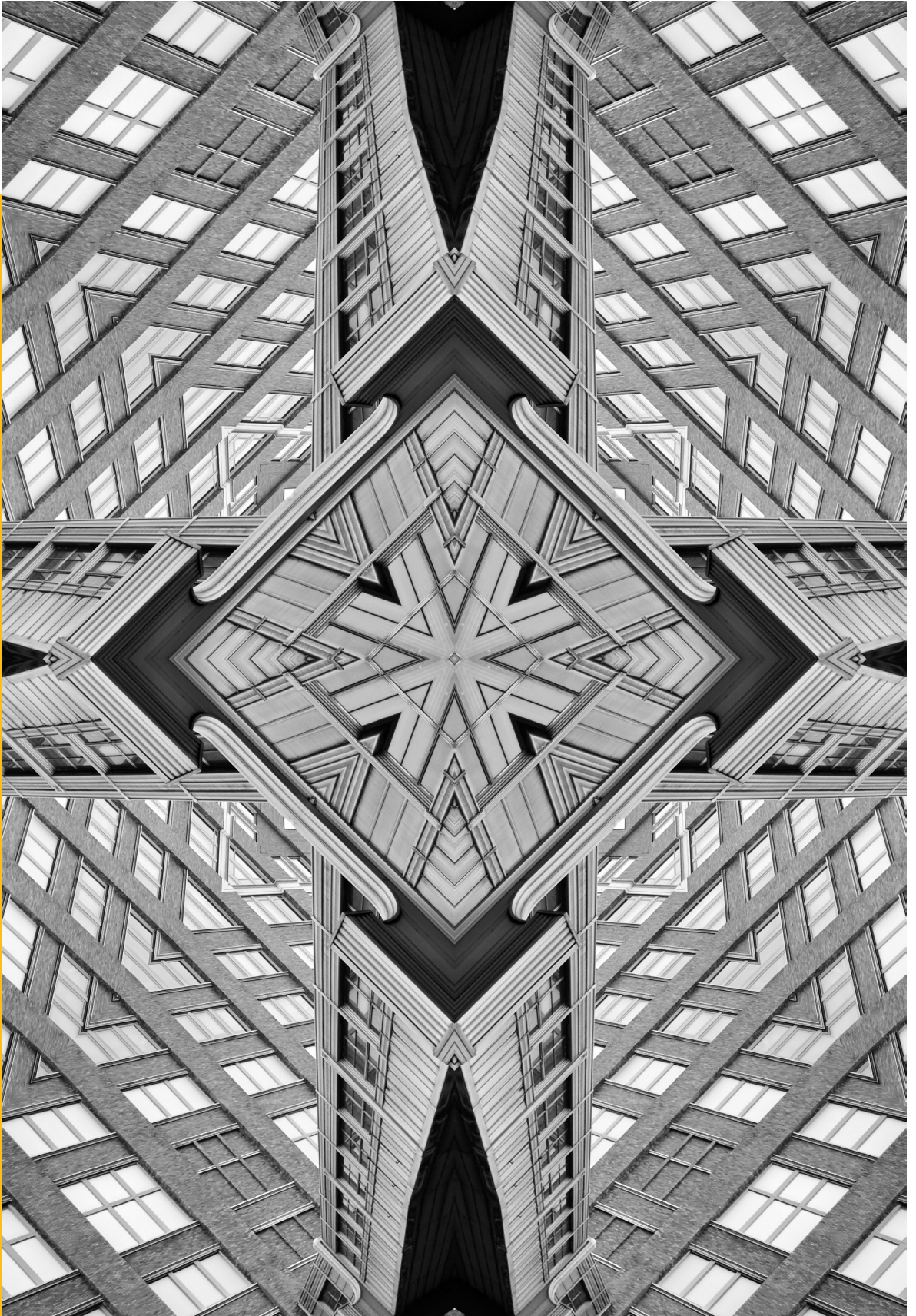


Occasional Paper



ISSUE NO. 457 DECEMBER 2024

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The Case for Tech-Based Wargaming in the Indian Armed Forces

Rahul Rawat

Abstract

Wargaming can aid in strategic thinking and operational preparedness and help assess potential outcomes in a conflict or a battlefield. In recent years, modern militaries have been moving to technology-based wargaming by developing better modelling and simulations and running AI-generated plausible scenarios to enhance understanding of threat environments and operational realities. This paper analyses the merits of technology-based wargaming and advocates for an overhaul of traditional wargaming in the Indian military. It tackles why and how India should adopt technology-based wargaming, and recommends that the country integrate human and AI capabilities to develop an improved generative and analytical wargaming infrastructure. In the long run, this can help enhance the doctrinal, organisational, and operational levels of decision-making, training, and education.

“In preparing for battle, I have always found that plans are useless but planning is indispensable.”

~ Dwight D Eisenhower, 34th US President

The operational strategies of militaries and nations are aimed at achieving ‘decision superiority’^a over adversaries. Reducing the probability of errors by both individuals and organisations requires sufficient preparation, which enhances awareness and understanding of threats and possible contingencies that could arise in real time. Additionally, it can help achieve an alignment between the thinking, logistics, plans, command and control, conduct, and limitations prior to their execution. In military parlance, a core component of such preparation is wargaming.^b

Wargames have three primary implications for military thinking:¹ they enable wargamers to challenge assumptions and add new perspectives to their existing knowledge; they provide insights into and enhance professional training and practice, thus catering to military readiness and effectiveness; and the planning component of wargames helps prepare, analyse, and plan for any possible scenario. The wargaming approach consists of six phases:² teach; apply; do; learn; repeat; and improve. The exercise helps situate a problem and provides a framework for decision-making by facilitating an assessment of emerging challenges, creating a feedback loop, and developing a better judgement of the strategic environment and crucial operational and tactical details.

