INDIA AND CHINA IN AN ERA OF ALGORITHMIC WARFARE

Maj Vishnu RJ

Abstract

The disruption in a multitude of computing technologies like algorithms is enabling the warfighting machines to interact, interplay and integrate to solve problems more efficiently and effectively. Algorithms are bringing a transformative shift in the way we perceive, plan, organise and fight wars. This critical capability enables field commanders to understand and assimilate minute circumstantial changes associated with each problem to find unique practical solutions. The lethal combination of Manned-Unmanned Teaming (MUMT) in algorithmic warfare is bringing an intimate intertwining of accuracy at tactical operations and creativity at operational and strategic planes to produce disproportionate dividends. China laid out its new modernisation goals in 2017 and new battle doctrines in 2020. Since then, China has been building the capability to conduct algorithmic warfare through significant organisational changes and capability enhancement using homegrown disruptive technologies. They are pursuing to develop the ultimate form of algorithmic warfare as 'Intelligentized Warfare' by 2050. The studies give the algorithmic warfare capabilities of the PLA to forecast its likely manifestation along the Line of Actual Control (LAC). The study also refers to the challenges posed by this new Chinese warfighting methodology to give broad guidelines to counter it. To mitigate this threat, a deliberate and deadline-driven modernisation of armed forces must be done by India on the backbone of homegrown disruptive technologies.

Introduction

Modern armies are pursuing the capability to undertake precision strikes on their adversaries in multiple domains including cyber, electromagnetic and space along with physical dimensions of warfighting. Though the military has always been a tool to show the political will of a nation, the cost of war is the primary factor affecting the decision to employ them. The recent disruptions in technology allow various stakeholders to integrate multiple domains of warfighting to fight as a cohesive unit by closing the gaps in the battlefield previously caused by huge space, time delays, difficulty in concentrating force and strained information sharing. Nations are embracing technology in all aspects of warfighting to reduce the cost of war and to increase the economy of effort for every action. PLA through a transformative shift has been embracing algorithmic warfare to make its armed forces leaner and meaner (Koh 2019).[1]

Algorithmic Warfare

Algorithms are the sequence of instructions and rules that machines use to solve problems. They transform inputs to outputs and as such are the crucial conceptual and technical foundation stone of modern IT and the new intelligent machines (Layton 2018, 02).[2] Algorithmic warfare intends to reduce the number of warfighters in harm's way, increase decision speed in time-critical operations and operate when and where humans are unable to operate (Crosby 2020, 01).[3] The manually programmed machines require directions and instructions at each step to develop a solution for the problem at hand and the same instructions will have to be provided by the user every time he engages with the system. The intelligent machines on the other hand use the new guidelines and instructions created by the learning algorithm for a new task. Instead of being pre-programmed, they learn from their interactions with humans and the environment to continually update their internal model of the world (Layton 2018, 06).[4]

These intelligent machines create new rules and guidelines by fusing the latest information absorbed from the working environment with existing ones in their database. They can do intricate jobs that traditionally programmed machines would not be able to and the new self-learning algorithm can provide a different answer for the same scenario. Since this

