Bhutan's Digital Future in the Age of Artificial Intelligence

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Abstract

Artificial Intelligence (AI) is rapidly transforming economies, governments, and societies around the world. AI is becoming a foundational technology like electricity and the internet, that influences almost every sector of development.

Countries that adopt AI responsibly are likely to improve productivity, strengthen public services, and create new economic opportunities. AI also offers new ways to overcome resource and capacity constraints for developing countries.

However, AI presents significant challenges, including cybersecurity threats, privacy concerns, misinformation, ethical issues, and widening digital inequalities. These risks require strong governance and responsible implementation.

For Bhutan, AI represents an opportunity to accelerate national development while remaining committed to the philosophy of Gross National Happiness (GNH). Rather than pursuing technology solely for economic growth, Bhutan seeks to use AI to improve the wellbeing of its people, protect the environment, preserve cultural heritage, and strengthen good governance.

This paper discusses Bhutan's vision for AI development and adoption, highlights the country's strategic priorities, and identifies the key foundations needed for successful AI adoption.

It argues that with appropriate investments in infrastructure, data governance, cybersecurity, human capacity, research, and collaboration,

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Bhutan can become a model for responsible and human-centred AI development.

Keywords: Artificial Intelligence, Bhutan, Gross National Happiness, Digital Transformation, AI Governance, Cybersecurity, Digital Economy

Introduction

Artificial Intelligence (AI) has become one of the most influential technologies of the 21st century, transforming how governments operate, how businesses compete, and how people live, learn, communicate, and work.

AI systems are now capable of understanding language, recognising images, analysing large volumes of data, and supporting decision-making in ways that were previously possible only through human intelligence. These capabilities are improving productivity, reducing costs, and enabling innovative services across sectors such as healthcare, education, agriculture, finance, transportation, and public administration.

Electricity transformed industries, homes, healthcare, and communication by providing a reliable source of power. Similarly, AI is becoming the intelligence that powers digital systems and modern economies. However, electricity can be both beneficial and dangerous depending on how it is used. Society did not stop using electricity because of its risks; instead, it established safety standards. AI should be viewed in the same way. It is a powerful tool that can improve lives when used responsibly, but it can also cause harm if deployed without appropriate safeguards.

The rapid growth of AI also introduces significant challenges. AI can be misused to generate misinformation, create convincing deepfakes, conduct sophisticated cyberattacks, invade personal privacy, or reinforce bias in automated decision-making. As governments and businesses become increasingly dependent on AI, cybersecurity and responsible governance become essential.

The challenge is, therefore, not whether countries should adopt AI, but how they can ensure that AI is developed and used in a manner that is ethical, secure, transparent, and beneficial to society.

Bhutan is a small country with a limited domestic market and a relatively small workforce. These constraints make it difficult to compete through traditional industrial development alone. AI provides an opportunity to overcome some of these limitations by improving productivity, strengthening public services, supporting innovation, and enabling better use of national resources.

Recognising this opportunity, the Royal Government of Bhutan has identified digital transformation as a national priority. The Digital Strategy: Intelligent Bhutan, led by the GovTech Agency, provides a long-term vision for building an intelligent government, a vibrant digital economy, and an inclusive digital society.

Within this broader vision, AI has emerged as one of the key technologies for accelerating national development. The National AI Strategy, launched in 2025, further outlines Bhutan's commitment to adopting AI in a manner that aligns technological innovation with the country's social, cultural, environmental, and economic priorities.

Unlike many national AI strategies that primarily focus on economic competitiveness, Bhutan's approach is guided by the principles of Gross National Happiness. The objective is not simply to increase productivity or maximise economic output, but to improve the overall wellbeing of citizens while protecting cultural heritage, promoting environmental sustainability, and ensuring good governance. This citizen-centred approach positions Bhutan to demonstrate how AI can support sustainable and inclusive development.

Bhutan's Digital Transformation Vision

The Digital Strategy is built on three interconnected pillars: Digital Governance, Digital Economy, and Digital Society.

