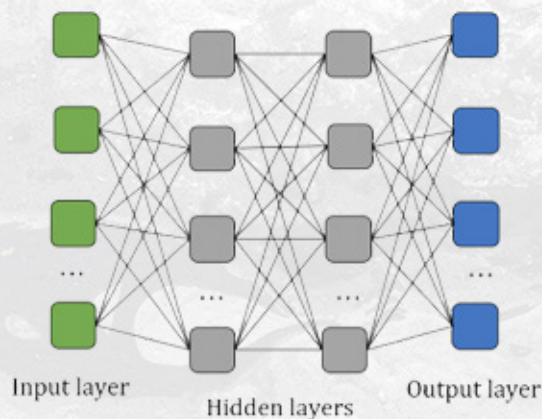
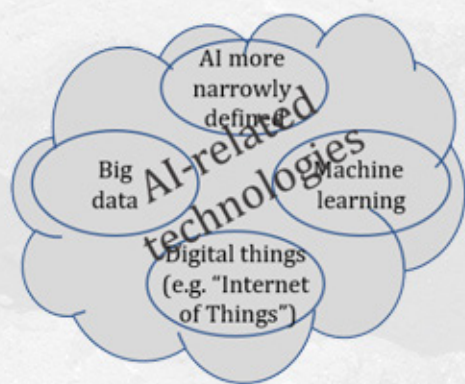


Defining China's Intelligentized Warfare and Role of Artificial Intelligence



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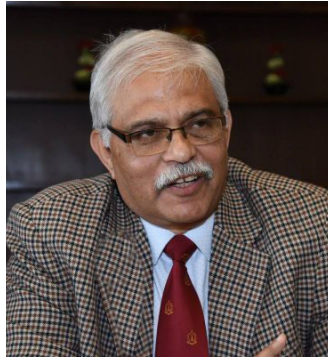
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Defining China's Intelligentized Warfare and Role of Artificial Intelligence

“Artificial intelligence is an important driving force for the new round of scientific and technological revolution and industrial transformation.

Accelerating the development of a new generation of artificial intelligence is a strategic issue that concerns whether my country can seize the opportunities of the new round of scientific and technological revolution and industrial transformation.” - Xi Jinping

Introduction

Marshal NV Ograkov, Chief of Staff of the Soviet Army in late 1970s-early 1980s gave out the theory of Military Technical Revolution (MTR). In the wake of overwhelming victory of coalition forces in Operation Desert Storm, net assessment specialists like Andrew Marshal came out with the term Revolution in Military Affairs (RMA) which basically evolved from earlier term MTR used by Soviet Military Theorists.¹

China has been keenly observing the use of technology by the U.S. and the western powers since the 1990-1991 Gulf War, the 1995-1996 Taiwan Straits crisis and the 1999 Belgrade embassy bombing. It has followed the concepts of Revolution in Military Affairs (RMA), the Network Centric Warfare (NCW), System of Systems and Military Transformation. Chinese analysts have critically reviewed the network warfare prowess of the U.S. during Operation Desert Storm.

Informatization to Intelligentization

Two years after the Gulf War, in 1993, the Chinese military modified its strategic military guidelines to the basic aim of Preparations for Military Struggle (PMS) which set the objective of “winning local wars in conditions of modern technology, particularly high technology”. This was during the era of Jiang Zemin (1989-2004). By the early 2000s, after witnessing western military operations in the Balkans and Afghanistan, the People’s Liberation Army (PLA) started preparing for “local wars under informationized conditions”. In 2004, one year after the Iraq War, the military’s PMS was changed to “winning local wars under conditions of informationization.” It was done under the direction of Hu Jintao (2004-2012).

In July 2014, the PLA’s formalized its idea of “winning informatized local wars.” After Xi Jinping took over as the General Secretary of Communist Party of China (CCP) and Chairman of the Central Military Commission (CMC), he gave impetus to modernization and inclusion of emerging technologies into China’s armed forces. President Xi’s strategic vision calls for the PLA to create a highly ‘informatized force’ capable of dominating all the information networks and expanding the country’s security and development interests. PLA considers Information Operations as a means of achieving information dominance early in a conflict. It aims to create an operational system-of-systems, which would enable the PLA to acquire, transmit, process and use information during a conflict to conduct joint military operations across the ground, maritime, air, space, cyber-space and electro-magnetic domains.

President Xi Jinping gave the theory of ‘*Intelligentization*’. In his report to the 19th Party Congress in October 2017, he urged the PLA to “accelerate the development of military *intelligentization* and improve all-domain joint operation capabilities based on network information systems.”² The information age had produced the concept of informationized warfare which was the basis for PLA’s development since the early-2000s. Now Chinese military leaders believe that informationized war is evolving and ‘intelligentized warfare’ will become the prevailing form of war. That would be the guiding principle for the future of Chinese military modernization.