Wargaming is a centuries-old exercise that has evolved through various phases to its current state.³ Wargaming has been conceptualised in various ways according to the utility, roles, functions, and objectives that it serves for a particular organisation. It is viewed as a method of active learning⁴ and an effective way to impart information,⁵ develop group cohesion,⁶ and create an understanding of strategic and tactical dynamics of real military operations.⁷ It also helps align the military and political dynamics of a nation-state.

a For more on decision superiority, see Anthony Bellione, “The Heart of Decision Superiority: Evolve or Lose – Why Your Next War May Be Won or Lost in Seconds,” *Journal of the Joint Air Power Competence Centre*, Vol. 36 (2023), <https://www.japcc.org/articles/the-heart-of-decision-superiority/>

b NATO defines ‘wargaming’ as “a simulation of a military operation, by whatever means, using specific rules, data, methods and procedures.” See: <https://www.act.nato.int/our-work/wargaming-the-future-at-the-cde-conference/>

The roots of wargaming can be traced to the ancient Chinese game Weiqi, also known as Go,^c which was based on the application of abstract strategy. First-generation wargames were primarily abstract strategy games that replicated warfare and helped players anticipate the move of the adversary. In 1811, wargames in Prussia began to involve the simulation of movement, attrition, and logistics, which gave rise to the development of models to achieve battlefield simulation.^{d,8}

During the 19th and 20th centuries, analog-based wargaming became the prominent mode of performing analysis and training-related tasks.⁹ After the First World War, Germany began to use wargames to develop plans and doctrines to invade France and Russia.¹⁰ The Japanese military also used wargames to validate their tactical and operational plans against the United States (US) during the World Wars.¹¹

The US also integrated wargaming in its planning process, with the RAND Corporation developing a range of scenarios and new wargames, including computer games and simulations.¹² During the Cold War, wargaming gained new relevance, with participation not being limited to military professionals but expanding to civilian bureaucrats and political leadership.¹³ Methods such as Operations Research (OR)^e also became prevalent for modelling and wargaming during this period.¹⁴ As nuclear weapons turned international politics into a zero-sum game, RAND began applying mathematical equations and game theory models to address issues in international politics.¹⁵ Such problems were endorsed with data

c Go is a strategic two-player game traditionally played on a grid of 19x19 lines. The objective of the game is to surround and capture more territory than your opponent. The game is played with two sets of stones, one black and one white. The game is considered to have immense strategic depth. See: <https://yulleyi.medium.com/the-art-of-strategy-life-lessons-from-a-famous-go-game-1c00baf17bc4>

d In 1837, when Lt. Helmuth von Moltke became Chief of General Staff of the Prussian army, he advocated for an increase in wargaming exercises and added more wargaming components in the curriculum of the war college of the Prussian army. With Moltke's leadership registering victory for Prussia, wargaming spread first across Europe and later to countries such as Japan and Turkey as well as in Latin America. See: <http://www.jstor.org/stable/26397333>

e OR is the application of scientific methods, techniques, and tools to problems involving the operations of systems to provide those in control of the operations with optimum solutions to the problem. See: C. W. Churchman et al., *Introduction to Operations Research* (New York: John Wiley, 1957). In the defence context, this area enables the evaluation and analysis of military problems to provide decision-makers with a scientific basis to improve military operations and capability. See: <https://www.dst.defence.gov.au/research-area/operations-analysis>

Introduction

and simulated and validated through wargaming exercises. Pure military simulations in wargaming moved beyond political and economic theme-based simulations to cover strategic landscapes and develop policy options in response to those circumstances.

Wargaming has since evolved to include more sophisticated methods and procedures. There have been substantial changes and standardisations in wargaming processes, which is reflected in conceptual development by various actors.^f

^f The transition in thinking began with 'Centaur Chess', introduced by world chess champion Gary Kasparov, where humans collaborate with computers to play chess. Through this experiment, Kasparov highlighted the potential to generate complementary strength from human-AI integration. While machines are able to perform better calculations and ensure precision, the human mind can bring a deeper understanding of strategy, operational moves, and tactics to design and train the machine to think in a more precise manner. See: Gary K. Kasparov and Mig Greengard, *Deep Thinking: Where Machine Intelligence Ends and Human Creativity Begins* (London: John Murray, 2017).

From Wargaming to Tech-Based Wargaming

Militaries such as those of the US and the United Kingdom (UK) have integrated tech-based wargaming in their planning processes,^g with early results showing promise.¹⁶ Tech-based wargaming can become a test bed for planning to confront complex developments in the battlefield, enabling the integration and absorption of technology in the armed forces.

Technology-based wargaming is also a useful tool for training and educating warfighters to prepare for worst-case scenarios in the battlefield and in campaigns. In tech-based wargaming, the real-time battlefield environment can be simulated to measure and analyse effectiveness and efficiency and validate systems and components through simulations. Key parameters like the lethality, mobility, protection, and endurance of a system can be assessed, unlike in conventional wargaming. Therefore, tech-based wargaming provides a platform to validate technological parameters¹⁷ and their integration with organisational command and control. This process, in turn, helps wargamers assess the strengths and weaknesses in the existing set of plans and capabilities.

Technology-based wargaming processes differ from conventional wargaming on the basis of the purpose; tech-based wargaming helps make simulations more accurate while maintaining simplicity to aid comprehension and learning and ensuring flexibility to enable refinement and adjustments to the game and specific parameters, depending on environmental factors.¹⁸ Finally, technology-based wargaming enables generating a scenario with the integration of environmental parameters and capabilities.

