

Artificial Intelligence and India: **Navigating Strategic Opportunities and Challenges**

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Foreword

In the rapidly evolving domain of technology, Artificial Intelligence (AI) stands at the cutting edge of modern strategic and economic advancements. It is against this backdrop that the monograph titled "Artificial Intelligence and India: Navigating Strategic Opportunities and Challenges" emerges as a timely and insightful scholarly endeavor. The work systematically explores how AI can redefine the contours of national capability.

From a meticulously detailed examination of AI's transformative role in defense strategies, drawing on global experiences such as those from Ukraine, to the exploration of its impact on economic growth, the monograph provides an all-encompassing view of the subject. A significant strength of this work lies in its balanced discourse on the imperative for robust AI capabilities and a thoughtful regulatory framework. It argues persuasively for India's commitment to harnessing AI's potential while being acutely aware of and prepared for its associated risks. The work is enriched by the discussion on India's strategic approach to AI, including pivotal initiatives by NITI Aayog and contributions of the burgeoning startup ecosystem, which collectively underscore a national blueprint towards becoming a formidable player in the AI domain.

I commend the author for his rigorous research and bringing out interesting insights, which are sure to inspire further scholarly inquiry and policy formulation. In this era, where technological prowess is increasingly synonymous with national strength, this work offers a valuable exploration of both the prospects and hurdles that AI presents to India. It stands out for its comprehensiveness and the clarity of its arguments, offering an insightful overview that will benefit scholars, policymakers and industry practitioners.

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Kamal Madishetty

Introduction

Artificial Intelligence (AI) today has emerged as an extraordinarily transformative force shaping the future of nations and societies around the world. In the context of India, developments in AI hold significant strategic relevance, touching upon various aspects of national interest, including defence, national security, economic growth, governance, and social welfare. As India positions itself in the global arena as a leading power, harnessing the potential of AI becomes essential to augment capabilities, drive innovation, enhance competitiveness, manage disruptions, and address complex challenges facing the world.

AI, at its core, can be defined as the development of computer systems capable of performing tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and language translation (Schroer, 2024). Through the use of algorithms, machine learning, and neural networks, AI systems can analyse vast amounts of data, identify patterns, and make predictions with increasing accuracy and efficiency (Brown, 2021). The evolution of AI technologies, including machine learning, natural language processing, computer vision, and robotics, has unlocked new possibilities across a wide range of domains, revolutionising industries and reshaping societal norms.

In the field of defence and national security, AI offers unprecedented opportunities to enhance military capabilities, optimise decision-making processes, and mitigate

emerging threats. With its increasing geopolitical significance and evolving security landscape, India has the potential to greatly benefit from the integration of AI technologies into its defence apparatus. AI-powered systems can enable autonomous surveillance, predictive analysis, and strategic planning, empowering defence forces to anticipate and respond to complex security challenges with agility and precision. From unmanned aerial vehicles (UAVs) to cybersecurity defences, AI-driven innovations have the potential to bolster India's strategic deterrence capabilities and safeguard its national interests in increasingly volatile regional and global security environments.

Moreover, the application of AI in intelligence gathering, counter-terrorism operations, and border surveillance can augment India's situational awareness and strengthen its defence architecture against asymmetric threats and non-traditional security risks. By investing in AI research, development, and deployment, India can reinforce its defence modernisation efforts, encourage technological innovation, and cement its position as a credible actor in the global security landscape.

Beyond defence and national security, the strategic relevance of AI for India extends to its economic growth and competitiveness on the global stage. As one of the world's fastest-growing large economies and a dynamic hub for technology and innovation, India must harness the transformative potential of AI to drive high productivity and growth, promote entrepreneurship, and create employment opportunities. From manufacturing and agriculture to healthcare and financial services, AI-powered solutions can unlock new avenues for productivity enhancement, cost optimisation, and market expansion, driving efficiencies and unlocking new business models in the digital economy.

In the context of India's demographic dividend and exemplary digital public infrastructure (DPI), AI holds the promise of empowering millions of entrepreneurs, startups, and small businesses to innovate, scale, and compete in the global marketplace. Furthermore, AI-enabled technologies such as the Internet of Things (IoT), blockchain, and augmented reality have the potential to catalyse digital transformation across key sectors of the Indian economy, including healthcare, education, transportation, and urban governance. By embracing AI as a strategic

enabler of innovation, India can unlock new sources of value creation and position itself to ride the wave of the Fourth Industrial Revolution.

Realising the full potential of AI in India, however, is fraught with complexities. Managing workforce transitions, addressing ethical questions, safeguarding data and privacy, and balancing innovation with regulation pose nuanced challenges. The military domain, while benefiting from AI, grapples with normative debates surrounding autonomous weaponry and the imperative of maintaining human oversight. Economically, while AI promises growth, it also raises concerns about job displacement, necessitating a thoughtful approach to reskilling and workforce adaptation.

Developments in the regulatory landscape, both national and international, highlight the urgency of governing AI's expansion. India's stance and strategies in this regard must be informed, agile, and aligned with its broader national objectives, drawing lessons from global precedents while forging its own path. At the same time, there is a need for creating robust AI infrastructure, talent cultivation, data governance, and cross-sectoral collaboration.

The strategic relevance of developments in artificial intelligence for India cannot be overstated. As India navigates the complexities of a rapidly changing global landscape, AI emerges as a force multiplier, empowering the nation to address multifaceted challenges and seize new opportunities for security, prosperity and progress. By embracing AI as a strategic imperative, India can harness the transformative power of technology to shape a bright future for generations to come.

Defence in the AI Era

Military Relevance of AI

AI is revolutionising modern warfare, enhancing military capabilities across various domains, and transforming the way armed forces perceive, plan, and execute missions. From intelligence gathering and analysis to command and control, surveillance and reconnaissance, and cyber operations, AI is reshaping the landscape of military affairs, enabling militaries worldwide to adapt to the complexities of contemporary security challenges.

Situational awareness, the ability to perceive, comprehend, and anticipate threats in real-time, is critical for effective military operations. AI plays a pivotal role in enhancing situational awareness by processing vast amounts of data from diverse sources, including sensors, satellites, drones, and social media platforms. Machine learning algorithms analyse this data to identify patterns, detect anomalies, and provide actionable intelligence to decision-makers. By integrating AI-driven situational awareness systems, military organisations can enhance their ability to assess threats, allocate resources effectively, and coordinate operations seamlessly across multiple domains (Tangredi, 2021).