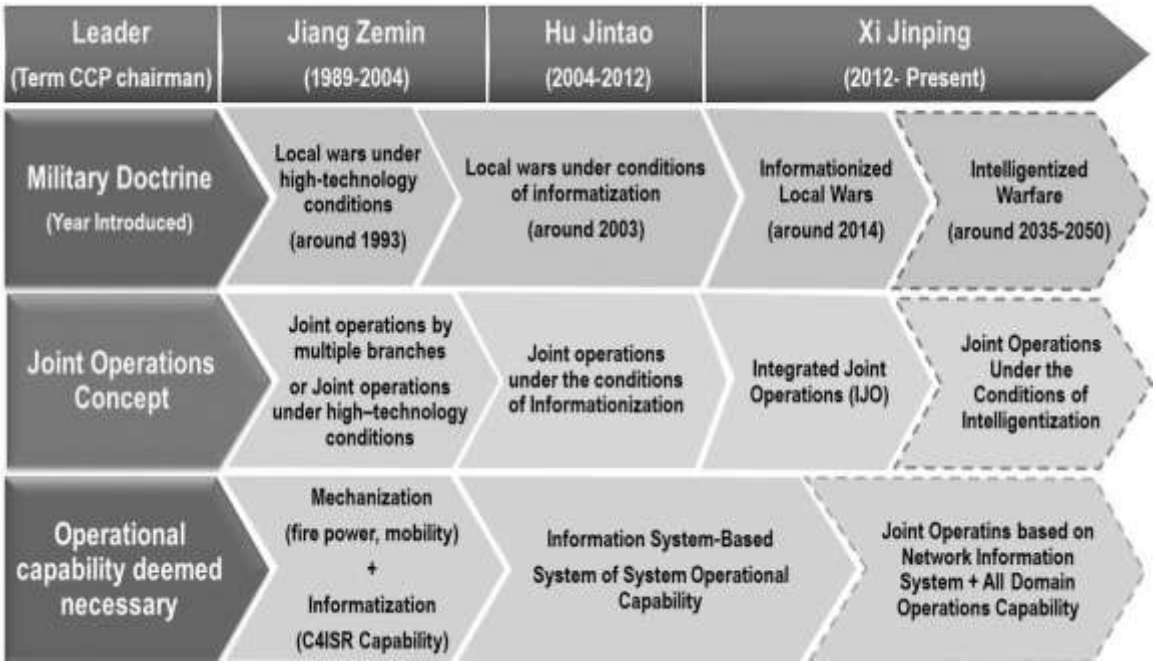
concept develops on the continuous interaction between the system and environment, the availability of data to train the algorithm will be critical in creating better rules and instructions. Thus, these machines must have substantial capabilities to collect large unprocessed data by interacting with the environment, analyse this big data and identify patterns or fresh insights to give intelligent answers to the queries of users.

Even though these machines are continuously trained on fresh data to give practical solutions, the logic behind arriving at them is usually absent in these solutions. This arises due to their incapability to recognise trivial situational alterations that are distinct in every instance and the absence of intuitive judgment of humans. This leads to difficulty in applying the knowledge gained from one scenario to another. Similarly, ethics and laws in this arena of technology are still nascent and responsibility is still with the person behind the machine. Thus, having a Man-Machine collaboration must allow us to understand the logic behind the decisions taken by the machines. The evolution of these warfighting doctrines and concepts will demand new force structures, new force components and training methodologies. The capacity of a nation to launch algorithmic warfare will depend on its capability in a multitude of computing technologies including Computer Processing Power, Big Data, AI, Cloud Technology, etc. Thus, algorithmic warfare is not a distinct capability but an integration of numerous technologies. Those who monopolize and embrace the nuances of this warfare will have a significant advantage over their enemies.

Algorithmic Warfare of PLA

Following General Secretary Xi Jinping's modernisation speech at the 19th Party Conference in 2017, the Peoples Liberation Army (PLA) is pursuing significant organisational changes and made huge progress in building the capability to conduct algorithmic warfare through synchronized long-range precise strikes across multiple domains (Yasuyuki 2021, 24-31).[5] 'Intelligentized Warfare' is the term used by the PLA to describe their ultimate form of algorithmic warfare (Kania 2017, 12).[6] In 2020, the Central Military Commission issued a new battle doctrine for warfare and announced their plans to create the capability to be networked into a system of systems that will facilitate them

to conduct 'Intelligentized Warfare' (Yasuyuki 2021, 01).[7] 'PLA Joint Operations Outline' clarifies the basis for conducting algorithm-based joint operations in the new era (Finkelstein 2021, 13).[8] Recent emphasis has been on conducting realistic training in this new warfighting doctrine.[9]



Conceptual Diagram of Evolution of Intelligentized Warfare

Source: (Yasuyuki 2021, 29). Source: Yasuyuki, "*The PLA's Pursuit of Enhanced Joint Operations Capabilities*", 29.

