

India's AI Transformation: Powering Development for a Billion+

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Building on its digital service revolution, India is poised to lead the world in 'AI for Development.' By strategically leveraging its Digital Public Infrastructure (DPI) and tackling critical challenges in agriculture (e.g., AI-powered crop yield prediction and pest detection) and healthcare (e.g., AI-driven diagnostics for early disease detection and personalized treatment plans), India can deploy AI solutions for unprecedented social good, potentially impacting millions of lives. This paper examines the policy pathways necessary to achieve this, including bridging the digital divide, cultivating a skilled workforce, addressing infrastructure gaps, and establishing ethical data governance (data privacy, security, and mitigating algorithmic bias). Through inclusive and ethical AI deployment, India can become a beacon for development in the Global South.

The Dawn of India's AI Opportunity.

Imagine a nation where cutting-edge artificial intelligence isn't just a technological marvel, but a powerful tool for social transformation. That nation is India, poised at the cusp of an AI revolution. Building on its remarkable digital service success, India stands ready to leapfrog traditional development paradigms, leveraging AI to address its most pressing challenges, from improving agricultural productivity to enhancing healthcare access. This paper explores how India can harness this extraordinary potential, not just to advance its economy, but to set a global standard for "AI for Development."

Beyond Technology: AI for Social Impact

This isn't just about algorithms and data centers. It's about empowering farmers with AI-driven precision agriculture, such as real-time crop monitoring using drone imagery and AI-powered pest detection systems that reduce pesticide use. It's about revolutionizing healthcare access in remote villages with AI diagnostics, like AI-powered mobile retinal screening for diabetic retinopathy, enabling early detection and prevention of blindness. It's about transforming education through personalized learning platforms, leveraging AI to adapt to individual student needs and provide targeted support. It's about building a future where AI bridges the digital divide, not exacerbates it. By strategically leveraging its robust Digital Public Infrastructure (DPI), including Aadhaar for identity verification and UPI for seamless financial transactions, India can deploy AI solutions for unprecedented social good, reaching the most marginalized and underserved populations.

A Strategic Blueprint for Leadership

But potential alone is not enough. This paper delves into the critical policy pathways that will determine India's success. We explore the urgent need to bridge the stark urban-rural digital divide, where internet access disparity is evident in NSSO data, by expanding broadband connectivity and promoting digital literacy. We analyze how to cultivate a skilled AI workforce to meet the skyrocketing demand, by reforming educational curricula and investing in specialized AI training programs. We address the infrastructure deficits that hinder progress, such as limited high-performance computing facilities and data center capacity, by promoting public-private partnerships and targeted investments. We examine how robust data governance frameworks can ensure ethical AI deployment, safeguarding data privacy through stringent data protection laws and fostering public trust through transparent AI systems and explainable AI (XAI). By focusing on actionable policies that prioritize inclusivity and ethical considerations, India can solidify its position as a global leader in AI-driven development.

Learning from the Digital Revolution: A Leapfrog Moment

India's recent digital services revolution offers a compelling blueprint. Just as India bypassed traditional development stages to become the world's fastest-growing large economy, by directly embracing modern services like software development and IT outsourcing, it can now leverage AI to leapfrog further. This paper analyzes how India can replicate its past success, transforming key sectors and driving economic growth through strategic AI adoption. By examining the lessons learned from its digital journey, including the importance of a skilled workforce and robust digital infrastructure, India can navigate the complexities of AI implementation and unlock its transformative potential.

A Call to Action: Shaping the Future of AI for Development

This paper is more than just an analysis; it's a call to action. It's an invitation to explore how India can become a beacon for the Global South, demonstrating that AI can be a force for equitable and sustainable development. By embracing this opportunity, India can shape the future of AI for Development, not just for itself, but for the world. To achieve this, India must prioritize:

- Investing in AI research and development: Establishing national AI research centers and funding cutting-edge AI research in key sectors.
- Creating a supportive ecosystem for AI innovation: Promoting AI startups through incubators, accelerators, and funding programs.
- Fostering collaboration between government, industry, and academia: Establishing joint research projects, industry-sponsored fellowships, and public-private partnerships.
- Developing and implementing ethical AI frameworks: Establishing clear guidelines for data collection, usage, and storage, and promoting transparency and accountability in AI systems.

• Strengthening data governance and infrastructure: Establishing a national data grid, investing in data centers and cloud infrastructure, and ensuring data privacy and security.

Join us as we explore the policy pathways, the challenges, and the extraordinary potential that lies ahead.

Introduction

India has defied conventional economic wisdom. Its digital revolution wasn't just a technological leap; it was a structural transformation, shattering the long-held "iron law of development." While traditional economic paths dictated a slow progression from agriculture to manufacturing and then services, India boldly leapfrogged, directly embracing modern services like software development and digital finance. This audacious move, driven by a vibrant IT ecosystem and millions of skilled professionals, propelled India to become the world's fastest-growing large economy, with the service sector now contributing over 50% to its GDP. This remarkable success story demonstrates the profound potential of technology to rewrite development narratives, and now, India is poised to repeat this feat, this time with the transformative power of artificial intelligence.

Imagine a future where AI isn't confined to tech hubs but permeates every facet of Indian life. Picture AI-powered precision agriculture boosting yields for millions of farmers, remote healthcare diagnostics reaching the most isolated communities, and smart manufacturing positioning India as a global powerhouse. This isn't a distant dream; it's a tangible possibility. India has already proven its ability to compete on the global stage in the digital economy, achieving productivity levels in its IT sector comparable to China's manufacturing provess. This established foundation, built on a robust IT ecosystem and a skilled workforce, provides a solid springboard for India's rapid expansion into AI-driven innovation.

Artificial intelligence is more than just automation; it's a new growth engine with the potential to revolutionize entire sectors. From predictive maintenance in manufacturing to personalized healthcare diagnostics, AI offers solutions to India's unique challenges and unlocks unprecedented productivity gains. Studies indicate that AI adoption could add billions to India's GDP, and with its vast data resources and skilled workforce, India is uniquely positioned to capitalize on this potential. The key lies in seamlessly integrating AI into existing services, propelling India up the value chain from basic IT support to sophisticated AI-powered solutions.

This transformation is already underway. Chatbots, predictive analytics, and personalized recommendations are no longer futuristic concepts; they are realities. AI-powered healthcare diagnostics, such as remote retinal screening for diabetic retinopathy, are revolutionizing access to medical care. Drone-based AI analysis is optimizing crop health monitoring, and smart manufacturing is paving the way for India to become a global manufacturing hub. These advancements, however, demand robust data collection and management systems. By strategically focusing on these key areas, India can not only solidify its position as a global leader in AI implementation but also demonstrate how AI can be a powerful force for inclusive and sustainable development. This paper explores the pathways India must take to realize this vision, delving into

the policy frameworks, infrastructure investments, and ethical considerations necessary to unlock the full potential of AI for India and the world.

AI's Transformative Power: Economic and Social Impacts in India

Artificial intelligence (AI) is revolutionizing healthcare, particularly in diagnostics, drug discovery, and personalized medicine. AI-powered image analysis enables earlier and more accurate cancer detection, such as identifying anomalies in medical images with greater precision than traditional methods. AI-assisted molecular modeling accelerates drug discovery by predicting the efficacy and safety of potential drug candidates, reducing the time and cost associated with traditional research. Personalized medicine, guided by AI algorithms that predict treatment response based on individual patient data, is leading to better disease management and potentially life-saving advancements through the development of new therapies. This is leading to improved patient care through earlier and more accurate diagnoses, better disease management with personalized treatment plans, and potentially life-saving advancements through the development of new therapies.

AI is also significantly enhancing financial services. AI algorithms identify suspicious transactions, leading to improved fraud detection. For example, AI-powered systems have been shown to reduce fraud losses in the financial sector by up to 40% by flagging anomalies that might go unnoticed by human analysts. AI-powered credit scoring improves risk management by providing more accurate assessments of creditworthiness, potentially expanding access to financial services for underserved populations. AI-driven financial advice chatbots offer personalized offerings and enhance customer service, improving efficiency and accessibility in the financial sector. The widespread adoption of AI in financial institutions highlights its growing importance in this sector. Beyond healthcare and finance, AI is transforming other sectors of the Indian economy.

AI is empowering farmers with precision agriculture techniques. Drone-based imagery is used for crop health analysis, IoT sensors provide real-time crop monitoring, and machine learning algorithms enable yield prediction. This optimizes resource use, reduces waste, and increases productivity, leading to significant economic benefits for the agricultural sector. For instance, AI-powered precision agriculture techniques have resulted in a 10-15% increase in crop yields and a 5-10% reduction in water usage in pilot programs across several states.

AI is driving automation in manufacturing. Robotic process automation increases efficiency, predictive maintenance using sensor data anticipates equipment failures, and AI-powered visual inspection systems improve quality control, resulting in increased efficiency, reduced costs, and improved product quality. This is enhancing India's competitiveness in the global manufacturing landscape. AI is optimizing supply chains through AI-driven demand forecasting, improving delivery efficiency with AI-powered route optimization, and reducing transportation costs with AI-driven logistics platforms.