Digital Governance aims to improve the efficiency, transparency, and responsiveness of government services through data driven decision-making and digital public services. Digital Economy focuses on promoting innovation, supporting technology driven industries, and creating new employment opportunities. Digital Society seeks to improve digital literacy,

promote digital inclusion, and ensure that all citizens can participate safely and confidently in the digital world.

AI has the potential to improve decision-making, automate routine tasks, analyse large volumes of data, and deliver personalised services across many sectors. As Bhutan continues its digital transformation journey, AI is expected to become an important driver of innovation and public sector modernisation.

Bhutan has already taken important steps toward AI adoption. In 2023, the GovTech Agency, in collaboration with the United Nations Development Programme (UNDP), conducted Bhutan's first national AI Readiness Assessment. It indicated that Bhutan was at the "Aware" stage (Level 1) of AI maturity, meaning that we have just started to explore the potential of AI and are not yet actively using it to drive business outcomes. The focus is on building awareness and understanding of AI technologies, exploring their potential applications, and identifying areas where AI can add value to the business.

Building on this assessment, Bhutan launched the National AI Strategy in 2025. The strategy provides a long-term roadmap for developing AI capabilities across government, industry, academia, and society. Its vision is not only to introduce AI technologies but also to ensure that these technologies contribute meaningfully to national development, while reflecting Bhutan's unique cultural values and development philosophy.

The country's ambition is to progress from early AI adoption towards systematic integration of AI across public institutions and the wider economy during the Thirteenth Five-Year Plan.

Achieving this transition requires more than deploying new technologies. It requires investment in digital infrastructure, human capital, trusted data ecosystems, effective governance, and strong collaboration between the public, private sectors and academia.

Artificial Intelligence and Gross National Happiness

Gross National Happiness emphasises that development should balance economic progress with environmental conservation, cultural preservation,

good governance, and the wellbeing of citizens. These principles remain equally relevant in the age of Artificial Intelligence.

AI offers significant opportunities to support each of the four pillars of GNH. It can improve healthcare by assisting doctors with disease diagnosis, expanding telemedicine, and enabling preventive healthcare services. In education, AI can personalise learning, support teachers, and improve access to quality education for students regardless of their geographical location.

In agriculture, AI can help farmers improve crop production, monitor livestock health, predict weather patterns, and optimise the use of water and fertilisers. AI can also strengthen disaster preparedness by providing early warning systems for floods, landslides, and forest fires.

Beyond improving public services, AI can also contribute to environmental sustainability. Bhutan is internationally recognised for its commitment to environmental conservation and carbon neutrality. AI can support these efforts through biodiversity monitoring, climate modelling, wildlife conservation, forest surveillance, and more efficient management of natural resources.

Equally important is the preservation of Bhutan's rich cultural heritage. Most existing AI technologies are designed for globally dominant languages and cultures. Without local investment, smaller languages and cultures risk becoming increasingly under-represented in the digital world.

Bhutan, therefore, has an opportunity to develop AI systems that support the Dzongkha language and other local languages through speech recognition, machine translation, optical character recognition, and locally trained language models. Such investments ensure that technological advancement strengthens rather than weakens national identity.

The GNH approach also stresses that AI should always remain human-centred. Technology should support human judgement rather than replace it, particularly in areas involving justice, healthcare, education, and public administration. Human oversight, ethical decision-making, transparency, and accountability must therefore remain central to AI governance.

Bhutan's AI strategy demonstrates that responsible AI adoption is not simply about deploying advanced technologies; it is about ensuring that innovation contributes to happier, healthier, more inclusive, and environmentally sustainable communities.

Strategic Focus Areas for AI Adoption

While Artificial Intelligence has applications across almost every sector of society, Bhutan has identified priority sectors where AI can generate the greatest national impact. Concentrating resources in these areas allows the country to address pressing development challenges while building experience and confidence in AI implementation. The implementation of AI adoption across key identified sectors will be steered by GovTech Agency in collaboration with relevant and associated agencies.

