolidated solutions. AI in Military intelligence along with military intelligence analytics is absolutely crucial for battle field efficiency, accuracy and lethality. There are certain taxonomy of roles that AI can play for supporting military intelligence cycle namely, automated analysis, evaluation support, collection support, information prioritisation and provide qualitative analysis of the drivers of system performance for each of these categories. Commanders rely on vast number of sensors, human intelligence, technical intelligence and other forms of fused military intelligence to understand patterns in data that enables them to take an informed decision. Many countries and organisations have begun to recognise that AI is no longer a futuristic technology; rather it is now a fundamental need with a new phenomenon of emerging 'Hyper war'[1].

AI went through three developmental stages[2] since the concept came into existence. The first stage was solutions focused on rules based approaches like decision trees, Boolean and Fuzzy logic, generally called expert systems. In second stage, AI Developers focused on development of statistical methods which resulted in the concept and methodology of machine learning. In third stage, which is ongoing, includes introduction of human like learning methods such as neural networks, defining concept of deep learning, sensing and perception.

Dovetailed in military intelligence cycle, AI can be effectively employed in fields of data collection, image and video analysis, NLP, predictive analysis, pattern recognition - anomaly detection, sentiment analysis/ social engineering, decision support systems, data fusion, geospatial analysis and intelligence integration and in counterinsurgency - counter terrorism grid.

Literature Survey

Following have been studied as part of literature survey to select sub topics:-

(a) Flysight, "Artificial Intelligence in Military Technology - 8 Applications & Examples," 18 June 2023.

(b) Drone Wars UK, "Military Applications of Artificial Intelligence," December 2021.

(c) Brig Sanjeev Chopra, "Artificial Intelligence in Military Operations," Centre for Land Warfare Studies, New Delhi, June 2022.

(d) Forest E. Morgan and Raphel S. Cohen, "Military Trends and Future Warfare," RAND Corporation, California, 2020.

(e) Mealanie Sisson, "The Militarization of Artificial Intelligence," Stimson Centre, New York, August 2019.

(f) "Artificial Intelligence for Military Logistics - Current Applications," Emerj Artificial Intelligence Research, Boston, 2019.

(g) Istvan Szabadföldi, "Artificial Intelligence in Military Application - Opportunities and Challenges," National University of Public Service, Budapest, Hungary, 2021.

(h) Tobias Vestner, "From Strategy to Orders: Preparing and Conducting Military Operations with Artificial Intelligence," Geneva Centre for Security Policy, January 10, 2023.

Division of Broad Area into Sub Topics

A total of five sub topics have been identified mentioned as under:-

(a) **Fusion of AI and Data Analytics with Military Intelligence**. Understanding how AI and data analytics can be exploited for optimisation of steps involved in intelligence cycle including collection, acquisition, collation, interpretation, synthesis and dissemination.

(b) **AI and Data Analytics for optimisation of Military Logistics Sustenance Chain**. In modern times, there is requirement to sieve and shift through data to make timely decisions about supply, transport and other logistics.

Using AI and machine learning can speed up the process and make it more agile[3], facilitating '*Just in Time*' concept.

(c) **Legal and Ethical Considerations related to Military Applications of AI**. With advances in field of AI and data analytics in field of military come social, ethical and legal implications. AI developers might not always take into account these implications, as that can require proficiency not only in the fields of computer science, psychology, linguistics and neuroscience but also ethics, law, and philosophy[4].

(d) **AI Domain Specialisation in Indian Army**. In order to keep pace with changing character of warfare, in era of hybrid and grey zone warfare, it is important to have a specialised and trained cadre in Indian Army including Subject Matter Experts. The idea of an incubator can be created at the tri-services level and called the '*Centre for Armed Forces Innovation*' (CAFI)[5].

(e) **Deploying Medical AI in Armed Forces during Conflict Situations**. Robotics and Neuroscience have already made immense progress in field of medicine. Integration of AI shall assist in effective casualty care and evacuation of personnel, especially in field conditions. As of now, AI may not be qualified to make medical decisions but it can provide rapid analysis to give humans more information on which to base their decisions[6].

Recommended Area for Further Research. "***Fusion and Integration of AI and Data Analytics with Military Intelligence, in Indian Armed Forces, with an emphasis on optimisation of intelligence cycle*"** is recommended to be chosen and developed further as part of the dissertation.

Reason for Selection.

(a) AI is the future which is being exploited for intelligence purposes by countries like USA, China, Israel and Russia. In order to keep pace with changing character of warfare, Indian military Intelligence too needs to graduate to AI based systems by dovetailing it into intelligence cycle.

(b) In times of multi domain operations and emerging threats of hybrid, Grey Zone and Non Contact Warfare, success of future operations will significantly depend on availability of time critical actionable intelligence.

(c) There is a need to graduate from elementary and compartmentalised data analysis to a unified structure/ platform. Use of AI shall assist in automating process of acquisition and collation, carrying out near real time interpretation and synthesis as also will facilitate speedier dissemination of information aiding quicker decision making process.

(d) While conducting literature survey, it has come to notice that there has been significant amount of study and research conducted on ibid topic, however,

its application in field of military intelligence in context of Indian Armed Forces needs further deliberation.

Literature Review

The literature that is being reviewed for the study is mentioned as under:-

Ser No	Title	Author	Source/ Journal Volume No & Pgs	Thrust of Paper
(a)	Artificial Intelligence and Future Warfare	Ekbal Prakash	Sumit Enterprises, 313	Book provides an overview about transformational role played by AI in future military operations and also analyses the ongoing debate of ethical nature of AI, delving on military perspective.
Findings and Recommendations				**Relevance to Research**
(i) Book brings out broadly the fields of machine learning, robotics and unmanned aerial vehicle that can be employed in field of military and other domains. (ii) It discusses the aspect of ethics, anthropomorphism and weaponisation of AI. (iii) Book did not address the core issue of AI in military intelligence and challenges thereof.				(i) Aids in understanding the concepts of Artificial Intelligence, machine learning, deep Learning, its broad applications and constraints. (ii) Includes description of autonomous platforms / equipments in use.
(b)	The Future of National Intelligence How Emerging Technologies Reshape Intelligence Communities	Shay Hershko-vitz	Rowman & Littlefield, 2022 edition,190	It spells the environment in which intelligence communities (ICs) operate and require a revolution in the way intelligence organizations perform by giving out personal experience and long term perspective to the issue.

(c)	Evaluating the Effective-ness of Artificial Intelligence Systems in Intelligence Analysis	Daniel Ish, Jared Ettinger, Christopher Ferris	Rand Corporation, Research Paper, 2021, 109	The research focuses on how are AI system measures of performance connected with effectiveness in intelligence analysis and highlights limitations of intelligence cycle.
Findings and Recommendations				**Relevance to Research**
(i) To distinguish among the six core intelligence collection disciplines of SIGINT, geospatial intelligence (GEOINT), HUMINT, IMINT, measurement and signature intelligence and open-source intelligence by AI system supporting each of those processes. (ii) Intelligence cycle does not distinguish between the three common intelligence analysis levels known as tactical, operational and strategic intelligence. (iii) Gives out AI based system function categories and support system with respect to steps of intelligence cycle as well as sample accuracy.				(i) Understanding nuances of AI in intelligence analysis and viability of metrics for decision making by commanders. (ii) Use of AI for information priortisation and Automated analysis systems.
(d)	Implement-ing Artificial Intelligence in the Indian Military	DS Hooda	Delhi Policy Group, Volume VIII, Issue 11, 16 Feb 2023, 12	Discusses key requirement for effective application of AI and current initiatives as well as implementation plan for adopting AI in Indian Military.
Findings and Recommendations				**Relevance to Research**

(i) In Feb 2018, the Department of Defence Production of Ministry of Defence constituted a task force for 'Strategic Implementation of AI for national Security and Defence'. (ii) Set up of Defence AI Council (DAIC) and Defence AI project Agency (DAIPA) set up in 2019. (iii) Budgetary allocation of 100 crores each likely to be made for next five years to DAIPA and each service. (iv) Need for preparing for AI strategy, organisational changes, managing human - machine interface.				(i) Knowledge of existing AI framework at National level. (ii) Includes relevant details of organisational changes like setting up of a separate directorate at Headquarters Integrated Defence Staff (HQ IDS).
(e)	Integrating Machine Learning in Military Intelligence Process: Study of Futuristic Approaches Towards Human-Machine Collaborat-ion	Lieutenant Colonel Nizam Uddin Ahmed, afwc, psc.	NDC E Journal, Dhaka, Bangladesh, Volume 02, No 1, Jan 2022, 20	The article explains how AI and Machine Learning (ML) can be used in Tier 1 (collection sources), Tier 2 (processing and storage), Tier 3 (fusing) and Tier 4 (data sharing) in intelligence cycle.
(f)	China's Military Decision Making in times of Crisis and Conflict	Edited by Roy D Kamphaus en	The National Bureau of International Research, Chapter 4 by Zi Yang, Sep 2023, 190	(i) Gives a brief of China's AI development programme and aspiration to surpass USA by 2030. (ii) AI based competitions being organised in civil as well as military domain (similar to game of 'Go').

Identification of Research Gap. AI and data analytics have shown promising advancements in field of military intelligence. Various facets like real time data processing, enhancing predictive analysis, data security have been explored and researched. Automation of Military Intelligence (MI) through Artificial Intelligence (AI) has broadened the spectrum of information collection procedure and analysis function in many folds. Intelligence agencies around the world are experiencing new dimensions of the informa-

tion what used to be overlooked due to limitation of human capacity to handle such large data set.[7] Review of literature indicates that no significant research has been conducted to study how AI can be effectively integrated and fused with military intelligence in context of Indian Armed Forces for facilitating process of intelligence cycle and augmenting efforts of intelligence operators/ interpreters.

Statement of Problem

The exponential growth of technology has given rise to an overwhelming influx of data, leading to a state often described as 'infoxication.' This inundation of information surpasses human cognitive abilities and poses a significant obstacle in efficiently navigating the intelligence cycle, critical at both operational and strategic level. Understanding the depth of this challenge is pivotal, as it may disrupt conventional intelligence processes. **It is therefore imperative to examine the existing framework of military intelligence and role of new age technologies for optimisation of military intelligence cycle.**

Research Objectives

Use of AI has made tremendous leaps forward in both capability and availability and Indian Armed Forces needs to keep pace with these developments in order to maintain security and a technological edge. As AI becomes more essential, military dominance won't be defined by the size of an army in future, but by the performance of its algorithms, so it merits examination of how the military intelligence currently uses AI and how it may use AI in the future[8]. Thus the aspect of fusion and integration of AI and Data Analytics with Military Intelligence, in Indian Armed Forces, with an emphasis on optimisation of intelligence cycle merits detailed research. Open source literature is available in form of books, articles, papers and journals for carrying out research on ibid objectives. The dissertation seeks to examine facet of integration of AI with present framework of military intelligence in Indian Armed Forces and future scalability options. The research objectives that emerge from research questions are as under:-

(a) **Research Objective 1**. To analyse current system of information collection, acquisition, collation, interpretation, synthesis and dissemination practiced in Indian Armed Forces and potential fields where AI & data analytics are/ can be optimally utilised.

(b) **Research Objective 2**. To analyse possible employment of AI and Big Data to achieve synergy and interoperability between multiple intelligence agencies at National level and requirement for development of human centric AI interface aligned with cognitive process of military intelligence.

(c) **Research Objective 3**. To ascertain scalability options, analyse various challenges faced for integration of AI & Data analytics with existing organisational framework and provide recommendations thereof.

Hypothesis

Integration of AI & data analytics with framework of Indian military intelligence will strengthen process of intelligence cycle as well as aid in achieving enhanced synergy, interoperability & real time data sharing between multiple intelligence agencies at National level.

Scope

The study will broadly cover the existing infrastructure of Military Intelligence wherein AI/ Data analytics have been introduced, sub fields where it can be employed, constraints prevalent in system and will suggest changes to facilitate better fusion of AI & Data Analytics in field of Military Intelligence.

Methods of Data Collection

Two methods of data collection employed are mentioned below:-

(a) **Primary**.

(i) **Questionnaire**. A questionnaire comprising of 16 questions was prepared and is attached at **Appendix 'A'**. The answers to the questionnaire was collected from maximum possible number of student officers undergoing 79th Staff Course at DSSC, Wellington, a set of officers from Corps of Military Intelligence and set of officers from other arms and services.

(ii) **Interview**. Interview on said topic was taken from CEO, Google Cloud India, Additional director, NSCS and a Senior officer from MCTE, who have adequate knowledge of the subject and are subject matter experts.

(b) **Secondary**. The secondary data was collected from World Wide Web, books, journals and papers published on the subject.

A *bibliography* is appended at the end of the text.

Methods of Data Analysis.

Primary data collected via the questionnaire was analysed keeping in view the objectives of the research. A questionnaire comprising of 16 was prepared on *Likert Scale* (google form) and circulated in environment. The replies to the questionnaire were converted to numerical values from 1 (strongly disagree) to 5 (strongly agree). A total of **212** responses were obtained.

Structured interview of subject matter experts to support quantitative with qualitative data.

Organisation of the Dissertation

This dissertation has been organised into various chapters as mentioned below:-

(a) **Chapter I : Introduction and Methodology**. The chapter will give the introduction to the dissertation covering the statement of problem, hypothesis, scope of research, method of data collection and chapertisation.

(b) **Chapter II : Intelligence Cycle - Paradigm Shift**. This chapter will provide insight into present system of military intelligence, contemporary intelligence paradigm and AI based intelligence cycle.

(c) **Chapter III : Integration of AI & Data Analytics In Armed Forces**. This chapter will briefly dwell on key requirements for integration of AI into Armed Forces, current initiatives at National and service level, proposed AI models under development by different countries and brief on generative AI.

(d) **Chapter IV : Data Collection and Analysis**. This chapter will cover how the data for analysis has been collected and also results of data analysis will be deliberated upon, thereby proving/ disproving the hypothesis.

(e) **Chapter V : Way Ahead, Recommendations and Conclusion**. This chapter will give out recommendations of the study along with conclusion.