Technology the Catalyst for Intelligentized Warfare

China has included the Military Civil Fusion as part of its national policy to modernise the military to suit its national security needs (Yasuyuki 2021, 16).[10] They are taking bold measures to domesticate its defence manufacturing and expand its military sector. The key technologies being developed for Intelligentized Warfare are given below:-

- **AI & Advanced Robotics**. PLA will be using the processing power of AI for enhanced data exploration, decision support and C4ISR. The battlefield will be mapped using

hundreds of AI-enabled sensors, cameras and similar surveillance systems operating in the ground air and space domains. These systems will enable them to sense, locate and identify objects on battlefields. Algorithms will quickly detect changes in the mapped battlefields to avoid set-piece mechanical response. A false and misleading picture of the battlefield will be orchestrated to create chaos for the enemy by jamming and deception systems. The enemy command and control setup will be both tempted and confused to act on the tricky battle front presented to him by these intelligent systems.

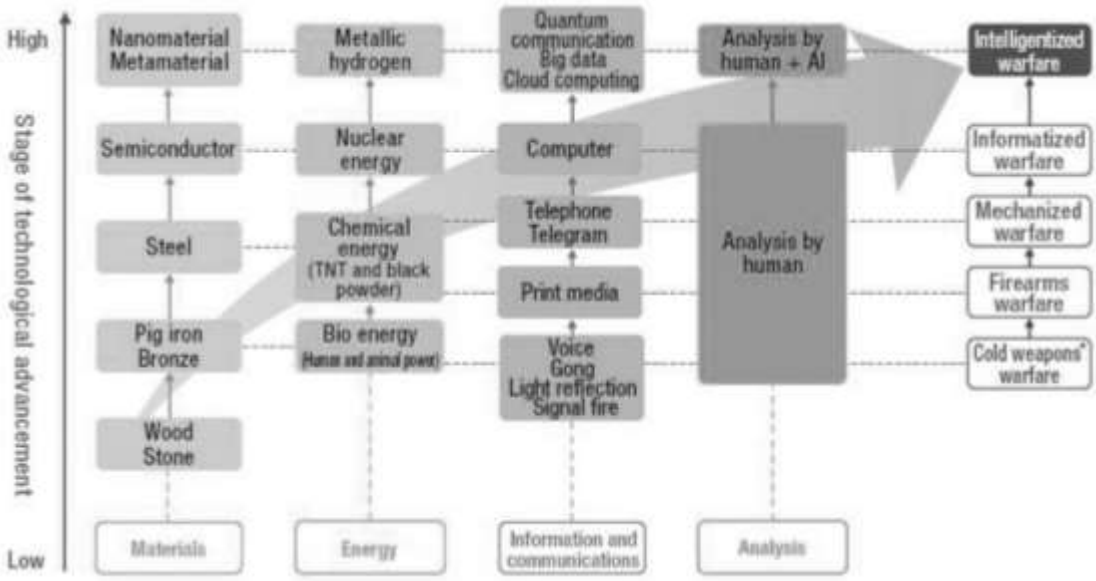
- **Big Data Analytics**. China's public security forces have been enthusiastic about adopting big data analytics; the capability would significantly enhance their ability to fulfill their missions (Derek Grossman 2020).[11] Mastering this will help them in the systematic processing and analysis of huge structured and unstructured data using various models such as predictive models, trend analysis, etc. The China Skynet, an intelligent surveillance network uses almost 600 million surveillance cameras equipped with facial recognition technology to monitor their population with 99.8% accuracy (McMillan 2024).[12] By analysing vast amounts of data from their local population, they are refining their algorithms to detect subtle changes in the volatile, uncertain, complex and ambiguous modern battlefield.

- **Quantum Technologies**. China has been investing heavily in quantum sensing, quantum communication and quantum computing technologies. These technologies ensure secure communications, enhanced computing capabilities and enhanced navigation capabilities. Quantum sensing can potentially improve lidar and radar for intelligence, surveillance, and reconnaissance and provide positioning and navigational capabilities in the absence of satellite-based systems. (Brian Hart 2024).[13]

- **Semi-conductor & Advanced Computing**. They play a crucial role in powering the sophisticated computing and advanced communication systems. To achieve self-reliance in this field, China has recently set up various semiconductor industries named Changsha Jingjia Microelectronics Co, Cambricon Technologies, etc, (Waldie

2022).[14] PLA has realised that replacing foreign chips in military equipment is critical in achieving military autonomy and guarding them against security risks.