Predictive threat analysis involves the use of AI to analyse vast amounts of data and anticipate potential threats before they materialise. AI algorithms analyse data from intelligence reports, surveillance systems, and open-source information to identify emerging threats, assess their likelihood and severity, and recommend preemptive countermeasures. By leveraging AI technologies, military organisations can adopt a more proactive defence posture, enabling them to anticipate and mitigate potential threats before they escalate. This proactive approach enhances operational readiness, resilience, and effectiveness, allowing military forces to stay ahead of adversaries and protect national security interests.

Command and control (C2) capabilities are enhanced by AI technologies, providing commanders with timely and relevant insights into complex operational

environments. Decision support systems powered by AI algorithms analyse data from multiple sources, including sensors, intelligence reports, and historical archives, to identify patterns, trends, and anomalies. These systems enable commanders to assess threats, anticipate enemy actions, and make informed decisions more quickly and accurately (Arkin, 2018). Furthermore, AI-driven automation and autonomy streamline C2 processes, automate routine tasks, and optimise resource allocation, allowing commanders to focus on higher-level decision-making tasks. By integrating AI technologies into C2 systems, military organisations can enhance their operational agility, resilience, and effectiveness in dynamic and contested environments.

AI-powered surveillance and reconnaissance systems enable military forces to gather critical information about enemy movements, terrain, and infrastructure with unprecedented speed and precision. Unmanned aerial vehicles (UAVs) equipped with AI capabilities can conduct autonomous surveillance missions, detect and track targets, and provide real-time situational awareness to ground forces. Computer vision algorithms analyse aerial and satellite imagery to identify objects of interest, detect changes in the environment, and assess potential threats. Additionally, AI-driven sensor fusion technologies integrate data from multiple sources, including radar, lidar, and infrared sensors, to create comprehensive and actionable intelligence for military commanders.

In the realm of cyber operations, AI is playing an increasingly important role in augmenting cyber capabilities, including both offensive and defensive operations. AI-powered algorithms can analyse network traffic, detect anomalies, and identify potential cyber threats in real-time. On the offensive side, AI enables the development of sophisticated cyber weapons and techniques, including automated malware generation, adaptive phishing attacks, and targeted exploitation of vulnerabilities. On the defensive side, AI-driven cybersecurity solutions can rapidly detect and mitigate cyber threats, enhance incident response capabilities, and strengthen network defences. By leveraging AI technologies, military organisations can stay ahead of evolving cyber threats and protect critical infrastructure and sensitive information from malicious actors.

Finally, AI can play an important role in counterterrorism efforts. It can help counter terrorist activities, particularly in the areas of communication, funding, and recruitment. Core AI technologies such as Machine Learning and Natural Language Processing can be used to identify suspicious financial transactions or communication patterns indicative of terrorist activities, and to analyse extremist content for actionable insights (Alhajeri & Alhashem, 2023).

AI is a transformative force in modern warfare, enhancing military capabilities and reshaping the way armed forces operate in dynamic and complex operational environments. By harnessing the power of AI technologies, militaries the world over can gain a strategic advantage, ensure mission success, and safeguard their interests effectively.

Lessons from Ukraine

AI has emerged as a significant tool in the ongoing conflict between Russia and Ukraine, transforming the nature of warfare and offering a glimpse into the future of military operations. Both Russian and Ukrainian forces have been leveraging AI for data analysis, decision-making, and targeting strategies.

AI's primary role in this conflict has been in data management and targeting. The military forces are using AI to sift through vast amounts of data, including satellite imagery, drone footage, and social media content. This data is then analysed to identify specific targets and make informed decisions. For instance, AI-enabled software processes raw intelligence from sources including drones, satellites, and Ukrainians on the ground, as well as radar that can see through clouds and thermal images that can detect troop movements and artillery fire. AI-enabled models can then present military officials with the most effective options to target enemy positions (Bergengruen, 2024).

In addition to data management, AI is also being used to enable unmanned and autonomous systems to operate in dangerous environments, potentially replacing soldiers in certain roles. This includes the use of AI-enabled drones and other

autonomous systems, which can operate independently in hazardous conditions, reducing the risk to human soldiers. The deployment of such systems in the Ukraine conflict highlights the potential of these technologies to transform military operations and the nature of warfare itself.

The conflict has also seen the use of AI in misinformation campaigns. AI and Machine Learning (ML) models have been used to spread disinformation, with AI-generated humans or deepfakes being used to sway public opinion (Raja, 2022). This highlights the potential for AI to be used not just in physical warfare, but also in information warfare.

At the same time, the use of AI in this conflict has also sparked debates about the ethical implications of using autonomous weapons and AI-driven military technologies. Concerns have been raised about the ease of targeting and the potential for harm, particularly in situations where AI systems are making decisions that have life-or-death consequences. These debates have led to calls for clear ethical guidelines and regulatory frameworks for the use of AI in military operations.

The Ukraine conflict also underscores the importance of adapting technology to doctrinal needs. The conflict has shown that the application of technology is doctrine-specific. Russia secured battlefield gains by adapting technology to its doctrinal needs, while Ukraine was caught midway between its own doctrine and that imported from NATO. This underscores the need for countries like India to ensure that their use of AI and other advanced technologies aligns with their own military doctrine and operational requirements (Varma, 2023).

The trend towards networked battlefields, as seen in the Ukraine conflict, offers substantial benefits but also locks in huge risks. The ability to quickly share and analyse information across different platforms and units can enhance operational effectiveness. However, it also increases the risk of cyberattacks and other forms of disruption. This highlights the need for countries to develop robust cybersecurity measures and strategies to manage the potential risks associated with networked warfare.

The Ukraine conflict offers valuable lessons on the use of AI in warfare, which India can draw upon in its own military modernisation efforts. These lessons underscore the importance of investing in AI capabilities, adapting technology to doctrinal needs, developing ethical guidelines for the use of AI in military operations, and carefully considering the potential risks and benefits of networked warfare. As the conflict in Ukraine continues to evolve, it will continue to provide further insights into the role of AI in modern warfare.