CHAPTER II : INTELLIGENCE CYCLE - PARADIGM SHIFT

"AI will transform the way we fight and defend, improving both offensive and defensive capabilities"

- Kai Fu Lee

Intelligence Cycle

The intelligence cycle is a continuous process involving collecting, analysing and disseminating information to support decision making. The traditional intelligence cycle has been a linear process that primarily focuses on collection of data, analysis till dissemination of the finished intelligence product (refer *figure 01*). In present day context, the intelligence community is undergoing paradigm shift in the manner it approaches intelligence gathering as also analysis[9].

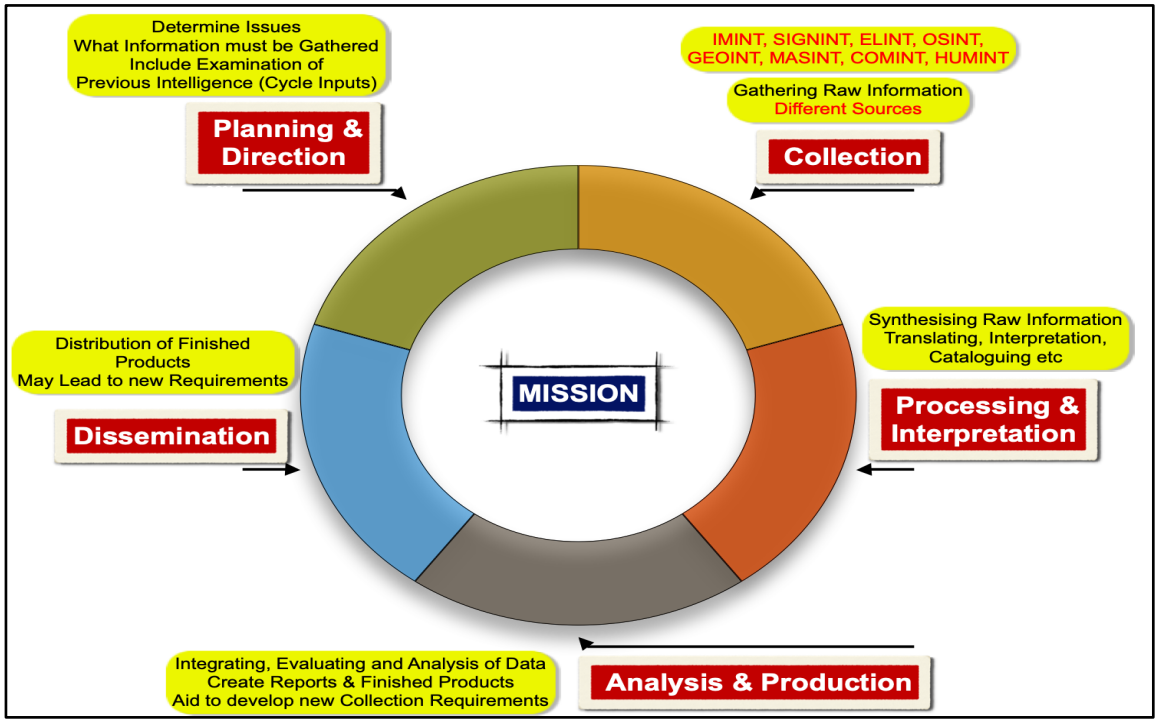


Figure 01 : Intelligence Cycle[10]

Traditional Intelligence Cycle.

(a) It starts from commander's mission and ensures that information collected is analysed and disseminated in systematic as well as structured manner. It entails planning and direction with identification & prioritisation of intelligence requirements. These phases lead to gathering of information from varied sources including Human Intelligence (HUMINT), Signal Intelligence (SIGINT), Technical Intelligence (TECHINT), Imagery Intelligence (IMINT) and Open source Intelligence (OSINT) and others in collection phase.

(b) The collected information is thereafter processed to eliminate insignificant data and converted into usable information which is subjected to further for analysis. Subsequently, examination of the data is undertaken to ascertain patterns/ trends that can provide insights into the situations being analysed. These findings are then disseminated to the relevant stakeholders through intelligence reports, briefings or other modes of communication. At final stage, feedback is collated to assess effectiveness of process and ascertain areas for improvement.

Shortcomings of Present System : Intelligence Cycle.

(a) **Linear and Rigid**. There has been criticism of traditional intelligence cycle for being rigid and linear in approach. The same may no be adequate to address the evolving dynamic and complex security challenges of the 21st century which is driven by changes in the threat environment, technological advancements, proliferation of social media & digital platforms thereby governing need for agility and flexibility in decision making.

(b) **Sequential**. The sequential and cyclical appearance of the cycle and absence of a standardised model poses another challenge. However, the orders of steps in intelligence cycle are intertwined encompassing several internal feedback loops. Thus, the cycle is better described as nonlinear operating "computer software than the prevailing metaphor of an electromechanical feedback system"[11]. The cybernetics aspect of intelligence cycle merits exploitation given availability of big data analytics tools and AI.

(c) **Changing Threat Environment**. Apart from traditional threats there are emerging threats such as cyber warfare, hybrid warfare and misinformation campaigns. These threats are relatively dynamic and continuously evolving, making it important to undertake a greater agile and bendy method for intelligence acquisition and analysis. The lopsided effect of existing intelligence cycle is that's its often attributed to be slow and bureaucratic, thus lacking in its response to rapidly evolving situational dynamics.

(d) **Multi sensor and Data Centric**. Another significant governing factor is access to more data in present day scenario of multiple and tiered sensor architecture which can inundate analysts with mountains of incoherent pieces of information and hence requires automated data fusion and processing. "In the integrated operating environment of the near-future, intelligence data will come from a multitude of sources from closed sources and open sources, from air defence radars, weapon-locating radars and maritime surveillance systems; from print media, radio, blogs and Twitter; from individual ships, aircraft and ground troopers"[12].

(e) **Time and OODA Cycle**. There has been growing emphasis of real time and quicker data collection, processing and dissemination. The availability of technologies with real time capabilities has altered the traditional approach,

thereby necessitating more agile and adaptable strategies to stay ahead in dynamic environment.

Contemporary Intelligence Paradigm

The contemporary intelligence paradigm is characterised by several key features as depicted in *figure 02*.

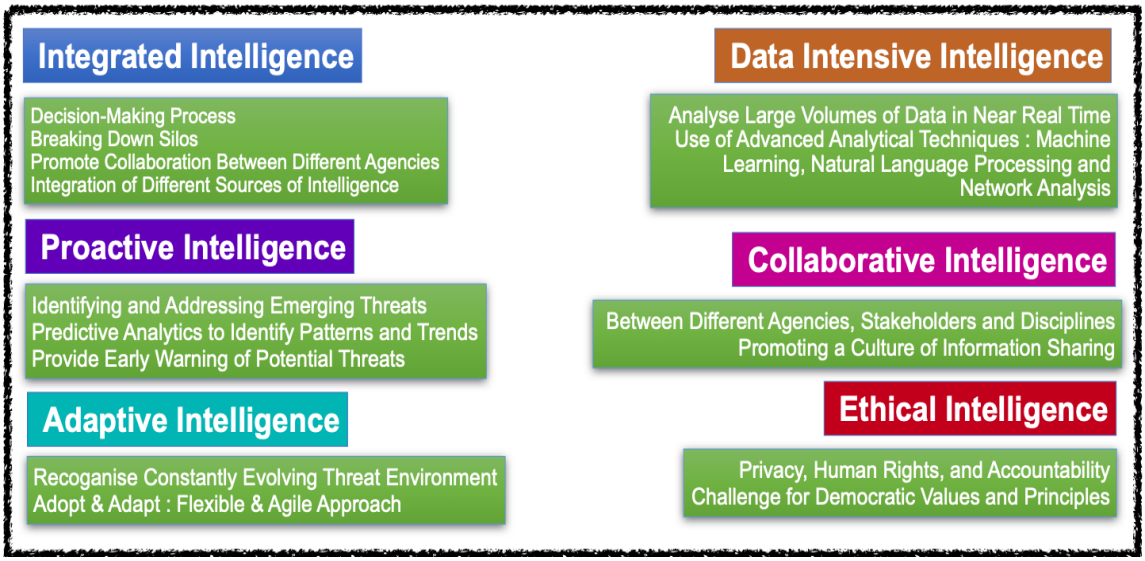


Figure 02 : Nuances of Contemporary Intelligence Paradigm

Benefits of AI in Military Intelligence. "AI is transforming the way militaries gather and analyse intelligence, providing them with new tools to better understand their enemies and protect their own forces. Some of the key benefits of AI in military intelligence include"[13]: -

(a) **Improved Speed and Accuracy**. AI systems can process mountains of incoherent data quickly as well as accurately thus facilitating military intelligence agencies to gain more precise insights. It provide systems the ability to respond at gigahertz speed thereby augmenting overall pace as also outcome of human combat.

(b) **Enhanced Situational Awareness**. AI powered sensors & alike technologies can aid military intelligence agencies for enhanced understanding of the battlefield. It can provide a more comprehensible larger picture of the enemy capabilities and intentions including detection of manipulations/ fake inputs.

(c) **Resource Utilisation**. AI systems can automate mundane tasks so that human intelligence analysts can focus on more challenging and strategic issues. Computer vision algorithms and AI can analyse data and raise alerts automatically, reducing the time taken to complete the task

manually. Employees can instead spend their time making more effective decisions based on actionable information from AI.

(d) **Reduced Risk to Human Life**. By using machines to carry out hazardous or challenging tasks, the military can minimise the risk to its people and enhance its operational efficiency. Autonomous systems operate at a higher level of efficiency and safety. They can carry out hazardous survey missions without putting their people in danger.

(e) **Decision Making and Predictive Analysis**. AI will assist military intelligence agencies in making more informed decisions and responding faster and more effectively to threats. AI can be leveraged to analyse large volumes of data to identify trends and threats, enabling faster and more precise responses to evolving battlefield conditions. In summary, AI will empower military intelligence agencies to learn more, observe more and act more quickly than ever before.

AI & Data Analytics in Intelligence Cycle.[14] Details are enunciated as under and diagrammatic representation is depicted at *figure 03*.

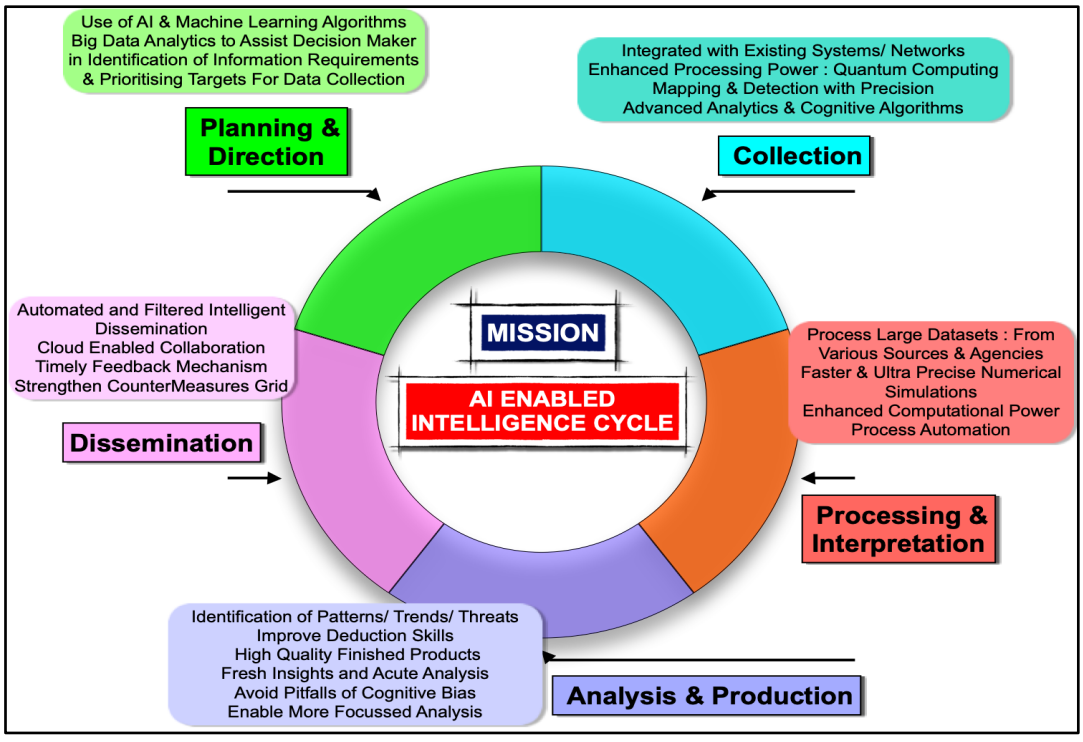


Figure 03 : Role of AI & Data Analytics in Intelligence Cycle

(a) **Direction & Mission**. Since all operations are Mission Oriented, this stage is probably less likely to be transformed by AI in the short term and may continue to remain the most human of all for the steps of the intelligence cycle. This is due to the limitations of Artificial Narrow Intelligence (ANI) which, by

definition, is focused on a narrow set of problem solving abilities in current scenario.

(b) **Collection**. Through AI, the intelligence collection stage can gain in efficiency, accuracy, force protection and cost-savings. Enhanced collection would be to exploit the possible synergy between existing technologies such as cloud computing, geo-mapping and machine learning as well as optimise the intelligence fusion model between intelligence organisations.

(c) **Processing**. Large volumes of structured, semi structured & unstructured data will be processed in near real-time with big data and data analytics as backbone having intelligent computational power. A network that leverages the work of its geographically dispersed analysts can be designed. In this model, intelligence analysts would represent the trusted sources that feed an AI system in charge of fusing the information and producing actionable intelligence. The result would then be redistributed across the network, linking together different individuals that may each possess a small portion of the answer to a bigger problem.

(d) **Analysis**. Analysis carried out by Deloitte "suggests that utilisation of AI capabilities has the potential to optimise analysts' efficiency and improve their productivity. The actual amount of time saved will vary depending on the nature of the tasks undertaken. For instance, an all source analyst who benefits from the assistance of AI-powered systems could potentially save up to 364 hours or even more than 45 working days a year (refer figure 04). These savings can free up analysts to devote more time to higher-priority tasks or build skills through additional training, among other activities"[15].