Tech-based wargaming can advance and improvise the existing capabilities of wargames through the following: improvise and upgrade modelling and simulations to make them more realistic; improvise the formatting of the games; make red-team and adversary information and moves more realistic and familiar, and the abilities bias free by inculcating cultural and behavioural traits to ensure more real-time observations and behaviour.

^g The same broad parameters of wargaming are applied to AI-based wargaming. See: <https://www.act.nato.int/our-work/wargaming-the-future-at-the-cde-conference/>

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These three key factors, when properly incorporated into wargames, will create a paradigm shift from conventional-wargaming-based linear thinking towards enhanced thinking based on treating warfare as a complex adaptive system.¹⁹

This holistic training and thinking capability to educate and upgrade military minds makes a case for establishing technology-based wargaming in the armed forces. Wargaming is generally viewed as an intellectual exercise²⁰ to test military commanders' thinking abilities when confronted by uncertainties. Tech-based (especially AI-based) wargaming enables warfighters to expand beyond existing knowledge and explore and create one of their own.

AI can be utilised in the design, execution, analysis, and logistics of wargames.²¹ Through a convergence of strategy, operational planning, and tactics, wargaming aims to refine doctrines and strategy²² and prepare stakeholders for contingencies.²³ A prominent AI-based wargaming technique is the use of metaverse^h technology, which enhances modelling and simulation in wargaming and facilitates agility in complex matters related to decision-making. Another important technology in wargaming is the use of Large Language Models (LLMs) that, when integrated with AI, can help shorten decision-making cycles and mitigate the limitations of broader AI-based systems.^{i,24} LLMs can support decision-making processes by enhancing strategic insight and operational accuracy through better simulations.²⁵ If integrated within the OODA (Observe, Orient, Decide, and Act) loop, LLMs can help understand and monitor changes, enhance predictive accuracy, and provide better context-driven recommendations to act in a given context.²⁶

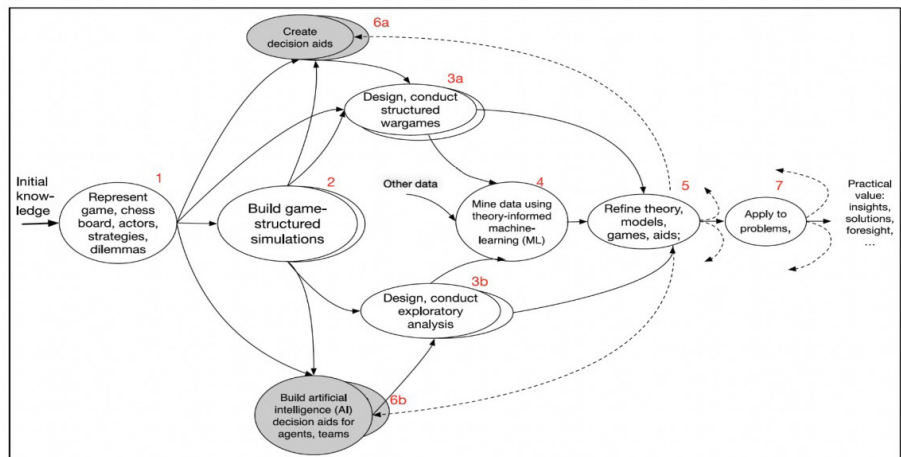
h The 'metaverse' refers to the convergence of physical space and the virtual space accessed through computers and enabled by immersive technologies such as virtual reality, augmented reality, and mixed reality. See: <https://www.techtarget.com/whatis/feature/The-metaverse-explained-Everything-you-need-to-know>; <https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-the-metaverse>

i LLMs can provide context-specific responses, ask pertinent follow-up questions, and generate creative and insightful content. They enhance the adaptive and dynamic nature of AI systems, facilitating more interactive, user-friendly, and intelligent interfaces. See: <https://www.pecan.ai/blog/role-of-llm-ai-innovation/>

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AI integration in wargaming can have three key possibilities: wargaming and AI as distinct activities; the complete takeover of wargaming processes by AI; and a collaborative approach between AI and human actions.²⁷ In the human-AI integration process, the complete set of wargaming processes could be more innovative through computer-based simulations for wargaming. AI can balance human understanding and biases with raw data to create more sound and intelligible findings.

Figure 1: AI Integration in the Wargaming Process



Source: Davis & Bracken (2022)²⁸

Wargaming in the US and the UK

The post-Second World War US strategic community has historically relied on developing an offset strategy against adversaries to maintain an asymmetrical advantage or edge.²⁹ Accordingly, the US has adopted three offset strategies since 1945.³⁰

From Wargaming to Tech-Based Wargaming

The first offset strategy, in the early 1950s, was aimed at addressing the challenge of nuclear deterrence posed by the Soviet Union and its Warsaw Pact allies and avoid enhancing conventional forces capabilities to deter the USSR and its allies.³¹ The second offset strategy was developed after the end of the Vietnam War and led to a decrease in defence expenditure in the US.³² Simultaneously, the USSR's conventional forces outnumbered NATO forces in the European region, with qualitative and quantitative developments in the Soviet nuclear forces closing the gap between NATO and USSR forces. The second offset strategy was also aimed at maintaining an advantage over the Soviet camp and leveraging the technological advantage to “build better weapon systems than those of the Soviet Union.”³³ The strategy also meant to increase the precision of defence strike systems and the automation of command-and-control systems. The third offset strategy was introduced in 2014 to foster innovative methods to ensure the US military's preparedness to tackle emerging threats from a strong adversary³⁴ and thus foster innovations in warfighting capabilities.^j This set the stage for innovative methods of conducting wargames to achieve the best outcomes.