India's approach to integrating AI into military

India's efforts to date to integrate AI into its military operations have aimed at taking a comprehensive approach to leveraging technology for enhanced operational efficiency and strategic advantage. The Indian military's engagement with AI spans various domains, aimed at modernising its defence mechanisms in alignment with global advancements.

India's military has embarked on various AI-driven projects with the intention of integrating AI into core defence operations. Notably, the development of AGNI-D, an AI-based surveillance software, exemplifies India's efforts to enhance border security and threat detection through AI. The Indian Navy's structured approach to AI, categorised into short, medium, and long-term goals, and the Army's use of AI for predictive maintenance highlight the sector-specific adoption of AI to improve efficiency and readiness.

The establishment of the Defence AI Council (DAIC) and the Defence AI Project Agency (DAIPA) in 2019 signified a systematic approach towards AI adoption in defence. These bodies, created following the recommendations of an AI task force convened by the government, are tasked with providing strategic direction, facilitating industry-academia partnerships, and ensuring the ethical and secure application of AI technologies in military operations. Significant funds have been allocated for AI application development across the Service Headquarters. Meanwhile, the efforts to establish AI centres of excellence and dedicated AI research labs by the Indian military and DRDO have been welcome steps towards building a robust AI infrastructure.

In 2021, the Indian Army demonstrated an AI-enabled swarm of 75 aerial drones and utilised AI for intelligence, surveillance, and reconnaissance purposes during the Dakshin Shakti military exercise. While the full details of public-private AI programmes remain classified, the government is engaged in projects related to predicting atmospheric visibility, imagery analysis, drone-collision avoidance, and ship tracking. AI-application centres within each armed-service branch are supporting these efforts (Levesques, 2024).

AI's application has also extended to logistics, supply chain management, and ISR capabilities, enhancing efficiency and providing actionable intelligence for on-field operations. In 2022, Raksha Mantri Rajnath Singh launched 75 AI products and technologies as part of the “Azadi Ka Amrit Mahotsav” celebrations, showcasing India's proactive initiatives in diverse AI applications. These projects span AI platform automation, autonomous systems, cybersecurity, human behavioural analysis, and more, reflecting a comprehensive attempt to infuse AI across defence operations.

The global context, with countries like the US and China heavily investing in AI for defence, emphasises the urgency for India to bolster its AI capabilities to maintain its strategic standing. Continuous investment, innovation, and collaboration are essential to fully harnessing AI's potential. This strategic focus is crucial for enhancing India's defence capabilities and ensuring its preparedness in the face of evolving security challenges.

Leveraging AI for Growth

Relevance of AI for Productivity and Growth

AI is reshaping the landscape of global productivity and economic growth, offering transformative potential across various sectors. By automating routine tasks, enhancing decision-making processes, and promoting innovation, AI will serve as a crucial catalyst for economic development in the years and decades ahead.

One of the most notable contributions of AI to productivity is its ability to automate tasks. By assuming responsibility for repetitive and time-consuming tasks, AI liberates human employees to concentrate on more strategic and creative aspects of their work, thereby boosting overall productivity (Shukla, 2023). For instance, in the manufacturing sector, AI-powered robots can execute assembly line tasks with increased speed and accuracy, minimising errors and enhancing output. Similarly, in the service industry, AI can handle customer inquiries via chatbots, optimising operations and improving customer satisfaction.

In addition to automation, AI's role in enhancing human decision-making is a key factor in productivity improvement. Sophisticated analytics and machine learning algorithms can process enormous data volumes, revealing insights that would be unattainable for humans without assistance (De Cremer & Kasparov, 2021). These insights can guide more precise and strategic decision-making in areas as diverse as financial investments and supply chain management. For instance, AI can forecast market trends, enabling businesses to adapt their strategies proactively or fine-tune logistics to cut costs and boost efficiency.

AI also serves as an accelerator of innovation, propelling the creation of new products, services, and processes. By facilitating rapid prototyping and offering novel solutions to complex problems, AI is leading the charge in technological

advancement. In the healthcare sector, AI-powered diagnostics can detect diseases with remarkable accuracy, often at stages earlier than humanly possible. In the automotive industry, AI is a fundamental technology behind self-driving vehicles, which could transform transportation and logistics.

Moreover, the influence of AI on productivity and economic growth extends beyond high-tech industries. It permeates various sectors, from agriculture, where AI-driven systems can maximise crop yields and resource utilisation, to education, where personalised learning algorithms can improve student performance. This broad applicability of AI implies that its economic advantages can be spread across the economy, although the magnitude of these benefits may differ between sectors and regions.

AI holds the promise to substantially enhance productivity and stimulate economic growth on a global scale. Its capabilities to automate tasks, enhance decision-making, and propel innovation can revolutionise industries and create new opportunities. While challenges persist, strategic policies and investments in AI can assist societies in overcoming these obstacles, ensuring that AI serves as a tool for sustainable and inclusive economic advancement.

NITI Aayog's National Strategy for Artificial Intelligence

AI stands as a transformative force with the potential to significantly boost India's economic growth. Its integration across various sectors promises to enhance productivity, create employment opportunities, and streamline services, thereby catalysing a new era of economic development in the country.

In June 2018, the NITI Aayog released the “National Strategy for Artificial Intelligence: #AIforAll.” The strategy is a comprehensive plan designed to harness the power of AI for economic growth, social development, and global collaboration. It recognises AI's potential to transform various sectors, including healthcare, agriculture, education, and infrastructure, by making them more efficient and effective.

In healthcare, the strategy envisions AI-powered solutions to enhance disease diagnosis, treatment personalisation, and patient care, aiming to make healthcare services more accessible and affordable. In agriculture, AI can help increase crop yields, improve farm management, and predict weather patterns, thus supporting the agricultural sector's resilience and productivity.

Education is another critical focus area, where AI can personalise learning experiences, automate administrative tasks, and provide teachers with tools to enhance student engagement and outcomes. The strategy also highlights the role of AI in improving urban infrastructure, such as through smart city initiatives, traffic management, and resource optimisation, enhancing the quality of life for citizens.

The strategy also envisages AI to augment smart city infrastructure in various ways, from optimising resource usage in public facilities like parks to streamlining daily tasks in smart homes. AI-driven service delivery would enhance resource allocation and grievance redressal, while crowd management systems would improve accuracy in predicting and managing large-scale events. AI-based safety measures, as exemplified by Surat's crime rate reduction, can bolster security through advanced surveillance and social media intelligence platforms.