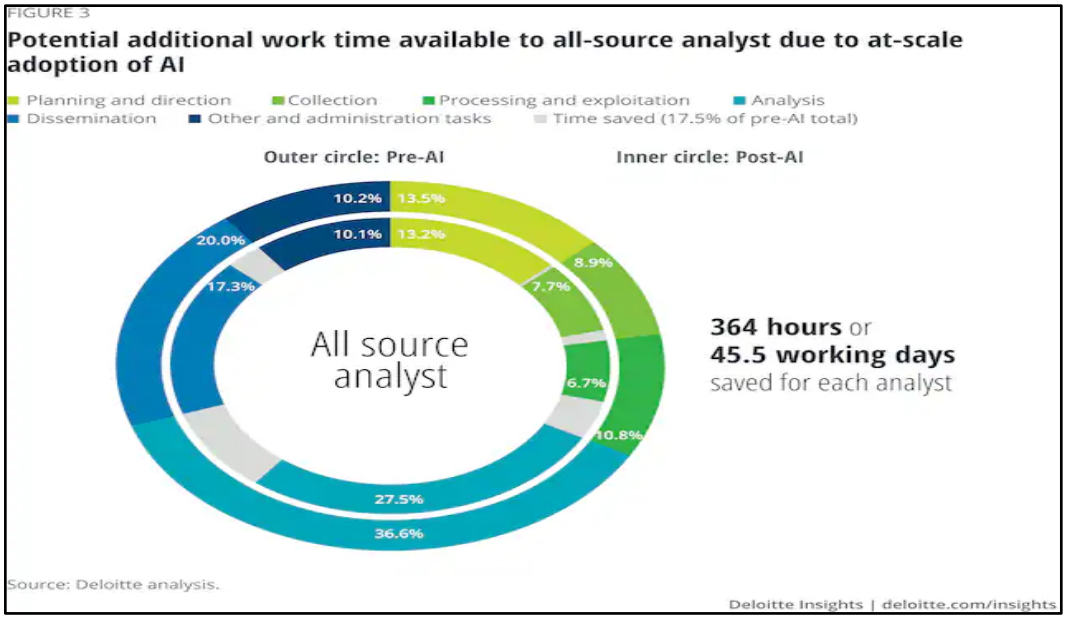


Figure 04 : Potential Additional Work Time Available to Analyst Deloitte[16]

(e) **Dissemination**. Even the best intelligence has no real value if it does not reach the intended audience in time to enable proper decision-making. Since recommendation systems and targeted advertisement algorithms already exist in the corporate world, an easy way to gain speed, accuracy and cost savings with dissemination would be to adapt and import such algorithms to the military classified systems used by intelligence operatives. The idea would be that, based on the research, production, communication and reading habits of an intelligence specialist, products, contacts or activities would be proposed by the software. This would foster professional networking and synergy within the intelligence fraternity.

The primary sources of intelligence that undergo dynamic process of intelligence cycle are given at *figure 05*.

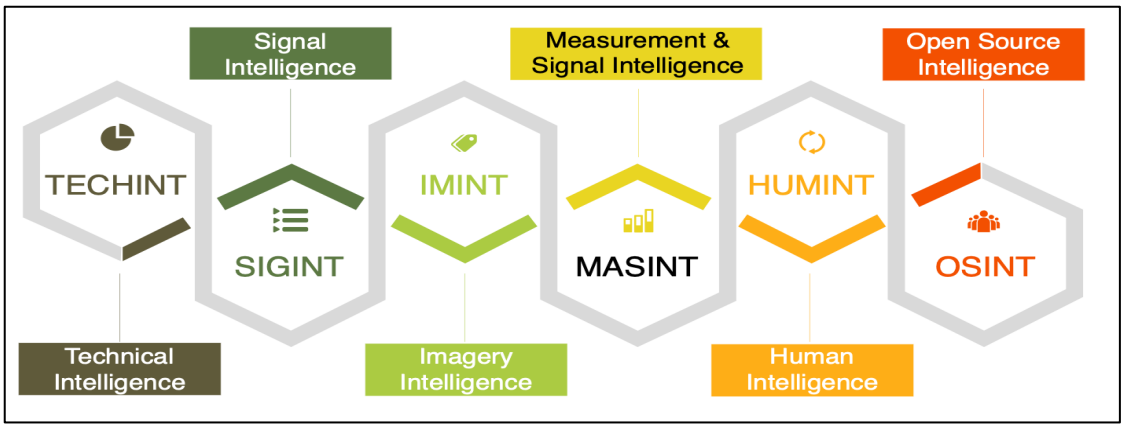


Figure 05 : Primary Sources of Intelligence[17]

CHAPTER III : INTEGRATION OF AI & DATA ANALYTICS IN ARMED FORCES

'Whichever country becomes the leader in artificial intelligence (AI) "will become the ruler of the world.'

-Vladimir Putin, Russian President

Requirements for Integration of AI. The vast field of AI aims to "create intelligent machines capable of"[18] tackling tasks typically requiring human intellect, such as processing visual information, understanding spoken language, making informed decisions and translating languages. Several approaches exist to build AI systems and the most common involves machine learning algorithms. This specific type of AI empowers computer programs to learn from vast datasets, thereby enabling system - machine module to make predictions and decisions based on their acquired knowledge. In order to effectively integrate AI into existing system, there are certain key requirements which are depicted in *figure 06* and basic AI model flow chart is depicted at *figure 07*.

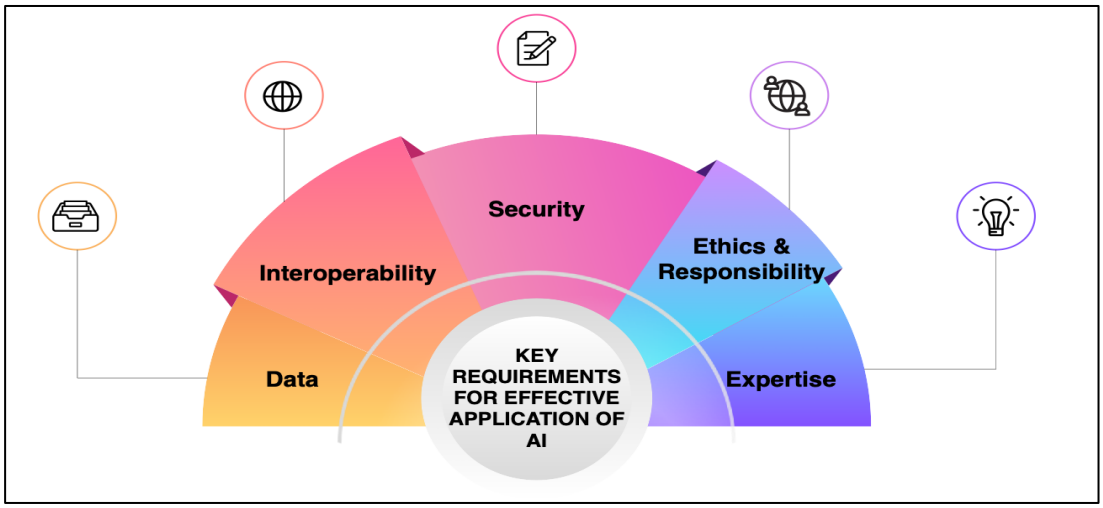


Figure 06 : Requirements for Integration of AI

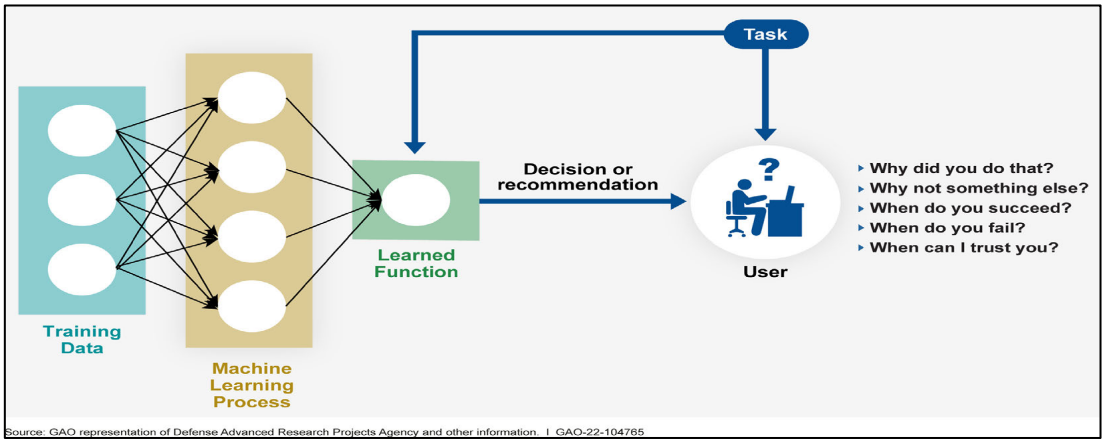


Figure 07 : Basic AI Model Development Framework

Current Initiatives : AI Adoption in the Indian Military. The initiatives at National level are attached at **Appendix 'B'** and initiatives related to military domain are summarised as under:-

(a) **Task Force 'Strategic Implementation of AI for National Security and Defence'**. "The task force was setup in Feb 2018 by the Department of Defence Production of the Ministry of Defence constituted to study the future use of AI in defence applications. The recommendations led to establishment of Defence AI Council (DAIC) and a Defence AI Project Agency (DAIPA) in 2019, headed by the Defence Minister and comprise the three service chiefs, defence secretary, National Cyber Security Coordinator, and members from the DRDO, industry, and academia. DAIC body is scheduled to meet twice a year for instituting operational framework, structural support and way ahead"[19]. Details of DAIPA are attached at **Appendix 'C'**.

(b) **Indian Navy**. "Currently, the service has several areas to consider in the application of AI, including its Tactical Data Link (TDL) system, Maritime Domain Awareness (MDA), and Combat Management. Investment in AI will be necessary to establish a credible TDL system to connect and generate interoperability among all Navy vessels widely dispersed at sea with an intention of generating greater level of situational awareness through AI for greater accuracy of combat environment. *Indian Naval Service (INS) Valsura* seeks to leverage AI by consulting several technology companies such as International Business Machines (IBM), Google, Infosys and Tata Consultancy Services (TCS) and work towards creating a Centre for Excellence (CoE) as also work on an AI and Big Data Analysis (BDA) laboratory set up in 2020. Beyond these initiatives, the Navy has signed a Memorandum of Understanding (MoU) with BEL. Under the terms of the MoU, the Navy and BEL will set up a Technology Incubation Forum (TIF) for the development of emerging technologies such as AI, Quantum Computing and Robotics"[20].

(c) **Indian Air Force**. Despite the fact that the more modern and advanced uses of AI are still in their early stages, the Air Force has taken steps towards acknowledging its applications in various fields. The Air Force is currently examining AI applications in threat monitoring, training, data and intelligence fusion and decision support. While automation is being explored, there is a level of doubt due to a lack of evidence regarding what algorithms can truly achieve. The main concern lies in how algorithms, which form the foundation of AI's ability to carry out complex missions, will adapt to unpredictable combat environments. There is uncertainty surrounding whether machines can be effectively trained to implement air combat strategies.

(d) **India Army**. The Army's adoption of AI technology has been slow. Internally, the Army has established the Army Technology Board (ATB), which was previously under the Headquarters of Army Training Command (ARTRAC) and is now under the Perspective Planning (PP) Directorate at the IA Headquarters in New Delhi. The ATB maintains a close partnership with the Indian Institutes of Technology (IITs) and Indian Institutes of Sciences (IISc), as well as

several other Research and Development (R&D) organisations, to incorporate new technologies, including AI, to meet the Army's needs. The Army's Military College of Telecommunications Engineering (MCTE) in Mhow, Madhya Pradesh, houses an AI Centre for Excellence (CoE). There are ongoing initiatives to implement AI in the Army, focusing on areas such as situational awareness, sensor fusion, faster decision-making, and autonomous weapons systems. To effectively harness the power of AI, it is crucial to reorient and introduce changes in the Army's combat doctrine, organisation and structure.

AI Models/ Projects Under Development in Field of Military Intelligence.

(a) **China**. Chinese thinkers imagine four types of future warfare where AI will play a lead role namely algorithmic warfare, mosaic warfare, joint all domain warfare and intelligentized warfare. Realising the enormous potential of AI in assuring regime survival, the Chinese government made scientific and technological advancement in this area a national priority. In July 2017 the State Council promulgated the 'Developmental Regulations on a New Artificial Intelligence Generation,' which serves as the blueprint for China's AI development[21]. The PLA Strategic Support Force's 'Intelligent Space Cup' aims to apply AI to data processing and analytics. The country has multiple private platforms and database products like '*DataEx', 'Knowfar', 'Techxcope*' and '*Kantian'* that are working under umbrella of PLA for OSINT data analytics and remote sensing.

(b) **Russia**. The first major Russian government AI proposal was the Russian Ministry of Defence's (MoD)10 point statement issued in March 2018. National Defense Management Centre (NTsUO), activated in 2014 in an effort to create a unified information space for the Russian national security apparatus might be a current location or future destination for AI. It will reportedly collect, collate and analyze information on the 'military-political situation' in the world including strategic directions and on the sociopolitical situation during peacetime and wartime.

(c) **USA**. The US Army's Project Linchpin, launched in 2022, seeks to establish a dedicated AI pipeline within the Program Executive Office for Intelligence, Electronic Warfare & Sensors (PEO IEW&S)[22]. The program aims to revolutionise the Army's approach to AI acquisition and deployment. Alongside Project Linchpin, the Army is developing "*Real-Time Threat Forecasting*," a tool designed to deliver continuous, real-time predictions of how threats might evolve in dynamic battlefield situations within minutes to hours.

(d) **United Kingdom**. The Defence AI & Autonomy Unit (DAU) was established in 2018 with the aim of assisting the department in swiftly adopting these technologies. Its primary focus is on strengthening the DAU, forming a multi disciplinary Operational AI task force and identifying and addressing crucial policy and legal considerations that are relevant to the timely adoption of AI in Defence. Details of EX SPRING STORM exercise conducted in May 2021, the utilisation of the KILPECK program working on Sensing for Asset Protection with

Integrated Electronic Networked Technology (SAPIENT) network is attached at **Appendix 'D'**.

(d) **Private Companies**[23].