In the 2017 and 2018 National Security Strategy of the US, there was a clear recognition of a military competition with China,³⁵ with amassing military power being a critical area for such competition.³⁶ Consequently, disruptive technology in the military domain became an enabler to help achieve US objectives and interests and maintain its military and warfighting edge.

The US Department of Defense (DoD) released its Artificial Intelligence Strategy in 2018, which warns that “failure to adopt AI will result in legacy systems irrelevant to the defence of our people, eroding cohesion among allies and partners, and reduced access to markets that will contribute to a decline in our prosperity and standard of living.”³⁷ In the 2023 Data, Analytics and Artificial Intelligence Adoption Strategy of the US DoD, Deputy Secretary of Defense Kathleen Hicks emphasised: “As we focused

j In a 2014 memo, Defense Secretary Chuck Hagel stated: “A reinvigorated wargaming effort will develop and test alternative ways of achieving our strategic objectives and help us think more clearly about the future security environment.” See: <https://wargamingcommunity.wordpress.com/2015/05/14/peter-perla-on-work-ing-wargaming/>.

From Wargaming to Tech-Based Wargaming

on integrating AI into our operations responsibly and at speed, our main reason for doing so has been straight forward: because it improves our decision advantage.”³⁸ Therefore, there is a clear indication that not integrating AI in defence can have consequences for US military superiority in the international sphere.

The US has consistently developed innovative methods to bring more accuracy and clarity to its operational plans and create better strategies through technology-based wargaming. The US Research and Development funding agency Defense Advanced Research Projects Agency (DARPA) invested in AI-based wargaming through the Gamebreaker project, which is nearing execution at the time of writing.³⁹ The game is meant to not be fair and aims to explore new capabilities, tactics, and rule modifications to “develop winning warfighting strategies when the adversary’s objectives— i.e. the “rules of the game”—are not clearly known.”⁴⁰ The aim is to let AI play in the wargame; if it can play, it can win, and if it can win, then it works.⁴¹ The game can be a useful tool to enhance the learning of military commanders and warfighters.^k

The US Marine Corps University has also launched a cloud-based wargaming initiative,⁴² which aims to integrate wargames and augmented reality to develop a database to enhance decision-making. Holographic tabletop exercises can also create new possibilities for wargaming.⁴³ The US Air Force is examining how wargaming can shape the role and integration of AI-based systems in the evolving battlefield and how AI can be leveraged to improve wargaming itself.⁴⁴ Another project, the US Army Synthetic Training Environment (STE), combines live, virtual, and constructive simulations to enable terrain mapping, mission planning, and rehearsal.⁴⁵

k The US Joint Chiefs of Staff 2020 guidance concerned with PME and talent management emphasises improving decision-making capabilities among servicemen. It states: “we require leaders at all levels who can achieve intellectual overmatch against adversaries.” See: https://www.jcs.mil/Portals/36/Documents/Doctrine/education/jcs_pme_tm_vision.pdf?ver=2020-05-15-102429-817

From Wargaming to Tech-Based Wargaming

Table 1: AI-Based Wargaming Projects by DARPA

DARPA Project	Overview	Gestation Period	Findings
Gamebreaker AI	Uses video games to study ways in which AI can be used in wargames.	May 2020-Present	<ul style="list-style-type: none"> • Possibility of learning from the successes of the commercial games industry rather than starting from scratch for defence applications. • Highly quantified approach may be applicable to tactical games or games with a predetermined rulebook. Unclear whether this is applicable to strategic wargames with a high level of uncertainty.
BrainSTORM	For multi-domain operations at the campaign level to assess whether AI can enhance the course-of-action analysis and whether AI-assisted non-expert players can beat expert teams in a wargame.	September 2018-Present	Early experiments show that users, even non-experts, prefer to interpret AI recommendations themselves rather than adopting them wholesale.

From Wargaming to Tech-Based Wargaming

DARPA Project	Overview	Gestation Period	Findings
SHADE	Use of AI to improve strategic decision-making for diplomacy, in particular for looking at negotiation processes.	January 2022-June 2023	<ul style="list-style-type: none"> Indicates that efforts are being made to understand how AI agents might deal with human concerns at the more strategic end of the spectrum, for example, deceptive human behaviours. Demonstrates the exploratory nature of existing work with the aim of developing a prototype AI agent rather than a near-term capability.
DARPA COMBAT	Developing AI applications that could model red-team ¹ behaviour and be used to challenge blue teams in subsequent wargames.	May 2020-Present	<ul style="list-style-type: none"> Illustrates the benefits of competitive research models to drive innovative ideas within private sector. Unclear whether this project demonstrates a successful application of AI red-team agents, given the lack of public evidence of the AI methodologies that are applied and the results that were achieved.
DARPA SCEPTER	A project using automation and AI to explore the development of novel course of action plans at machine speed.	January 2022-Present	This project is at an early stage, and developments need to be tracked for further insights.

Sources: DARPA⁴⁶ and Alan Turing Institute⁴⁷

¹ In a wargame, generally, players are teamed up to represent a blue team (friendly forces) and a red team (depicting adversarial forces). Red teams are established by an enterprise to challenge aspects of that same enterprise's plans, programs, assumptions, and so on. Red teams, by playing the devil's advocate, provide a way to probe existing vulnerabilities and also provide alternative analyses. See: Micah Zenko, *Red Team: How to Succeed by Thinking Like the Enemy* (New York: Basic Books, 2015); <https://irp.fas.org/agency/dod/dsb/redteam.pdf>

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In the UK, meanwhile, there is a recognition that innovation and emerging technologies, especially AI, can help generate breakthroughs in strategic advantage.^{m,48} The country's Ministry of Defence (MoD) is investing⁴⁹ in developing wargaming capabilities. These developments are also marked by the strong conceptual undercurrents within the UK defence community that aims to explore and develop a theory for wargaming with the intervention of AI-based technologies.