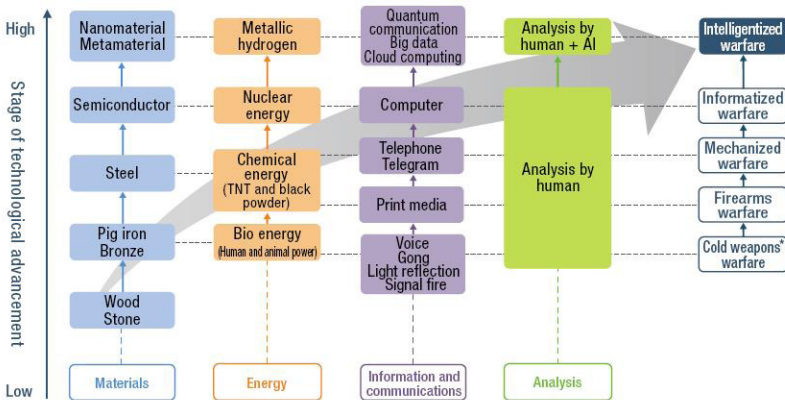
Intelligentization through Artificial Intelligence

China is aware that Artificial Intelligence (AI) has the potential to change the global balance of power and is integral to future national competitiveness. U.S, China

and Russia are leading the race to develop and incorporate AI into their respective defence modernization efforts. Russian President Vladimir Putin in 2017 stated, “Whoever becomes the leader in AI will become the ruler of the world.” China understands this and is going ahead with the intent to dominate the cognitive domain through intelligentization. China’s ambitions of leading the world in AI were prominently highlighted in the launch of the New Generation Artificial Intelligence Development Plan of the PRC State Council of July 20, 2017. This Plan entails that PRC “Strengthen the use of new generation AI technologies as a strong support to command decision-making, military deductions through war-gaming and operations research, and modernization of defence equipment, among other applications.”

China does not seek to merely integrate AI into existing war-fighting functions. China wants to use it to shape a new cognitive domain and thus revolutionize their entire approach to war-fighting. Xi Jinping and China’s leadership believes that China should pursue global leadership in AI technology and reduce its dependence on imports of international technology. China’s aim is to overtake the West in AI R&D by 2025, and more importantly, to be the world leader in AI by 2030.³

As to how China has progressed from People’s War to ‘High Tech Local War to Local War under Informationized Conditions’ to Intelligentized Warfare is illustrated in the following diagram:-



Source: NIDS China Security Report 2021 China’s Military Strategy in the New Era Published by The National Institute for Defense Studies 5-1 Honmura-cho, Ichigaya, Shinjuku-ku, Tokyo 162-8808 Japan Website: <http://www.nids.mod.go.jp>, Page 17

This emerging concept of military intelligentization or the development of an intelligent military includes the development of weapons systems to leverage adaptive control or involving autonomy in various aspects of their operation. The PLA Strategic Support Force (PLASSF) could apply advances in AI to its missions of cyber, space, electronic and psychological warfare.⁴ The PLA believes it may even offset U.S. military power if China can leapfrog ahead successfully in advancing AI innovations in the course of this transformation. However, it continues to confront critical challenges in operationalizing AI across a range of applications, from issues of talent to the management of data and adaptation as an organization.

Defining Intelligentized Warfare

Intelligentization is the distinctive Chinese concept of applying AI's machine speed and processing power to military planning, operational command, and decision support. With rapid advancement of artificial intelligence technologies, China seems keen to lead the curve in the long term than honing tactics in the immediate future. With AI technology rapidly infiltrating into the military domain, it will inevitably lead to a thorough change in the way combat power manifests itself. The PLA's aim is to use AI algorithms, autonomous systems, machine learning, human-machine teaming collaboratively to paralyze its enemies. The ultimate objective of the Chinese military appears to be gaining a cognitive advantage, the ability to adapt one's system-of-systems faster than one's adversary. The Chinese seek to use AI to deliver precise effects to immobilize their adversary while defending their own system-of-systems. Any Chinese military challenger would be wise to understand the implications of how future AI capabilities may be employed to realize Chinese goals in system-of-systems confrontation⁵.

Development of AI technology has elevated computers from computing, storing, transmitting and executing commands to thinking and reasoning, from information processing to knowledge processing, from replacing and extending the function of human hands to replacing and extending the functions of the human brain. AI has the capability to affect strategy, operations, logistics, personnel, training and every possible military aspect. AI is likely to be used as such by militaries as it has been done for computers or electricity.

