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The Role of Artificial Intelligence and Big Data in Modern Development Administration

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Abstract

The integration of Artificial Intelligence (AI) and Big Data analytics in modern development administration holds transformative potential for accelerating inclusive growth and fostering prosperity in Bangladesh. *This study aims to explore the role of AI and Big Data in enhancing decision-making, service delivery and overall governance.* Specifically, it examines their application in understanding cultural sensitivity, organizational behavior and policy formulation. Given Bangladesh's diverse socio-cultural landscape, incorporating cultural awareness into AI systems is essential to ensure equitable outcomes.

The qualitative approach solely used for carried out of the present study such as critically reviewed the existing literature and observation including case studies of AI-driven initiatives and analysis of Big Data applications in public sector of the country. By contextualizing AI adoption within Bangladesh's cultural framework, the research highlights the need for cross-cultural competence and adaptive decision-making capabilities within AI systems. Hence, the study was carried out based on Desktop methodology.

Key findings indicate that AI, combined with Big Data, can revolutionize public administration by enhancing labor productivity, streamlining governance processes and promoting innovation. Bangladesh's commitment to technological advancement, as evidenced by initiatives such as "AI for Innovative Bangladesh," has already yielded substantial growth in ICT export earnings and digital transformation. However, advanced technologies like blockchain, IoT and quantum computing are yet to enable for ensuring efficient service delivery, while AI-driven insights improve policy decisions.

This research underscores the importance of integrating AI into development administration to achieve sustainable economic growth, with projections suggesting a potential doubling of GDP growth rates by 2035. By leveraging AI and Big Data, Bangladesh can foster an environment of innovation, inclusivity and prosperity, aligning with the theme of the conference: "Accelerating Inclusive Development Through Effective Development Administration for a Prosperous Bangladesh.

Keywords: Artificial Intelligence, Big Data, Development Administration, Cultural Sensitivity, Fourth Industrial Revolution, Public Sector, Evidence-based Decision.

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1. Introduction

Artificial Intelligence (AI) refers to a collection of technologies that enable machines to replicate human cognitive functions, such as learning, reasoning, problem-solving and decision-making. AI encompasses various subfields, including machine learning, deep learning, natural language processing and computer vision, which allow systems to process vast amounts of data, identify patterns and make autonomous decisions. By continuously evolving, AI enhances automation and efficiency across multiple sectors, including governance and public administration (Ahmed, 2022, Nourani, et.al.2020; Babu, 2021).

Big Data, on the other hand, represents large, complex datasets that are difficult to manage using traditional data processing techniques. These datasets originate from multiple sources, including digital transactions, social media interactions, sensor data and online platforms. Characterized by high velocity, volume and variety, Big Data requires specialized analytical tools and technologies to extract meaningful insights. When effectively utilized, Big Data analytics supports informed decision-making, enhances operational efficiency and drives strategic improvements in governance (Agustian et al.,2024).

AI and Big Data play a transformative role in strengthening governance, optimizing service delivery and improving decision-making in Bangladesh. These technologies have significantly contributed to modern public administration by enabling evidence-based policy formulation, efficient resource allocation and enhanced citizen engagement. AI-powered data analytics provides policymakers with deep insights derived from real-time and historical data. By identifying trends and forecasting outcomes, decision-makers can implement policies that address emerging challenges effectively. On the other hand, Big Data analytics assists government agencies in assessing public needs, detecting inefficiencies and ensuring data-driven governance. Machine learning algorithms can predict socio-economic trends, enabling the government to develop proactive strategies for economic growth and development. AI and Big Data enable predictive governance by analyzing patterns of social behavior, economic fluctuations and demographic changes. This aids in crisis management, disaster preparedness and resource distribution (Ding et al.,2023).

As Bangladesh continues to embrace digital transformation, the integration of AI and Big Data in governance will lead to a more responsive, transparent and efficient administrative system. By leveraging these technologies, policymakers can enhance public sector performance, ensure data-driven decision-making and build a more inclusive and citizen-centric governance framework. The adoption of AI and Big Data analytics will not only modernize governance structures but also contribute to the nation's socio-economic development and global competitiveness.