Transportation is identified as another sector where AI can significantly improve safety, efficiency, and sustainability. The strategy outlines the use of AI in managing traffic flows, optimising public transport, and developing autonomous vehicle technologies.

In the agricultural sector, which still accounts for almost half of India's workforce, the strategy argues for the role of AI in enhancing the monitoring and restoration of soil and crop health, as well as in increasing the efficiency of farm mechanisation. Furthermore, using AI-driven predictive analytics can enhance farmers' share of price realisation by providing them with more precise supply and demand data. Such an approach would help minimise the information gap between farmers and intermediaries, ultimately benefiting farmers.

To achieve these goals, the strategy emphasises the need for a robust AI ecosystem in India, which includes fostering research and innovation, developing skills and talent,

and encouraging public-private partnerships. It recognises the importance of creating a supportive regulatory framework, ensuring data privacy and security, and promoting ethical AI development.

The document acknowledges the challenges in implementing AI, such as the digital divide, data availability, and infrastructure readiness, and proposes measures to address these issues. It advocates for international collaboration in AI research and development, sharing best practices, and aligning global standards.

Overall, the strategy aims to position the country as a leader in AI technology, driving economic growth and societal progress while ensuring ethical and inclusive development. The strategy underscores the importance of leveraging AI not just for economic benefits but also for enhancing the well-being of its citizens, reflecting a vision of technology serving humanity.

Since the introduction of the strategy in 2018, however, the technology sector has evolved significantly, including the emergence of generative AI and the surrounding hype that have introduced uncertainties, impacting investment and innovation. These and other developments over the years, therefore, necessitate the need for a fresh strategy for today's post-COVID tech environment (Abhivardhan and Manwani, 2023).

AI and India's Startup Ecosystem

India's startup ecosystem has witnessed remarkable growth in recent years, propelled by a combination of supportive government policies such as Startup India and Standup India, a number of technological advancements, and an increasingly entrepreneurial mindset among the younger generations. Amid this dynamic landscape, AI has emerged as a critical force capable of catalysing further innovation, unlocking new business opportunities, creating new jobs, and driving economic growth. The transformative role of AI in boosting India's startup

ecosystem, therefore, spans across various dimensions, with the potential to revolutionise industries, empower entrepreneurs, and fuel sustainable development.

AI serves as a catalyst for innovation within India's startup ecosystem by enabling startups to leverage cutting-edge technologies for problem-solving and product development. AI-powered solutions offer unprecedented capabilities in data analysis, pattern recognition, and automation, empowering startups to optimise processes, enhance efficiency, and deliver innovative products and services. For instance, AI-driven algorithms are revolutionising sectors such as healthcare, agriculture, finance, and education, unlocking new possibilities for startups to address complex challenges and meet evolving market demands.

Intello Labs, an AI startup, is using computer vision, machine learning, and artificial intelligence to reduce food waste by digitalizing the quality assessment of fresh fruits and vegetables, enhancing the transparency and efficiency of the food and agricultural supply chain.

The integration of AI technologies opens up a range of new business opportunities for startups in India, enabling them to tap into emerging markets and disrupt traditional industries. Startups can leverage AI for personalised customer experiences, predictive analytics, and targeted marketing strategies, gaining a competitive edge in an increasingly digital marketplace. Moreover, AI-powered platforms facilitate the development of scalable and sustainable business models, fostering a culture of innovation within the startup community.

Conversational AI platforms like Avaamo are providing rapid and personalised assistance in various sectors, including healthcare and banking, showcasing the broad applicability of AI in enhancing customer experiences and business operations.

Even as it evokes concerns about job displacement, AI also has the potential to create a significant number of new jobs within India's startup ecosystem, particularly in highly skilled sectors such as data science, machine learning, and software development. As startups harness AI technologies to drive growth and innovation, they require a skilled workforce capable of designing, implementing, and managing

AI systems. This demand for talent presents opportunities for job creation, skill development, and entrepreneurship, contributing to the overall expansion and diversification of India's labour market.

Uniphore, a conversational AI technology company, secured the highest funding among Indian AI startups in 2022, with \$400 million, indicating a significant growth trajectory and potential for job creation in the AI sector.

AI democratises entrepreneurship by lowering barriers to entry and empowering aspiring entrepreneurs to turn their ideas into viable businesses. With the advent of AI-driven tools and platforms, startups can access advanced capabilities in areas such as natural language processing, computer vision, and predictive modelling without requiring substantial upfront investment or technical expertise. This democratisation of technology fosters a more inclusive startup ecosystem, where innovation thrives and diverse voices contribute to economic growth and social progress.

Programmes like AWS's ML Elevate 2023 are offering generative AI startups access to AI models, technical mentorship, and resources, underscoring the role of AI in democratising entrepreneurship and providing startups with the tools to innovate and grow.

India's startup ecosystem benefits from a supportive environment conducive to AI innovation, characterised by a robust network of incubators, accelerators, venture capital firms, and government initiatives. Programmes such as Startup India and the Atal Innovation Mission provide funding, mentorship, and regulatory support to budding entrepreneurs, facilitating the development and deployment of AI-powered solutions. Additionally, collaborations between academia, industry, and government institutions facilitate knowledge exchange, skill development, and technology transfer, nurturing a vibrant ecosystem for AI-driven startups to flourish.

The Indian government's "INDIAai" initiative aims to catalyse AI innovation through pillars like the Data Management Office, the National Centre on AI, and skilling for AI, demonstrating a commitment to building a supportive environment for AI-driven startups.

AI represents a game-changing technology with the potential to strengthen India's startup ecosystem and drive sustainable economic growth. By increasing innovation, unlocking new business opportunities, creating jobs, and empowering entrepreneurs, AI catalyses a new era of entrepreneurship and innovation in India. Realising the full benefits of AI requires a collaborative effort to address challenges, promote responsible AI deployment, and build a supportive ecosystem that nurtures talent, encourages creativity, and embraces diversity. With the right policies, investments, and partnerships, India can harness the transformative power of AI to build a brighter future for its startup ecosystem and society as a whole.