Sno	Company & Product	Product Description
(i)	SAAB : Information Fusion System (IFS V2)	IFS V2 system is a flexible, scalable and modular IT system to support the processes of aggregation of information from intercepts to intelligence reports. Embedding of commercial standard solutions for processing and analysis of contents is optionally possible and provided.
(ii)	North Grumman's Justified Confidence Models	In order to continue building AI based products for Department of Defence, USA, it has to align with ethics and principles devised. It is in process of developing '*Justified Confidence*' models.
(iii)	Thales, Multi Sensor Image Interpretation and Dissemination System (MINDS), Networked Image Exploitation System (NIES) and Digital Mapping Tool (DMPS)	MINDS enables data production for recce, surveillance and targeting by real time data acquisition. NIES gains picture of battlefield encompasses all types of light wavelengths, allowing for the sharing of resources and situational awareness. DMPS process images and create 3D object extraction.

(e) Take Aways from ibid world scan are summarised in figure 8 below:-

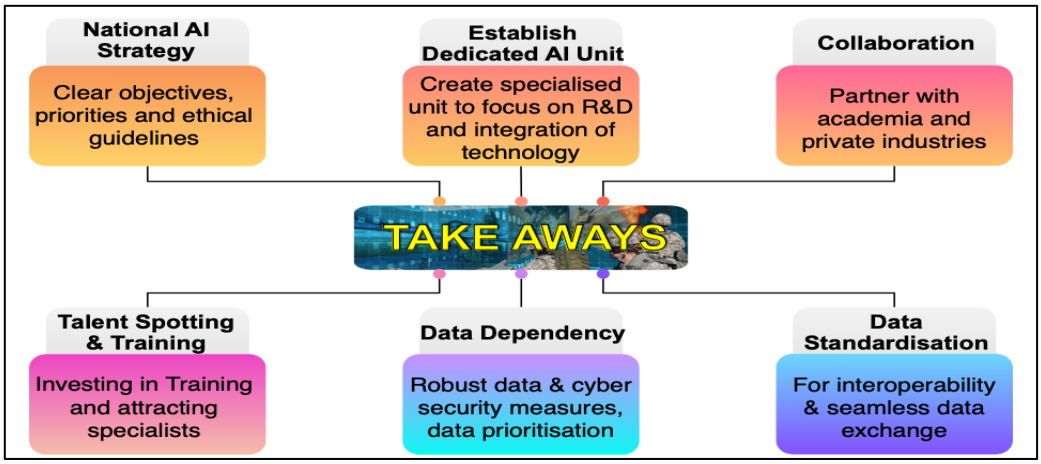


Figure 08 : Take Aways - Global AI Initiatives

Current Limitations of AI in Context of Military Intelligence. Even with the incredible advances over the past few years, the current approach to leveraging AI for multi-domain operations is still limited in its ability to provide decision makers with real-time situational awareness and to respond quickly and accurately to imminent activities or threats. The Intelligence Community (IC) Challenges include:-

(a) **Data Complexity & Structuring**. Increased volume and velocity as well as an ever increasing complexity of variety of data poses challenge to acquire, manage, correlate, fuse and analyse data across agencies.

(b) **Formats**. Data in the IC are generated in too many diverse formats, in too many disconnected or inaccessible systems, without standardised structures and without overarching agreed upon ontology. This situation risks wasted collections, lack of timeliness, missed indications and warnings and lack of relevance for decision making. The result is an inability to fuse data to create multi sourced intelligence as early in the intelligence cycle and as close to the point of collection as possible.

(c) **Cumbersome Process & Timely Analysis**. Analysts are given a task too difficult, too cumbersome and with too many hurdles too clear to provide timely and relevant analytic judgments or actionable intelligence to policymakers and warfighters.

(d) **Challenges**. In order to mitigate above, four major challenges faced are highlighted as listed in *figure 09*.

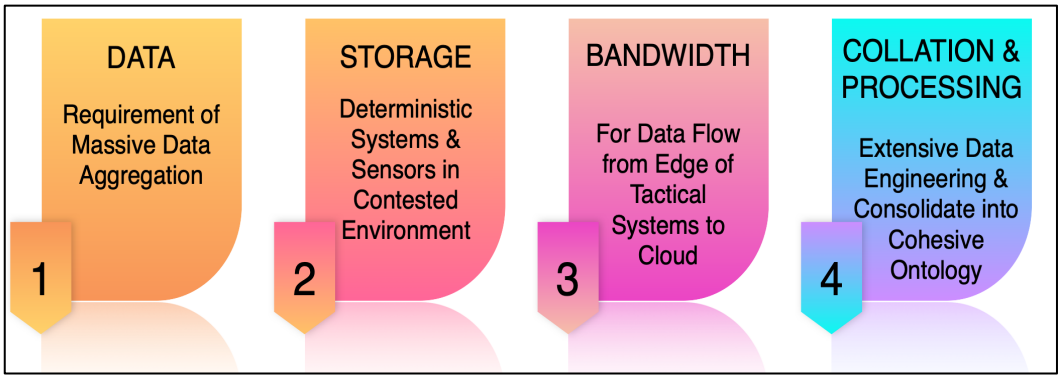


Figure 09 : Four Major Limitations For AI in Context of Military Intelligence

Implementation Plan : AI in Indian Armed Forces. The global artificial intelligence market size will be valued at $97 billion by 2023 and is expected to grow at a CAGR of over 19% over the forecast period[24]. For effective implementation of AI, steps to be taken will have to be at the level of the Chief of Defence Staff (CDS) and the HQ IDS so that a joint service approach can be adopted. These steps include the formulation of an AI strategy, creating organisational structures, and bringing in new processes[25]. The details of the road map proposed is attached at **Appendix 'E'**, major heads are mentioned in *figure 10* below.

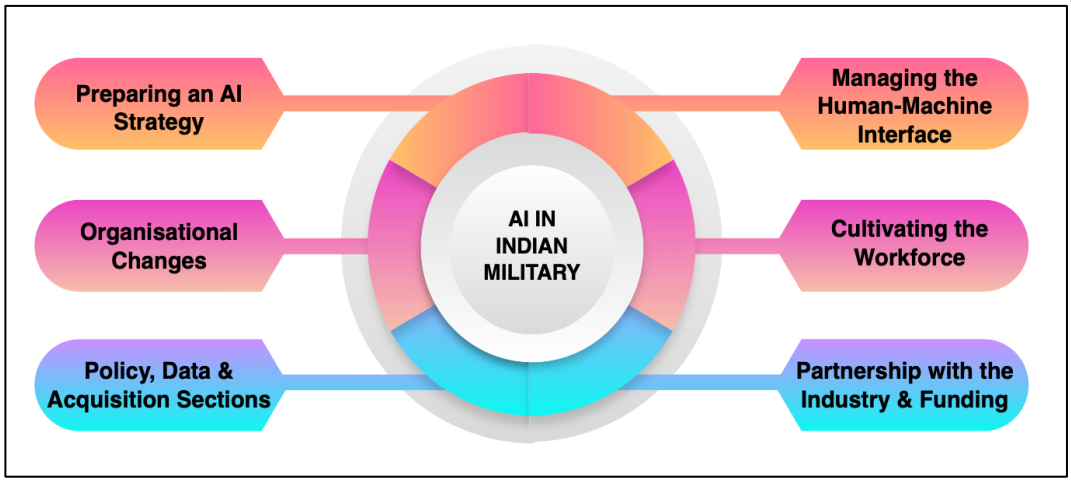


Figure 10 : Road Map : AI Implementation in Indian Armed Forces

Generative AI. Another example is natural language processing for intelligence analysis. Applications like ChatGPT could be trained on a dataset of intelligence reports and other relevant text and then automatically generates summaries of the information contained in the reports or to identify key pieces of information that may not be immediately obvious. The ways in which this disruptive technology can be exploited in military intelligence domain is summarised in *figure 11.* Though there are certain potential disadvantages like lack of context, bias of data set on which its trained, security concerns, limited autonomy as its presently not developed for independent reasoning and data intensive.

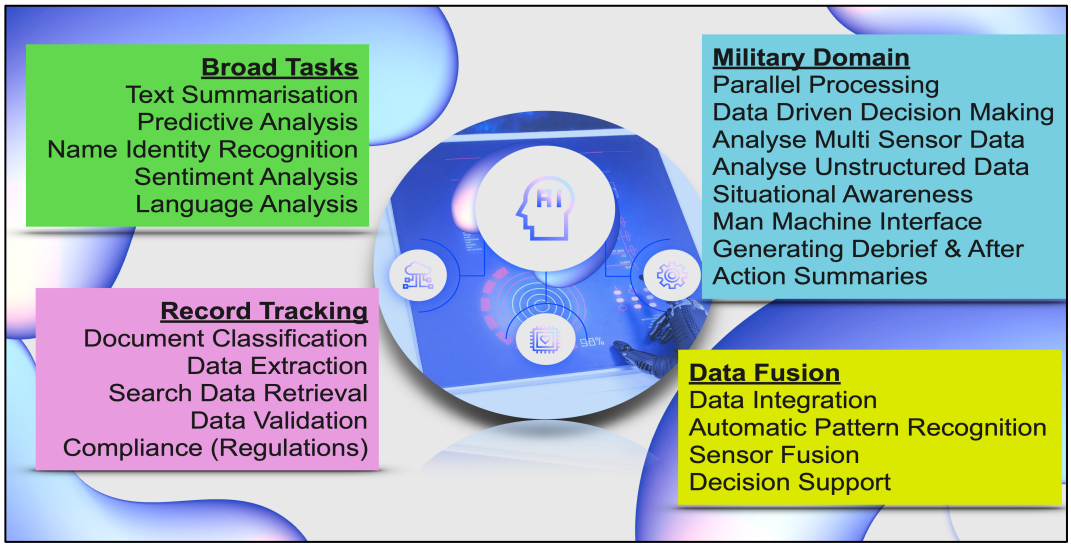


Figure 11 : Generative AI Applications in Military Domain (Intelligence)

CHAPTER IV : ANALYSIS OF DATA

Preamble

Purpose of Study. The objective of this study is to analyse integration of AI & data analytics with framework of Indian military intelligence (intelligence cycle) and its impact on synergy, interoperability & real time data sharing between multiple intelligence agencies at National level.

Hypothesis. Integration of AI & data analytics with framework of Indian military intelligence will strengthen process of intelligence cycle as well as aid in achieving enhanced synergy, interoperability & real time data sharing between multiple intelligence agencies at National level.

Data collection Technique. As part of mixed method research, both approaches, qualitative and quantitative have been followed.

(a) **Primary Data**.

(i) **Quantitative**. The questionnaire was structured using the Likert scale to enable statistical analysis of the obtained data. The response was obtained via google form.

(ii) **Qualitative**. Interview of SMEs having requisite domain knowledge was conducted. The interview was conducted in form of online questions/ interview guide in an interactive manner.

(b) **Secondary Data**. Analysis of secondary data was carried out using books, articles, journals, research papers, dissertations, open source literature on the internet.

Sample Overview.

(a) **Quantitative Data Collection**. As part of the questionnaire survey, the data has been collected from 212 respondents spanning across three services.

(b) **Qualitative Data collection**. The details of qualitative data collected from SMEs is listed in *table 01* below:-

SNo	Name	Expertise
(i)	Mr Rajat Pandit	CEO, Google Cloud India
(ii)	Mr Kundan Krishnan	Additional NSA, National Security Council Secretariat
(iii)	Brig A Shridhar	MCTE

Table 01 : List of Interviewees

Primary Data.

(a) **Pilot Survey Analysis**. Pilot Questionnaire (Refer to Questionnaire at **Appendix A**). The questionnaire comprised of 16 questions spanning across three constructs and also included an open ended suggestion box towards the end. All the questions were based on Likert scale (1 to 5) with under mentioned design (*table 02*).

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

Table 02 : Likert Scale

(b) **Questionnaire Design**. A total of **212 respondents** across tri services including retired service personnels was obtained. The questionnaire comprised of questions related to service bracket, arm/ service, association with AI related projects, knowledge about military intelligence and knowledge about AI & Big data analytics. Refer *table 03*.

Ser No	Demography Variable	Aspect
1	Demography Variable 1	Service Bracket
2	Demography Variable 2	Arm/ Service
3	Demography Variable 3	Association with AI related Projects
4	Demography Variable 4	Understanding of Military Intelligence
5	Demography Variable 5	Understanding of AI & Big Data Analytics

Table 03 : Sample Selection

Demographic Variable 1 : Service Bracket (DV 1). Refer *figure 12*, the service distribution - based population grouping has been presented. It has been found that, **0.9%** of the total participants in the main survey are upto 7 years, **35.4%** are between 7 to 13 years, **32.5%** between 13 to 20 years of service and **25.9**% of the total participants in the main survey are above 20 years of service.

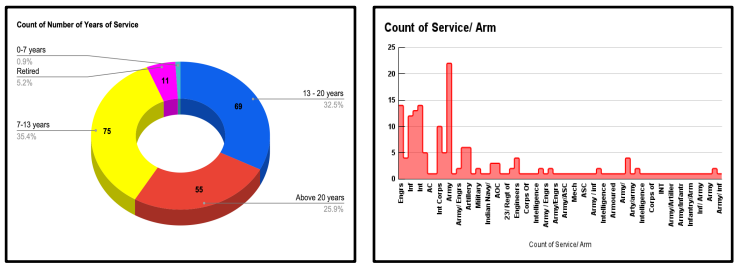


Figure 12 &13 : Demographic Variable 1 (Service Bracket) & Demographic Variable 2 (Arm & Service)

Demographic Variable 2 : Arms & Service (DV 2). Refer *figure 13*, the responses received from individuals of various arms and services (those who furnished details) were analysed.

Demographic Variable 3 : Association With AI Related Projects (DV 3). Refer *figure 14.* Out of total respondents **71.2% (151)** have not been associated with any AI related project and approx **28.8% (61)** have been associated with AI related projects in some way or other.