It is argued that integration of military and non-military domains takes place in Intelligentized Warfare. The boundary between peace and wartime is getting

increasingly blurred. Cross-domain asymmetrical and unconventional fighting in battle will become the new normal. The rules of engagement and the support process will have to be rewritten for unmanned operations. Intelligent control will become the centre of gravity. There will be integration of human and machine intelligence in Intelligentized Warfare. Combining wearable devices and gadgets implanted into human bodies, humans and machines into brain-machine interfaces, external skeletal systems, will “comprehensively enhance the inherent cognitive and physiological capacity of human fighters and will forge out superman combatants.”⁶

The official Xinhua state news service has defined intelligent operations as: “Intelligent operations have AI at their core, and use cutting-edge technologies throughout operational command, equipment, tactics, and other areas... they must be understood by the core concepts of ‘system intelligence is central,’ ‘full use of App Cloud,’ ‘multi-domain integration,’ ‘brain-machine fusion,’ ‘intelligent autonomy,’ and ‘unmanned struggle for mastery’ in the battlefield environment.” Li Minghai, Associate Professor at the National Defense University, elucidates Intelligentized Warfare as “integrated warfare based on Internet of Things (IoT) systems that uses intelligent weaponry and equipment and their corresponding operational methods in the land, sea, air, space, electromagnetic, cyber and cognitive domains.”

In PLA, there is some overlap with U.S. military thinking on the use of AI. But there is also subtle difference in thinking U.S. puts emphasis on the role of AI in enhancing firepower and maneuver centric strategies. The PLA thinks that AI enhances its information centric military strategies.

Discussions on Intelligentized Warfare

Within the Chinese military, there are robust debates on contemporary military affairs. The PLA's newspaper, the PLA Daily, and the PLA's official web site provide a venue for discussion over emerging phenomena on any number of topics, including Intelligentized Warfare. These publications come out with the tacit endorsement of the Chinese authorities' thinking. Monographs by select military authors published in the PLA Daily newspaper's *Military Forum* offers insights of the emerging thinking within the PLA on Intelligentized Warfare.

To comprehend the Chinese military's thinking on AI, it is essential to read what People's Liberation Army (PLA) officers, defence industry engineers and academics

involved in the day-to-day development and deployment of AI are writing about it. Chinese military scientists and strategists are undertaking extensive theoretical research on the impact of AI on future warfare. These initial conceptual developments will likely influence future directions in PLA strategy, doctrine and weapons development. Chinese military strategists and scientists from well-established institutions like the National Defense University, PLA's Academy of Military Science and National University of Defense Technology, foresee AI and intelligent weapons playing an increasingly important and decisive role in future warfare. They closely examine antecedents in U.S. strategy and capabilities.

The whole issue has started with the publication of the official White Paper on 'China's National Defense in the New Era', released in July 2019. It states: "Driven by the new round of technological and industrial revolution, the application of cutting-edge technologies such as artificial intelligence (AI), quantum information, big data, cloud computing and the (IoT) is gathering pace in the military field. International military competition is undergoing historic changes. New and high-tech military technologies based on IT are developing rapidly. There is a prevailing trend to develop long-range precision, intelligent, stealthy or unmanned weaponry and equipment. War is evolving in form towards Informationized Warfare, and intelligent warfare is on the horizon."⁷

Since then, lot of publications have come out with increasing frequency in official PLA media discussing informationised warfare, intelligentized warfare, unmanned systems, autonomous decision-making and cognitive warfare.⁸

Highlights of Writings by Chinese Strategic Community

Some of the recent writings on Intelligentized Warfare by Chinese experts are given below.

Vice Chief of Staff of the Eastern Theater Command, Major General Wang Peng summarises the characteristics of Intelligentized Warfare compared with informatised warfare as follows:-⁹

- The goal of information dominance is to seize the initiative in land, sea, air, space, cyber and electromagnetic battlefields. In Intelligentized Warfare, 'intelligence dominance' is the new domain for seizing the initiative. It would result in competition for superiority in human cognitive speed and cognitive quality.

- Development of autonomous weaponry and equipment is a major part of Intelligentized Warfare. Capabilities comparable to human thinking are imparted to weaponry and equipment to autonomously conduct reconnaissance, movement, attack, defence and more.
- Intelligentized Warfare incorporates the operational spaces of land, sea, air, space, cyber and electro-magnetism so that the operational domains can complement each other.
- Though AI-equipped weaponry is given some autonomy and the battles themselves may be unmanned, the battles are not completely devoid of human involvement. Humans control the battles.
- AI is expected to help commanders make decisions by processing large quantities of data quickly and accurately. AI will begin to support decision-making by commanders.

Lieutenant General Liu Guozhi, director of the Central Military Commission's Science and Technology Commission, writes: "The world is on the eve of a new scientific and technological revolution. We are entering the era of intelligentization due to rapid advances in artificial intelligence and its applications. AI will accelerate the process of military transformation, causing fundamental changes to military units' programming, operational styles, equipment systems and models of combat power generation, ultimately leading to a profound military revolution. Whoever doesn't disrupt will be disrupted! The PLA presently has a unique opportunity to take advantage of today's transformation of warfare through artificial intelligence and automation through leveraging the dynamism of Chinese private sector advances in AI."