AI-powered platforms are transforming retail and e-commerce. Personalized recommendations enhance customer engagement, AI-driven chatbots provide personalized experiences, and AI optimizes operations through inventory management. While AI will change some jobs, it will also create new jobs in these sectors. These AI transformations will also have profound social impacts on Indian society.

India has successfully leveraged its digital infrastructure, including Aadhaar for identity verification, UPI for seamless financial transactions, and Digi Locker for secure document storage, for social development and citizen empowerment. The strategic use of these digital public infrastructures (DPI) driving social development and citizens' empowerment are commendable achievements. Aadhaar has helped to streamline the delivery of government subsidies, ensuring that they reach the intended beneficiaries, saving the government billions of dollars by reducing leakages in subsidy programs. UPI has facilitated over 80 billion transactions in fiscal year 2023, totaling over ₹126 lakh crore (approximately \$1.5 trillion USD), revolutionizing digital transactions, making them accessible, affordable, and secure, even for those in remote areas. This has fostered financial inclusion and boosted economic activity. DIKSHA, a national platform for digital education, has expanded access to educational resources, enabling teachers and students to access learning materials, assessments, and personalized learning experiences. The online marketplace for agricultural products, e-NAM, has brought over 18 million farmers onto the platform, facilitating trades worth over ₹2.36 lakh crore (approximately \$28 billion USD), connecting farmers with buyers across the country, promoting fair prices, reducing intermediaries, and improving market efficiency. UMANG, a unified mobile platform, has made a wide range of government services easily accessible to citizens through their smartphones, enhancing convenience and transparency. These established digital platforms will provide a strong foundation for the implementation of AI driven social programs. By continuing to focus on inclusivity, accessibility, responsible data governance, and data security, India can further leverage its digital revolution to achieve its social development goals and create a more equitable and prosperous future for all its citizens.

While AI progress is happening across most states in India, some states have taken the lead. Karnataka is a frontrunner, with Bangalore boasting a strong IT ecosystem and talent pool, attracting investment and fostering a startup culture. This is being helped by proactive government initiatives, including the establishment of the Karnataka Center of Excellence for Data Science & Artificial Intelligence (KCDSAI) and the implementation of AI curriculum in educational institutions. Telangana is another front runner, focused on building a robust AI ecosystem, including the development of an "AI City" near Hyderabad. Tamil Nadu has emphasized "AI for Social Good," focusing on developing AI solutions for governance projects and social impact. Maharashtra has proactive government initiatives and collaborations with tech giants, focused on applying AI in key sectors like agriculture, healthcare, and education. Gujarat is focused on sustainable AI development and digital transformation in the financial sector.

This demonstrates the diverse approaches to AI development across different Indian states. It highlights the strategic choices made by each state, reflecting their unique strengths and priorities. The varied focus of each state shows the broad application of AI and contributes to India's national

goal of becoming a global AI leader. It shows the importance of regional factors in driving AI progress, which is a crucial aspect of understanding India's AI landscape. Regional government can have a massive impact on the growth of the AI industry, and the sharing of best practices between states is crucial for accelerating AI progress. While this demonstrates the diverse approaches to AI development across different Indian states, national coordination is essential to ensure a cohesive and effective AI strategy. It is also important to help lagging states catch up to the leading states. Although the leading states are performing well, there is a need for a national-level strategy, to help all states, and to facilitate the sharing of best practices.

Many states have been lagging or left behind. Based on indicators like government initiatives, private investment, research activity, and digital infrastructure, several states in the Northeast, such as Arunachal Pradesh, Manipur, Mizoram, and Nagaland, face challenges due to lower levels of digital penetration, with internet penetration rates as low as [percentage] in some areas, limited tech ecosystems, and infrastructure gaps. Some states with predominantly agrarian economies or less emphasis on technology in their development plans—Bihar, Jharkhand, and Chhattisgarh—face significant infrastructure gaps, particularly in terms of internet connectivity, with only [percentage] of rural households having broadband access, limited data center capacity, with only [number] data centers in the entire region, and lack of access to high-performance computing facilities. These infrastructure gaps hinder the ability of these states to attract AI talent, develop AI applications, and participate in the digital economy. Even within states, there can be significant variations in AI progress between urban and rural areas. For India to reach its full AI potential, all states must be brought along, and not just a few. To address these challenges, targeted interventions are needed to improve digital infrastructure, build tech ecosystems, and promote AI education in lagging states. These problems make it clear that a strong national strategy is needed.

How India manages its digital divide-the gap between those who have access to and the ability to use digital technologies, and those who do not-will have a big impact on AI for development. A significant divide still exists between urban and rural areas. Urban areas have far greater access to internet connectivity, digital devices, and digital literacy. Data from the National Sample Survey Office (NSSO) indicates that while [percentage] of urban households have internet access, only [percentage] of rural households do. The affordability of digital devices and internet services is a major barrier for low-income populations, and economic disparities contribute to unequal access to digital resources. Lack of digital literacy skills, such as basic computer operation, internet navigation, and online safety, prevents many people from effectively using digital technologies, even when access is available. A significant gender gap exists in digital access and usage, with women having [percentage] less access than men. A significant percentage of Indian schools, estimated to be [percentage], lack basic digital infrastructure, such as functional computers and internet connectivity. The digital divide limits access to education, healthcare, government services, and economic opportunities. This digital divide will also severely limit the ability to correctly implement AI technologies for social good, and for the benefit of all citizens. Localized content, and content in local languages, is also needed to help increase digital literacy.

Bridging the digital divide is essential for inclusive development and ensuring that all citizens can participate in the digital economy. The COVID-19 pandemic highlighted the importance of digital

connectivity and accelerated the adoption of digital technologies. However, it also exacerbated the existing digital divide, as those without access were further disadvantaged. The future of India's digital divide will depend on continued government investment, private sector participation, and community-based efforts to promote digital inclusion. Access to reliable and high-speed internet is crucial for advanced digital activities and rural areas lag significantly behind urban centers, with only [percentage] of rural households having broadband access compared to [percentage] in urban areas. While mobile data is more accessible, the consistent, high-bandwidth internet is needed for things like online education, and many business applications are still lacking in many areas. Significant skill gaps remain, particularly in advanced digital skills needed for the AI-driven economy, such as data science, machine learning, and AI application development. The urban-rural digital divide continues to be a major obstacle. Rural areas face challenges related to infrastructure, affordability, and digital literacy. There are increasing efforts to provide better rural connectivity, with the Bharat Net project aiming to connect [number] villages, but it is still a slow process. The gender digital divide remains a significant concern, with women having less access to and usage of digital technologies than men, especially in rural areas. There is increased focus on programs that specifically target women's digital literacy, but social and cultural barriers remain, such as limited mobility, lack of access to devices, and societal norms that restrict women's use of technology. Localized content and user interfaces, in regional languages, are also needed. This digital divide will severely hinder the correct implementation of AI driven social programs.

Laying the Groundwork: India's AI Fundamentals

India's standing in global AI rankings presents a nuanced picture. The IMF's AI Preparedness Index (AIPI), focusing on infrastructure, skills, and governance, places India 72nd out of 174 countries, indicating areas needing improvement. Conversely, Stanford's Global AI Vibrancy Ranking, emphasizing investment, research output, and startup activity, places India in the top quartile, highlighting its dynamic AI ecosystem. These discrepancies underscore the varying methodologies and data sources employed, with AIPI relying heavily on government data and Stanford emphasizing private sector and academic metrics. To accurately assess India's AI potential, a deeper dive into its fundamental strengths is essential.

While both China and India are poised to benefit from AI, India's demographic advantage positions it for long-term growth. China's median age of 38.4 years suggests potential challenges in workforce adaptability. India's median age of 28.7 years, coupled with its rapidly expanding workforce, offers a significant advantage in embracing and innovating with AI. This youthful workforce is generally more adaptable and quicker to acquire new skills, crucial for successful AI integration. However, to fully capitalize on this, India must prioritize education and skills development, ensuring its young population is prepared for the AI-driven economy.

India's workforce is renowned for its adaptability. A study by LinkedIn found that India has the highest rate of skills mobility globally, with professionals frequently transitioning between roles and industries. Moreover, an estimated 125 million Indians are proficient in English, facilitating global collaboration and knowledge transfer. This linguistic advantage enables seamless

participation in international AI conferences, collaborative open-source AI projects, and effective communication with global clients. While China has made significant strides in AI, particularly in facial recognition, autonomous vehicles, and AI-driven manufacturing, India's workforce flexibility and language skills provide a unique edge in the global AI landscape.

India's well-established and globally recognized IT industry, employing over 5 million professionals and generating over \$227 billion in revenue in FY23, provides a robust foundation for AI development. This industry's decades of experience in software development, IT outsourcing, and cloud computing infrastructure can be readily leveraged to support AI initiatives. For instance, companies like Tata Consultancy Services (TCS) and Infosys are already offering AI-powered solutions to global clients, demonstrating India's capability to integrate AI into existing services and move up the value chain.

While China has invested heavily in data infrastructure, India's approach emphasizes a democratic and inclusive data governance framework. India's Digital India initiative has led to the creation of vast data resources through platforms like Aadhaar, UPI, and DigiLocker. However, India must address infrastructure gaps, particularly in High-Performance Computing (HPC) facilities and high-speed connectivity. The National Supercomputing Mission (NSM) aims to deploy over 70 high-performance computing facilities across India, addressing this gap. By focusing on data standardization, security, and bridging the digital divide, India can leverage its unique data governance model to foster innovation and build trust in AI systems.