AI and the Fourth Industrial Revolution

The Fourth Industrial Revolution is ushering in an era where technology transcends traditional boundaries, blending the physical, digital, and biological worlds. AI is at the heart of this transformation, redefining the global economic, social, and cultural landscape. India, with its strong digital infrastructure and prowess in information technology, stands at the cusp of this revolution. By integrating AI with other groundbreaking technologies like the Internet of Things (IoT), blockchain, and augmented reality (AR), India can accelerate its digital transformation, impacting key sectors and positioning itself among global technology leaders.

The convergence of AI and IoT, often referred to as AIoT, is creating intelligent systems that enhance decision-making and optimise processes. AIoT can transform urban landscapes into smart cities, where everything from traffic management to waste disposal is automated and optimised for efficiency. In agriculture, AIoT can lead to precision farming, where sensors can monitor crop health, soil moisture, and weather conditions, allowing for data-driven decisions that increase yield and reduce resource waste.

Blockchain, with its decentralised and transparent nature, complements AI by providing a secure and tamper-proof framework for data management. In the financial sector, blockchain can revolutionise payments, remittances, and fraud detection, ensuring faster, safer, and more transparent transactions. Healthcare can benefit immensely from blockchain, where patient data can be stored securely,

allowing for easy and secure access while maintaining patient privacy and trust (Malynovskyi, 2023).

Augmented reality (AR) stands to transform the retail, education, and healthcare sectors by providing immersive and interactive experiences. In retail, AR can provide customers with virtual try-ons, enhancing the shopping experience and reducing return rates. For education, AR can create interactive learning environments, making complex concepts easier to understand and more engaging for students. In healthcare, AR can assist in surgeries and medical training, providing real-time data and visualisations that enhance precision and learning.

The synergy of AI, IoT, blockchain, and AR can create a multiplier effect, enhancing the capabilities of each technology and unlocking new possibilities (Adebisi, 2022). For instance, in supply chain management, the combination of these technologies can ensure end-to-end visibility, real-time tracking, predictive maintenance, and secure and efficient operations. In the energy sector, this synergy can lead to the optimisation of renewable energy sources, predictive maintenance of infrastructure, and efficient energy distribution.

The integration of AI, IoT, blockchain, and augmented reality offers a transformative potential that can redefine India's economic and social fabric. By harnessing these technologies, India can enhance its industrial competitiveness, improve public services, and drive sustainable growth. This requires a strategic approach, encompassing investment in technology, human capital, and regulatory frameworks. As India embarks on this journey, it has the opportunity to not only transform its own economy but also to contribute significantly to the global digital ecosystem.

Mapping the Challenges

Questions around Military AI

Integrating AI into military operations worldwide presents a host of challenges that encompass ethical, technical, regulatory, and organisational dimensions. Many of these challenges are not unique to a single country but are shared across global military establishments as they navigate the complex landscape of modern warfare augmented by AI.

Ethically, the use of AI in military contexts raises significant concerns, especially regarding autonomous weapons systems. The idea that machines could make life-and-death decisions without human intervention brings forth pressing moral questions about accountability, transparency, and adherence to international humanitarian law. Ensuring AI's ethical deployment in military operations necessitates a commitment to these principles, ensuring that AI-enhanced capabilities are used responsibly.

Technically, the integration of AI requires handling vast and complex data sets, demanding high standards of data quality, interoperability, and security. Military organisations must establish robust systems to protect sensitive information against cyber threats, ensuring operational security and strategic advantage in a contested digital realm.

The rapid evolution of AI technology leads to a skills gap within military organisations. Personnel must acquire new competencies in data science, machine learning, and related fields, necessitating on-the-job education and professional development. Collaboration with academic and industrial partners can provide military personnel with the necessary skills and knowledge to effectively leverage AI.

Strategically, the adoption of AI can introduce risks of escalation and miscalculation in military operations. Autonomous decision-making systems may behave unpredictably, and reliance on AI for critical decisions could lead to errors and

biases, potentially causing conflicts or exacerbating existing tensions. These shared risks would, therefore, be best addressed through collective and multilateral efforts.

On an organisational level, integrating AI requires substantial change management. Military institutions must evolve, embracing innovation and adapting to new technologies. This necessitates a cultural shift, promoting a mindset that values agility, experimentation, and continuous learning.

In the particular context of India, the challenges become more nuanced, reflecting India's unique geopolitical, technological, and organisational landscape. Ethically, India must navigate the integration of AI into its military in a manner that aligns with its democratic values, international obligations, and civilisational ethos. Technically, India faces a distinct set of challenges in managing and securing its military data. The massive data sets that will go into training AI applications for the Indian military are likely to face cybersecurity threats from neighbouring adversaries. Given these threats, India must prioritise the protection of its military data, ensuring robust defences against cyber intrusions and data breaches.

The skills gap represents a significant hurdle for India, where the military must cultivate a workforce proficient in AI and related technologies. This requires targeted education and training programmes, and partnerships with India's thriving technology sector and academic institutions, to equip military personnel with the necessary skills. Going forward, both recruitment processes as well as in-career training programmes in the military must reflect these priorities.

Organisationally, the Indian military faces the challenge of integrating AI into its existing structures and protocols. This requires not only technological upgrades but also a shift in organisational culture towards embracing innovation and adaptability, collaborating with private and often young entrepreneurs, and overcoming the inertia and resistance to change inherent in any large, traditional institution.

Therefore, while the challenges of integrating AI into military operations are global, each country, including India, faces unique issues that reflect its specific context. For India, addressing these challenges requires a balanced approach that considers ethical imperatives, technical demands, security concerns, and organisational flexibility. By navigating these challenges thoughtfully, India can harness AI's

potential to enhance its military capabilities while upholding its values and strategic interests.

Risk of Job Disruption

AI is transforming industries across the globe, streamlining processes, enhancing efficiency, and creating new paradigms of innovation. However, this technological leap forward brings with it significant challenges, particularly in the realm of employment. In India, a country with an ever-increasing requirement for jobs, mapping AI-induced job disruption and finding potential solutions to mitigate its adverse effects is of critical importance. The integration of AI into key industries—manufacturing, services, agriculture, and the MSME and informal sectors—poses unique challenges and necessitates a nuanced understanding of its implications.