Major General Wang Kebin, director of the former General Staff Department Informatization Department, writes: "China's information revolution has been progressing through three stages - first digitalization, then networkisation and now intelligentisation. In its agenda for informatisation, the PLA has sought to integrate information technology into the PLA and to improve its ability to utilize information in warfare. To date, the PLA has succeeded in the introduction of information technology into platforms and systems. It has progressed gradually towards integration, especially of its command, control communications, computers, intelligence, surveillance and reconnaissance capabilities, and seeks to advance towards a deeper fusion of systems

and sensors across all services, theatre commands and domains of warfare. In this final stage, intelligentization would enhance the PLA's capability to process and utilize the information at scale and machine speed.

Major General Li Bingyan, a former senior editor of the PLA Daily newspaper and a researcher for China's National Security Commission has argued for a concept of light warfare which would leverage directed energy technologies in conjunction with autonomous systems for 'zero-hour' attacks enabled by real-time information.

Chen Hangui, a researcher with the Army War College, writes: "On the future battlefield, with the continuous advancement of AI and human-machine fusion technologies, the rhythm of combat will become faster and faster, until it reaches a singularity. The human brain can no longer cope with the ever-changing battlefield situation, unavoidably a great part of decision-making power will have to be given to highly-intelligent machines. As a result, the role of humans could transition from being 'in' the loop, to 'on' the loop, and perhaps even out of the loop. Although there is not sufficient evidence to conclude that the PLA is likely to take humans 'out of the loop' entirely, there is expectation that there will be a future point at which the rhythm of intelligentized operations will be unprecedentedly accelerated beyond the capabilities of human cognition.

Zhang Zhanjun, a senior researcher with the Academy of Military Science's Theory and Operational Regulations Research Department, who also serves as editor-in-chief of its journal China Military Science, wrote in a lengthy commentary in October 2017 on how the PLA might compete to seize the initiative in future maritime combat using new-type combat forces to fight in new domains such as networks and space and implement asymmetric autonomous operations. According to him, PLA's traditional concentration on devising capabilities designed to target perceived weaknesses of an adversary's ways of warfare will likely persist in conceptual and technological developments that leverage these emerging technologies.

Li Minghai, in his early 2019 publications, addressed the importance of grasping the mechanisms for victory in Intelligentized Warfare in a military environment in which information technology and AI-enabled weapons systems are critical factors on the battlefield. He writes: "In recent years, Informationized Warfare has been the primary paradigm discussed in PLA writings. This will be superseded by a new paradigm of Intelligentized Warfare, which will be fundamentally different in nature. In comparing informationized warfare and future Intelligentized Warfare, the winning mechanisms

have seen a clear change... operational key factors are changing from information in the lead to machines leading in battle.”

Centre for Security and Emerging Technology of Georgetown University, U.S., carried out a detailed study of writings by Chinese experts. It examined 58 journal articles written from 2016–2020 by PLA officers, defence industry engineers and academics at leading Chinese universities about artificial intelligence and future weapons systems.¹⁰ The findings are given below:-

- Chinese specialists predict that AI will improve detection, targeting and strikes against military targets. The advantages of machine learning is to track or strike at forces through unmanned aerial vehicles, intelligent munitions and ISR software. However, reliance on AI would leave systems vulnerable to adversarial cyber attacks which could threaten command and control systems.
- Chinese professionals think that AI could increase the risk of miscalculation or escalation in conflicts and reduce the ability to retaliate. They are seriously worried about U.S.’ advances in AI which could overpower Chinese command and control systems and its air defences, and reduce China’s time to respond to an imminent attack.
- Chinese experts have a tendency to overestimate U.S. military AI capabilities.
- China faces major hurdles in developing and deploying AI applications due to the shortage of data and computing power and the technical literacy of service members.

Principles of China’s Intelligentized Warfare

AI may have changed the character of war, but the nature of war endures. Chinese experts stress that humans will still plan, organize and initiate wars. They always place humans in a dominant role. However, there are a number of unique views from the Chinese discourse on AI and warfare theory and doctrine which merit attention. Some of these are:-¹¹

- Intelligentized Warfare is an evolution of Informationized Warfare. Informationization and intelligitization are inextricably linked. But there

is a thinking to categorize intelligentization as an independent military development.

- Ubiquitous networks, similar to the U.S. Defense Advanced Research Projects Agency's (DARPA) Mosaic Warfare concept, will enable systems-of-systems warfare. These will reduce the distance between perception, judgment, decision-making and action.
- AI enables command and operational design. The PLA considers that command and control can be built-in to operational plans and system design and to mitigate threats of either human or machine errors in combat. AI and machine-learning will provide the Chinese military with algorithms and tools to develop invulnerable systems-of-systems, operational capabilities and military plans, and determine end results.
- AI will enable new operational concepts. Future Chinese operational concepts may include autonomous swarm attrition warfare, autonomous dormant assault warfare, autonomous cross-domain mobile warfare and autonomous cognitive control warfare. Future autonomous systems will provide cognitive advantage, enabling faster cycling of military action to dominate an adversary in parallel operations.
- In Intelligentized Warfare AI and autonomous systems will be able to release precise kinetic energy and paralyze an opponent's system-of-systems.
- In the development of military AI, China is well behind the United States in terms of top talent, technical standards, software platforms and semi-conductors.