The 'British Army's Approach to Artificial Intelligence' document is aimed at making the military AI- and future-ready.⁵⁰ The document emphasises human-AI integration as a dominant model to ensure more trusted and responsible use to gain a competitive edge. The UK, under the banner of the Army Warfighting Experiment, is conducting the Army's Collective Training Transformation Programme to train its warfighters in a fully immersive virtual environment, helping them prepare for eventualities.⁵¹ The MoD also launched its first tactical wargaming centre in 2024 with the aim of building and supporting a wargaming ecosystem.⁵² The Defence Experimentation and Wargaming hub aims to include experimentation and wargaming to facilitate faster tactical decision-making.

m Former Defence Secretary Ben Wallace has said: "Wargame outputs have been central to our decision-making." See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1164868/Influence_Wargaming_Handbook_web.pdf

The Indian military faces a range of threats from state and non-state actors, with varied terrains, capabilities, and adversaries. This geopolitical and military challenge sets a complex operational environment for the Indian armed forces. To develop a better understanding and decision-making of the prevailing strategic and operational environment, the military still relies on traditional modes of wargaming, only adopting software-based wargames in 2019 by the Indian Navy to serve the training purposes.⁵³

Terrain and Threat Perception

The Indian military has serious conventional and nuclear challenges, including a two-front war⁵⁴ with China and Pakistan that can take the form of nuclear escalation and the use of tactical nuclear weapons or coercion.ⁿ Swift military operations in conventional but limited conflicts have also been undertaken, such as anti-piracy missions in the seas,⁵⁵ the Balakot strike,⁵⁶ the Uri surgical strike,⁵⁷ and Operation Snow Leopard.⁵⁸ The irregular warfare in the Indian context demands a high-level understanding of the complex terrain as well as warfighting skills such as operational and tactical acumen and optimum decision-making to outsmart the enemy within the constraints of capabilities, agility, and time.

The Indian Military's Integration of Technology

The 'Make in India' campaign highlights the defence sector as a key priority, with policy steps thus far resulting in structural changes such as the indigenisation of the armed forces and the defence industry.⁵⁹ It also involved the transformation and modernisation of the Indian armed forces through indigenous efforts, including by private players, to bring more innovative ideas and projects to cater to the complex demands of the armed forces.⁶⁰ These measures have aided the forces in meeting challenges related to operational readiness.

n As of writing, the Indian military and the People's Liberation Army (PLA) are engaged in Ladakh and across the Line of Actual Control (LAC), alongside addressing terrorism in Jammu and Kashmir-like terrain and the involvement of proxy terrorist groups sponsored by Pakistan.

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India has also been following and, where possible, inculcating best practices in different domains of the defence sector. The recent geopolitical and military challenges from China and the dependence on supply chains in the midst of the Russia-Ukraine war has increased the pace of indigenisation.⁶¹ In May 2020, Prime Minister Narendra Modi announced the Atmanirbhar Bharat mission,⁶² which had the defence sector as one of its pillars.⁶³ Efforts to create critical components and sub-systems of a defence system to developing advanced defence systems have been integrated into the philosophy of the armed forces and bureaucracy. Subsequently, 2023 was declared a year of transformation for the Indian Army.⁶⁴

The goal for 2024 is technology absorption.⁶⁵ Integrating technological advancements with conventional legacy and developing capabilities necessitate strategising, planning, innovating, and conceptualising the deployment, conduct, and battlefield operationalisation of technological capabilities by integrating human and technology capabilities. Here, technology-based wargaming can streamline thinking, operational plans, and readiness to challenge the plans of adversaries.

Following the recommendations by the task force set up by the Department of Defence Production (DDP), India established the Defence Artificial Intelligence Council (DAIC) in 2019.⁶⁶ Within the DAIC, the Defence AI Project Agency (DAIPA) was established in 2019, with an annual budget of INR100 crore for the following five years.⁶⁷

India's primary public-sector defence research institute, the Defence Research and Development Organisation (DRDO), has three dedicated laboratories: Centre for Artificial Intelligence and Robotics (CAIR), DRDO Young Scientist Laboratory (DYSL-AI), and DRDO Young Scientist Laboratory-Cognitive Technology (DYSL-CT).⁶⁸ Given the limited expertise and wide domain of AI and related technologies, more academic and private research institutes should study the potential uses of AI, specifically in the defence sector.

The DPP (MoD) has also published an extensive report on AI in defence,⁶⁹ which lists how AI is making inroads into various tasks and roles associated with the armed forces and defence sector. This includes India's

ongoing preparedness through the integration of AI in surveillance, unmanned aerial vehicles (UAVs) and drones, cybersecurity, Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems, logistical management, and the Internet of Things (IoT).⁷⁰

In the first-ever ‘AI in Defence’ symposium and exhibition in New Delhi in 2022, Minister of Defence Rajnath Singh said, “(The) timely infusion of technologies like AI and Big Data in the defence sector is of utmost importance so that we are not left behind the technological curve and can take maximum advantage of technology for our services.”⁷¹

At the doctrinal level (both individual services and joint), the articulation of AI and its integration, even among discussions about other emerging technologies, is largely missing. In practice, the three services—Army, Navy, and Air Force—are acquiring and using emerging and AI-related technologies to understand their functional precepts. There are also multiple initiatives⁷² for the absorption, adoption, and integration of AI and emerging technologies within the military. The effectiveness of these initiatives also depends on efforts by the scientific community, industry, and the government to develop and popularise these technologies.