In the manufacturing sector, AI-driven automation holds the promise of increasing efficiency and precision. AI-powered robots and machines are increasingly deployed to perform tasks that require high levels of accuracy and stamina, domains where human workers are predominantly engaged. For instance, in automobile manufacturing, AI-driven robots can perform tasks like welding and painting with unmatched precision and speed. However, this shift, while beneficial for productivity and quality, raises concerns about the displacement of blue-collar workers. These individuals, often with specialised skills tailored to manual tasks, face the risk of job loss as their roles become redundant in the face of advancing technology. The transition challenges the very fabric of the manufacturing workforce, necessitating a strategic approach to reskilling and upskilling workers to adapt to the changing job requirements.

The service sector, particularly IT and IT-enabled services (ITES), is at the forefront of AI adoption in India. This sector, often applauded for its significant contribution to India's GDP and employment, is experiencing a paradigm shift with AI. The integration of AI in services ranges from customer support chatbots to advanced data analysis, enhancing efficiency and creating new service paradigms. However, this integration is not without its challenges. Jobs that are repetitive and based on set

algorithms are particularly at risk. For instance, roles in data entry, routine customer query resolution, and basic IT support, which constitute a significant portion of service sector employment, are increasingly automated. The transition poses a threat to job security for individuals in these roles, necessitating a reevaluation of skill sets and job roles in the sector.

Agriculture, the backbone of India's workforce, is also experiencing the winds of change with the introduction of AI. AI applications in agriculture, from precision farming to crop yield optimisation, promise a revolution in efficiency and productivity. For example, AI can analyse soil data to recommend precise amounts of water and fertilisers, optimising resource use and improving yields. However, this technological advancement brings into question the future of agricultural labourers. In a country where such a large section of the population relies on agriculture for livelihood, the automation of agricultural processes, even if limited in scope, poses the risk of workforce displacement.

The MSME and informal sectors, which employ the majority of the Indian workforce, are particularly vulnerable to AI-induced disruption. These sectors are characterised by their limited resources and often lack the capacity to invest in advanced technologies. The rapid pace of AI integration can leave these enterprises and their employees vulnerable, as they may not have the means or the know-how to adapt effectively. The informal sector, with its less structured nature and lack of formal employment protections, faces even greater challenges. Workers in these sectors might find it difficult to transition to new roles or industries, exacerbating employment and income insecurity in the face of AI advancements.

The AI-induced job disruption in India is a multifaceted challenge that requires a comprehensive and proactive response. While AI promises significant benefits in terms of efficiency and innovation, its impact on the workforce is profound and varied across different sectors. Addressing this disruption necessitates a concerted effort from the government, industry, and educational institutions to ensure that the workforce is prepared and resilient in the face of these changes. This includes policies and schemes focused on reskilling and upskilling, along with a strategic vision that aligns AI adoption with job creation and economic inclusiveness.

The evolving job landscape necessitates a workforce that is proficient in technical skills pertinent to the AI-driven economy, as well as being endowed with soft skills such as critical thinking and creativity, which remain challenging for AI to replicate. Developing an AI-literate workforce is essential for ensuring that individuals can thrive in a future where AI tools and systems are ubiquitous. Educational institutions, vocational training centres, and online platforms need to adapt their curricula and training programmes to equip individuals with the necessary skills to navigate and succeed in an AI-integrated job market.

Moreover, the role of government policies and regulations in shaping the AI transition is paramount. Regulations that push companies to retrain workers, at least temporarily, who have been displaced by AI technologies, ensuring that the workforce can transition to new roles that emerge in the evolving economy, must be deliberated upon. Additionally, the government can incentivise businesses that are pioneering in creating new employment opportunities within the AI sector, facilitating the creation of a job market that is resilient in the face of technological change.

Public-private partnerships can also serve as a vital mechanism for addressing the challenges posed by AI to the job market. Through increased collaboration between the government, academia, and the private sector, India can develop targeted training programmes and research initiatives that cater to the demands of an AI-centric economy. Such partnerships can facilitate a seamless exchange of knowledge and resources, ensuring that the workforce is prepared for the changes brought about by AI and that the policies enacted are informed by a comprehensive understanding of the technological landscape.

Entrepreneurship and innovation are also key drivers in generating employment in the age of AI. Encouraging individuals and startups to engage in innovative practices and to develop new business models in AI and related fields can catalyse job creation, drive economic growth, and provide new avenues for employment. This not only helps in mitigating the displacement effect caused by AI but also propels India towards becoming a hub of technological innovation and entrepreneurship.

Lastly, the relevance of social welfare schemes is also important to recognise in the context of AI-induced job disruptions. Retraining programmes, industry-relevant

vocational training, and easy access to healthcare and education are all crucial for providing a safety net for those impacted by the transition. These measures ensure that individuals who lose their jobs due to the advent of AI have the support and opportunities to re-skill and re-enter the job market, thereby maintaining social stability and economic resilience in the face of rapid technological change.

The threat of Disinformation and Deepfakes

Turning back to the digital realm, as AI technologies become more sophisticated, their ability to generate convincing fake content has increased, posing serious risks to individuals and society at large. This results in unprecedented challenges in the form of disinformation and deepfakes.

Disinformation, intentionally false information spread to deceive, has found a potent ally in AI. AI algorithms can craft text that mimics human writing styles, making it increasingly difficult to distinguish between genuine and AI-generated content. This capability is particularly alarming in the context of fake news, where AI can be used to create entirely fictitious but believable news stories. These stories can spread rapidly across social media platforms, influencing public opinion and potentially swaying elections (Zhou & Zafarani, 2020).

Deepfakes, a term that blends 'deep learning' and 'fake,' refer to hyper-realistic video and audio forgeries made with AI. These forgeries can make individuals appear to say or do things they never did, challenging our perceptions of reality. For instance, deepfake technology has been used to create videos of celebrities and politicians in compromising or unlikely scenarios, damaging reputations and causing confusion (Chesney & Citron, 2019).

The 2019 manipulated video of Speaker Nancy Pelosi, which was altered to make her speech appear slurred, serves as a stark example of the potential misuse of deepfake technology to influence public perception and discredit individuals (Paris & Donovan, 2019). Closer home in India, the deepfake video of actor Rashmika Mandanna in late 2023 prompted a number of discussions on deepfakes in the national public discourse. The episode resulted in the Indian government issuing

directives to social media platforms for timely action against such nefarious activities (Ahmed, 2023).