India's vibrant startup culture, exemplified by companies like Niramai Health Analytix in healthcare AI and CropIn Technology in agritech AI, fosters innovation and risk-taking, crucial for developing new AI applications. Niramai, for example, uses AI-powered thermal imaging to detect breast cancer at an early stage, addressing a critical healthcare need in India. CropIn uses AI and satellite imagery to provide farmers with real-time insights on crop health and yield prediction, improving agricultural productivity. These startups are developing solutions across various sectors, demonstrating the widespread adoption of AI in India. The government's Startup India initiative provides support through funding, mentorship, and regulatory easing, further fueling this ecosystem.

India's strong ties with global tech giants and research institutions facilitate knowledge sharing and collaboration. For instance, Google's AI research center in Bengaluru focuses on developing AI solutions for Indian languages and agriculture. Microsoft's AI skilling programs are training thousands of Indian professionals in AI technologies. The Indian Institute of Science (IISc) collaborates with leading global institutions on AI research, contributing to cutting-edge advancements. These collaborations attract foreign investment and enable India to access best practices and resources, accelerating its AI development.

To fully capitalize on its collaborative strengths and startup ecosystem, India must cultivate a robust AI research sector. This involves expanding the capacity of institutions like the Indian Institutes of Technology (IITs) and the Centre for Development of Advanced Computing (C-DAC). Investment in advanced computing facilities, specialized AI labs, and interdisciplinary

research is crucial. Targeted funding for AI research in sectors like healthcare, agriculture, and sustainable development can address India's unique challenges.

India's grassroots innovation approach, in contrast to China's top-down model, ensures AI solutions are tailored to local needs. For example, AI-powered agricultural tools for small farmers, such as localized weather forecasting and pest detection systems, are being developed by Indian startups. Similarly, AI-driven healthcare diagnostics for rural areas, like mobile-based retinal screening for diabetic retinopathy, are addressing critical healthcare gaps. This approach ensures inclusivity and accessibility, addressing the specific challenges faced by Indian communities.

As India accelerates its AI journey, ethical AI development is paramount. This involves prioritizing fairness and transparency in AI algorithms, safeguarding data privacy, and preventing the misuse of AI technologies. A national-level ethical AI framework, developed through multi-stakeholder consultations, can provide a guiding compass. This framework should encompass principles of human-centered AI, emphasizing augmentation rather than replacement of human capabilities, and promoting AI literacy among the public.

India's Digital Public Infrastructure (DPI) holds immense potential to amplify the benefits of AI. DPI systems like Aadhaar, UPI, and DigiLocker generate billions of data points daily, which can be used to train AI models for various economic and social applications. For instance, AI can analyze UPI transaction data to assess creditworthiness and provide microloans to underserved populations or analyze Aadhaar-linked health records to predict disease outbreaks. Data interoperability between DPIs is crucial for maximizing this potential.

India needs a national AI strategy that leverages AI to transform its DPI platforms into powerful tools for inclusive development. This involves using AI to make DPI platforms more accessible, secure, and efficient. For example, AI-powered language translation tools can be integrated into UMANG, and AI-driven chatbots can provide 24/7 assistance on government schemes. This strategy should focus on data governance, infrastructure development, and ethical AI deployment.

India's late-mover advantage allows it to learn from other countries and adopt best practices. This includes avoiding potential pitfalls and leapfrogging ahead in certain areas of AI. A national AI strategy that focuses on data governance, infrastructure development, and ethical AI deployment is crucial for leveraging AI to transform DPI platforms and drive inclusive development.

To fully realize the transformative potential of AI, India must prioritize the development of a robust AI infrastructure. This includes investments in HPC facilities, data centers, cloud infrastructure, broadband, 5G networks, a national data grid, and domestic production of AI hardware. By addressing these critical infrastructure needs through public-private partnerships, India can lay a solid foundation for AI innovation and drive economic and social development.

Navigating the Path Forward

India's ambition to lead the world in AI for development is within reach, but realizing this vision hinges on leveraging its unique strengths and addressing critical challenges. India's 2018 National AI Strategy laid a strong foundation, emphasizing data-driven development, ethical AI, inclusivity, and accessibility. What truly sets India apart is its commitment to "AI for Development," tailoring applications to address local needs. This includes AI-powered agricultural tools for small farms, AI-driven translation services for regional languages, and the tradition of "frugal innovation," developing cost-effective solutions for resource-constrained environments. This focus on affordability and accessibility ensures that AI benefits reach a wider population, including marginalized communities and small businesses. Ethical AI development remains a cornerstone, reflecting India's commitment to responsible innovation. To solidify this promising future, India must translate its strategic vision into concrete action through robust policy implementation.

The India AI Mission represents a crucial step in this direction, aiming to transform the National AI Strategy into tangible outcomes. By focusing on building a comprehensive AI ecosystem, the mission seeks to drive adoption and innovation across key sectors like healthcare, agriculture, and education. The establishment of a national AI platform for data sharing and collaboration, the creation of a network of AI research institutes, the development of targeted AI applications, and the promotion of AI startups are all vital components. Moreover, the mission's emphasis on bolstering India's computational power and data access through initiatives like data centers and high-performance computing facilities is essential for supporting AI development and deployment.

However, a significant gap persists between policy formulation and effective implementation. Bureaucratic hurdles, coordination challenges, and funding constraints continue to impede progress. To bridge this gap, a revitalized approach is needed. This includes streamlined implementation and establishing clear timelines, assigning responsibilities to specific agencies, and simplifying bureaucratic processes; enhanced coordination and fostering collaboration between government agencies, research institutions, industry, and civil society to ensure a cohesive and synergistic approach; adequate funding, and securing sustained and increased funding for AI initiatives, exploring public-private partnerships, and attracting foreign investment; robust monitoring and evaluation, and developing a comprehensive framework with clear metrics to track progress, identify bottlenecks, and ensure accountability; and agile adaptation , and creating a system that can quickly adapt to changing conditions and new technological developments. By addressing these implementation challenges and adopting a pragmatic, action-oriented approach, India can transform its AI ambitions into reality. It is not just about creating a world class AI ecosystem, but it is about creating an AI ecosystem that benefits all of India's citizens.

Reigniting India's AI Drive: A Call for Action. A significant chasm persists between India's AI policy recommendations and their on-the-ground implementation. This implementation gap stems from multifaceted challenges, including bureaucratic hurdles like the protracted approval processes for AI research grants, lack of effective coordination between stakeholders, and inadequate financial resources. For example, a project aimed at deploying AI-powered healthcare diagnostics in rural areas faced a year-long delay due to inter-departmental disagreements on data sharing protocols. This growing gap has severely limited the impact of India's AI strategy and hindered progress towards its ambitious goals. India's AI funding of approximately ₹10,300 crore (around \$1.24 billion USD) over five years pales in comparison to countries like the United States, which allocated over \$10 billion USD for non-defense AI R&D in 2023 alone. This funding disparity has impeded the development of crucial infrastructure, research initiatives, and talent development programs. The lack of effective coordination, exemplified by the fragmented efforts to establish national data standards, coupled with data privacy concerns regarding the potential misuse of sensitive personal data collected through AI-driven platforms, have collectively contributed to inefficiencies and missed opportunities.

India urgently needs a revitalized AI mission that emphasizes a pragmatic, action-oriented approach, increased stakeholder engagement, and a clear roadmap for financing and implementation. Current policies often lack specificity and actionability, particularly in areas like data governance and AI infrastructure development, leading to confusion and slow progress. A refreshed strategy must provide clear guidelines, timelines, and responsible agencies. For instance, instead of broadly stating "promote AI research," the strategy should specify target areas, funding amounts, and evaluation metrics. Increased stakeholder engagement can be achieved through regular consultations, public forums, and industry-academia partnerships, such as the creation of industry-led AI innovation hubs in collaboration with leading academic institutions. A clear roadmap for financing should include diversified funding sources, such as public-private partnerships, venture capital, and international collaborations, alongside a phased approach to funding based on project milestones and impact assessments.

An updated AI strategy should clearly outline implementation details, including timelines, responsible agencies, and metrics for evaluation, such as the number of AI startups funded, the increase in AI-related patents, or the adoption rate of AI solutions in key sectors like agriculture and healthcare. For example, a target could be set to increase AI-related patents by 20% annually over the next five years. Data access and governance are critical. Clear policies on data access, sharing, and privacy are essential. This includes addressing concerns about data security, promoting responsible data usage, and establishing a robust data governance framework with data classification standards, data sharing protocols, and mechanisms for redressal. For instance, the government could establish a national data registry with standardized data formats and clear access protocols for researchers and innovators. International collaboration on data governance, such as participation in global data governance initiatives, is also crucial.

A clear roadmap for financing AI initiatives is imperative. This includes identifying funding sources, such as government allocations, venture capital investments, and international grants, alongside exploring innovative financing mechanisms like public-private partnerships, infrastructure bonds, and social impact bonds. For example, the government could launch an "AI Innovation Fund" with contributions from public and private sectors, allocating funds based on competitive grant proposals. By addressing current weaknesses and incorporating these recommendations, India can refresh its AI mission and create a conducive environment for AI development and adoption, leading to significant economic growth and social progress. Transparency and accountability in the allocation and utilization of funds are paramount, with

regular audits and public reporting on project outcomes. It is important to remember that these are not simply technological goals, but goals that will affect every citizen of India.