Operationalising Intelligentization

Intelligentization is an exclusively Chinese concept of applying AI's machine speed and processing power to military planning, operational command and decision support. In that concept, as AI infiltrates into the military domain, it will change how combat power manifests itself. The cognitive domain will become a battle domain, human fighting will change and intelligent equipment will be brought onto the battlefield. Cross-domain unconventional and asymmetrical fighting will be the new normal and intelligence control will replace territorial control as the centre of

gravity in war. Intelligentized Warfare is expected to reshape the rules of engagement and restructure combat forces such that machine-on human or machine-on-machine warfare will be the new 'traditional'.

Further, the focus of competition between the two warring sides will be shifted to the cognition domain. The side that can be the first to gain control of this domain will be able to seize the strategic initiative in war. The AI-enabled decision-making support system will be making sure that commanders may rapidly and accurately judge and predict the development of a war situation to take operational decisions and gain decision-making superiority over the adversary.¹² To imbibe AI into warfare, structural functions and organisational models and forms of the Armed Forces will have to undergo disruptive changes. Forces will deliver attacks on vital nodes of an opponent's operational system and further cripple his capabilities and will to fight. Intelligentization will cause the development of new management models for defence technology and the war industry. These models will be based on the big data that is gathered and processed before being sent to intelligentized operations.

Four forms of smart operations in AI warfare are propounded as follows:-

- **Wasp Swarm Operations.** Enhanced effects with massive quantities turning quantity superiority into qualitative superiority. These are 'wolf pack' or 'wasp swarm' saturated attacks that break through enemy defences and destroy major targets.
- **Trojan Operations.** It is based on stealthy ahead-of-time deployment and activation of systems only when needed. It will use offensive or cyber weapons with bionic or stealth features to sneak into an opposing side's core facilities, sea routes, equipment, vital parts and systems, where they lie dormant and are only activated when war or conflict breaks out.
- **Self-determined Operations.** These are actions without human command when quick rhythm move under cover, requiring automatic sensing, decision-making and actions. These disrupt an enemy's smart operational systems and undermine an his thinking and cognition.
- **Incapacitation Operations.** These are supersonic and ultrasonic weapons that enable high-speed instant strikes against important facilities that destroy points and neutralize bodies, taking aim at nodes, hubs and other

vital parts of an opponent's operational system.¹³

Operational Planning. The following are some key takeaways from the PLA's understanding of how AI and smart weaponry are affecting operational planning:-¹⁴

- Technical domain will combine with various conventional physical domains to form a cross-domain battlefield. Advances in the brain and cognitive technologies will give rise to the cognition domain of war which, together with other domains, will forge a mega-domain operational systems.
- Drone swarm operations will attempt to overload an opponent's defensive systems and responses. Swarms will be used in the air, sea and land domains. One big drone swarm could involve reconnaissance, jamming, attack and other capabilities that fulfill multiple missions.
- A group of 'smart warfare systems' is being built where AI is the brain, operational networks the nerves and operational big data the blood. Counters to an adversary's use of smart wars must also be considered. Topics such as algorithmic and anti-algorithmic warfare must be researched in depth.
- The focus of military engagements will change from system confrontations to algorithm competition, due to the use of AI. It was noted that algorithms are stratagem mechanisms for resolving various issues.
- Intelligent power will become the most crucial factor in determining a war's outcome. It will utilize innovation in areas such as intelligent perception, intelligent decision-making, intelligent control and unmanned platforms.
- Cross-domain, unconventional and asymmetrical fighting will be the new normal, and intelligence control will replace territorial control as the centre of gravity in war. Perhaps this will cause a redefinition of war.
- Attrition warfare, launched with intelligent swarms, cross-domain mobile warfare and cognition control warfare will become basic types of combat operations.
- Civil-military integration, which involves the collaborative industry-university-research innovation system, will open society's innovative power and promote development of military intelligence. The development of

Chinese Institute of New Generation Artificial Intelligence Development Strategies (*CINGAIDS*) is but one civilian development that will be integrated with the military response.

China's CMC, in its construction of a joint operations command system, has called for the PLA to leverage AI and related technologies to advance towards intelligentized command and decision-making. PLA is developing military capabilities by establishing the Strategic Support Force (SSF) as part of the military reforms. The SSF is tasked with the military use of new security domains including space, cyber and electro-magnetism. SSF is also in charge of the military use of AI, robotics, nano-technology and other advanced technologies. Establishment of such a force is inviting attention as an example of the PLA's priority on the military value of new security domains.¹⁵

Leapfrog Technology in the 4th Industrial Era

Prof. Klaus Schwab, founder of the Davos World Economic Forum, wrote in 2016: "The Fourth Industrial Revolution is characterized by ubiquitous and mobile internet, smaller and more powerful sensors, artificial intelligence and machine learning. We are in the age of the 4th Industrial Revolution." The term "leapfrog development" describes a technology for countries which are lagging behind to skip a development stage and adopt the next generation technology. An example is the rapid and extensive adoption of cellular phone technology in countries that had only nominal landline phone adoption.