- **Cloud Technology**. Cloud technology is a critical battle enabler in "Intelligentized Warfare" and has been an area of geopolitical manoeuvring between the US and China. Algorithmic warfare necessitates high-speed analysis of huge data for fast and precise decision-making. This is possible only through the intermingling of multiple technologies with the cloud technology. "Cloud technology has remained a relatively closed industry in China," said Thomas Zhang, Dezan Shira & Associates' IT Director (Dunseith 2018).[15] This isolation of cloud technology within China ensures faster and more secure services.



Conceptual Diagram of Evolution of Technology in Warfare Source: (Yasuyuki 2021, 17).
Yasuyuki, "*The PLA's Pursuit of Enhanced Joint Operations Capabilities*", 17.

Critical Enablers of Intelligentized Warfare

Intelligentized Warfare will focus on subduing the enemy without actual human contact thereby reducing human casualty. The central tenet of this idea is the application of stealth, unmanned and precise operations supported by the information and space domain. The pace at which the battle will be unfolding, the critical battle-winning factor will still be the decisions taken by the commander who will be presented with multiple options by the algorithms. PLA will be able to manoeuvre their enemy to fight from an unfavourable position by precluding enemies' options and expanding their opportunities thereby defeating the enemy in the spatial dimensions of time. A few critical enablers are given below :-

- **Human-Machine Collaboration**. Intelligent machines in the futuristic battlefield with the existing level of technology will have to leverage an optimal mix of the unique capabilities of both machines and humans. This lethal combination will overthrow the existing established beliefs and characteristics of warfighting. Even though the concept of MUMT will be used, initially machines will have a limited role in this team. The machine with inherent disadvantages of intuitive decision-making will mostly be used to collect large volumes of data and present processed data using their trained algorithms to the human team members till they mutate to become smart or intelligent systems.

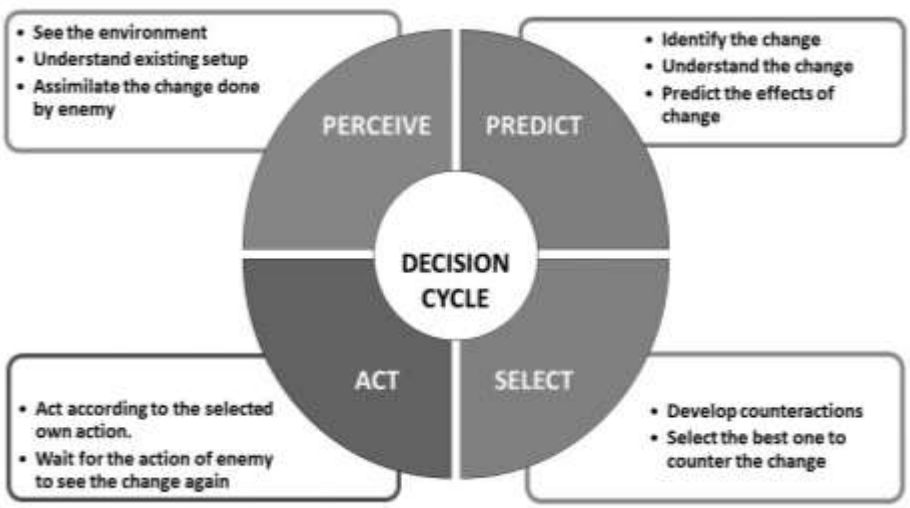
- **Autonomous Systems**. PLA visualizes that autonomous systems will gradually replace human frontline combatants with the air domain having the highest potential due to the advent of drones and intelligent swarms. The initial steps will be the "mothership concept" in which the manned fighters will direct the unmanned drones and subsequently migrate to the "swarm warfare concept" in which intelligent drones will overwhelm the enemy with masses of intelligent drones. Even at tactical level operations, enhanced participation of intelligent systems can be visualised with swarm drones acting with much more autonomy.

- **Battlefield Targeting System.** The tactical knowledge achieved by the algorithms of the intelligent machines will support the intuitive thinking of the human being to work with greater operational and strategic depth. The algorithms will derive ideal target

sets for the commanders from a pool of high-quality targeting data. These data will be communicated to autonomous weapon systems to engage with precision.

- **Cognitive Warfare**. The AI-enabled autonomous systems will be operated by the PLA to manipulate the minds of citizens to change not only what they but also how they think. It will aim to fragment otherwise cohesive society using synchronized chaos to create a crisis.