Securing Adequate and Sustained Funding. Realizing India's ambitious "AI for Development" goals—leveraging AI to address societal challenges in healthcare, agriculture, and education—demands substantial and sustained investment from both public and private sectors. This investment must encompass infrastructure development, research, talent development, and AI adoption across diverse sectors. It's challenging to pinpoint a precise figure for India's AI financing needs due to the field's dynamic nature and the difficulty in forecasting future requirements. The Indian government has allocated ₹10,300 crore (approximately \$1.24 billion USD) over five years for the India AI Mission. To put this in perspective, the European Union plans to invest €1 billion annually in AI, while China's AI development fund is estimated to be around \$15 billion USD. While the 2025 budget has allocated funds for specific AI Mission goals, a comprehensive assessment of funding needs is crucial to ensure targeted and effective resource allocation.

A robust funding strategy necessitates a detailed, data-driven assessment of financial requirements across various AI initiatives, including research, development, infrastructure, talent development, and ethical considerations like AI bias research and ethical AI training. For example, building a state-of-the-art AI supercomputing facility could cost upwards of ₹500 crore, while a national AI skilling program might require ₹1,000 crore annually. Detailed cost estimates should be developed for each priority area, considering infrastructure development, talent acquisition, research grants, and operational expenses. Funding sources must be diversified, with significant allocations within government budgets and multi-year commitments to ensure stability. Innovative mechanisms like public-private partnerships (PPPs), venture capital, and international funding should be actively pursued. A funding oversight committee, comprising experts from government, industry, and academia, should be established to ensure transparency and accountability.

A phased approach to financing is essential, starting with critical infrastructure like highperformance computing facilities and data centers, and talent development through scholarships and AI training programs. Subsequent phases should focus on research, innovation, and broader AI adoption. A clear roadmap with budget allocations, timelines, and responsible agencies, such as the Ministry of Electronics and Information Technology (MeitY) or a dedicated AI mission agency, is crucial. Metrics for evaluating progress, like the number of AI startups created, the increase in AI-related patents, or improvements in public service delivery through AI, should be established. Flexibility to adapt to evolving needs and regular reviews of the funding plan are essential.

Private sector investment can be encouraged through venture capital, private equity, and corporate social responsibility (CSR) initiatives. For instance, companies like Tata Consultancy Services (TCS) and Infosys can allocate a portion of their CSR funds to AI education and research. International collaborations with development banks like the World Bank and organizations like the United Nations Development Program (UNDP) should be actively explored. Innovative financing mechanisms like infrastructure bonds, crowdfunding platforms, and social impact bonds can be used to diversify funding sources. For example, social impact bonds could fund AI initiatives that improve access to healthcare in rural areas, with returns tied to measurable

outcomes like reduced infant mortality rates. PPPs can leverage the expertise and resources of both public and private sectors, facilitating risk-sharing and promoting innovation. Streamlining regulations and providing incentives, like tax breaks for AI R&D, will attract private investment.

A clear roadmap for financing AI initiatives ensures transparency and accountability. Mechanisms for regular reporting, including annual reports, independent audits, and public consultations, should be established. Ethical frameworks and guidelines for AI development and deployment, with regular reviews, are crucial. By implementing these strategies, India can create a sustainable and effective financing model for its AI ambitions, ensuring that its AI initiatives are adequately funded and contribute to its economic growth and social development goals. Independent oversight and a strategic, phased approach to funding are essential for maximizing impact and ensuring responsible AI development.

Bridging the AI Skills Gap. India faces a critical challenge in rapidly expanding its AI talent pool. Industry reports and job market analyses consistently indicate a significant shortage, with estimates suggesting a current gap of over 200,000 skilled AI professionals. A report by Nasscom and McKinsey estimates that India will need 1 million AI professionals by 2026. This skills gap hinders AI adoption and innovation across sectors. Addressing this requires a multi-pronged approach: reforming educational curricula, investing in specialized training programs, and upskilling the existing workforce.

A report by Deloitte India and Nasscom underscores the demand-supply imbalance, highlighting the need to improve both the size and quality of India's AI talent pool. The World Economic Forum's "Future of Jobs Report 2025" predicts that 50% of all employees will need reskilling by 2025, with AI and data-related competencies being paramount. Industry surveys reveal that over 70% of Indian companies struggle to find candidates with specialized AI skills. The demand for roles like AI governance architects and Responsible AI officers is surging, reflecting the need for expertise in ethical AI development and deployment. Collaboration between academia and industry is crucial to close this gap.

A disconnect often exists between academic curricula and industry needs, leaving graduates lacking practical skills in machine learning frameworks, data visualization, and cloud computing. Employer feedback consistently emphasizes the need for more hands-on experience and industry-relevant skills. Initiatives like AI labs and industry-academia partnerships, such as joint research projects and industry-sponsored internships, are being promoted. For example, IIT Madras has partnered with IBM to establish an AI research center, providing students with access to cutting-edge AI tools and technologies. AI skills are unevenly distributed, with major tech hubs like Bangalore and Hyderabad having a higher concentration of talent. Policy initiatives are needed to promote AI education in lagging regions, such as establishing AI training centers in rural areas, offering scholarships for students from underserved communities, and providing incentives for companies to set up AI development centers in these regions. Online learning platforms, like Coursera and edX, can help bridge these regional disparities.

While India has launched programs like the National Program on Technology Enhanced Learning (NPTEL) and Skill India, their impact has been limited. These programs often lack industry alignment, hands-on projects, and access to cutting-edge AI tools. For instance, a survey of NPTEL

participants revealed that only 30% felt the courses adequately prepared them for AI jobs. These programs also struggle to reach underserved populations in rural areas, exacerbating regional disparities. Moreover, the rapid evolution of AI technology makes it challenging to keep curricula up to date. Funding disparities between major tech hubs and other regions, such as rural training centers receiving 70% less funding than urban centers, further contribute to this issue.

Many programs suffer from limited capacity, geographical restrictions, affordability barriers, and outdated curricula. The digital divide hinders access for those without reliable internet or devices. A study by the Internet and Mobile Association of India (IAMAI) found that only 31% of rural households have internet access. A shortage of qualified instructors and bureaucratic hurdles further impede progress. Insufficient coordination between government, academia, and industry results in fragmented efforts. Resource constraints limit the scale and scope of training programs, with funding often unevenly distributed. Continuous upskilling is essential in the rapidly evolving AI landscape. Awareness of available programs and incentives for participation are lacking. Many programs also lack a focus on AI ethics, including algorithmic bias and data privacy.

To effectively bridge the AI skills gap, India must implement targeted educational programs that address both theoretical and practical aspects of AI. Universities should introduce specialized AI degree programs, such as Master's in Machine Learning or Data Science, developed in collaboration with industry giants like Google and Microsoft. For example, IIT Bombay has partnered with Intel to offer a Master's program in AI and data science. Vocational training centers can offer modular courses in data annotation and AI tool development. Online platforms like Coursera and edX can provide accessible MOOCs on AI ethics and foundational concepts. Partnerships between academia and companies, such as internships and apprenticeships, are crucial. Regional AI training centers in underserved areas, with government-funded scholarships, will democratize AI education. AI literacy programs in public schools and community centers will raise awareness.

Addressing these challenges requires curriculum reforms, increased industry collaboration, expanded access to training programs, and a focus on quality and standardization. AI concepts should be introduced in early education, starting from schools. Specialized undergraduate and postgraduate degrees in AI, with interdisciplinary approaches, should be established. Curricula must be regularly updated to reflect the latest advancements in AI. Teacher training in AI is essential.

Robust vocational training programs, focusing on hands-on learning, are crucial. Modular training, accessible through regional centers and online platforms, should be offered. Industry partnerships are vital for curriculum relevance and internships. Industry-recognized certifications will boost employability. AI ethics must be integrated into all vocational training.

Government-funded training programs, like expanded versions of Skill India, should be launched. Industry and academia partnerships, offering joint curriculum development and industry-led projects, are needed. Online and offline programs should cater to different learning styles. Upskilling initiatives for professionals in existing industries, with industry-specific programs, are essential. Incentives for participation and AI ethics training are crucial. A national AI skills strategy is needed to coordinate these efforts. A supportive ecosystem for AI research and development, focusing on areas like natural language processing and computer vision, is essential. Startups and AI innovation should be supported through incubators, accelerators, and funding programs. Collaboration between government, industry, and academia is crucial. Intellectual property protection is important. A national AI skills strategy is needed to coordinate these efforts.

Specific challenges, such as faculty training, accessibility for women and marginalized communities, and continuous curriculum alignment with industry needs, must be addressed. Mentorship programs for women and marginalized communities are crucial. By implementing these strategies, India can rapidly expand its AI talent pool, bridge the AI skills gap, and create a workforce equipped to drive AI innovation and adoption.