The legal and ethical implications of AI-generated disinformation and deepfakes are significant. Current legal frameworks often fall short in addressing the nuances of these technologies, leaving gaps in accountability and recourse for affected individuals (Chesney & Citron, 2019). Moreover, the potential for deepfakes to interfere with democratic processes, such as elections, is a growing concern. For example, a deepfake could be used to create a video of a political candidate making inflammatory or false statements, potentially swaying public opinion and election outcomes.

Combating these challenges, therefore, is imperative. Technological solutions, including AI-driven detection tools, are essential for identifying and flagging fake content. However, these technologies are in a constant arms race with the evolving capabilities of deepfake creation tools, necessitating continuous development and vigilance (Lyu, 2020).

Public awareness and education are also critical. Individuals must be equipped with the skills to critically evaluate and question the authenticity of the digital content they encounter. Media literacy campaigns can empower people to discern between real and manipulated content, reducing the likelihood of being misled by disinformation and fake news.

On the legislative front, there is a pressing need for laws that specifically address the challenges posed by AI-generated content. Regulations should aim to balance the prevention of harm with the protection of free speech and innovation, setting clear standards for transparency and accountability for content creators and distributors (Balkin, 2018).

While AI continues to advance and offer new possibilities, its role in facilitating disinformation and deepfakes necessitates vigilant oversight, innovative solutions, and collective responsibility. By increasing awareness, strengthening detection capabilities, and establishing appropriate legal frameworks, the benefits of AI can be harnessed while safeguarding against its potential to misinform and deceive.

Addressing the Regulatory Question

Global Race to Lead

The landscape of AI is evolving at a breakneck pace, compelling governments worldwide to come up with regulatory frameworks that ensure the safe, ethical, and beneficial deployment of AI technologies. In recent months, there have been a flurry of activities aimed at regulating AI.

The UK's AI Safety Summit, held on November 1-2, 2023, marked a significant step, drawing global leaders to agree on the "Bletchley Park Declaration," which emphasises international collaboration to tackle AI risks. This initiative underscores the UK's ambition to be at the forefront of AI safety and regulation.

Just days ahead of this summit, on October 30, 2023, US President Joe Biden issued an executive order outlining a comprehensive strategy to address AI's challenges, focusing on safety, security, and trustworthiness. This order signifies a proactive stance by the US to guide AI development within and beyond its borders, trying to reassert its leadership in the global technological landscape.

The European Union has not been idle either. In December 2023, the EU made important advancements with its AI Act, poised to be the world's first comprehensive legal framework for AI when it is out in 2025. This legislation aims to categorise AI applications based on risk levels, imposing stringent controls on high-risk uses while fostering innovation in less critical areas.

The UK's AI Safety Summit stands out for its collaborative approach, seeking to establish a common understanding of AI's opportunities and risks. The summit's outcome, the "Bletchley Park Declaration," reflects a commitment to shared action

against the potential dangers of AI, highlighting the UK's role in shaping the global AI discourse. In contrast, the US's approach, embodied in President Biden's executive order, is more prescriptive, mandating AI developers to adhere to new safety and transparency standards. This move is part of a broader effort to maintain American leadership in AI, ensuring that its rapid development aligns with ethical and security standards. The EU's AI Act is arguably the most comprehensive regulatory effort, setting out a detailed framework for AI governance. It categorises AI systems according to their risk levels and introduces a legal structure to oversee their deployment, aiming to balance innovation with citizen protection.

While these initiatives are commendable steps towards governing AI, they are not without their critics. Some argue that the UK's focus on safety, while important, may not fully address broader ethical concerns. Others believe that the US's executive order, though significant, may lack the enforceability of formal legislation. The EU's AI Act is perhaps the most scrutinised, given its ambitious scope. There is also the danger that stringent regulations may stifle innovation, particularly for smaller companies that cannot bear the compliance costs. Proponents of such regulations, nevertheless argue that they provide necessary protections against the misuse of AI, setting a standard for global AI governance.

These initiatives collectively signify a growing recognition of the need for international cooperation in AI governance. The emphasis on safety, security, and ethical deployment underscores a shift towards a more cautious approach to AI development. However, the diversity in these approaches—from the UK's collaborative stance to the US's prescriptive measures and the EU's comprehensive legal framework—suggests that a one-size-fits-all solution may be elusive. The interplay between these initiatives will likely shape the future landscape of AI regulation. As countries look to balance innovation with safeguards, the experiences of the UK, US, and EU offer valuable lessons.

The Specific Case of LAWS

The rapid advancement in AI has also put the global regulatory spotlight on the development of lethal autonomous weapons systems (LAWS). These systems, which can select and engage targets without human intervention, have sparked a global debate on the ethical, legal, and security implications of their deployment.

The core ethical issue with LAWS is their ability to make life-and-death decisions autonomously, raising questions about accountability, moral responsibility, and compliance with international humanitarian law. The legal challenges stem from the difficulty in defining LAWS and determining how existing laws of armed conflict apply to them. Critics argue that LAWS could contravene the principles of distinction and proportionality, risking civilian lives and potentially creating an accountability vacuum in the event of unlawful acts.

The international community has engaged in numerous discussions, particularly under the United Nations Convention on Certain Conventional Weapons (CCW), to address the concerns posed by LAWS. While there are growing calls on the need for meaningful human control over weapon systems, states have divergent views for the definition of autonomy and the scope of proposed regulations. Efforts to establish a binding legal framework have been hampered by disagreements among key stakeholders, including major military powers and developers of AI technology.

The US and China, two of the leading developers of AI-enabled military technology, have adopted ambiguous positions on LAWS. Both countries emphasise the importance of human oversight but remain non-committal on specific limitations, reflecting their strategic interests in maintaining flexibility in the development and deployment of autonomous weapons. This ambiguity complicates efforts to reach a global consensus on regulating LAWS.

India, with its growing AI capabilities and strategic concerns, particularly regarding China, has been actively participating in international discussions on LAWS. India's stance reflects a pragmatic approach, balancing ethical considerations with national

security interests. As a significant player in global technology and defence, India's engagement in shaping international norms on LAWS is crucial.

Developing a comprehensive and effective regulatory framework for LAWS requires international cooperation, clear definitions, and a pragmatic approach. Transparency, confidence-building measures, and the establishment of accountability mechanisms are essential components of any future agreement. Moreover, encouraging a multidisciplinary dialogue involving military experts, technologists, ethicists, and policymakers is vital for addressing the multifaceted challenges posed by LAWS.