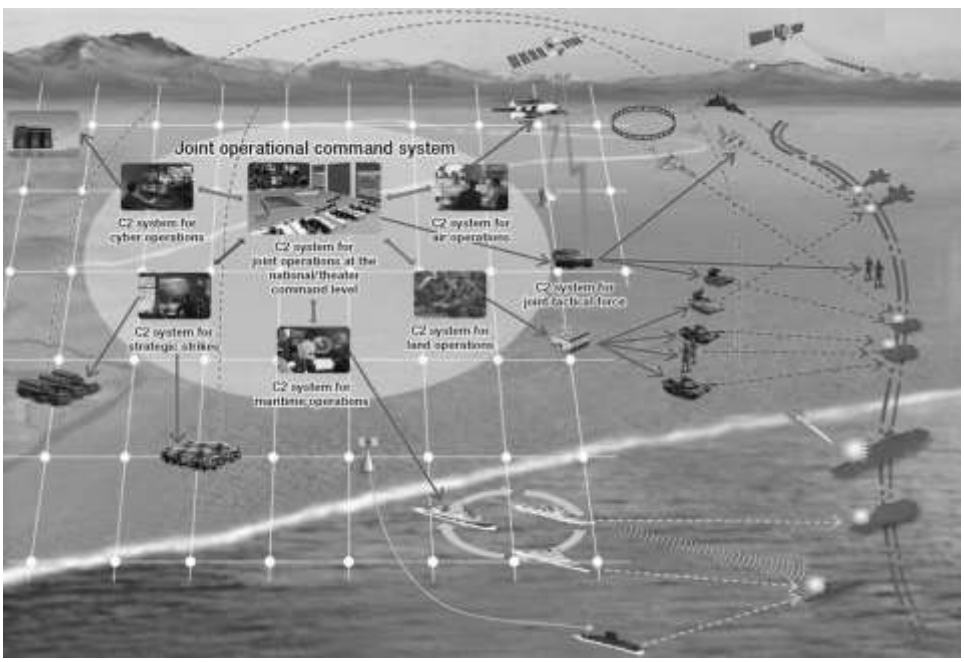
- **Battle Decision-Making Setup**. The intimate interlacing of precision at tactical operations and innovation at operational planes will mutate the Observe-Orient-Decide-Act (OODA) loop into the Perceive-Predict-Select-Act (PPSA) Decision Cycle which would be a predictive model based on data. Under this model, the intelligent machine supported by AI will recognise the battlefield changes to predict the various courses of action that can be envisaged from an enemy based on their capability, terrain, capability of their forces, etc. The multiple courses of action of the enemy will be analysed by algorithms to suggest suitable counteracts that PLA must take. The human interface in this MUMT will analyse both enemy and PLA actions suggested by the intelligent system to produce the most suitable one for PLA forces.



Conceptual Diagram of PPSA Decision Cycle (Source: Author.)

Likely Expansion of Intelligentized Warfare by PLA. PLA aims to complete force modernisation by 2035 and to be a world-class military by 2047 (Burke 2020, 01).[16] This entails them to evolve the 'Intelligentized Warfighting' capability over varying timeframes as given below: -

- **2030: Limited Area Limited Duration**. PLA in its pursuit to be a world-class military by 2047, is likely to achieve the capability to undertake 'Intelligentized Warfare' supported by algorithms and intelligent machines in a limited area and for a limited duration by 2030.
- **2040: Limited Area Longer Duration**. By 2040 manifestation of 'Intelligentized Warfare' would likely be for a longer duration due to the enhanced capability due to advancement in various disruptive technologies. This coupled with enhanced infrastructure development would assist them in fighting the algorithmic warfare for a longer duration in a limited area.