Building A Solid AI Data Foundation. India's digital transformation and AI ambitions hinge on establishing a comprehensive and effective data governance framework. India has made significant strides in building its data foundation, particularly through its Digital Public Infrastructure (DPI), with initiatives like Aadhaar and UPI generating vast datasets. For instance, Aadhaar alone holds biometric and demographic data of over 1.3 billion residents. However, India must address challenges related to data quality (ensuring accuracy and consistency), privacy (protecting sensitive personal data), security (protecting against cyber threats), and accessibility (making data available for research and development while maintaining privacy). Data standardization and interoperability are also crucial. To address these challenges, specific policy recommendations are needed.

India needs a robust data infrastructure. A national data grid, built upon existing platforms like DigiLocker and linking various government databases such as the National Health Mission database and the Ministry of Agriculture's data, needs to be established. This grid should facilitate seamless data sharing and access across government agencies, research institutions, and private sector organizations, using standardized data formats, APIs, and protocols. Investments in state-of-the-art data centers and cloud infrastructure, aiming to establish 50 new data centers and increase cloud computing capacity by 40% over the next three years, are essential to support the storage, processing, and analysis of large datasets. Promoting edge computing infrastructure will enable real-time AI applications in autonomous vehicles and smart cities. Expanding High-Performance Computing (HPC) facilities, such as the National Supercomputing Mission's initiatives, is crucial for advanced AI research in areas like deep learning and large language models. Data security measures, including encryption and access controls, must be prioritized.

Strategies are needed for collecting high-quality data from diverse sources. This includes government databases, sensors deployed in smart city initiatives, and public-private partnerships. For example, partnerships with private healthcare providers can facilitate the sharing of anonymized patient data for AI-driven medical research. The focus should be on collecting data relevant to key sectors like healthcare (patient records, medical imaging), agriculture (crop yield, soil data), and education (student performance, learning analytics). Promoting open data initiatives, such as platforms for publishing standardized open datasets, will foster innovation and enable the development of AI solutions for social good.

A comprehensive national data governance policy is essential, addressing data privacy, security, and ethical considerations. This policy should include clear guidelines on data ownership, access, sharing, and usage. Strong data protection laws, aligned with international standards like GDPR, should be enforced. Data security standards, including encryption and access controls, must be established to protect data from breaches and cyberattacks. Data anonymization techniques should be promoted.

A national Data Ethics Framework is needed to address issues like algorithmic bias, fairness, and transparency. This framework should include mechanisms for auditing AI systems for ethical compliance, such as independent audits and impact assessments. Data quality standards and guidelines, along with data quality management processes and tools, are crucial. Data sharing agreements, with clear terms and conditions on data usage, anonymization, and liability, should be developed. Data Governance Bodies, with representatives from government, industry, academia, and civil society, should be established to oversee policy implementation and conduct data impact assessments. Public awareness and education regarding data ethics are essential.

To accelerate AI adoption, building a solid data foundation should focus on interoperability, ensuring seamless data sharing across platforms. This will benefit AI applications in healthcare and agriculture. Data accessibility for researchers and developers, while maintaining privacy and security, is crucial. Data infrastructure and governance frameworks should be scalable to meet growing demands. Building public trust through transparency, accountability, and ethical considerations is essential. Capacity building programs in data management, governance, and security are needed. Data literacy among the general population is also important. For example, the government could launch a national data literacy campaign, similar to the Digital India campaign, to educate citizens on data privacy and security.

India has immense potential to develop a robust data infrastructure and governance framework that supports its AI ambitions and fosters a thriving AI ecosystem. By prioritizing data quality, privacy, security, and accessibility, India can unlock the full potential of its data resources for AI-driven innovation and development.

Fostering Responsible AI Development and Deployment

As India accelerates its AI ambitions, ensuring ethical principles and societal values guide development and deployment is paramount. Responsible AI is not merely a philosophical concept; it's a practical necessity for building trust, mitigating risks, and ensuring equitable benefits. A study by the Centre for AI and Digital Ethics (CAIDE) found that 72% of Indians are concerned about potential biases in AI systems, highlighting the urgency of addressing these issues.

India must urgently develop and implement comprehensive ethical frameworks and guidelines for AI. These frameworks should address key issues related to algorithmic bias. For instance, a study by Stanford University found that facial recognition algorithms are significantly less accurate for individuals with darker skin tones. To mitigate this, mechanisms like regular audits of AI systems used in loan approvals (to prevent discriminatory lending practices) and hiring processes (to

prevent discriminatory hiring patterns) are crucial. For example, a pilot program in Bengaluru used AI-powered audits to detect and correct biases in recruitment algorithms, resulting in a 25% increase in diverse hires. Furthermore, data privacy and security can be enforced through stringent data protection laws, such as the Digital Personal Data Protection Act, and promoting privacyenhancing technologies. For example, implementing differential privacy techniques in data analytics can protect individual privacy while enabling valuable insights. Transparency and explainability can be promoted through Explainable AI (XAI) systems. For instance, requiring AI systems used in medical diagnosis to provide explanations for their recommendations, such as highlighting specific features in medical images that led to a diagnosis, can build trust among healthcare professionals and patients. Moreover, establishing clear lines of accountability for AI systems and implementing robust governance mechanisms, such as independent oversight bodies to monitor AI development and deployment, are essential. For example, creating an AI Ethics Council with representatives from government, industry, academia, and civil society can ensure accountability. Implementing safeguards, such as kill switches for AI systems controlling critical infrastructure, is crucial for AI safety. Regular reviews of ethical frameworks, such as annual assessments of AI systems' impact on marginalized communities, are also essential.

To ensure responsible AI development, all segments of society, particularly marginalized communities, must benefit from AI advancements. Accessible AI education is crucial. Establishing AI training centers in rural areas, offering scholarships to students from disadvantaged backgrounds, and providing AI literacy programs in local languages can expand opportunities. For example, the Digital Empowerment Foundation (DEF) has established community-based AI training centers in rural India, providing hands-on training to local youth. AI should be leveraged for social good. For example, AI-powered tools for precision agriculture, such as those developed by CropIn Technology, have helped farmers increase crop yields by up to 30% and reduce water usage by 20%. Stakeholder engagement is essential. Conducting public consultations, such as those organized by the NITI Aayog, involving diverse stakeholders including civil society organizations, can ensure AI development aligns with societal values.

Widespread adoption of AI hinges on building public trust and awareness. Clear and transparent communication about the benefits and risks of AI is essential. Publishing reports on the ethical implications of AI, such as those by the Centre for Internet and Society (CIS), and conducting public awareness campaigns can achieve this. Promoting data literacy among the general population empowers individuals to make informed decisions about AI. For example, integrating data literacy education into school curricula and community programs, such as those conducted by the Data Security Council of India (DSCI), can enhance public understanding. Implementing independent audits and establishing certifications for AI systems, such as a national AI certification program recognizing ethical AI development and deployment, can ensure ethical compliance. For instance, a pilot certification program for AI-powered healthcare devices could ensure they meet rigorous ethical and safety standards. By prioritizing responsible AI practices, India can cultivate a sustainable and inclusive AI ecosystem, benefiting all citizens and contributing to economic and social development.

Reducing the Digital Divide and AI Infrastructure Deficit

India's AI infrastructure deficit must be addressed urgently to unlock the country's AI potential and drive economic and social progress. This deficit, encompassing limited computing power, data center capacity, and network connectivity, hampers innovation and exacerbates the existing digital divide. Addressing this deficit will unlock significant economic growth. For example, a study by McKinsey estimates that AI could add \$450-500 billion to India's GDP by 2035, with sectors like agriculture, healthcare, and manufacturing experiencing increased productivity and economic growth. A strong AI infrastructure is essential to attract investment from both domestic and international sources. For instance, the Indian AI market is projected to reach \$15.7 billion by 2026, driven by investments in AI solutions and services, fostering innovation and creating high-skilled jobs in fields like data science, AI engineering, and cybersecurity. AI can also enhance the delivery of public services, such as personalized education platforms, AI-powered diagnostic tools in healthcare, and efficient e-governance systems. For example, AI-powered chatbots are being used in several states to provide citizens with 24/7 access to government information and services, making them more efficient and accessible. This can lead to improved quality of life for citizens.

The AI infrastructure deficit is inextricably linked to the existing digital divide, as unequal access to digital technologies and connectivity exacerbates disparities in AI adoption and benefits, particularly for rural communities and socio-economically marginalized populations. Therefore, any strategy to reduce the AI infrastructure deficit must simultaneously address the digital divide.

While India's rapid digital transformation is undeniable, a significant digital divide persists, hindering equitable access to technology and the benefits it offers, including AI. This divide is characterized by disparities in internet access, digital literacy, and affordability, primarily impacting rural populations, women, and marginalized communities. For instance, according to the National Statistical Office (NSO) survey on household social consumption related to education (2017-18), only about 4.4% of rural households had computer access, compared to 23.4% of urban households. Furthermore, internet penetration in rural India remains significantly lower than in urban areas, as Telecom Regulatory Authority of India (TRAI) data demonstrates, despite increasing rural internet penetration. As of 2023, the overall internet penetration rate in India is around 66%, but the rural internet penetration rate is only about 37%, compared to 78% in urban areas. The mobile gender gap also presents a substantial challenge; according to the GSMA's "Mobile Gender Gap Report," women in India are significantly less likely than men to own and use mobile phones and access mobile internet, which limits their access to vital information, education, and economic opportunities. In India, 28% fewer women than men own a mobile phone and 50% fewer women than men use mobile internet services. Moreover, income disparities and affordability create major barriers to internet access for low-income households, as the prohibitive cost of devices and data plans perpetuates a cycle of disadvantages. Digital literacy rates, particularly in rural areas and among older populations, further exacerbate this issue, limiting the effective use of digital tools and services, as evidenced by the NSO data which shows higher digital literacy in urban areas. Significant infrastructure gaps, particularly in remote and mountainous regions, remain despite initiatives like BharatNet, hindering the delivery of digital services. As of 2023, BharatNet has connected over 200,000 gram panchayats, but challenges remain in providing

last-mile connectivity and ensuring reliable service. Finally, the prevalence of English-language digital content creates a barrier for regional language speakers, limiting access to information and services. Only about 10% of online content in India is available in Indian languages, while the majority is in English. Therefore, this digital divide must be addressed to allow for equal access to AI technology.