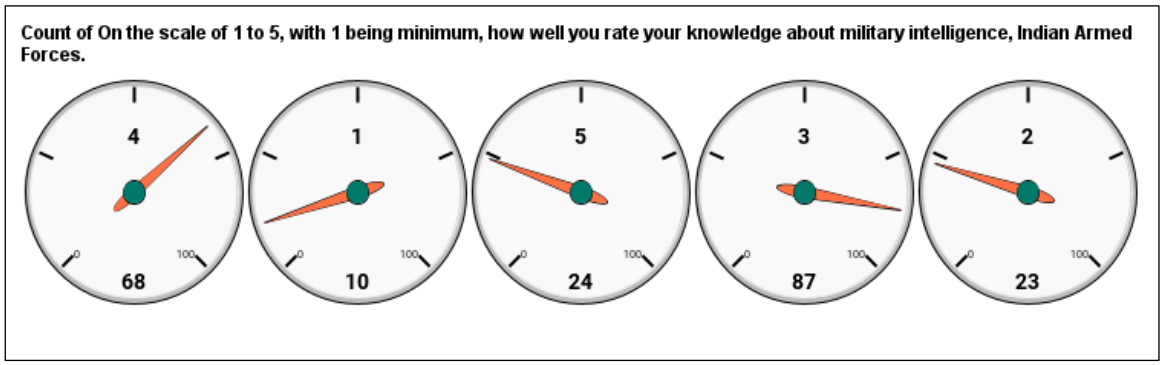


Figure 14 : Demographic Variable 3 (Association With AI Related Projects)

Demographic Variable 4 : Understanding of Military Intelligence. Refer *figure 15.* On scale of 1 to 5, with 1 being oblivious or minimal knowledge and 5 being fully aware, a total of **23 (11%)** respondents scored themselves as five, **68 (32%)** as four, **87 (41%)** of them as three and **23 (11%)** of them as two and **10 (5%)** as one with minimal knowledge.

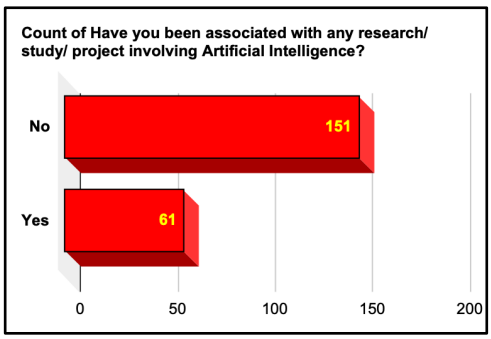


Figure 15 : Demographic Variable 4 (Understanding of Military Intelligence)

Demographic Variable 5 : Understanding of AI & Big Data Analytics. Refer *figure 16.* On scale of 1 to 5, a total of 14 rated their knowledge of AI as one being minimum, 51 rated as two, 94 (maximum) rated as three with reasonable awareness, 44 rated their understanding as fairly adequate and 09 with maximum understanding/ awareness.

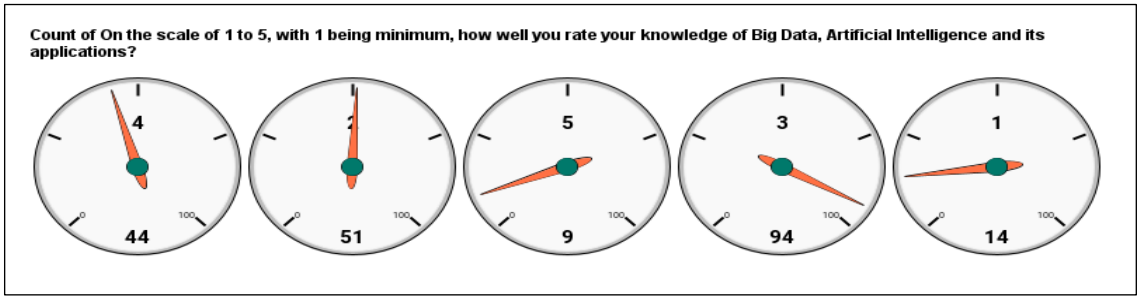


Figure 16 : Demographic Variable 5 (Understanding of AI & Big Data Analytics)

Quantitative Analysis

The datasets have been analysed on the parameters mentioned below and question wise analysis is given at **Appendix 'F' (NOT ATTACHED)**.

(a) **Google Poll**. The google poll percentages and figures have been analysed that give a broad overview of the responses collected from 212 persons.

(b) **Statistical Data**. Three demographic variables namely 1 to 3 have been scrutinised in under mentioned format and thereafter **median method** has been applied to extract the percentages of datasets.

Overall Summary of Quantitative Analysis.

(a) **Intelligence Cycle & Data Management**. It is inferred that AI & Data Analytics have been recognised as an essential to be dovetailed in intelligence cycle steps of collection as well as dissemination having better accuracy and less time penalty and incorporating AI with various steps of intelligence cycle can accrue benefits by not only managing unstructured data but also decreasing possibilities of oversight. The processing power and ability to sieve through multiple datasets gives AI leverage over traditional methods adopted for collation, synthesis and dissemination of information. Thus AI based system can lead to expediting steps of intelligence cycle that are otherwise time consuming and labour intensive.

(b) **Enhance Interoperability**. In the present day context, intelligence agencies are criticised to function in vertical silos. AI, hence is being looked at one of the plausible options that can bridge the existing gap thereby ensuring a seamless and updated intelligence picture at apex as well as tactical level. There is thus a requirement to design a model or plan to practically execute the concept for our organisation.

(c) **Infrastructure Requirement**. It is apparent from the response of poll that intelligence mechanism in vogue is somewhat able to handle the data inflow however merits upgradation to be effective, specially in backdrop of increased multi sensor - data environment. Also, in order to have real time information dissemination & flow, there is a requirement of increased bandwidth and commu-

nication architecture supporting the same. AI is likely to enhance accuracy & reliability, for which a robust infrastructure in terms of software and hardware including dedicated clouds are required.

(d) **Cost Effective**. Majority respondents agree that AI and big data will prove to be cost effective once developed and adopted by the system. It will enhance the mechanism of intelligence operations.

(e) **Training & Subject Matter Experts**. There is need for training manpower in field of emerging technologies and at national level along with creating pool of experts that can prove to be instrumental in designing future road map for organisation, backbone of which rides on AI and data analytics.

(f) **Cognitive AI**. It is essential to explore options and carry out research & development in fields of Artificial Super Intelligence (ASI)/ Cognitive Computing which can analyse subjective data in addition to metric scale binary data.

(g) **Environment & Technical Challenges**. In addition to upgradation of present infrastructure, there exists environmental and technical challenges resent organisational framework that may impede AI's integration.

(h) **AI as an Aid**. Upon pattern analysis of responses, it emerges that as far as intelligence corps respondents are concerned, AI is indeed being viewed as a force multiplier however, is not recommended to be considered as one stop solution. Complete reliance and automation may lead to cognitive errors.

(j) **AI as Countermeasure**. Majority of senior officers of Indian Armed Forces see AI as potent tool to evolve countermeasures to fight against grey zone, hybrid, asymmetric and cyber warfare. This re-emphasises the importance of evolving AI for both kinetic as well as non kinetic domain.

Quantitative Analysis

Interview -1 : Mr Rajat Pandit. He is the current CEO, Google Cloud India and was interviewed in person during his visit to DSSC, Wellington on 05 Dec 23. The interview script is attached at **Appendix 'G' (NOT ATTACHED)**.

(a) The answers given by SME were primarily focused on civil aspects of AI, however few deductions & parallels can be drawn based on his views that find relevance in military domain.

(i) **AI for Real Time Threat Assessment in Military Intelligence**. AI can be utilised for anomaly detection, regular data updation and time series analysis.

(ii) **Correlation between AI modules and Big Data**. Training to be conducted on large datasets available. This data can be used to carry out histogram and entity analysis as regards information gathered from varied

sources. The softwares that convert voice into text, NLP can also be exploited.

(iii) **Role of AI in Optimising Dissemination of Intelligence**. It can be utilised for structuring the voluminous data, populate attributes of respective information, carry put pattern analysis by adopting 'data clustering strategy'. Like civil sector has various social media platforms based on different requirements/ purpose, similarly tailor-made platforms can be there for dissemination of information to concerned stakeholders.

(iv) **Regulatory & Proprietary Concerns**. Since AI is based on neural network, it can be designed and later ingested into military closed network without compromising security.

(v) **Recommendation for Making Organisation AI Ready**. There is a requirement to formulate '*Enterprise Architectural Team*' that can formulate strategy and road map for future. The development can follow *hub & spoke model*, where research is at hub (central level) and innovation can be undertaken at spoke level.

(vi) **Fully Autonomous System (Human out of the loop)**. There has to be human supervision and a system for reinforcement learning to address anomalies and skewed patterns, which relates to making system autonomous by with human override.

(vii) **Data Collection**. A mechanism needs to be devised for collection of data for enable machine learning. The data can be standardised and any deviation can be easily identified.

(b) **Analysis**. The major takeaways include:-

(i) AI can be integrated in closed network of military organisation and there is requirement to institute a core group that focuses on incorporating AI into present framework.

(ii) There is need to carry out data structuring to enable machine analysis that can later carry out time series analysis, predictive analysis and pattern analysis.

(iii) AI systems need to have human in the loop[26] for supervision.

Interview -2 : Mr Kundan Krishnan. He is tenanting appointment of Additional Secretary, National Security Council Secretariat (NSCS) and was personally interviewed during his visit to DSSC, Wellington on 07 Dec 23 script of which is attached at **Appendix 'H' (NOT ATTACHED)**. The aim of interviewing ibid personality was to gain insight into the thought process as regards AI at apex level. The interaction was short and analysis is as under:-

(a) Present infrastructure does not have capacity & bandwidth for integration of AI - multiagency coordination & synergy. This aspect substantiates the views expressed by respondents.

(b) There is requirement of a nodal agency at national level and presently AI projects are underway at NSCS, however no major deals divulged due to information pertaining to different department and being classified in nature.

Interview -3 : Brig Shridhar, MCTE. He is heading the Centre of Excellence Cell for AI at Military College of Telecommunication engineering (MCTE) and was personally interviewed during his visit to DSSC, Wellington on 19 Dec 23 script of which is attached at **Appendix 'J' (NOT ATTACHED)**. The aim of interviewing ibid personality was to gain insight into the thought process as regards AI initiatives in armed forces and challenges being faced. The analysis is as under:-

(a) **Data**. AI can assist in process of data collation from varied sources, however in order to have a comprehensive seamless integration, we need to have systems of systems approach.

(b) **Funds vs Trained Manpower**. It emerged that more than funds the concern is having dedicated and trained manpower.

(c) **Projects Under Development**. Presently three institutions are in nascent stages of project development in Indian Army. There exists an option to incorporate third party or indulge in collaborative effort for same. The fields of AI in IMINT interpretation, computer vision, natural language processing are being exploited. He highlighted three major challenges namely 'Data', 'Computing Power' and 'Infrastructure' being faced in present scenario.

(d) **Apex Body**. As per SME, we already have multiple verticals functioning in field of intelligence and hence there is no requirement of creating a new organisation/ headquarter for same. The Joint Working Groups are already in place and the existing mechanism can be empowered.

Overall Summary of Qualitative Analysis.

(a) AI with big data as well as robust architecture (infrastructure) as foundation, can be used in field of Military Intelligence by evolving systems of system. AI can indeed undertake multifaceted roles, which otherwise are being performed by humans, however complete autonomy is not suggested.

(b) Concern regarding security of data can be addressed and there is no significant financial constraint. What emerges is the requirement of dedicated as well as trained professional manpower who can deliver products aligned with military requirement.

(c) There is requirement of constituting a dedicated core group that handles AI related research and development; however we may refrain from creating another

vertical. The need of the hour is to have concerted actions to embrace this technology of future in multi domain warfare environment.

Validation of Hypothesis

Comments. The two quantitative and qualitative data analysis offer complementary perspectives on AI in military intelligence, highlighting its potential benefits while acknowledging the challenges (refer figure 17). Significant points of convergence that substantiate as also contribute in validating the hypothesis is amplified as under:-

(a) Both analyses acknowledge the benefits of AI for faster, more accurate intelligence processing and analysis.

(b) Human expertise and training remain crucial for responsible AI implementation and avoiding over reliance.

(c) Upgrading infrastructure and addressing security concerns are essential for successful AI integration.

(d) AI has the potential to enhance information sharing and interoperability within intelligence agencies.

(e) AI research and development should explore both data-driven and cognitive capabilities.

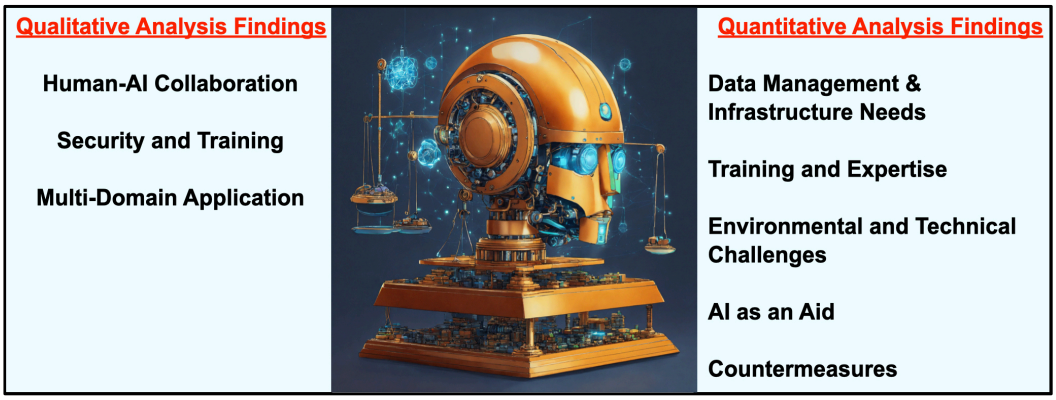


Figure 17 : Summary of Findings

Hence, from the valuable inputs received from the respondents, data analysis and inferences carried after qualitative and quantitative analysis, it is established that the hypothesis 'Integration of AI & data analytics with framework of Indian military intelligence will strengthen process of intelligence cycle as well as aid in achieving enhanced synergy, interoperability & real time data sharing between multiple intelligence agencies at National level' formulated was correct.

CHAPTER V : WAY AHEAD & RECOMMENDATIONS

Recommendations : National Level.

(a) **Evolving AI Road Map 2047**. There is a requirement to evolve an AI strategy that will provide a strategic **roadmap 2047** for AI development with **mid term goals set in year 2035**. The strategy to encompass goals, objective and designing systems of system in where AI can be optimally exploited, the scale of application including organisational restructuring and security/ ethical issues.

(b) **Partnership & Industry**. Unlike countries like USA, China, Russia, Japan, there has been relatively less impetus as also participation of the private players/ industry in military sector. However, this trend is now changing, as private sectors including startups are now developing solutions to the problems (listed as part of IDEX). **A directorate responsible for AI** needs may be constituted to identify and engage with such private sectors. The concern of intellectual property rights (IPR) (security) for AI applications which is a contentious matter needs to be addressed by balancing the interests of both the military and the civilian industry.