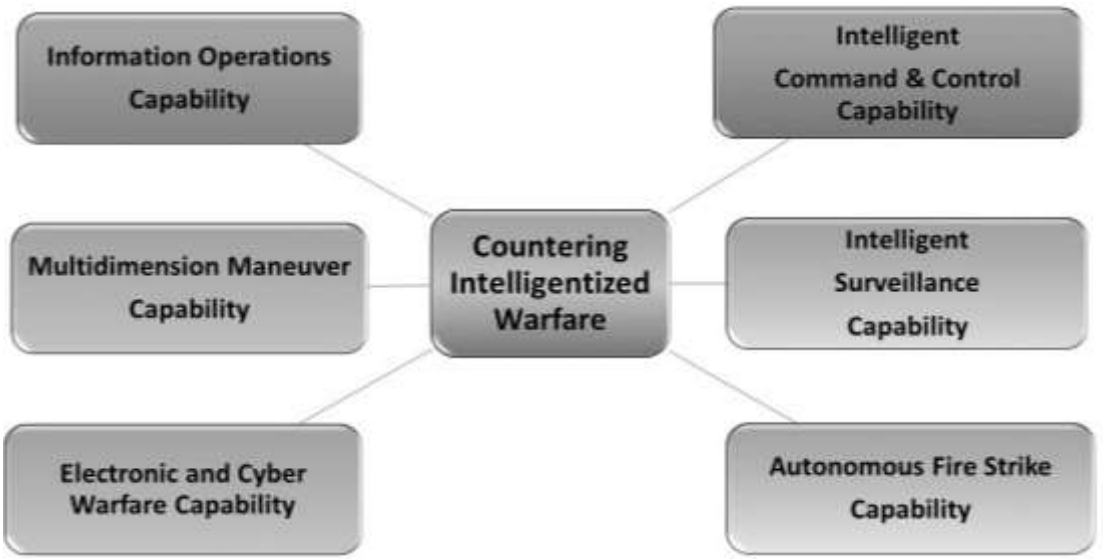
Conceptual Diagram of Intelligentized Warfare of PLA ***Source: (Yasuyuki 2021, 27).Source:*** **Yasuyuki, "*The PLA's Pursuit of Enhanced Joint Operations Capabilities*", 27.**

- **2050: Larger Area Longer Duration.** By 2050, PLA is likely to develop the capability to conduct Multi-Domain Integrated Operations supported by AI-enabled Autonomous Weapon Systems (AWS) for a longer duration across the northern borders of India. The disruption in chip manufacturing, AI, Big Data Analytics, Data Communication, space, cyber domains, etc enables these machines to interplay and solve problems more efficiently and effectively**.**

India Looking North

India and China have had a tantalizing relationship in the last few years, especially since 2017. India seems to have increased its faith in its military might which resulted in the rebalancing of its forces for a Northern Contingency. This perspective is necessary to understand the 'No War No Peace' like situation that now exists along the boundaries of the two countries. Since the conventional balance of power is measured on the size of armed forces that can be effectively brought about each other, the effects and capabilities of 'Intelligentized Warfare' are not being essentially considered. Therefore, we need to understand and visualise the integrated impact of Kinetic and Non-Kinetic Intelligentized Warfare in temporal and spatial frames to develop a counter capability.

Capability Development. National leadership has realized that technology will be a catalyst to transform the army to be future-ready and understands that being self-reliant will be the game changer. Army Design Bureau has been working with this purpose to integrate the entire defence ecosystem and is collaborating with premier academic institutes of the country. Major projects like Integrated Battlefield Management System, Netra and Daksh are taking confident steps in monitoring, collecting and analysing the battlefield with AI-powered systems in a network-centric real-time integrated setup (Sharma 2023).[17] Algorithms being the critical battle enabler, India must focus on developing algorithms that can understand the minute changes in the background and detect useful information from the clutters of big data. Self-sufficiency in intelligence and battlefield awareness supported by a robust disruption-free communication network will be key in fighting algorithmic warfare. Some of the required capabilities are given below:-



Conceptual Diagram of Required Capabilities (Source: Compiled by the author.)

- **Intelligent Command Control Capability**. Intelligent joint command and control setups at strategic, operational and tactical planes equipped with multiple intelligent and autonomous systems can assist the commanders in following the 'PPSA Decision Cycle' to fight the fluid and volatile modern battles. This will facilitate an overarching dominance over the battlefield through information, cyber, electronic, cognitive and physical dominance of the battlefield.

- **Intelligent Surveillance Capability**. Units must be formed by dovetailing both surveillance and shooter drones to the same setup. It must have the flexibility to scale up as a system capable of functioning as an intelligent swarm of drones. The surveillance drones will map the battlefield and pick up the enemies through the algorithm to assist the shooters in striking them with precision. These units will critically dislocate enemies both physically and psychologically.