Path Ahead for India

India's approach to AI regulation and its strategic deployment is informed by its ambition to harness AI's potential while navigating the complex matrix of global innovation, security imperatives, and normative considerations. As AI becomes increasingly central to national security, economic growth, and global competitiveness, India will need to evolve a dynamic strategy that balances innovation with responsible governance, drawing lessons from international efforts and its own historical experiences.

Recent initiatives like the AI Safety Summit hosted by the UK, the US' executive order on AI, and the EU's legislative efforts provide a benchmark for India, and also increase the sense of urgency in deliberating upon the AI regulatory question. India's engagement with these initiatives is not merely about adherence but about understanding the spectrum of regulatory philosophies—from the EU's structured classifications to the US' more laissez-faire stance—and applying these insights into a framework that acknowledges India's unique socio-economic and strategic context.

In this context, it has been pointed out that both the US and EU approaches work for static, linear systems with predictable risks. Regulating AI demands a departure from

traditional approaches due to its complex adaptive nature. As AI embodies characteristics akin to complex adaptive systems (CAS), its behaviour cannot be fully anticipated through reductionist methods. This unpredictability underscores the need for a novel regulatory framework, emphasising boundary conditions, real-time monitoring, and collaborative governance (Sanyal & Dudani, 2023). Rather than attempting to meticulously regulate AI's trajectory over extended periods, the focus should lie on implementing hard guardrails and oversight mechanisms to navigate its multifaceted feedback loops and susceptibility to nonlinear phase transitions.

Proposing a CAS-informed approach, five principles are outlined. Firstly, guardrails and partitions must delineate clear boundaries to curtail undesirable AI behaviours, akin to erecting firebreaks in a forest to prevent localised malfunctions from cascading catastrophically. Secondly, mandating manual overrides and chokepoints in critical infrastructure enables human control, necessitating specialised skills and attention. Thirdly, transparency and "explainability" requirements are crucial, achieved through open licensing of core algorithms and continuous monitoring of black-box systems. Fourthly, establishing clear accountability lines ensures liability protocols keep pace with technological advancements. Finally, recognising the inadequacy of traditional legal systems, the establishment of a specialised regulator equipped to adapt swiftly is deemed essential in navigating the evolving AI landscape (Sanyal & Dudani, 2023).

Meanwhile, the discourse around LAWS and the increasing scrutiny they receive internationally presents another critical area for India's strategic consideration. While the normative debate on LAWS is significant, India must also weigh the strategic imperative to develop and integrate advanced AI capabilities into its defence apparatus. Learning from the experiences of India's past engagement in nuclear disarmament discussions, India's stance today on LAWS must be based on the pragmatic realisation that strategic enhancement and technological sovereignty must precede international normative commitments (Rajamohan, 2023). This approach is vital for India to maintain strategic autonomy and ensure it is not left at a disadvantage in the evolving landscape of military technology.

Balancing the imperatives of national security, economic growth, innovation, and democratic governance are all necessary constituents of India's AI approach. A potential regulatory framework must catalyse innovation while establishing robust safeguards against misuse and ethical transgressions. India's trajectory in AI regulation should reflect a synthesis of global best practices and its intrinsic national priorities, ensuring that AI development is judiciously leveraged. It is important for India to debate and deliberate upon ideas emanating from both state and non-state stakeholders as it crafts its regulatory approach to AI.

But beyond regulatory and normative questions, it is important that India's commitment to building capabilities in the realm of AI remain strongly intact. Ultimately, India's ambition to be a prominent player in the global AI race hinges on addressing four key determinants: computing power, talent, data, and infrastructure. Despite India's robust talent pool, there is a great need for substantial improvements in computing capabilities and data accessibility. The government's initiatives to create a “sovereign AI” ecosystem, emphasising the development of digital public infrastructure and encouraging data sharing, are steps towards creating a conducive environment for AI innovation. However, these efforts must be amplified and integrated with a broader strategy that includes significant investments in infrastructure and a concerted push to cultivate and retain top-tier AI talent.

CONCLUSION

As we stand on the threshold of a new era shaped by AI, India's journey through this transformative landscape is both promising and fraught with complexities. This monograph has delved into the various dimensions of AI's integration into India's defence and security, its important role in accelerating economic growth, and the disruptions it introduces into the labour market, while also engaging with normative, societal, and regulatory challenges that accompany its adoption.

While the body of this monograph has elaborately outlined the strategic opportunities AI presents for India, particularly in enhancing military capabilities and stimulating economic growth, it is useful to acknowledge the inherent limitations of this analysis. The rapidly evolving nature of AI technology, coupled with the fluid policy landscape, introduces a degree of unpredictability that challenges the work's comprehensiveness. The pace at which AI innovations are outstripping regulatory frameworks and ethical debates also highlights the difficulty of providing a definitive commentary on a subject in constant flux.

Looking towards the future, the scope for research in AI's application in India is vast and multifaceted. There's a pressing need for in-depth studies on the societal impacts of AI, particularly concerning data privacy, individual autonomy, and social equity. Another critical area for future research is the exploration of AI's role in India's environmental and sustainability challenges. AI's potential to address issues ranging from climate change mitigation to sustainable agriculture and waste management is an untapped area of research that could yield significant insights for policy and practice.

Additionally, the interplay between AI and India's cultural and philosophical ethos offers a unique avenue for research. Examining how AI aligns with or challenges India's civilisational values could provide deeper insights into the broader implications of AI adoption beyond the technical and economic realms.

Furthermore, as India strides towards establishing itself as a leader in the AI domain, future research must also focus on the geopolitical dimensions of AI. Understanding how AI shapes India's international relations, particularly with AI powerhouses like the US and China, and its role in global governance of AI, will be crucial in the coming years.

Even as this report has endeavoured to encapsulate the strategic contours of AI's integration into India's defence and economic sectors, it is not an exhaustive commentary on the still-ongoing transformation. The journey of AI in India is not just about harnessing a technology; it's about navigating a socio-technological

transformation that touches every facet of human life. As India continues to chart its course in the AI-driven world, it must do so with a vision that is foresighted, inclusive, and anchored in the values that define its identity. The dialogue between AI and India's future is an ongoing one, with each chapter promising new insights, challenges, and opportunities to shape a future where technology and humanity converge in harmony and progress.

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