(c) **Finances**. The world is heading towards Human Machine Teaming and autonomous platforms, backbone of which is AI. The future multi domain warfare is likely to be disruptive in nature, hence keeping pace with technological advancements is necessary. The Indian military has assigned $50 million (Rs 400 crore) to AI spending each year. Though a good step, but minuscule when compared to China which is spending more than 30 times this amount. It is suggested that **dedicated budget for R&D and procurement** be allocated in forthcoming budget 2025-26.

Recommendations : At Organisation Level.

(a) **AI Workforce**. Skilled manpower in AI domain is need of the hour that may entail enrolling talent from the private industry and creating niche for intelligence corps personnel (and those who are associated) with domain specialisation. A **curated training program for Tri Services soldiers**, **Junior Commissioned Officer as well as Officers** to be formulated to ensure that the workforce keeps pace with AI developments. A **curriculum can be designed** and conducted at **Military Intelligence training School and Depot** in conjunction with other Category A establishments like College of Military Engineering, Military College of Technical Engineering and Indian Navy (those who are currently involved in AI development projects).

(b) **Upgradation of IT Hardware (HW) and Software (SW)**. In order to function optimally, there is **requirement of overhaul of IT HW & SW** that can be integrated with AI trial models and final systems (designed). This needs to be worked by Information Security branches and Signals Corps/ department of three services.

(c) **Collaboration**. Collaboration with start ups with partial funding/ provision of infrastructure for tailor made products is recommended to develop customised products for closed defence network/ environment. The IITs have already been working in this direction and other institutes like Indian Institute of Science Bangalore, **Indian Institute of Remote Sensing, Dehradun** and **Birla Institute of Technology and Science, Pillani** etc may be **incorporated**.

(d) **Communication**. Robust communication backbone and common platform for all services for information and intelligence sharing has emerged as one of the crucial requirements. The existing projects & **Network For Spectrum** including **5G NW** can be **leveraged** for same thereby streamlining intra & inter service cooperation as well. It is highlighted that all intelligence agencies, despite having AI systems/ models will continue conducting analysis independently so as to obviate oversight and maintain redundancy.

(e) **Training**. **Mandatory exposure** to AI and ML in **short term courses/ curriculum** and **dedicated capsule in long term courses** in Armed Forces needs to be introduced. **Training with Friendly Foreign Countries** (FFCs) in technological domain while conducting operational physical training to learn best practices can be introduced wherein selected officers/ soldiers to undergo courses/ cadres.

(f) **Data Cell**. Data structuring for initial phases require sieving through voluminous data for developing machine learning. Development of AI systems for IMINT, for SIGINT, for OSINT etc with an overarching system of system that integrates them all as one entity is required. This will provide effective analysis and collated intelligence picture. The **algorithm of entity to be enabled with predictive analysis** to evolve multiple plausibility/ scenarios that can emerge or be encountered as a result (similar to game of GO). This **merits creation of a Data cell at Command and Corps Level integrated with representatives of intelligence and operations branch** in near future.

(g) **Accessibility & Dissemination**. By all formation headquarters from command **till Division** ensuring real time updation during active operations and periodic updation during peace time. For dissemination of information, **space can be provided on existing Army web pages or Defence communication Network**, that works akin to commercial **applications providing 'pop ups'/ notifications having various colour codes** for information for routine, important and critical nature.

(h) **Analysis**. Using **historical data** carrying out **trend analysis** for enabling scenario building and carrying out predictive analysis. For example AI can be used in field of interpretation of satellite imagery wherein machine learning can be done based on archival data and AI modules are trained accordingly. However, the model designed will have to factor aspects of type of adversary being analysed, terrain, equipment profile (for dimensions and identification), training patterns etc. On similar lines, data of signal intercepts, HUMINT, ELINT

and other subjective reports can be analysed. The field where effort should be concerted is the analysis of subjective reports (articles).

(j) **Integration of Systems of Systems**. For effective intelligence picture to emerge, all facets of AI (cognitive domain) needs to be employed in tandem. For example customised **NLP AI model integrated with SIGNINT** can be employed on **eastern border (Sikkim) that can differentiate between Dzongkha, Mandarin and Tibetan dialects**.

(k) **Test Bed**. The initial trials can be conducted in **Northern and Eastern Command**. Though it has emerged during the study that there is no requirement of creating a new organisation, however, a **nodal umbrella agency is recommended to be nominated** with representatives of tri services as well as civil IT sector.

(l) **Red Team**. Akin to red team, there is need to have a body that ensures veracity and correctness of data so that data outputs generated in unbiased and not exaggerated. This function can be performed by a '**Data Validation Team**'.

(m) **Counter AI Technology**. To ensure Human in the Loop and guard against ethical concerns, there is requirement to **simultaneously invest in development of technology to counter threats** emanating from AI and its spinoffs.

Recommendations : AI in Military Intelligence Cycle.

(a) **AI Modules**. Customised AI models needs to be evolved as per user requirement and constraints that can be used for data collection, collation, analysis, synthesis and dissemination.

(b) **Training (Domain Specialisation)**. Intelligence analysts need to be trained on how to recognise attempts by an adversary to use altered or manipulated data, including understanding how to use AI to maximum advantage to prevent even the more sophisticated influence operations from affecting desired operational outcomes. Rapid data access requires effective data management, which calls for new skill sets and expertise, such as data architects and data scientists.

(c) **Database**. Concerted efforts should be made to digitise the datasets available within organisation and in open domain in structured form. This entails having dedicated servers and robust hardware as well as software architecture. Network access across all security domains, access to all relevant data types and agile integration of disruptive technologies are key to achieving and sustaining decision advantage. Handling voluminous data also assumes importance that needs to be shifted to generate intelligence of value.

Recommendations : Proposed AI Systems. The proposed architecture for AI systems/ models is depicted in figure 18:-

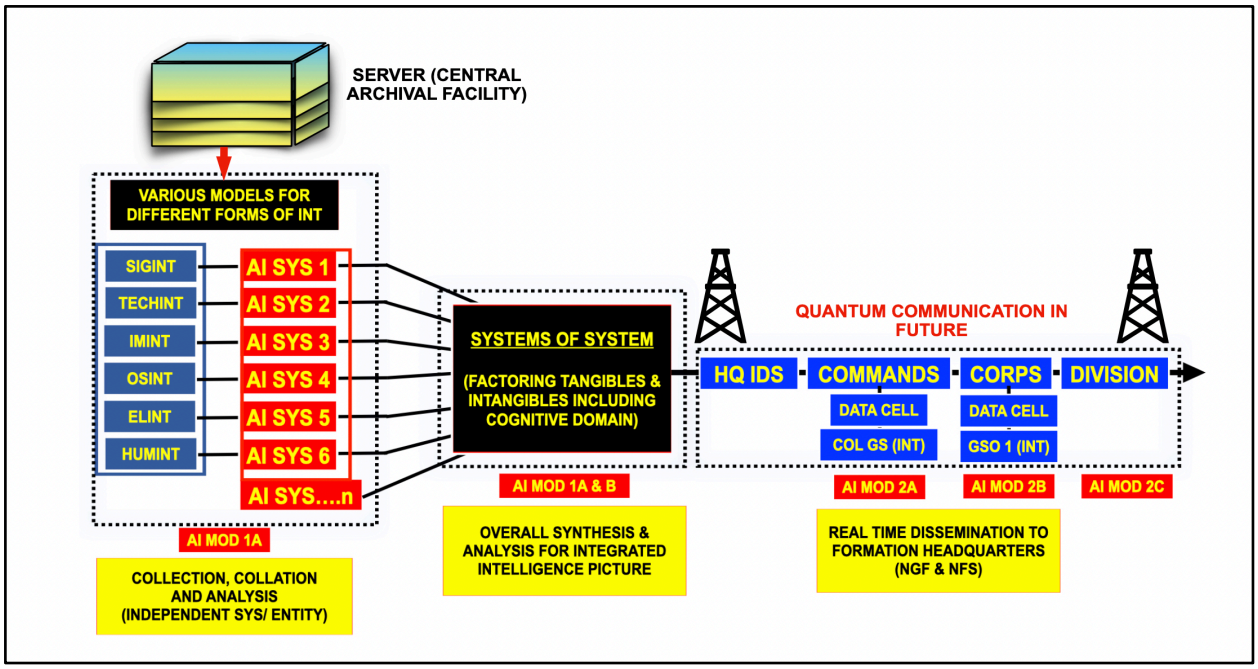


Figure 18 : Proposed AI Systems & Their Integration

Recommendations : Proposed Organisational Architecture. Upon qualitative and quantitative analysis, it emerges that formulation of 'Enterprise Architectural Team'/ Directorate looking into aspects of AI is recommended to be set up at HQ IDS or NSCS level. The directorate can be headed by a rank of Major General or equivalent under whom two Brigadiers function, with one handling op int wing and data lab/ archives and another controlling policy & training, research & development & finance section functions. These wings are recommended to have subject matter experts from Tri Services as well as civil domain. *It is highlighted that though the scope of dissertation is 'AI & Data Analytics', the directorate proposed may incorporate verticals for 'Quantum Computing' as well*. Recommended organogram of AI directorate is given at figure 19 and details are listed at **Appendix 'K'**.

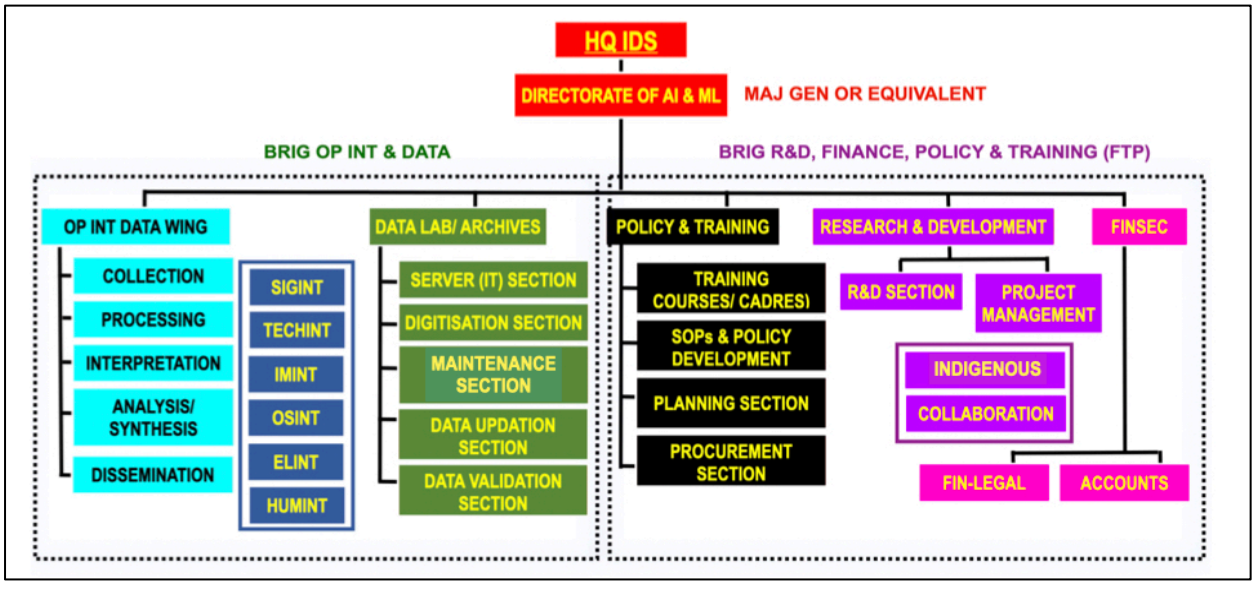


Figure 19 : Proposed Organogram for AI & ML Directorate at HQ IDS Level

Future Areas of Research. After carrying out ibid research, certain offshoots of topic that merit research subsequently are enunciated as under:-

(a) **AI & ML Training**. It's vital to research and propose structure of an institute amongst the Tri Services that will undertake training of manpower in future. In my research, MINTSD has been proposed as one of the suitable institute. Due to the strides made by Indian Navy in field thus far, it also presents self as a suitable contender for same.

(b) **Organisational Structure for Disruptive Technology**. The model recommended above focuses primarily on AI & ML. However, in today's fluid and ever evolving technological environment, there is a need to formulate an overarching directorate and agency that can deal with disruptive technologies and niche technologies like quantum communication.

(c) **Counter AI Technologies**. A research is recommended to be conducted in field of 'counter AI technology' so as to simultaneously evolve counter measure and address ethical concerns.

Conclusion. Present Russian President Vladimir Putin states "*Whichever country becomes the leader in artificial intelligence (AI), will become the ruler of the world*". The deployment of AI in India's military intelligence holds immense potential to revolutionise nation's defence capabilities. With AI-driven systems analysing vast datasets, identifying patterns, and predicting potential threats, the intelligence cycle has become more proactive and agile. The real-time insights provided by AI enhance situational awareness, allowing for more informed and timely decision-making. Looking ahead, the strategic integration of AI technologies is poised to be a force multiplier, providing India with a competitive edge in addressing complex security challenges. As AI continues to advance, its role in military intelligence will be pivotal, shaping the future landscape of national defence and security in India.

Appendix 'A'

QUESTIONNAIRE FOR GOOGLE SURVEY (QUANTITATIVE ANALYSIS)

A questionnaire comprising of 16 questions was prepared floated in the environment, primarily targeting service personnel from different arms and services of Armed Forces, both retired and serving. The questionnaire was prepared on 'Likert Scale' being 'strongly agree', 'agree', 'neutral', 'disagree' and 'strongly disagree'. It aimed to ascertain the thought process of target audience as regards integration of AI into military intelligence. The questionnaire is tabulated below.