- **Autonomous Fire Strike Capability**. Tailor-made autonomous weapon systems can be integrated into existing setups to execute precision strikes to degrade and destroy enemy combat power. The 'CABisation' by the PLA emphasizes mobility and firepower to neutralize and destroy the enemy. The recent clashes in Eastern Ladakh

highlighted the use of armoured vehicles in high-altitude areas. Even though the "CABisation" gives an edge through mobility and firepower, its application will be restricted by the limited availability of mobility corridors in the mountainous terrain. Tailor-made anti-tank units enriched with AI-enabled anti-tank weapons systems which are centrally controlled by an algorithmically enabled Joint Command Post can give disproportionate dividends. An autonomous integrated air defence setup must be organised at the national and command level with MUMT based on algorithms to adapt to fast-paced air operations with reasonable flexibility.

- **Electronic and Cyber Warfare Capability**. The new generation equipment like Software Designed Radio is electronically hardened to facilitate communication even in brutally jammed and electronically saturated modern battlefields. The electronic warfare units must exploit new generation disruptive technologies to provide information support to their forces and deny the same to the enemy. Modern armies are exploiting cyber as a dynamic weapon for non-contact non-kinetic warfare. The 'Cyber Militia' (Baughman 2022, 06)[18] of the PLA is turning regular corporate workers into part-time military workers. India should learn from its enemy and take active measures to launch large-scale cyber warfare on its enemies while protecting our systems. The key capabilities of the enemy can be neutralised or destroyed through cyber warfare to incapacitate them before contact warfare.

- **Information Operations Capability**. The modern era necessitates justice behind the war or 'Jus ad bellum' must be achieved before going to war. Thus, timely dissemination of credible information to support own cause of war and discrediting the enemy is an essential war-winning factor. Moreover, monitoring open-source intelligence like social media through algorithms will give credible intelligence for the military force to predict the enemy's plans. The "50 Cent Army" of the PLA employs civilians to collect data and spread disinformation (Allen 2021).[19] The aim will be to psychologically dislocate the enemy military, gain political and legal dominance through public opinion warfare, legal warfare and psychological warfare.

- **Multi-dimensional Manoeuvre Capability**. Joint fighting will necessitate a rapid switching of forces facilitated by rapid infrastructure development along the LAC and the capability for strategic communication supported by satellite communication. This capability must ensure the transportation of operational units and equipment to a designated area in a safe manner to ensure a smooth implementation of operational action.

Change in Doctrine and Organisation. The fast-paced fluid modern battles necessitate us to change the existing warfighting doctrines which are primarily based on contact battles and primitive battle planning tools like Intelligence Preparation of the Battlefield, Military Decision-Making Process, Joint Operations Planning Process, etc. Algorithmic warfare has changed the landscape and dynamics in which modern battles will be fought necessitating us to modulate the way we think and plan the battle. A futuristic and time-specific method must be evolved by the Indian Armed Forces to develop the capabilities not only to counter an 'Intelligentized Warfare' by PLA but also to launch algorithmic warfare using our force multipliers against them. India must take guidelines from ANC, SFC and HQ IDS to achieve jointness and integration (Kuanr 2019, 49).[20] There is an urgent requirement to have strategies and procedures to fully exploit the available technology by formalizing organisations at all levels of the military hierarchy. An organisation needs to be fashioned at the national level to collate and collaborate not only with the information needed for supporting joint algorithm-based operations but also for prompt dissemination of intelligence and orders.

Change in Selection, Training and Professional Military Education. There is an urgent need to evolve our joint training methodologies and practices with added emphasis on conducting joint exercises. This can be achieved through a focused effort in developing infrastructures and human resources conducive to jointness. The quality of the human capital must be enhanced and junior leadership must be trained to use these modern machines with proficiency. The staff officers must be trained to operate in a joint environment enabled with real-time information. Wargames must be fought more realistically to understand the capability of the machine and the new battle rhythms must be imbibed from the tactical to strategic level.