China has identified one of the emerging technologies, AI, where they should put maximum effort into developing new frontiers. China's stress on AI as a leapfrog technology extends to national security applications. China's National AI Development Plan of 2017 identifies AI as a historic opportunity for national security leapfrog technologies.

Lt. Gen. Xiao Tianliang, the Vice Commandant of the PLA's National Defense University writes: "Military intelligentization advances new and higher requirements for armed forces construction. it provides a rare opportunity for latecomer militaries to undertake leapfrog development... It is necessary to confront the challenge of intelligentization, planning actively and preparing a strategy for the development of military intelligentization to seize commanding heights of future military

competition.” As per Chinese thinking, the current advantages of the U.S. in aircraft carriers, stealth aircraft and precision munitions are actually long-term disadvantages. The vested political and business interests that support defence industry today will adversely affect the U.S. in transitioning to an AI-enabled military technology paradigm in the future. China is of the opinion that the U.S. will spend more to upgrade and maintain mature systems and spend less in disruptive new systems that make America’s existing sources of advantage vulnerable and obsolete. AI presents a leapfrog opportunity to China as it is in a better position to adopt military AI than the U.S. China thinks that military AI development is a cheaper and easier path to threaten the U.S. military power than developing Chinese equivalents of American systems. It will also be easier to implement in China than the United States.¹⁶

China is interested in AI capabilities for military command decision making and for autonomous military robotics. If the PLA succeeds in realizing the military potential of AI, these technologies could become a critical force multiplier for China’s future military capabilities. China believes that in both AI R&D and commercial AI products, it has managed to close the gap with the U.S. China’s current strength in AI R&D and commercial applications have been built through access to international markets, technologies and research collaboration. China now sees AI as “a race of two giants.”

U.S. View on China’s Concept of Intelligentized Warfare

China has been following the U.S.’ use of technology in warfare very closely. It has tried to transform the PLA taking lessons from the U.S. while keeping in view the typical Chinese condition and requirements. It is time now for the U.S. to keep an eye on the Chinese development of new concepts of warfare like Intelligentized Warfare. Like China, U.S. too is following closely as to what China is thinking and doing on Intelligentized Warfare. Recent thinking by U.S. on China’s Intelligentized Warfare is elaborated below.

In its annual report to Congress on Chinese military, released in September 1, 2020, the U.S. Department of Defense noted that China sees emerging disruptive technologies such as AI, big-data analytics, cloud computing, unmanned systems and quantum computing as driving a shift toward Intelligentized Warfare.¹⁷ These technologies and other issues are the supporting concepts to China’s way of war. These will influence future war’s design and conduct in conjunction with specific and important concepts

imbedded in the PLA's military culture. This new form of warfare is an extension of existing Chinese strategy and operational concepts.¹⁸

U.S. infers that the PLA thus wants to improve its cyber and electronic warfare capabilities through AI-assisted network vulnerability analysis, counter-measure identification and electro-magnetic spectrum management. Some PLA thinkers anticipate that warfare's intelligentization will result in a trend towards a battlefield 'singularity', such that human intelligence may prove unable to keep pace with the new operational tempo of machine-age warfare. AI could take on a greater role in command and control. China, through its Military-Civil Fusion (MCF) Development Strategy wants to lead the shift to Intelligentized Warfare by reforming both its research and development as well as strategy and doctrine organizations.

Further, Information Warfare and information control are the core of the PLA's approach to warfare and AI. To counter China's strategy, defensive and offensive use of new AI technologies will be required. In a future confrontation with China, the U.S. military will have to employ AI and autonomous capabilities to permit and defend its information system-of-systems while simultaneously using AI technologies to attack China's information-centric strategy and capabilities. Based on the information that is readily available, the PLA is exploring and/or pursuing research and development of technologies and potential capabilities in AI, as elaborated at the Appendix attached. This list is not comprehensive but is generally representative of the overall directionality of these efforts that can be readily confirmed based on open sources.

Limitations of Intelligentized Warfare

As of now, AI cannot replace human intelligence in the military domain, but it can be integrated with military systems. The art of war is often based on intuition. In the present state of development of AI, robots cannot be trained on intuition. AI cannot resolve uncertainly during military operations caused by contradictory information, deception and disinformation. Errors and mistakes may occur in judgments and decisions if made by systems alone.¹⁹

AI warfare aims to seize intelligence superiority by controlling the adversary's perception. Use of AI in the automatic decision-making process in areas such as reconnaissance, strikes and damage assessment contains several risks. If an opponent figures out a certain algorithmic logic behind an AI system, own forces could be led

into making erroneous judgments. At present, AI systems have no human emotion and are not restricted by ethics and morals. Decisions must still be reached with discretion. Human beings possess a unique subjective initiative, intellect and creativity, while machines have precision, rapidity and repetition. AI-weapons search, identify and attack but have limited capacity of initiative.²⁰ Humans remain more important than machines in their ability to counter an opponent's AI.²¹

There are difficulties in developing future technologies and implementing new capabilities. Delegation of decision-making authorities to lower echelons may run counter to the PLA's traditionally hierarchical and centralized Command and Control (C2) structure. PLA's capability to leverage big data will depend upon its ability to obtain large quantities of high quality data on foreign militaries. The complexity of future conflict will pose challenges to the PLA to retain, train and recruit highly competent and technically proficient personnel necessary to understand and operate future intelligentized systems.