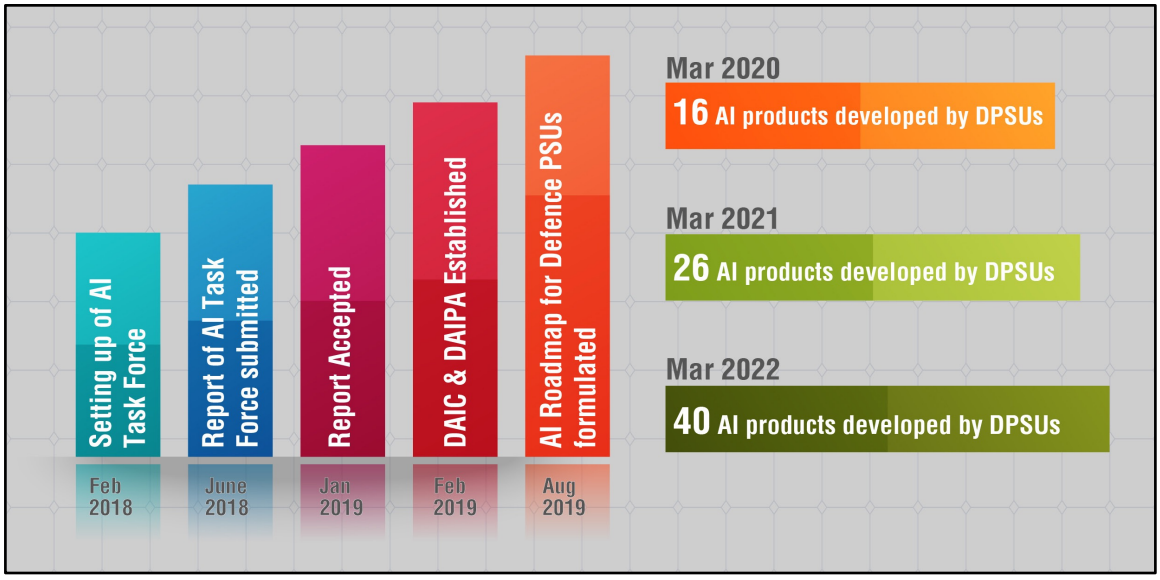
Ser No	Statement	Response (Details not attached)
1.	Integrating AI and Data Analytics would lead to more accurate and timely generation of intelligence reports/ inputs.	
2.	Incorporating AI into process of intelligence cycle will aid in optimal handling of large volumes of data ensuring lower rates of failure or oversight.	
3.	The utilisation of AI can lead to improved accuracy and reliability intelligence gathering and analysis.	
4.	The present infrastructure and framework of military intelligence in Indian Armed Forces is robust enough to absorb AI as it's backbone.	
5.	Better Synergy and Interoperability amongst multiple intelligence agencies operating in country can be achieved by incorporating AI as back bone of the system.	
6.	Current process of intelligence cycle being practiced in the Indian Armed Forces is capable of handling inputs received from multiple sources and agencies.	
7.	The current communication architecture and data infrastructure promotes optimum interagency synergy and real time intelligence sharing.	
8.	Integration of AI and provision of big data is a cost effective approach to improve intelligence operations.	
9.	Scalability of AI in Indian armed forces will rely on adequate training of personnel and availability of Subject Matter Experts. There is hence a need to evolve AI based domain specialisation.	

10.	AI is heavily based on metric scale and is data centric. There is hence a need to develop an AI system with cognitive ability to assist in interpretation of intangibles like Human Intelligence and subjective information/ reports.	
11.	AI based systems will aid in achieving enhanced interoperability between multiple intelligence agencies.	
12.	Integrating AI would enhance the military's ability to respond quickly and effectively to emerging security threats.	
13.	Environmental and technical constraints prevailing in organisation pose an impediment towards integration of AI with framework of military intelligence.	
14.	The system of data integration and data fusion needs to be completely automated.	
15.	In era of asymmetric, hybrid, gray zone and cyber warfare, success of intelligence operations will depend on evolving effective AI based countermeasures.	
16.	AI integration into closed network of defence systems is likely to get affected or delayed due to security challenges posed and clearances required.	

Appendix 'B'

INITIATIVES AT NATIONAL LEVEL

National Strategy for Artificial Intelligence. There are currently no specific laws in place for AI, Big Data (BD), and ML. Furthermore, India does not have a legal definition for 'AI'. In 2018, the government released two AI roadmaps, the Report of Task Force on Artificial Intelligence by the AI Task Force under the Ministry of Commerce and Industry and the National Strategy for Artificial Intelligence by Niti Aayog. The 2022 Global Legal Insights (GLI) Report states that the government's main focus is on promoting AI and its applications in sectors such as healthcare, e-commerce, and defence. However, the Niti Aayog report on AI, as highlighted by the Center for Internet and Society (CIS), lacked proper public scrutiny of its recommendations prior to its release. The recommendations were made without a comprehensive understanding of how AI applications vary across different sectors. The document can be accessed at 'https://niti.gov.in/sites/default/files/2019-01/NationalStrategy-for-AI-Discussion-Paper.pdf'. The road map till 2022 is depicted below.



Evolution of National AI Strategy & Road Map

Appendix 'C'

DEFENCE AI PROJECT AGENCY : DAIPA

(Excerpts : press information bureau document dated 01 august 2022)

Enhancement of Capabilities of AI Technology Dated 01 August 2022 (Press Information Bureau, Ministry of Defence. As per the recommendation of a task force set up by DDP under the Chairmanship of Shri N Chandrasekaran, Chairman Tata Sons, and in consultation with all stakeholders, Defence Artificial Intelligence Council (DAIC) has been set up under the Chairmanship of Raksha Mantri to provide necessary guidance and structural support. Further, Defence AI Project Agency (DAIPA) has been created under the Chairmanship of Secretary DDP for enabling AI based processes in defence Organisations. Artificial Intelligence framework and guidelines for projects and programmes in DRDO have been issued. All DRDO system laboratories have started AI technology groups to introduce AI features in all product. An AI roadmap has also been finalised for each DPSU under which 70 defence specific AI projects have been identified for development. Out of these projects, 40 projects have been completed by the DPSUs. Steps taken to train youth are as given below:-

(a) DRDO has three dedicated laboratories, Centre for Artificial Intelligence and Robotics (CAIR), Bengaluru and DRDO Young Scientist Laboratory (DYSL)-AI and DYST-CT (Cognitive Technology) for application orientated research in AI in different domains.

(b) CAIR is nurturing start-ups & also conducting workshops for DRDO scientists to create skill sets on AI in Defence Systems.

(c) Defence Institute of Advanced Technology (DIAT) is conducting Certified courses in AI & Machine Learning and so far more than 1000 professionals have been trained in these domains.

(d) AI is also promoted in academia and industry through R&D projects under Defence Industry Academia Centre of Excellences, Extramural Research and Technology Development Fund schemes of DRDO.

(e) DDP has earmarked Rs 100 crore per year for AI projects for Armed Forces. IAF has established the Unit for Digitization Automation, AI an App Networking (UDAAN) which is in the process of developing many applications for Campaign Planning and Analysis System, e-Nirikshan etc.

(This information was given by Raksha Rajya Mantri Shri Ajay Bhatt in a written reply to Shri Sushil Kumar Gupta in Rajya Sabha today).

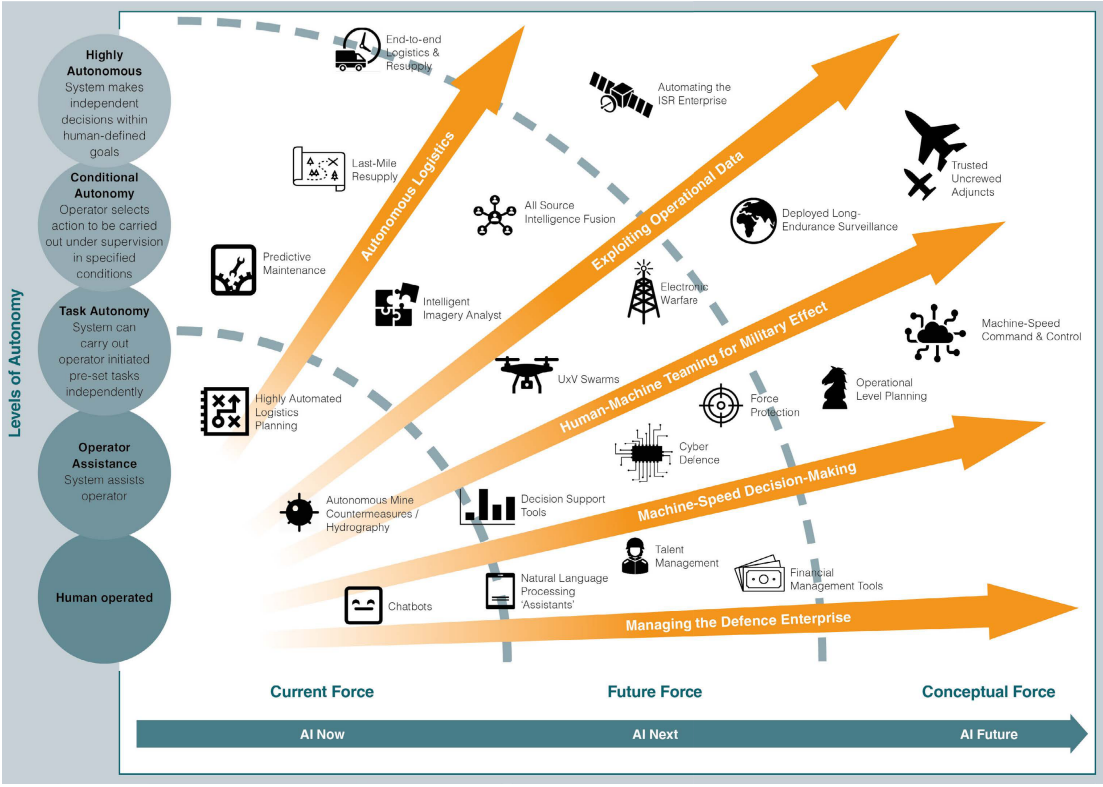
Fund Allocation. It has also been decided that a budgetary allocation of Rs. 100 Crore ($12 million) will be made by MoD each year for the next five years to DAIPA for taking up AI projects, setting up AI-related infrastructure, preparing AI-related data, and capacity building. In addition, each service shall earmark Rs. 100 crore per year for AI-

specific application development for the next five years from their annual budgetary allocations.

The DAIPA has the Secretary (Defence Production) as the ex officio head of the agency and members drawn from the services, Defence Public Sector Undertakings, DRDO, academia and industry partners. The DAIPA will evolve and adopt standards for technology development and delivery process for AI projects and review the adoption plan of AI-led and AI-enabled systems and processes with the user groups.

Appendix 'D'

EXAMPLES OF AI's INTEGRATION INTO MILITARY INTELLIGENCE DOMAIN IN UNITED KINGDOM



Illustrative AI Opportunities for Defence : 2022 (United Kingdom)

Exercise SPRING STORM – AI on the Ground (Defence Artificial Intelligence Strategy June 2022, Ministry of Defence). Exercise SPRING STORM held in May 2021 used AI on a British Army operation for the first time wherein soldiers from the 20th Armoured Infantry Brigade trialled a Machine Learning engine designed to process masses of complex data, including information on the surrounding environment and terrain, offering a significant reduction in planning time over the human team; whilst still producing results of equal or higher quality thereby transferring the cognitive burden of processing data from a human to a machine.

KILPECK. Likewise the KILPECK program is working to enable this through establishing an operational data science environment, where datasets from Official through to Top Secret are stored and accessed by the analyst. Using an Activity Based Intelligence methodology, all data is geo referenced to enable the rapid integration, exploitation, and production of intelligence.

SAPIENT. Sensing for Asset Protection with Integrated Electronic Networked Technology (SAPIENT) is a network of advanced sensors with AI at the edge, combined with intelligent fusion and sensor management. SAPIENT was trialled during the Contested Urban Environment (CUE) 2021 international exercise held in Portsmouth.

Appendix 'E'

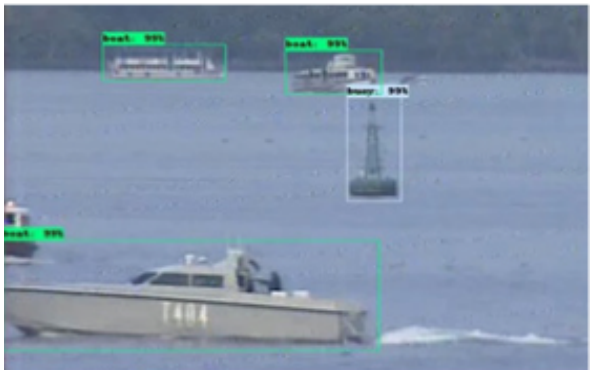
AI ROAD MAP IN INDIAN ARMED FORCES

(Authority : Excerpts from Delhi Policy Group, Implementing Artificial Intelligence in Indian Army, Lt. Gen. Deependra Singh Hooda (Retd.),PVSM, UYSM, AVSM, VSM & Bar, 16 Feb 2023 and AI for Defence - 75 AI Projects, Government of India Document)

In February 2018, the Department of Defence Production of the Ministry of Defence constituted a task force to study the future use of AI in defence applications. Known as the task force for 'Strategic Implementation of AI for National Security and Defence,' it submitted its report in June 2018. Based on the task force's recommendations, a Defence AI Council (DAIC) and a Defence AI Project Agency (DAIPA) were set up in 2019.

The DAIC is headed by the Defence Minister and comprises the three service chiefs, defence secretary, National Cyber Security Coordinator, and members from the DRDO, industry, and academia. The DAIC is supposed to meet twice a year and provide necessary guidance to enable and effect development or tailoring of the operating framework, policy level changes and structural support.

A series of classified projects are under development at MCTE, CME, NSCS and Defense Space Agency that are evolving AI algorithms for interpretation and analysis of varied forms of intelligence. Armed Forces are working in close collaboration with premier institutes of country as well as private companies for designing solutions.



AI based RPA feed and data analysis, AI-Enabled Airborne Electro-Optic Infrared System and Target Tracking for Complex Naval Scenarios

Appendix 'K'

PROPOSED ORGANOGRAM : AI & ML DIRECTORATE

Op Int Data Wing. This wing will deal with all steps of intelligence cycle from collection to dissemination (in all concerned fields). This shall be based on customised systems as well as systems of system, based on which various AI modules will be developed.

Data Laboratory/ Archives. The archival information to be stored in high end servers in closed network and can further have IT section for server, section responsible for digitisation of information, maintenance section for hardware issues, section that will do the periodic data updation (in server) and lastly a data validation section that shall ensure that no data is left unattended/ unaccounted & is unbiased.