Agriculture and livestock remain the backbone of rural livelihoods in Bhutan. AI-powered precision agriculture can help farmers monitor crop health, predict pest outbreaks, optimise irrigation, and improve livestock management. Combined with drones, satellite imagery, Internet of Things (IoT) sensors, and climate data, AI can increase agricultural productivity while reducing environmental impact.

Tourism is another sector with significant potential. Introduce AI to improve visitor experiences through intelligent travel assistants, multilingual digital services, personalised recommendations, and predictive analytics that help tourism authorities better understand visitor preferences. These technologies can strengthen Bhutan's high-value, low-volume tourism policy while improving service quality.

Green energy represents another important opportunity. Bhutan's economy is closely linked to hydropower. Integrate AI to improve energy generation, forecast electricity demand, optimise power distribution, and enhance the efficiency of future green data centres, contributing to both economic growth and environmental sustainability.

Education can benefit from AI through personalised learning platforms, intelligent tutoring systems, automated assessment, and administrative support. AI can also help teachers prepare learning materials and identify students who require additional support, enabling more inclusive education.

Healthcare is expected to experience some of the greatest benefits from AI adoption. Clinical decision support systems, medical image analysis, disease prediction, telemedicine, and AI-assisted diagnostics can improve healthcare access, particularly in remote communities where medical specialists are limited.

AI also offers opportunities to modernise public service delivery. Intelligent virtual assistants, automated document processing, and integrated digital government platforms can provide citizens with faster, more convenient, and more accessible public services while reducing administrative workload. Natural resource management is another priority area. AI can strengthen environmental monitoring through satellite imagery, wildlife tracking, forest surveillance, biodiversity conservation, and disaster prediction. These capabilities support Bhutan's long-standing commitment to environmental stewardship.

Finally, the strategy places strong emphasis on preserving its language and cultural heritage. AI technologies for Dzongkha language processing, speech recognition, translation, handwriting recognition, and digitisation of historical documents can ensure that Bhutanese culture remains relevant in the digital age while making AI more accessible to all citizens.

Building the AI Ecosystem: Seven Strategic Enablers

The successful adoption of Artificial Intelligence depends not only on advanced technologies but also on the availability of strong supporting systems. The National AI Strategy identifies seven strategic enablers that will provide the foundation for sustainable AI development.

Digital Infrastructure

Digital infrastructure is the backbone of AI development. AI applications require reliable internet connectivity, modern data centres, cloud computing platforms, high-performance computing resources, and secure digital networks. Without these capabilities, AI systems cannot be developed, trained, or deployed efficiently.

The AI Implementation plan recommends upgrading existing government data centres with greater computing capacity to support AI workloads;

expanding broadband connectivity, particularly in rural communities, and ensuring that AI-enabled services are accessible across the country. Investment in energy-efficient computing infrastructure and green data centres also supports Bhutan's commitment to environmentally sustainable development.

Data Ecosystem and Data Governance

Data is often described as the fuel that powers Artificial Intelligence. AI systems learn from data, and their performance depends largely on the quality, availability, and reliability of that data. A strong national data ecosystem is therefore essential for successful AI adoption.

Standardised data management practices, interoperable information systems, open data sharing platform, data annotation and curation platform, and common data standards will be put into place to improve data quality and reduce duplication across institutions.

Establishing a trusted data ecosystem not only improves AI performance but also strengthens public confidence by developing clear policies for data governance, covering responsibilities for data ownership, data sharing, security, privacy, and ethical use.

AI Governance and Regulation

The growing use of AI requires clear governance mechanisms to ensure that the technology is used responsibly. AI systems should operate in ways that are transparent, accountable, fair, and aligned with national values.

A National AI Governance Framework will be developed to provide guidance on ethical AI development and deployment. The framework will promote principles such as fairness, transparency, accountability, explainability, privacy protection, human oversight, and risk management.

Human judgement will remain central whenever AI systems influence decisions affecting people's rights or wellbeing. Appropriate legislation and regulatory standards will be further developed to strengthen public trust while encouraging innovation and responsible investment.