At present, the interface between industry and military is at an emergent stage, and clarity can only be achieved with the integration and operationalisation of technology in the Indian military. This process will gain momentum as the civil-military technology interface picks up pace and the military enhances the use of AI in its operational and logistical tasks. In addition, the lack of a civil-military interface and innovation has slowed the process of developing AI-based systems and integrating them at the operational level. However, it is important to note that services are conscious of both the power and the implications of AI and other innovative technologies.⁷³

When users lack clarity regarding operational requirements due to the absence of discussions at the doctrinal level, technological progress deviates from the optimum pathway of technological (specifically AI) integration. The top-brass civilian leadership can push for AI integration, but it is

imperative that the armed forces develop a consensus on their perceptions and expectations from AI as a technological advancement. There are numerous policy initiatives in place to integrate AI in the Indian military.^o

However, there is a lack of substantial information about how to examine these systems to develop concepts and doctrinal requirements in peacetime to understand their nuances and potential operational uses. It is important to develop a robust tech-based wargaming infrastructure to support and learn more about prospective questions and possibilities. Additionally, it is imperative to encourage, discuss, develop, and contextualise technology and its integration in the doctrinal philosophy of the armed forces. This will streamline the development of technology-based wargaming to become more future-ready for the changing character of warfare.

The Merits of Tech-Based Wargaming in the Indian Context

In India, the MoD has laid out a framework for simulators in the Indian Armed Forces, emphasising the objective of “Fight as you train - Train as you fight”.⁷⁴ A private industry player, Tecknotrove, secured the contract from the MoD for the supply of advanced military training simulators for the Indian Air Force and the Indian Army.⁷⁵ The use of simulators has been considered crucial for training purposes, but a comprehensive view to integrate them in the wargaming process is missing.

Project WARDEC (Wargaming Research and Development Centre) is the first concrete step towards developing a simulation-based training centre in India.⁷⁶ It is an initiative by the Army Training Command (ARTRAC), with support from Rashtriya Raksha University, Gujarat, and private-industry player Tech Mahindra, and will use a metaverse-enabled environment to prepare warfighters against adversarial situations in various scenarios, with multiple aspects—such as “the slope of the terrain, weather, time, air pressure, enemy surveillance reach, the reach of artillery, the position of troops, soldier’s health, and the enemy’s reaction capabilities”—are taken

^o These initiatives include the creation of the DAIC, headed by the Defence Minister, to boost the research and innovation base to cater to Indian military operational requirements. In the operational domain, the Indian military is using AI-based surveillance, integration with combat and communication systems, and associated sensor-based command and control systems.

into account.⁷⁷ The same platform could be extended to paramilitary forces to develop plans and conduct training more effectively.

However, this development comes with two caveats. First, there is a knowledge gap between the users, i.e., Indian military personnel, and wargame developers, who are usually from technical and non-military backgrounds. Second, the project remains in the conception stage rather than as a concrete step towards an end product. Such products, once developed, need more clarity and must be categorised in terms of their usage. In its current form, metaverse-based wargaming will cater primarily to the tactical level of training wargames to prepare warfighters for small-scale complex operations. However, integration with operational and strategic level requirements needs to be well thought out.

A few propositions are outlined in the following points that can help establish the case for AI-based wargaming, in general, and specifically for the Indian armed forces.

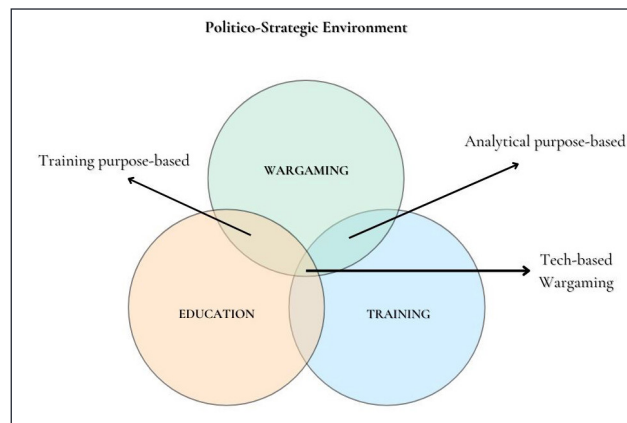
- a. AI-based wargaming serves as the best feedback loop to identify uncertainties in the environment and assess plausible solutions without becoming subordinate to adversarial conditions aided by fog and friction on the battlefield.
- b. The changing nature of warfare has led to variable threats and technological, organisational, and doctrinal changes, as in the case of the Russia-Ukraine war and the Israel-Hamas war. These developments also carry lessons for India's armed forces and the militaries of adversarial states. With emerging domains and cross-domain/multi-domain operational strategies in military campaigns—which involve space, sea, land, air, and electromagnetic-based warfare—multiple vectors, variables, and combinational tactics are at play on the battlefield. Conventional wargaming and modelling fall short in understanding these contexts. On the other hand, tech-based simulations and scenarios provide better predictive accuracy, create mental models, enrich plans and make them more resilient, and expose warfighters to probabilities in conceptualising warfare and related uncertainties through better foresight on battlefield campaigns.