Policy & Training. This wing will include formulation of Standing Operating Procedures (SOP) & policies (development, maturing and transformation of AI technologies for operational use and evolve short term, mid term and long term goals). The wing has a planning section that will ensure that requirements of all arms & services are addressed and synergised so as to ensure there is no duplication of efforts among Tri services. It will also look into courses and cadres for all ranks and have a procurement section that will work in close coordination with financial section.

Research & Development (R&D). As name suggests, this wing shall deal with R&D aspects that will involve the stakeholders designated within the organisation like MCTE, CME as well as DRDO and other private players. The impetus her will be on developing indigenous solutions and transfer of technology (ToT), if need be. This wing will also project management wing to deal with various systems/ modules being developed and their subsequent integration with defence architecture.

FinSec. It will deal with all financial matters including legal aspects.

End Notes

[1] Tobias Vestner, "From Strategy to Orders: Preparing and Conducting Military Operations with Artificial Intelligence," Geneva Centre for Security Policy, 10 January 2023.

[2] István Szabadföldi, "Artificial Intelligence In Military Application - Opportunities and Challenges," National University Of Public Service, Budapest, Hungary, 2021.

[3] "Artificial Intelligence for Military Logistics - Current Applications," Emerj Artificial Intelligence Research, Boston, 2019.

[4] G, C. 2023. “The Militarization of Artificial Intelligence.” Stimson Center, February. https://www.stimson.org/2020/the-militarization-of-artificial-intelligence/.

[5] Brig Sanjeev Chopra, "Artificial Intelligence in Military Operations," Centre for Land Warfare Studies, New Delhi, June 2022.

[6] "The Most Useful Military Applications of AI in 2023 and Beyond," Sentient Digital INC, 31 January 2023.

[7] Lieutenant Colonel Nizam Uddin Ahmed, "Integrating Machine Learning in Military Intelligence Process: Study of Futuristic Approaches Towards Human-Machine Collaboration," afwc, psc, Engineers, NDC E Journal, Dhaka, Bangladesh, Volume 02, No 1, January 2022.

[8] "The Most Useful Military Applications of AI in 2023 and Beyond," Sentient Digital INC, January 31, 2023.

[9] Colonel Gaurav Puri, "Paradigm Shift in the Intelligence Cycle," Linkedin, 16 April 2023.

[10] Joint Chiefs of Staff, United States, "Joint Publication 2.0, Joint Intelligence," 22 October 2013.

[11] Bram Spoor and Peter de Werd, "Complexity in Military Intelligence," International Journal of Intelligence and CounterIntelligence, 30 May 2023, https://doi.org/10.1080/08850607.2023.220949.

[12] ME4 Toh Bao En, "Swimming In Sensors, Drowning In Data— Big Data Analytics For Military Intelligence," Tech Edge Pointer, Journal, The Singapore Armed Forces, 2016.

[13] ADF Solutions, "The Power of AI in Military Intelligence: How Machines are Changing the Game," 15 March 2023.

[14] Major Sylvain Rouleau, "Potential Use of AI within Military Intelligence Cycle," Canadian Forces College, JCSP 46, 2020.

[15] Kwasi Mitchell, PhD, Joe Mariani, Adam Routh, "The Future of Intelligence Analysis," Deloitte Insights, 11 December 2019.

[16] Kwasi Mitchell, PhD, Joe Mariani, Adam Routh, "The Future of Intelligence Analysis," Deloitte Insights, 11 December 2019.

[17] Wikipedia contributors, "Intelligence Cycle," Wikipedia, 09 September 2023, https://en.wikipedia.org/wiki/Intelligence_cycle.

[18] Zheng Yang and Dihai Wu, "The Digital Nexus: Tracing the Evolution of Human Consciousness and Cognition within the Artificial Realm—a Comprehensive Review," SpringerLink, August 2023, https://doi.org/10.1007/s00146-023-01753-7.

[19] Lt Gen Deependra Singh Hooda (Retd.), PVSM, UYSM, AVSM, VSM & Bar, Delhi Policy Group, "Implementing Artificial Intelligence in Indian Army," 16 February 2023 (https://www.delhipolicygroup.org/publication/policy-briefs/implementing-artificial- intelligence-in-the-indian-military.html).

[20] Lt Gen Deependra Singh Hooda (Retd.), PVSM, UYSM, AVSM, VSM & Bar, Delhi Policy Group, "Implementing Artificial Intelligence in Indian Army," 16 February 2023 (https://www.delhipolicygroup.org/publication/policy-briefs/implementing-artificial- intelligence-in-the-indian-military.html).

[21] Zi Yang, "Chapter 4: How China Leverages Artificial Intelligence for Military Decision-making," in China's Military Decision-Making, September 2023.

[22] "Project Linchpin: Approved for Release," U.S. Army, Program Executive Office Intelligence, Electronic Warfare & Sensors, September 2023, https://peoiews.army.mil/wp-content/uploads/2023/09/Project-Linchpin-Approved-for-Release-1.pdf.

[23] Thales Group, "Command and Intelligence," n.d., https://www.thalesgroup.com/en/worldwide/defence/command-and-intelligence.

[24] Lt Gen Deependra Singh Hooda (Retd.), PVSM, UYSM, AVSM, VSM & Bar, Delhi Policy Group, "Implementing Artificial Intelligence in Indian Army," 16 February 2023 (https://www.delhipolicygroup.org/publication/policy-briefs/implementing-artificial- intelligence-in-the-indian-military.html)

[25] Ibid 24

[26] https://www.justsecurity.org/12708/autonomy-killer-robots-human-control-force-part/

BIBLIOGRAPHY

Books

1. Ekbal Prakash, Artificial and Future Warfare, Sumit Enterprises, 2020.

2. Istvan Szabadföldi, "Artificial Intelligence in Military Application - Opportunities and Challenges," National University of Public Service, Budapest, Hungary, 2021.

3. Kai-Fu Lee, *AI Superpowers: China, Silicon Valley, and the New World Order, (New York: Houghton Mifflin Harcourt, 2018).

4. Shay Hershkovitz, The Future of National Intelligence : How Emerging Technologies Reshape Intelligence Communities, Rowman & Littlefield, 2022.

5. Zi Yang, "Chapter 4: How China Leverages Artificial Intelligence for Military Decision-making," in China's Military Decision-Making, September 2023.

Research Papers, Journals & Publications

1. ”Artificial Intelligence for Military Logistics - Current Applications," Emerj Artificial Intelligence Research, Boston, 2019.

2. Ben Connable, Artificial Intelligence and National Security, Congress-ional Research Service, Report, 2020.

3. Bram Spoor and Peter de Werd, "Complexity in Military Intelligence," International Journal of Intelligence and CounterIntelligence, 30 May 2023, [https://doi.org/10.1080/08850607.2023.220949](https:doi.org10.1080/08850607.2023.220949).

4. Brig Sanjeev Chopra, "Artificial Intelligence in Military Operations," Centre for Land Warfare Studies, New Delhi, June 2022.

5. Congressional Research Service. "Artificial Intelligence and National Security." [Report R45178], 26 August 2020.

6. Daniel Ish, Jared Ettinger, Christopher Ferris, Evaluating the Effectiveness of Artificial Intelligence Systems in Intelligence Analysis, Rand Corporation, Research Paper, 2021.

7. Forrest E. Morgan, Benjamin Boudreaux, Andrew J. Lohn, Mark Ashby, Christian Curriden, Kelly Klima, Derek Grossman, Military Applications Of Artificial Intelligence Ethical Concerns In An Uncertain World, Rand Cooperation, 2020.

8. G, C. 2023. “The Militarization of Artificial Intelligence.” Stimson Center, February [https://www.stimson.org/2020/the-militarization-of-artificial-intelligence/] (https://www.stimson.org/2020/the-militarization-of-artificial-intelligence/).

9. Joint Chiefs of Staff, United States, "Joint Publication 2.0, Joint Intelligence," 22 October 2013.

10. Kartik Bommakanti and Harris Amjad, “China’s Military Modernisation: Recent Trends,” April 11, 2023, page 9.

11. Kerbusch, Philip, Bas Keijser, and Selmar Smit. "Roles of AI and Simulation for Military Decision Making." [Report]. TNO - The Netherlands Organisation for Applied Scientific Research, MP-IST-160-PT-4.pdf, 2022.

12. KUMAR, Ashok. “Indian Intelligence Agencies in Democratic Framework: An Analysis.” *Webology* 18, no. 6, 2021.

13. Lieutenant Colonel Nizam Uddin Ahmed, "Integrating Machine Learning in Military Intelligence Process: Study of Futuristic Approaches Towards Human-Machine Collaboration," afwc, psc, Engineers, NDC E Journal, Dhaka, Bangladesh, Volume 02, No 1, January 2022.

14. Lt Gen Deependra Singh Hooda (Retd.), PVSM, UYSM, AVSM, VSM & Bar, Delhi Policy Group, "Implementing Artificial Intelligence in Indian Army," 16 February 2023 (https://www.delhipolicygroup.org/publication/policy-briefs/implementing-artificial- intelligence-in-the-indian-military.html).

15. Major Sylvain Rouleau, Potential Use of Artificial Intelligence within the Military Intelligence Cycle, Service Paper/Étude Militaire, JCSP 46 – PCEMI 46, Canadian Forces College – Collège des Forces canadiennes, 2019–2020.

16. ME4 Toh Bao En, "Swimming In Sensors, Drowning In Data— Big Data Analytics For Military Intelligence," Tech Edge Pointer, Journal, The Singapore Armed Forces, 2016.

17. Mitchell, Kwasi, Joe Mariani, and Adam Routh. "The Future of Intelligence Analysis: A Task-Level View of the Impact of Artificial Intelligence on Intel Analysis." December 11, 2019.

18. Pant, Harsh V., and Kartik Bommakanti. "Towards the Integration of Emerging Technologies in India's Armed Forces." Observer Research Foundation, February 24, 2023.

19. "The Most Useful Military Applications of AI in 2023 and Beyond," Sentient Digital INC, 31 January 2023.

20. Tobias Vestner, "From Strategy to Orders: Preparing and Conducting Military Operations with Artificial Intelligence," Geneva Centre for Security Policy, January 10, 2023.

21. United Nations. "The Militarization of Artificial Intelligence." August 2019.

22. Zheng Yang and Dihai Wu, "The Digital Nexus: Tracing the Evolution of Human Consciousness and Cognition within the Artificial Realm—a Comprehensive Review," SpringerLink, August 2023, https://doi.org/10.1007/s00146-023-01753-7.

23. Zoe Haver, "Private Eyes: China’s Embrace of Open-Source Military Intelligence," Insikt Group®, June 1, 2023.

Articles

1. ADF Solutions, "The Power of AI in Military Intelligence: How Machines are Changing the Game," 15 March 2023.

2. Artificial Intelligence (AI) Market Size, Share, Trends, Analysis and Forecast by Product/Service (Specialized AI Applications, AI Hardware, AI Platforms, AI Consulting and Support Services), Enterprise Size Band, Vertical and Region, by 2026, October 18, 2022 (Report Code: GDTMT-SC-MR022-BB), (https://www.globaldata.com/).

3. BABOȘ, Alexandru. “Artificial Intelligence as a Decision Making Tool for Military Leaders.” *Land Forces Academy Review* 26, no. 4(104), 2021.

4. Colonel Gaurav Puri, "Paradigm Shift in the Intelligence Cycle," Linkedin, 16 April 2023.

5. Drone Wars UK, "Military Applications of Artificial Intelligence," December 2021.

6. Flysight, "Artificial Intelligence in Military Technology - 8 Applications & Examples," 18 June 2023.

7. Kwasi Mitchell, PhD, Joe Mariani, Adam Routh, "The Future of Intelligence Analysis," Deloitte Insights, 11 December 2019.

8. Military Applications of AI in 2023- Sentient Digital, Inc.pdf.

9. MOORE, Mary Beth. "13 Ways to Use AI in Military Intelligence." World Economic Forum, Feb 1, 2018. https://www.weforum.org/agenda/2018/02/13-ways-use-ai-military-intelligence/.

10. Nijjar, KS. "Military Intelligence: Great Potential in Big Data-Based Intelligence Gathering." Indian Military Review (IMR),10 January 2020).

11. "The Most Useful Military Applications of AI in 2023 and Beyond," Sentient Digital INC, 31 January 2023.

12. TROPOTEI, Teodor Octavian. “Criticism against the Intelligence Cycle.” “Mihai Viteazul” National Intelligence Academy, Romania, 2018,doi:10.19062/2247-3173.2018.20.9.

Brochures of Commercial AI Projects

1. Decision Making in the Battlespace of the Future, digital intelligence, bae systems, https://www.baesystems.com/en/digital/capability/multi-domain-integration.

2. "Project Linchpin: Approved for Release," U.S. Army, Program Executive Office Intelligence, Electronic Warfare & Sensors, September 2023, https://peoiews.army.mil/wp-content/uploads/2023/09/Project-Linchpin-Approved-for-Release-1.pdf.

3. Sirius-ifs-v2-information-fusion-system.pdf, https://www.saab.com/contentassets/a5ca7c2d1bb845728f88ded729f2eab6/sirius-ifs-v2-information-fusion-system.pdf.

4. Thales Group, "Command and Intelligence," n.d., [https://www.thalesgroup.com/en/worldwide/defence/command-andintelligence](https:// www.thalesgroup.com/en/worldwide/defence/command-and-intelligence).

Websites

1. Wikipedia contributors, "Intelligence Cycle," Wikipedia, 09 September 2023, https://en.wikipedia.org/wiki/Intelligence_cycle.

2. Government of India, Department of Defence Production. "AI in Defence." July 8, 2022. (https://www.ddpmod.gov.in/artificial-intelligence-defence).

3. ‘https://niti.gov.in/sites/default/files/2019-01/NationalStrategy-for-AI-Discussion-Paper.pdf'.

4. https://www.nbr.org/wp-content/uploads/pdfs/publications/chinas-military-decision-making_sep2023.pdf.

5. https://www.iar-gwu.org/print-archive/blog-post-title-four-xgtap.

6. https://www.hindawi.com/journals/ijis/2023/8676366/.

7. https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf.

8. https://www.atlanticcouncil.org/in-depth-research-reports/report/how-modern-militaries-are-leveraging-ai/.

9. https://www.marketresearchfuture.com/reports/ai-in-military-market-7660.

10. https://www.janes.com.

11. https://www.rand.org/pubs/research_reports/RRA464-1.html.

12. https://usnwc.libguides.com/c.php?g=494120&p=3381427.