Cybersecurity

Cybersecurity is becoming increasingly important as AI creates new security risks. Cybercriminals are now using AI to automate attacks, generate convincing phishing emails, produce realistic deepfake audio and videos, identify software vulnerabilities, and launch sophisticated cyberattacks at unprecedented speed.

As Bhutan expands the use of AI across government services and critical sectors, cybersecurity becomes an integral component of every AI initiative. A secure digital environment is essential for maintaining public confidence in AI systems and ensuring the continuity of critical services.

A comprehensive cybersecurity strategy that includes secure system design, regular security assessments, continuous monitoring, incident response mechanisms, AI-specific security standards, and protection of sensitive government data, will be developed. Investment in national cyber defence capabilities, cybersecurity awareness programmes, and specialised training will be provided to strengthen national resilience against emerging cyber threats.

AI Skills and Human Capacity Development

Technology alone cannot drive digital transformation. People remain the most important resource for successful AI adoption.

There is a plan to invest in building AI knowledge and skills across all levels of society. AI education can be gradually introduced into school curricula to prepare future generations for an AI-enabled economy. Universities and technical institutes will expand programmes in artificial intelligence, data science, machine learning, robotics, and related fields.

Government officials and private sector employees will be given specialised training to understand AI technologies, manage AI projects, and develop evidence-based policies. At the same time, citizens will be trained in digital literacy to help them use AI safely, responsibly, and effectively in their daily lives. Local expertise will be built to reduce dependence on foreign technologies while creating new employment opportunities for Bhutanese professionals.

Research, Innovation, and Entrepreneurship

Research and innovation are essential for developing AI solutions that address Bhutan's unique challenges. Rather than relying solely on imported technologies, this strategy encourages local research that focuses on national priorities.

Universities, research institutions, start-up companies, and private industries will be supported through research grants, innovation programmes, technology incubators, and pilot projects. Collaborative research opportunities will be offered to generate AI applications for agriculture, healthcare, education, environmental conservation, disaster management, and public administration.

Collaboration and Sustainable Financing

AI development requires cooperation across government, academia, industry, civil society, and international development partners. No single institution possesses all the expertise and resources needed to develop a national AI ecosystem.

Strong partnerships to facilitate knowledge sharing, technology transfer, capacity building, and collaborative research will be explored. Regional and international cooperation will also help Bhutan learn from global best practices while adapting solutions to local needs.

Sustainable funding mechanisms to support digital infrastructure, research, education, innovation, and AI pilot projects will be explored. Public investment can be complemented by development assistance, private sector participation, and international partnerships to ensure the continued growth of Bhutan's AI ecosystem.

Risks and Challenges of AI Adoption.

Responsible AI development depends on recognising its risks and challenges early and implementing appropriate safeguards.

One of the most significant concerns is privacy. AI systems often require access to large volumes of personal and organisational data. Sensitive

information may be collected, shared, or used in ways that compromise individual privacy. Strong data protection policies and secure data management practices are, therefore, essential.

Cybersecurity presents another growing challenge. AI-powered cyberattacks are becoming increasingly sophisticated, making it easier for malicious actors to exploit digital systems. Governments must continuously strengthen cyber defence capabilities to protect critical infrastructure and maintain public trust.

The increasing use of AI may also affect employment. Automation is expected to replace some routine and repetitive tasks, creating uncertainty for parts of the workforce. However, AI will also create new jobs requiring advanced digital skills. Continuous education, reskilling, and lifelong learning will, therefore, become essential for ensuring that workers can adapt to changing labour market demands.

Ethical concerns represent another important challenge. AI systems may unintentionally produce biased or unfair outcomes if they are trained using incomplete or unrepresentative data. Transparent algorithms, human oversight, and regular auditing are necessary to minimise bias and ensure fairness.

The rapid spread of misinformation and deepfake technologies pose additional risks to institutions and public confidence. AI-generated text, images, audio, and videos are becoming increasingly realistic, making it more difficult for citizens to distinguish authentic information from fabricated content. Public awareness, digital literacy, and responsible AI governance will be developed to address these challenges.