Military environments are chaotic, unpredictable and adversarial. Even as AI may perform very well in some situations, in other settings their performance can fall significantly. AI systems used by militaries will then break, may suffer accidents and be manipulated by adversaries. Data available on the battle field is not adequate. Armed Forces can only test their AI systems in training environments but can never fully recreate the chaos and violence of war in peace time. Humans are adaptable and can innovate in battle, using their training as a foundation. But machine intelligence is not as flexible and adaptable as human intelligence. Failures could result in accidents or simply cause military systems to be ineffective. Even if AI systems are restricted to only giving advice, it remains risky. Humans frequently over trust the machines, a phenomenon known as automation bias.

Extreme brittleness of AI systems and how that will affect their performance on the battlefield must be taken into account before an assessment of the role of AI in warfare is made. Against the weakness in machine intelligence, the strength of human intelligence is very important in warfare where unpredictability and chaos are central elements. In its present state of development, no AI system can replace the flexibility, robustness and generality of human intelligence.

Analysis

There have been intense discussions within the Chinese experts on AI and Intelligentized Warfare in the last two years. The focus shifts back and forth from AI to intelligent warfare and back. Different writers arrive at their conclusions from different sources and angles. While both concepts are important to thinking and planning into future warfare, AI is currently central to the PLA's crafting of future war scenarios. AI is increasingly playing supporting role to intelligentized or 'smart' warfare.

In a March 2018 article it was stated that a machine's cognitive element should never go beyond human control: "Along with appearance of neural network, optical, biological and other types of new-concept computers supported by AI technologies for voice, text, and image recognition, the human-machine interface of the command information system will become highly intelligent. The art of command and the employment of military stratagems will be deeply merged into the human-machine interactive relationship and will be applied through the expert knowledge repository system and smart weapon-guided systems".²²

Operational Challenges

In the evolving era of systems warfare, advancement in AI, 5G, quantum computing, big data analytics, AI-enabled cloud computing, robotics and autonomous systems will make future confrontations between the sides increasingly sophisticated, intense and lethal.

Militaries need to visualize as to how they want to exploit technology and organize themselves as a coherent war-fighting force and as to how will they employ that force to fight and win against near-peer opponents? Incremental adjustments to current concepts will not be sufficient, given the severity of the armed forces' operational challenges. Complete new war-fighting concepts will be required to contest peer adversaries and provide the armed forces with battlefield advantage in systems warfare.

PLA may try to attain deterrence-by-denial by fielding new battle networks which operate faster and better than an adversary's operational systems. It can develop capabilities and platforms optimized for systems warfare that leverage AI-enabled autonomy for human-machine collaborative battle networks to wage algorithmic operations at near machine speeds. That will lead to consistently better and faster

decision making, thus giving the PLA both a decisive advantage in its Observation-Orientation-Decision-Action (OODA) Cycle and an ability to prevail against system destruction attacks. In future, attrition warfare launched with intelligent swarms, cross-domain mobility and cognition control will become basic types of combat operations. Offensive and defensive operations characterized by human and equipment deployments, automatic coordination and energy concentration will become the basic forms of cross-domain, whole-area operations.

Chinese military strategists are applying innovative thinking to consideration of modern technology and its application to warfare. The PLA recognizes that and intends to take advantage of the transformation of today's informatised ways of warfare into future Intelligentized Warfare. PLA thinks that AI will result in fundamental changes to combat power generation, operational styles, equipment systems and programming of military units, leading to another profound military revolution. As China is leading in research on AI, the PLA will have a unique opportunity to take advantage of this trend Cognitive initiative can become a revolutionary concept if China's Intelligentized Warfare doctrine can trickle down for use by the PLA's lower echelons. However, some of the capabilities may take many decades to be implemented on ground, presently they remain but aspirational goals.

Whether Chinese aspirations for an innovative military strategy and doctrine become reality will mostly rest on the application of emerging big data and AI technologies to military purpose and integration of new capabilities to the existing concept of system-of-systems warfare. The CCP leadership has prioritized and resourced the development of requisite technologies and systems. Future will tell whether the PLA will be first to develop an operational construct to fit the future battle-space.

AI, Intelligentized Warfare concept, quantum computing and other issues are likely to be supportive of the concepts to China's way of war. They will influence the design and conduct of future war in conjunction with specific and important concepts imbedded in the PLA's military culture.