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- c. The materialisation of theatre commands will necessitate a rethinking of operational preparedness, concepts, and warfighting among the three services of the Indian military. Tech-based wargaming will serve as a key feedback loop that will inculcate and reorient these factors to suit shifting realities. The idea is to analyse force-application models for refining operational doctrines and concepts. Further, potential operational and tactical fallacies can be laid out and recalibrated to improve capabilities distribution as per the context-specific demands and requirements of a plan and associated contingencies. This has implications for the improvisation of real-time decision-making.
- d. On the battlefield, it will help improve coordination and team-level performance and enable better training and adaptation to dangerous or unforeseen contexts. It will also have extreme utility in designing and conducting irregular warfare-related operations to strengthen the will, morale, and emotions related to warfighters.
- e. Tech-based wargaming provides more options, including a range of kinetic and non-kinetic options, beyond conventional means. This facilitates the implementation of a spectrum of tasks, from low-risk to optimum to high-risk, enabling the framing of responses even in worst-case scenarios. The data and variables fed into the system will help generate other responses and options if one option fails to deliver an outcome.
- f. Wargaming will provide a platform for underrepresented viewpoints in the services by embracing counterfactuals or diverging views among or within the three services of the armed forces or the national security establishment, including the civilian counterparts of the country. This will also help instil confidence and ensure improved cohesiveness and uniformity in the planning process and among wargame participants.
- g. An improved and sustainable wargaming infrastructure and culture can contribute to better military adaptation (of ideas) and effectiveness measures on the battlefield.⁷⁸

- h. Conventional wargaming is qualitative⁷⁹ in nature. Tech-based wargames can be quantitative, depending on the design and structure, and thus contribute to a dataset that can be used to compile and maintain a record. This data can also be improved in the future to identify better alternatives.
- i. Wargames can enhance the preparations for military exercises and training and help develop better planning schemes. At the operational level of strategy, war plans can be made more robust through incorporating technological advancements such as technology-based wargaming. This will strengthen the plans and the agency of commanders over their conduct and control on the battlefield and deliver better outcomes in sync with national policy and objectives.
- j. AI-based wargames with human-level intervention have the potential to produce the best outcomes, aiding commanders and decision-makers to generate better plans.
- k. Virtual-reality applications and the metaverse can also help cater to previously missing elements of emotions like fear and morale in wargames, thereby better preparing warfighters for real-world problems.

Figure 2: Tech-Based Wargaming for the Indian Armed Forces



Source: Author's own

Challenges to Tech-Based Wargaming in India

The integration of AI-based wargaming in the Indian armed forces depends on three factors: culture, processes, and people.

Culture

India's organised wargaming culture is nascent, with occasional gaming at the political (i.e., National Security Council Secretariat or NSCS) and tri-services level.⁸⁰ Most of the wargaming is done at training and educational institutions such as war colleges, which are both single service and inter-services. These are largely situational wargames, where modern tools including AI and systems analyses have limited use. In the absence of a robust wargaming culture at the apex level, their effectiveness and significance will remain limited.

Another drawback of the present system is that the absence of wargaming potentially creates a gap between political and military assessments, thereby impacting national security decision-making. Wargaming as a process is not endorsed due to the lack of realisation of its immense utility and awareness by key stakeholders. This can be attributed to prevailing bureaucratic and military silos, where decision-making takes place on paper more than through scenario planning and strategic gaming.

The current situation reflects the lack of a robust national planning psychology. Wargames that include an evaluation of options through detailed analysis based on historical data, trends, and analysis are also used to examine possible future pathways. However, this sub-optimism in national planning can hinder learning and adaptation. It can only be developed when the top brass absorbs the idea of the utility of (tech-based) wargaming and develops it to make it a part of the organisational culture in higher defence organisations and the armed forces. Civilian leadership also needs to provide a space for this innovation and the development of expertise in the private and government sectors and institutional expertise in the armed forces. There is also a need to understand and develop the requirement criteria for AI-based wargaming. The armed forces should seek greater clarity about the purposes and tasks of such wargaming. The

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absence of dialogue in the Indian security architecture also poses another problem.⁸¹ The requirements of the armed forces, once defined clearly, need to be understood by civilian counterparts to help proceed more effectively towards achieving objectives.

The silos between intelligence agencies, armed forces, and civilian bureaucracies create different and sometimes diverging assessments, which leads to a lack of precise and reliable information on critical issues. To make wargaming a success, the agencies must develop trust and exchange critical information to enhance the cohesion and coordination among various actors and realise the goals of better understanding and sound decision-making.

The Indian ecosystem can tap into the potential of AI through the large skilled workforce of analysts and software developers in the country. This expertise can be realised through creating AI labs across the country, both government-sponsored and private sector, which will ensure a diversity of ideas and the establishment of institutions that can enhance the innovation base and AI domain knowledge to conduct cutting-edge research. This can allow India to realise the potential of AI, which is not just limited to wargaming or defence applications but also includes more extensive dual-use applications.

Processes

In terms of processes, the validation and verification in AI-related⁸² processes remains a challenge. The design, development, testing, and procurement of AI-based software and simulation technologies also demand greater clarification of military or industrial standards and the procurement procedures within the defence and bureaucratic ecosystem.

Additionally, there is need to formalise texts such as the manual for wargaming and the codes-and-procedures handbook and to measure environmental statistics for emulation, which could serve as a guide for practitioners on conducting and maximising the use of integrated technology. However, the Indian armed forces are facing issues related to conceptualising the role of wargaming, its applications, and the level at which it is to be used in the future.

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Addressing for whom and by whom wargaming will be utilised will also address the involvement of institutions in developing wargaming infrastructure and the role and functions of various government agencies, individuals, and armed forces institutions and officers in the process. The wargaming doctrine should also draw from the emerging dimensions of threats and technologies in the operational domain while staying in alignment with the fundamental doctrines of the Indian armed forces.