Finally, the strategy must ensure that AI does not contribute to cultural erosion. Many existing AI systems are developed using data from larger economies and dominant languages. Without local investment, smaller languages, traditions, and cultural practices may become under-represented in future digital technologies. Dzongkha language technologies and culturally appropriate AI systems will be built to help preserve Bhutan's unique identity while ensuring that AI remains inclusive and accessible.

Monitoring, Evaluation, and Future Directions

The successful implementation of Bhutan's National AI Strategy will depend on continuous monitoring, evaluation, and adaptation. Artificial Intelligence is evolving rapidly, and policies that are effective today may need to be revised as new technologies, opportunities, and risks emerge. A flexible and evidence-based monitoring framework will enable Bhutan to respond to these changes while ensuring that AI continues to support national development objectives.

The GovTech Agency, as the lead institution for digital transformation, will coordinate the implementation and monitoring of the National AI Strategy in close collaboration with government agencies, academic institutions, the private sector, and development partners. Clear institutional responsibilities, measurable performance indicators, and regular reporting mechanisms will be developed to ensure accountability and effective implementation.

Monitoring will go beyond measuring the number of AI projects implemented. It will assess whether AI is delivering meaningful improvements in public service delivery, economic productivity, environmental sustainability, and citizen wellbeing. Key performance indicators will include improvements in government efficiency, increased adoption of digital public services, growth of AI-related industries, digital skills development, research outputs, cybersecurity readiness, and citizen satisfaction with AI enabled services.

Regular reviews will also examine the ethical and social impacts of AI. This includes evaluating fairness, transparency, data privacy, cybersecurity, and public trust in AI systems. Independent assessments and stakeholder consultations can help identify emerging risks and recommend appropriate policy adjustments.

Looking ahead, Bhutan has an opportunity to become an international example of responsible and human-centred AI development. Rather than competing solely through the scale of investment or technological capability, Bhutan can distinguish itself by demonstrating how AI can support sustainable development while respecting cultural values, environmental conservation, and social wellbeing.

Future priorities include strengthening national AI research, expanding digital infrastructure, developing local language AI technologies, supporting innovation and entrepreneurship, and increasing international collaboration. Bhutan will continue investing in AI education and workforce development to prepare future generations for an increasingly digital economy.

Emerging technologies such as generative AI, agentic AI, autonomous systems, robotics, quantum computing, and advanced data analytics are expected to reshape industries over the coming decades. Bhutan, therefore, maintains a forward looking AI strategy that remains flexible, encourages innovation, and continuously adapts to technological change.

Conclusion

Artificial Intelligence is rapidly becoming one of the defining technologies of the 21st century. The question is no longer whether countries should adopt AI, but how they can do so responsibly and effectively.

For Bhutan, AI presents a significant opportunity to overcome structural challenges associated with a small population, limited natural resources, and a geographically dispersed society. When applied responsibly, AI can improve healthcare, strengthen education, modernise agriculture, enhance public service delivery, protect the environment, preserve cultural heritage, and create new opportunities for economic growth and innovation.

However, technological advancement alone does not guarantee positive outcomes. AI also introduces challenges related to cybersecurity, privacy, misinformation, employment, ethics, and digital inequality. Addressing these risks requires strong governance, effective regulation, secure digital infrastructure, trusted data ecosystems, and continuous investment in human capital.

The journey towards an AI for GNH vision will require sustained commitment, institutional coordination, financial investment, and public participation. With careful planning and responsible implementation, Bhutan has the opportunity not only to harness the benefits of Artificial Intelligence for national development but also to contribute a unique perspective to the global conversation on ethical, inclusive, and sustainable AI.

AI Usage Declaration: The author used Google's notebooklm (https://notebooklm.google.com/) during the preparation of this manuscript to assist with language editing, improving clarity, and restructuring sentences. The author reviewed, verified, and revised all AI-generated content and validated against the references provided.

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