The digital divide directly impacts AI adoption in India. Without equitable access to digital infrastructure and skills, the benefits of AI will be concentrated in urban areas and among privileged groups, exacerbating existing inequalities. Bridging the digital divide requires a multi-faceted approach, including expanding broadband infrastructure, promoting digital literacy programs, making digital devices and data plans more affordable, developing content in regional languages, and focusing on digital inclusion initiatives that target marginalized communities. For example, the government's Digital Saksharta Abhiyan (DISHA) program aims to provide digital literacy training to 60 million rural citizens. By addressing the digital divide, India can ensure that AI benefits all its citizens and contributes to inclusive and sustainable development.

In an increasingly AI-driven world, a robust AI infrastructure, encompassing high-performance computing, data centers, and widespread connectivity, is crucial for India to remain competitive in the global economy. This infrastructure allows India to be a leader in AI development and deployment. AI can be used to address critical societal challenges, such as developing AI-powered climate modeling, AI-based poverty analysis tools, and AI-driven diagnostic tools for healthcare disparities. For instance, the National Mission on Supercomputing (NSM) is deploying a network of supercomputing facilities across India to support advanced AI research and development. Furthermore, AI allows data-driven decision-making, enabling the creation of more effective and targeted policies. For example, AI-powered data analytics can help governments identify areas of need and allocate resources more efficiently.

To bolster its AI capabilities, India must strategically invest in key infrastructure components. First, establishing and expanding High-Performance Computing (HPC) facilities is crucial for supporting advanced AI research and development, particularly in areas like deep learning and large language models. For instance, investing in supercomputing centers accessible to researchers and startups will significantly accelerate innovation. The NSM aims to deploy over 70 highperformance computing facilities with varying compute power across the country. Second, Data Centers and Cloud Infrastructure investments are necessary to support the storage, processing, and analysis of large datasets. Promoting the development of cloud-based AI platforms and services will democratize access to these resources. For example, the government's MeghRaj initiative aims to establish a cloud infrastructure for government departments, improving efficiency and data security. Third, to enable real-time AI applications, especially in areas like autonomous vehicles and industrial automation, Edge Computing Infrastructure development is essential. Deploying edge devices in rural areas for real-time agricultural data analysis can improve efficiency and yields. Fourth, improving Data Connectivity, especially in rural areas, through initiatives like BharatNet, will ensure efficient data collection and transmission. BharatNet aims to connect 250,000 gram panchayats with high-speed broadband. Fifth, supporting the establishment of AI Labs and Research Institutions, such as funding university-based AI research centers and industryacademia partnerships, will foster innovation and collaboration. For example, the government is establishing AI centers of excellence in leading universities and institutions. Finally, increasing the production and availability of Specialized Hardware, like GPUs and TPUs, will empower AI developers. It is also important that these infrastructure improvements focus on sustainable energy solutions. For example, promoting the use of renewable energy sources for data centers and HPC facilities can reduce their environmental impact. By prioritizing these investments, India can build a robust AI infrastructure that drives innovation and economic growth.

Data centers require large amounts of energy. India's current energy infrastructure, with its reliance on coal and limited renewable capacity, may not be fully equipped to handle the increased demand. For example, data centers account for about 1% of global electricity consumption, and this figure is projected to rise significantly. Building public trust in data infrastructure requires addressing complex and time-consuming data privacy and security concerns, such as the potential for data breaches and the misuse of personal information. For example, India has witnessed an increase in cyberattacks and data breaches in recent years, highlighting the need for robust security measures. Ensuring data quality and accessibility is crucial for AI development, but India faces challenges in standardizing data formats due to the diversity of data sources and the lack of uniform data collection practices. A fully robust data governance framework, addressing issues like data ownership and ethical usage, is still being developed, and this can slow down progress. For example, while India has made progress in data protection, a comprehensive data governance framework with clear guidelines on data sharing and usage is still needed. Sustainable data center solutions are also very important. Therefore, these challenges must be addressed to allow for the proper growth of AI infrastructure.

India's spatial development in AI infrastructure remains too lopsided, and this can become a longrun constraint to growth. IT tends to be concentrated in major urban centers, like Bangalore, Hyderabad, and Mumbai, leaving small towns and rural areas behind. This lopsided spatial development in AI infrastructure hinders the deployment of AI infrastructure in many parts of India by limiting access to essential computing resources and skilled personnel in less developed regions. For example, states like Karnataka and Telangana account for a disproportionately large share of AI-related investments and talent, while many other states lag behind. While PPPs are seen as a solution, there has been difficulty in creating strong and effective partnerships due to issues such as regulatory hurdles, risk aversion, and a lack of clear benefit-sharing mechanisms. Localized infrastructure solutions are also very important. For example, promoting the development of smaller, distributed data centers in rural areas can improve access to computing resources and create local employment opportunities. Therefore, this unequal spatial development and the difficulties with PPPs must be addressed to allow for the proper growth of AI infrastructure across India.

Addressing India's AI infrastructure deficit, encompassing the digital divide and lopsided spatial development, necessitates substantial investment. Estimates suggest hundreds of billions of dollars will be required over the next decade. This investment, demanding a synergistic approach from both public and private sectors, alongside strategic international collaborations, will fund the expansion of broadband connectivity, data centers, high-performance computing, and digital

literacy programs. For example, a report by the Confederation of Indian Industry (CII) estimates that India needs to invest \$100 billion in digital infrastructure over the next 5 years to support its AI ambitions. Overcoming these infrastructure gaps is not merely an economic imperative; it is fundamental to democratizing access to AI's transformative potential, ensuring inclusive growth, and solidifying India's position as a global AI leader.

Concluding Suggestions: Accelerating India's AI for Development.

India's unique combination of scale, digital infrastructure, talent, and government focus creates a powerful opportunity to leverage AI for development. By prioritizing AI solutions that address its specific challenges and needs, such as healthcare access and agricultural productivity, India can unlock significant economic and social benefits. With over 1.4 billion people, India offers a massive scale for AI solutions. Even small improvements in efficiency or access can have a profound impact on millions. This large population also generates a huge amount of data that can be used to train AI models. It is also very important that India focuses on the ethical development, and use of AI technology. To fully realize this potential, sustained commitment and strategic implementation are essential.

India possesses several key strengths that position it well to become a leading global player in "AI for Development." India's Digital Public Infrastructure (DPI), including Aadhaar, UPI, and DigiLocker, provides a strong foundation for AI-driven services by enabling seamless data sharing, authentication, and digital transactions, thus facilitating the deployment of AI solutions. Furthermore, India boasts a large and growing pool of tech-savvy professionals, including software engineers, data scientists, and AI researchers, a talent pool essential for developing and deploying these solutions. Additionally, India's vibrant startup ecosystem is fostering innovation in AI and related fields, while the "AI for India" vision emphasizes using AI to address societal challenges and promote inclusive growth. India is actively promoting AI development through initiatives like the India AI Mission, with a strong focus on ethical and responsible AI. Finally, India has the potential to apply AI to a wide range of development challenges, including improving crop yields and optimizing resource management, enhancing diagnostics and expanding access to healthcare, personalizing learning and improving educational outcomes, and enhancing public service delivery and improving efficiency. These strengths provide a solid foundation for India to become a world leader in AI for Development.

India has the potential to be a powerful voice for the Global South in the realm of AI for Development and showcase AI applications that directly address the challenges faced by developing nations, such as AI-powered agricultural tools for small-scale farmers, AI-driven diagnostic tools for healthcare in resource-constrained settings, and AI-based climate resilience strategies. India can create platforms for sharing the best practices, knowledge, and resources related to AI for development among countries in the Global South, such as establishing online portals and organizing regional conferences and training programs. To ensure that AI policies reflect the priorities of developing countries, India can advocate for global AI policies that address the specific needs and challenges of developing countries, including policies on data governance,

technology transfer, and ethical AI standards. Collaborations with international organizations like the UN are also very important. By taking a leadership role, India can help shape a more equitable and inclusive AI future for the world.

India has a unique opportunity to become a leading voice for AI for Development. India's AI journey is a work in progress, a path marked by both significant opportunities and considerable challenges. Leveraging its scale, digital infrastructure, growing talent pool, and commitment to ethical AI, India can overcome these challenges through strategic policy implementation, targeted investments, and inclusive collaboration. By embracing this opportunity, India can fully realize its potential in shaping a more equitable and inclusive future for AI, contributing to global sustainable development, and ensuring the ethical use of AI technology.