Conclusion

The Chinese concept of war has changed drastically in the last 20 years. However, basic thinking of PLA like stratagems, deception etc. remain as important parts of their concept and are being incorporated with modern technological advances. AI

is now being seen as a tool to help the PLA in controlling future conflicts. That will provide PLA with a deterrence to confront other nation states in a conflict scenario. It seems that China's earlier belief of 'technology determines tactics' is now changed to 'technologies determine strategy' due to the recent stress on technologies, including cyber technology. PLA's thought process on use of technologies in warfare is changing, and we would do well to evaluate this thought process.

The emerging theory of intelligentized operations attempts to address what Prussian theorist Carl von Clausewitz called the "fog of war" on the battlefield. The PLA can thus take credit for thinking big to solve problems that war-fighters have grappled with for generations. It is trying to create a strategic doctrine for AI and other cutting-edge technologies in future warfare. China is thinking long term. If successful, the PLA will have an obvious advantage over its adversaries in future conflicts.²³ Notably, the PLA has not fought a war after 1979 in Vietnam. Since then, China has not engaged in any violent conflict within or outside its country. In the recent past, Military Operations Other Than War (MOOTWA) has consistently engaged the Chinese thought. PLA feels that counter-terrorism, stability operations, disaster relief, protection of Chinese rights and interests, and international peacekeeping all fall under MOOTWA.

The world was stunned by the Allied Forces' use of technology in the First Gulf War and Operation Enduring Freedom in Afghanistan. But character of warfare changes, adversaries adapt, and so the Allied Forces were subsequently made to fight with 'grey' opponents. The results are well known. In Afghanistan, the Allied forces have all technologies, weapon systems, as well as cyber, electronic, space, air, C4ISR warfare capabilities. The Taliban, who are hardly literate, can only use weapons and munitions that they can carry on their person. But who is winning this war? As they say, U.S. may have the clock but they have the time. Warfare is not all about technology - it is a great enabler, of course.

China feels that U.S. is its main adversary. The U.S. has tremendous technological capabilities as compared to China. China is trying to match that with its own strength in AI as a leap frog technology and a new concept of war. But there will be lot of problems in implementing this concept of Intelligentization Warfare to reality. However, President Xi Jinping has thrown the gauntlet, and it is up to the U.S. the other adversaries and the rest of the world to follow this concept keenly.

Appendix

Research and Development on AI Technology Undertaken by the PLA

1. Leveraging machine learning in support of maintenance, including for fault prediction.
2. The application of new algorithms, including machine learning, to remote sensing and battlefield environmental support.
3. The employment of natural language processing for analysis in military intelligence, Machine learning techniques that can function under conditions of limited computing capabilities.
4. The exploration of options to leverage artificial intelligence for political work and psychological operations.
5. Advances in generative adversarial networks that can be leveraged for image manipulation, including the potential employment of deep fakes.
6. The improvement of algorithms for Automatic Target Recognition (ATR) to enhance precision, including the identification of multiple targets in real time based on the use of neural networks.
7. The application of virtual and augmented reality to modeling, simulations and actual combat training.
8. The use of deep learning and other algorithms to model the dynamics of offense and defense in free air combat.
9. The introduction of AI to war-gaming as a tool for training and evaluating the dynamics of intelligent confrontation.
10. The use of neural networks for missile guidance to enable greater autonomy in cruise missiles for control and targeting.
11. The introduction of new approaches to spectrum management and techniques for electronic countermeasures, including an emphasis on cognitive electronic warfare.

12. The use of AI technologies for cyber security and cryptography, including in advanced steganography.
13. The use of artificial intelligence to improve communications and to secure networks against jamming.
14. New techniques for data fusion intended to improve situational awareness, including through potentially integrating information from sensors and unmanned systems in support of anti-submarine warfare.
15. The use of expert systems and more advanced techniques for decision support to commanders or to the operators of specific platforms (e.g., fighter jets and submarines).
16. Overcoming obstacles to and challenges of human-machine interaction, involving new models to improve reliability.
17. The application of neural networks to the guidance of hypersonic glide vehicles to enable more precise and autonomous control.
18. Increased autonomy in 'unmanned' systems across all domains of warfare, including a number of aerial vehicles, ground vehicles, surface vessels, and underwater robotics, as well as autonomous submarines.
19. New algorithms and architectures for swarm intelligence aimed at enabling 'swarm combat.'
20. Methods for modeling and evaluation of unmanned equipment to test reliability and functionality.
21. 'AI satellites' and software-defined satellites for military, commercial, and dual-purpose applications with the onboard capability for intelligent processing.
22. Wearable systems for individual personnel intended to enhance situational awareness and decision-making on the battlefield.
23. The management of massive amounts of military data, including through parallel processing, in support of joint operations.

24. Improving the integration and processing of information for the PLA's integrated command platform.
25. Capabilities and techniques to counter or subvert an adversary's AI systems via manipulation of data and/or exploitation of hardware vulnerabilities, among others.

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