The Indian government can also follow the approach of DARPA's Gamebreaker, which includes multi-agencies, government, civilians, private, and academic institutions collaborating towards execution by lending domain-specific expertise.⁸³ Government-led institutions such as the DRDO's Institute for System Studies and Analyses (ISSA) and the Centre for Development of Advanced Computing (C-DAC); armed forces training institutions such as the Army Training Command (ARTRAC), which includes a Simulations Development Division (SDD) and a Wargaming Development Centre (WARDEC); the Indian Navy; and the Indian Air Force could develop the content, technicalities, and infrastructure to address the requirements of the Indian armed forces. These should be developed in consultation with the three services to meet the demands of the Integrated Theatre Commands' organisational structure and allocate responsibilities to each service.

At the apex level, the civilian-led bodies should also actively participate in overseeing and developing the political-strategic level of wargaming. This involves the prime minister, the Raksha Mantri, the Cabinet Committee on Security members, national security advisers, and associate members from the National Security Advisory Board (NSAB) and NSCS, the Chief of Defence Staff (CDS), and the service chiefs of the Indian Army, Air Force, and Navy. Additionally, at the development stage, private defence industry players investing in simulation methods and infrastructure and academic institutions with the capabilities to run and develop simulations need to be consulted and integrated into the conceptualisation processes for developing tech-based wargaming.

Another hurdle is the lack of a database of information that could be fed to AI systems to form the basis of data analytics for running simulations.

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The cloud computing infrastructure within India needs to be developed by upgrading the technological base and indigenising the system. The same cloud infrastructure can be utilised to support cloud-based wargaming, which can be further utilised to train India's paramilitary and other security agencies as well.

People

It is essential to factor in people and related non-tangibles in the processes and steps involved in tech-based wargaming. As Peter Perla highlights, "Wargames can be very effective at building a consensus on the importance of key ideas or factors in the minds of participants."⁸⁴

The perceptions of wargame participants determine the assessments derived from the wargaming process. As the wargaming process becomes more advanced through technology integration, it needs to incorporate intangible but determining factors such as morale, fear, and courage to produce more sustainable and realistic outcomes. Given the role of emotions in military strategy and warfighting,^p it is important to include them to ensure a more real-world synthetic environment for qualitative improvements in wargaming.

The people component also includes developing a tech-savvy and skilled workforce through the involvement of civilians trained in niche areas of research such as OR, AI and emerging technologies, defence technologies, and computer science. The armed forces also need to tap into talent within organisations in the form of technically skilled soldiers to ensure better coordination and expertise to develop, sustain, advance, and conduct wargames using the proper methodology, verification, and validation involved in the processes.

p According to Samuel Zilnick, there are three main thrust areas at the intersection of emotions and military strategy: "The character of war and emotional stimuli, emotional influence on strategic choices, and the relationship between emotional manipulation and the pursuit of victory." Therefore, emotions determine the character of warfare in terms of what people care about; whether and how to include strategic choices within the framework of military strategy and the manner in which the military and force should be used; and to enable one's sustainment and disrupt the enemy's sustainment efforts through manipulation of emotions, thus contributing to achieving victory. See: <https://tnsr.org/2022/01/the-role-of-emotions-in-military-strategy/>

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Wargaming at the commanders' level can be addressed by the officers themselves. It needs to be coordinated at the individual service level, given that, despite theatrisation, each service will still have a context-specific threat perception and requirements. At the same time, the philosophical foundations of jointness and integration in understanding should reflect at the commanders' and mid-level ranks towards conducting wargaming as a united force against the adversarial team.

Modern militaries are integrating tech-based wargaming into their organisational structure, providing them with a qualitative, multiplier edge in real-time battlefield operations in a specific terrain and geography. Tech-based wargaming provides a more nuanced, creative, and innovative way to reorganise force structure, tactics, and operational command and control for specific operations. Tech-based wargaming can therefore be instrumental in bridging the gap between planning and conduct.

AI integration in the Indian Armed Forces has already begun and serves as a basis for advancements through recalibration and innovation using existing capabilities and a more advanced wargaming infrastructure. If India aims to match the growing pace of adversarial militaries, it must adopt a more standardised process and infrastructure in top-to-bottom ranks and files in the armed forces.

AI-based wargaming is relatively more costly than conventional wargaming but more effective in the long term. Moreover, it is a one-time investment that can save the costs of training and wargaming to create better warfighters and decision-making. The best outcomes can be achieved by bringing together the top brass in each service, individually by each service or jointly, to lay a groundwork for theatrisation in the military. Meanwhile, the mid- and lower ranks can cultivate technical skillsets to assemble ideas and integrate them into the systems to gain better results.

Support from government agencies and private players can boost tech-related infrastructure, which is essential when aiming for a technological edge to keep up with the developments in warfighting and wargaming. Wargaming should also be an integral part of Professional Military Education (PME) which, in content and substance, remains insulated from debate and discussions around the scope of improvement. With theatrisation, a joint PME is essential, where the early introduction of tech-based wargaming will prove to be a cohesive element to make officers from the three services think more critically, conceptualise, and tackle planning-related challenges as a single unit. In the long run, this amendment in the PME will improve young and mid-rank officers' capabilities to respond

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more creatively and enhance their cognitive skills to frame optimum responses to crisis-like situations in real time.

Wargaming is not the only way to serve all purposes of testing, validating, executing, and evaluating plans and decision-making. Yet, it has immense potential, and it would be beneficial to aim for greater accuracy, precision, and creativity towards becoming more future-ready amid the changing character of warfare. [ORF](#)

Rahul Rawat is *Research Assistant, Strategic Studies Programme, Observer Research Foundation.*

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20, Rouse Avenue Institutional Area,
New Delhi - 110 002, INDIA

Ph. : +91-11-35332000. Fax : +91-11-35332005

E-mail: contactus@orfonline.org

Website: www.orfonline.org