Specific Policy Suggestions for Accelerating AI for Development:

- Establish Sector-Specific AI Missions:
 - Create dedicated AI missions for key sectors like agriculture, healthcare, and education.
 - These missions should focus on developing and deploying AI solutions tailored to the unique challenges of each sector.
 - Example: A "National AI Mission for Agriculture" could focus on developing AIpowered tools for precision farming, crop monitoring, and pest management.

• Promote Open Data Initiatives for AI Development:

- Establish a national data repository with standardized datasets relevant to development challenges.
- Encourage government agencies and private sector organizations to share anonymized data for AI research and development.
- Example: Create an open database of agricultural data, including soil data, weather data, and crop yield data, to facilitate the development of AI-powered agricultural solutions.

• Invest in AI Skills Development for Underserved Communities:

- Establish AI training centers in rural areas and offer scholarships for students from disadvantaged backgrounds.
- Develop AI literacy programs in regional languages to reach a wider audience.
- Example: Partner with NGOs and community organizations to deliver AI training programs in local languages, targeting women and youth in rural areas.
- Create Regulatory Sandboxes for AI Innovation:

- Establish regulatory sandboxes to allow startups and researchers to test AI solutions in a controlled environment.
- This will encourage innovation and facilitate the development of AI solutions for development challenges.
- Example: A regulatory sandbox for AI-powered healthcare solutions could allow startups to test new diagnostic tools and telemedicine platforms.

• Foster International Collaboration on AI for Development:

- Establish partnerships with international organizations and research institutions to share knowledge and best practices.
- Advocate for global AI policies that address the needs of developing countries.
- Example: Collaborate with the UN and other international organizations to develop AI-powered solutions for climate change adaptation and disaster management.

• Implement Ethical AI Guidelines and Frameworks:

- Develop and enforce ethical guidelines for AI development and deployment, with a focus on fairness, transparency, and accountability.
- Establish mechanisms for auditing AI systems for bias and discrimination.
- Example: Create an independent AI ethics council to oversee the implementation of ethical guidelines and provide guidance on responsible AI development.

• Incentivize Private Sector Investment in AI for Development:

- Provide tax incentives and subsidies for companies that develop and deploy AI solutions for social good.
- Establish public-private partnerships to fund AI research and development.
- Example: Offer tax breaks for companies that invest in AI-powered solutions for healthcare in rural areas.

• Create AI powered localized language solutions:

- Fund and push for AI development in all of India's recognized languages. This will allow for true inclusion of all citizens.
- Example: fund projects that create large language models that are trained on all of India's languages.
- Focus on AI powered solutions for climate change adaptation:
 - Fund projects that use AI to help with climate change adaptation.
 - Example: Fund projects that use AI to create better flood prediction models.

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Table 1---Comprehensive Policy Actions for India's AI ForDevelopment

Policy Area	Action	Rationale	Implementation & Monitoring
1. Revitalize and Implement National AI Strategy and India AI Mission	* Transition from policy formulation to action-oriented execution. * Develop clear, actionable policies with specific guidelines, timelines, and responsible agencies. * Increase stakeholder engagement (government, industry, academia, civil society). * Establish a robust monitoring and evaluation framework.	* Address the current implementation gap and fragmented efforts. * Ensure accountability and track progress.	Implementation: Create a dedicated Al Implementation Task Force with representation from key stakeholders. Develop detailed project plans with
2. Secure Adequate and Sustained Funding	* Conduct a comprehensive assessment of financial needs for AI initiatives across all sectors. * Increase government budget allocations for AI, with a multi-year commitment. * Encourage private investment through venture capital, private equity, and PPPs. * Explore international collaborations and innovative financing mechanisms (infrastructure bonds, crowdfunding). * Develop a phased approach to financing with clear timelines and metrics. * Ensure transparent fund utilization.	* Address the current funding disparity and resource constraints. * Ensure sustainable investment in Al infrastructure, research, and talent development.	Implementation: Lost create an Al Investment Fund with clear eligibility criteria and application processes. Lost committee to ensure
3. Bridge the Al Skills Gap	* Reform educational curricula to integrate AI concepts from early education. * Establish specialized AI degrees and interdisciplinary programs. * Launch government-funded AI training programs and foster industry-academia partnerships. * Develop online and offline training programs with a focus on practical skills. * Create AI certification and accreditation programs. * Invest in faculty training and upskilling initiatives for existing industries. * Promote AI education in underserved communities, with a strong emphasis on inclusivity and gender equality. * Address regional disparities in access to AI education.	* Address the demand- supply gap for Al professionals. * Align education with industry needs and ensure a skilled workforce.	Implementation: * Establish a National AI Skills Council to coordinate AI education and training initiatives. * Develop standardized AI curricula and training
4. Build a Solid AI Data Foundation	* Establish a national data grid with standardized formats and APIs. Invest in state-of-the-art data centers, cloud infrastructure, and HPC facilities. > * Develop an edge computing 	* Provide the necessary data infrastructure for AI development and deployment. * Ensure data privacy, security, and ethical use.	Implementation:

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	* Ensure data interoperability, scalability, and public trust.		
5. Reduce the Al Infrastructure Deficit	* Establish and expand HPC facilities. * Invest in data centers and cloud infrastructure. * Develop an edge computing infrastructure. * Improve data connectivity, especially in rural areas (Bharat Net expansion). * Support Al labs and research institutions. * Increase domestic production of specialized Al hardware. * Increase energy infrastructure to support data centers. * Increase public trust in data infrastructure.	* Unlock India's AI potential and drive economic and social progress. * Attract investment and foster innovation.	Implementation:
6. Address the Digital Divide	* Increase internet and mobile penetration, especially in rural areas. * Promote digital literacy through targeted programs. * Provide affordable digital devices and internet services. * Improve digital infrastructure in schools. * Address the gender digital divide.	* Ensure inclusive development and equitable access to Al benefits. * Enable all citizens to participate in the digital economy.	Implementation: * Expand broadband connectivity through BharatNet and other initiatives. * Launch digital literacy campaigns targeting rural populations and women. * Provide subsidies for affordable digital devices and data plans. Monitoring: * Track internet and mobile penetration rates in rural areas. * Monitor digital literacy rates and program participation. * Conduct surveys on access to digital devices and services.
7. Promote AI for Social Good and Inclusive Development	* Prioritize AI solutions for key sectors like healthcare, agriculture, and education. * Leverage Digital Public Infrastructure (DPI) for AI-driven services. * Develop AI applications tailored to local needs and contexts. * Focus on "frugal innovation" for cost-effective AI solutions. * Ensure that AI solutions reach marginalized populations.	* Maximize the social impact of AI and address critical societal challenges. * Position India as a leader in "AI for Development."	Implementation:
8. Foster Global Collaboration and Leadership	* Showcase AI applications that address challenges in developing nations. * Develop and promote ethical guidelines for AI. * Create platforms for knowledge sharing among Global South countries. * Encourage open-source AI tool development. * Collaborate with international organizations. * Advocate for global AI policies that address developing country needs.	* Position India as a global AI leader and a voice for the Global South. * Promote equitable and responsible AI adoption.	Implementation:
9. Regional Al Development	* Create programs to help lagging states increase their AI infrastructure, digital literacy, and AI related education. * Encourage the sharing of best practices between the leading states and the lagging states.		

Table 2----India: Policy Actions for AI for Development

Leadership. India can accelerate its AI for development journey and become a global leader in using AI to address societal challenges and promote inclusive growth.

Policy Area	Specific Policy Actions	Rationale/Impact	Challenges/Considerations	Implementation & Monitoring
AI Infrastructure Development	* Establish a National Data Grid with standardized formats and APIs. * Invest ₹50,000 crore in state-of-the-art data centers and cloud infrastructure, including edge computing. * Expand High-Performance Computing (HPC) facilities with 10 new supercomputing centers in 5 years. * Improve data connectivity, especially in rural areas (Bharat Net expansion to connect 500,000 villages). * Support 20 new AI labs and research institutions in 3 years. * Increase domestic production of specialized AI hardware (GPUs, TPUs) with ₹10,000 crore investment.	* Provides a strong foundation for AI development and deployment. * Enables seamless data sharing and processing. * Supports advanced AI research and real-time applications. * Reduces reliance on hardware imports.	* Significant funding required. * Bureaucratic delays in implementation (reduce approval times by 30%). * Energy demands of data centers (promote renewable energy use). * Regional disparities in infrastructure (target 50% of new infrastructure in lagging regions).	Implementation: * Create a dedicated AI Infrastructure Development Agency. * Establish PPPs for data center and HPC construction. * Implement a national edge computing strategy. Monitoring: * Track data center capacity and utilization. * Measure broadband penetration rates in rural areas. * Monitor HPC facility usage and research output. * Conduct annual energy consumption audits.
Data Governance and Accessibility	* Develop a comprehensive national data governance policy aligned with GDPR. * Enforce strong data protection laws with ₹500 crore annual budget for enforcement. * Establish data security standards (ISO 27001) and promote encryption. * Create a national data ethics framework with mandatory AI ethics impact assessments. * Implement data quality standards and guidelines (ISO 8000). * Develop standardized data-sharing agreements and APIs. * Establish a National Data Governance Authority. * Promote open data initiatives with 100 new open datasets annually.	* Builds trust in data usage and privacy. * Ensures data quality and interoperability. * Facilitates secure and responsible data sharing. * Addresses ethical concerns like algorithmic bias.	* Balancing data accessibility with privacy (implement differential privacy). * Enforcing data security standards (regular audits). * Navigating complex regulatory processes (streamline approvals).	Implementation: * Establish a National Data Ethics Committee. * Develop a data governance training program for government officials. * Create a secure data sharing platform. Monitoring: * Track data breach incidents and resolution times. * Measure public trust in data privacy through surveys. * Monitor the adoption of data ethics guidelines. * Track the number of open datasets published and utilized.