Marching Forward. We must 'Learn from the Enemy' and should take ambitious steps to fight as a joint organisation. The current superficially peaceful situation along the LAC will be debilitated by PLA through a well-planned and coordinated 'Intelligentized Warfare'. We should develop and construct capability for joint algorithm-based operations based on self-sustained technological development. The suggested roadmap is as given below: -

- **Between 2025-35: Force Strengthening Phase**. India must focus on increasing battle space awareness and training the technology including AI and algorithms to understand and assimilate the environment. The focus must be on developing the technology and human capital to fight algorithmic warfare. Organisational changes will be needed to facilitate our armed forces in fighting as an integrated unit under the umbrella of continuous networking. Dedicated effort must be taken in developing Defense R&D, Civil-Military Fusion and in training the human capital to use the technology-driven warfare. Joint training must be institutionalised by the formation of joint training institutes at each Command for training of troops especially officers of junior ranks and troops. India must form strong pillars for the development of algorithmic warfare capability between 2030-35 and strive to achieve the capability to counter the 'Intelligentized Warfare in a limited area'. The main pillars will be capability development based on technological advancement, doctrinal changes, reorganisation and restructuring of military forces to ease interoperability, infrastructure development and human capital development.

- **Between 2035-45: Strong Defensive and Limited Offensive Algorithmic Warfare Capability**. The organisations formed during the previous phase should be functioning to effectively counter the 'Intelligentized Warfare' of PLA. AWSs to counter PLA Rocket Force, artillery bombardments, cyber-attacks and unmanned aerial attacks are to be developed by integrating AI. Once effective autonomous counter capabilities are achieved, India must focus on developing a limited offensive in the framework of algorithmic warfare. The key to the success of this phase will be achieving self-reliance in disruptive technology dovetailed with the strengthening of rules, procedures and organisations formed during the previous phase. Strategic sustainability must be achieved through tangible steps from the conceptual to the

practical stage in tailor-made logistics systems and strategic mobility is to be achieved by developing a capability to mobilise and maneuver forces at the area of interest with ease and speed.

- **Between 2045-55: Large Area Longer Duration Multidomain Joint Operations Capability**. India must achieve time-space-force-information dominance to conduct Effect-Based Operations using algorithms. The strong pillars of previous phases must enable India to fight Multi-Domain Algorithmic Warfare Capability for a large and longer duration along the LAC. During a conflict situation, India must pre-empt PLA by launching an offensive in a place and time of its choosing with the right force level and countermeasures against 'Intelligentized Warfare'. This type of conflict will heavily rely on technology to connect the actors in air, sea, network, electromagnetic spectrum, etc to achieve "cross-domain kill-capability".

Conclusion

Algorithms are being developed by various players as a decisive battle winning component capable of identifying critical vulnerabilities of the enemy. This enables any force to attack their enemy with improved speed, precision and intensity. The increased permeation of the algorithms will make it easier to influence the battle and force a system collapse. The evolution of algorithmic as a method of warfare will facilitate MUMT and an increased autonomy to the machines. The velocity of data creation, collection and collation will necessitate evolution of commander decision cycle from OODA to PPSA decision cycle. PLA is developing the capability to launch an algorithmic warfare and named its ultimate form as 'Intelligentized Warfare'.

The strengthening of the Mountain Strike Corps by side-stepping an existing Division Size Force towards the northern borders coupled with assigning dual tasks to several formations give a credible capacity for India to articulate its forces as per current threat perception (Negi 2021).[21] But, the complete evolution of 'Intelligentized Warfare' and further comprehensive application would have an overwhelming effect on this setup. By 2050, these capabilities would have been developed, allowing the PLA to engage in synchronous and simultaneous 'Intelligentized Warfare' in multiple domains. India and

her Armed Forces must understand this criticality and should embrace jointness under the umbrella of disruptive technology. A 'whole of nation' approach must include infrastructure development, civil-military cooperation, development of homegrown disruptive military technology and creation of new doctrine that must enable us to fight technology-intense algorithmic warfare.

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Maj Vishnu RJ is an alumnus of the Defence Services Staff College, Wellington, the Nation Defence Academy, Khadakwasla and the Sainik School, Kazhakootam. He is a serving officer in the Regiment of Artillery and is currently serving in the United Nations Organisations Stabilisation Mission in the DR Congo.

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