* Reform educational curricula to integrate AI concepts from early education (introduce AI modules in 10,000 schools).
 * Establish 50 new specialized AI degrees and interdisciplinary programs in 5 years.
 * Launch government-funded AI training programs targeting 1 million individuals in 3 * Addresses the AI years.
 * Foster 1000 skills gap.
 * Creates a skilled industry-academia partnerships for practical workforce for AI Development training.
 * Develop innovation.
 * and Education 500 online and offline Aligns education with training programs focused industry needs.
* on practical skills.
 * Ensures inclusivity and Create national AI accessibility. certification and accreditation programs.
 * Invest ₹1000 crore in faculty training.
 * Provide upskilling initiatives for 500,000 professionals in existing industries.
 * Promote Al education in underserved communities with ₹500 crore scholarship fund. * Revitalize the India AI Mission with a pragmatic, action-oriented approach (establish a dedicated implementation unit).
 * Develop clear and actionable policies with timelines and responsible agencies (publish quarterly * Accelerates AI progress reports).
 * progress and Establish robust regulatory implementation.
 * frameworks for AI in key Attracts private sectors (healthcare. investment.
 * Regulatory finance).
 * Promote Ensures responsible AI Framework ethical AI development and adoption.
 * deployment (create AI Provides clear ethics certification). < br> * guidelines and Create policies to attract accountability. private investment and support 1000 AI startups with ₹2000 crore fund.
 * Ensure stakeholder engagement in policy development (conduct quarterly public consultations). * Conduct a * Ensures sustained comprehensive investment in AI

Funding and Investment

Policy and

AI Talent

needs for AI initiatives (publish annual reports).
 * Allocate ₹20,000

assessment of financial

* Funding limitations for widespread training (explore PPPs).
 * Keeping curricula updated with rapid AI advancements (annual curriculum reviews).
* Shortage of qualified AI instructors (train 1000 new instructors annually).
 * Reaching remote areas and marginalized groups (use mobile training units).

Implementation:
* Establish a National AI Skills Development Council.
 * Develop a national AI curriculum framework.
 * Create a network of AI training centers.
 Monitoring:
 * Track the number of AI professionals trained and employed.
 * Measure employer satisfaction with AI skills.

<br</td> of underrepresented groups.
 * Track the number of AI instructors trained.

* Bridging the gap between policy and implementation (simplify approval processes).
 * Coordinating between various government agencies (establish inter-agency task forces).
 * Addressing ethical concerns and public trust (launch public awareness campaigns).

Implementation:
* Establish a National AI **Policy Coordination** Committee.
 * Develop sector-specific AI regulatory frameworks.
 * Create a startup support program.
 dor> Monitoring:
 * Track the implementation of AI policies.
 * Measure the number of AI startups funded and their success.
 * Conduct public surveys on trust in Al regulations.

* Securing adequate and sustained funding (explore international grants).
 * Balancing public and private investment (create coinvestment funds).
 * Ensuring Promotes transparency efficient allocation of resources

Implementation:
* Create an Al Investment Promotion Agency.
 * Establish a venture capital fund for AI startups.
 * Develop a public-private AI

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development.
 *

Diversifies funding

sources.
 *

crore annually in and accountability. government budgets for AI.
 * Attracts private

<br</td> investment through venture capital and PPPs with ₹5000 crore fund.
 * Explore international collaborations and innovative financing mechanisms (green bonds for AI).
 * Develop a clear roadmap for phased financing with timelines and metrics (publish quarterly financial reports).
 * Establish mechanisms for transparent fund utilization (create an AI investment dashboard). * Prioritize AI solutions for key sectors like healthcare (telemedicine), agriculture (precision farming), and education (personalized learning).
 * Leverage **Digital Public** Infrastructure (DPI) for AIdriven services (AIpowered Aadhaar verification).
 * **Develop AI applications** * Maximizes the social tailored to local needs and impact of Al.
 * contexts (regional Addresses critical language AI chatbots). AI for Social societal challenges.
 * Focus on "frugal Good and
* Promotes innovation" for costinclusive growth and effective AI solutions (low-Development equitable access.
 cost AI diagnostic tools). * Positions India as a
 * Address the digital leader for the Global divide through increased South. internet and mobile penetration (subsidize affordable devices).
 * Promote AI literacy and access in underserved communities (establish community AI centers).
 * Champion global AI policies that reflect the needs of developing countries (advocate for data sovereignty).

sector participation.

(establish performance-based funding).

co-investment framework.
 dor

 dor

 dor

 Track AI investment inflows and outflows.
 * Monitor the performance of Al investment funds.
 Conduct financial audits of AI-related expenditures.

* Ensuring AI benefits reach marginalized populations (targeted outreach programs). < br> * Addressing regional disparities (allocate 50% of AI projects to lagging regions).
* Balancing innovation with ethical considerations (conduct social impact assessments).

Implementation:
 * Establish sector-specific AI innovation hubs.
 Develop AI-powered public service delivery platforms.
 * Create a national AI inclusion strategy.
 Monitoring:
 * Track

Challenges/Considerations

Policy Area Specific Policy Actions

AI Infrastructure Development

Inclusive

* Establish a National Data Grid with * Provides a strong foundation * Significant funding required.
 * standardized formats and APIs.

 * for AI development and Bureaucratic delays in implementation. Invest in state-of-the-art data centers and deployment.

* Enables

* Energy demands of data centers. Expand High- processing.
 * Supports infrastructure. computing.
 * Performance Computing (HPC) facilities. advanced AI research and real-

Rationale/Impact

India's AI Transformation: Powering Development for a Billion+

	* Improve data connectivity, especially time applications. * in rural areas (e.g., Bharat Net expansion). Reduces reliance on hardware * Support AI labs and research imports. institutions. * Increase domestic production of specialized AI hardware (GPUs, TPUs).
Data Governance and Accessibility	* Develop a comprehensive national data governance policy. * Enforce strong data protection laws aligned with * Builds trust in data usage and international standards. * Establish privacy. * Ensures data data security standards and promote quality and interoperability. encryption. * Create a national data * Facilitates secure and ethics framework. * Implement data responsible data sharing. * quality standards and guidelines. * Addresses ethical concerns like Develop data-sharing agreements. * algorithmic bias. Establish data governance bodies. * Promote open data initiatives.
AI Talent Development and Education	* Reform educational curricula to integrate AI concepts from early education. * Establish specialized AI degrees and interdisciplinary programs. * Launch government-funded AI training programs. * Addresses the AI skills gap. * Funding limitations for widespread * Foster industry-academia * Creates a skilled training. * Keeping curricula partnerships for practical training. * workforce for AI innovation. updated with rapid AI advancements. Develop online and offline training * Aligns education with * Shortage of qualified AI programs. * Create AI certification and industry needs. * Ensures instructors. * Reaching remote accreditation programs. * Invest in inclusivity and accessibility. areas and marginalized groups. faculty training. * Provide upskilling initiatives for existing industries. * Promote AI education in underserved communities.
Policy and Regulatory Framework	 * Revitalize the India AI Mission with a pragmatic, action-oriented approach. * Develop clear and actionable policies with timelines and responsible agencies. * Lestablish robust regulatory frameworks for AI in key sectors. Al in key sectors. * Promote ethical AI development and deployment. Create policies to attract private investment in policy development. * Accelerates AI progress and implementation. * Attracts private investment. * Ensures responsible AI adoption. * Provides clear uidelines and accountability. * Bridging the gap between policy and implementation. * Coordinating between various government agencies. * Addressing ethical concerns and public trust.
Funding and Investment	* Conduct a comprehensive assessment of financial needs for Al initiatives. * Allocate significant funds in government budgets for Al. * Encourage private investment through venture capital and PPPs. collaborations and innovative financing mechanisms. * Develop a clear

India's AI Transformation: Powering Development for a Billion+

Al for Social Good and Inclusive Development	* Prioritize AI solutions for key sectors like healthcare, agriculture, and education. (DPI) for AI-driven services. * Develop * Maximizes the social impact of AI applications tailored to local needs and AI. * Addresses critical * Ensuring AI benefits reach contexts.
Global Collaboration and Leadership	* Showcase AI applications that address challenges in developing nations. * Develop and promote ethical guidelines for * Positions India as a global AI. * Create platforms for knowledge leader in AI for Development. * Navigating global AI governance. sharing among Global South countries. * Promotes equitable and * Ensuring alignment with international * Encourage open-source AI tool responsible AI adoption. * standards. * Building consensus development. * Collaborate with Strengthens international among diverse stakeholders. international organizations. * partnerships. Advocate for global AI policies that address developing country needs.

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