Bangladesh is adopting AI to further advance its digital transformation, a journey that began over a decade ago. AI is now poised to act as a catalyst in this ongoing process. For operating and functioning 5G technology, advanced technologies such as IoT, using robot, decision making by analyzing big data and AI and blockchain becoming increasingly prevalent in the country. Technology is essential and the future depends on it. Bangladesh is dedicated to this technological path, encapsulated in the slogan "AI for Innovative Bangladesh". Because of emphasizing on advanced technology and ICT, the country's ICT export earnings have grown significantly, from just $26 million in 2008 to nearly $1 billion today since the country has invested substantially in different relevant sectors which includes Hi-Teck, Data center and IT training and Incubation centers etc. Hence, AI has significant impact on

increasing the GDP of the country. It is evident that the AI has ability to increase the annual economic rates twice within 2035 through changing the environment and nature of the work (GoB, 2020a). As a result, labor productivity could rise up to 40% through developing their capacities and skills which provide opportunity to human being to utilize their time more efficiently. Moreover, the PWC predicts that with in 2030, the world will observe around 45% gains in terms of total economic growth which will motivating innovation in case of customer demand and their products (Azam, 2020).

2. Literature Review

Artificial Intelligence (AI) and Big Data have emerged as transformative technologies in modern development administration worldwide. AI enables machines to simulate human intelligence through learning and decision-making, while Big Data refers to vast and complex datasets that require advanced analytical tools for processing. Governments increasingly leverage these technologies to enhance policy-making, improve service delivery and ensure data-driven decision-making. In Bangladesh, Big Data is primarily utilized in financial management through the IBS++ system, demonstrating its role in governance and economic administration. This literature review explores the significance of AI and Big Data in development administration, their applications in Bangladesh and the challenges and opportunities they present (Chen et al., 2013, LI, 2013 & Mohamed, 2020)

2.1 Fourth Industrial Revolution (4IR) and AI

Now a day 4IR becomes the buzz word which driven by advancements of Internet of Things (IoT), security system in terms of cyber and interconnected networks, has profoundly transformed how we live and work. By integrating these new technologies into workplaces, machines now communicate with each other and provide a holistic and inclusive picture of the entire production process, enabling faster and more autonomous decision-making. This revolution has already made significant impacts on society, the economy and industries worldwide. It is known as the continuous of Digital Revolution or 3rd Industrial Revolution. (Absar et al., 2014). Unlike its predecessors, the 4IR is unfolding globally, affecting every industry at an unprecedented speed.

However, the 1st Industrial Revolution started during 18th century but continued up to 19th century, driven by steam engines and other technological innovations, which marked a shift from agrarian societies to industrialization while advent electricity, leading to mass production and further technological advancements was the main components of 2nd Industrial Revolution. On the other hand, Artificial intelligence is the main elements for the 4IR which is continuously reshaping the world. Technologies like genome editing, 3D printing and AI-powered robotics are revolutionizing every aspect of human life, from art and communication to medicine and research.

A key aspect of this revolution is that it is shaped by human choices. As these technologies evolve at an accelerating pace, they are increasingly influencing personal and community life including social life as well as political arena. Hence, it is very much important how we are interacting with the technologies as well as how we are perceiving about the technology in the age of 4IR. Because if we are not committed to upgrade our relation with the machine through internalizing ourselves and using our potentiality then we cannot make a positive impact on the world. However, while we benefit from 4IR, we must also properly show respect and maintain our responsibility for maximizing the benefit (Babu, 2021).

2.2 Big Data in Development Administration

Big Data encompasses large datasets generated from various sources, including government transactions, social media and sensor networks. According to Jain et al. (2016), Big Data exhibits high volume, velocity and variety, making traditional data-processing techniques inadequate. Governments worldwide use Big Data to analyze trends, predict policy impacts and enhance administrative efficiency (Udeh et al., 2024). The integration of Big Data into public administration fosters data-driven governance, improving transparency and accountability.

2.3 Artificial Intelligence in Development Administration

AI refers to technologies that mimic human cognitive functions, including machine learning, natural language processing and predictive analytics (Collins et al., 2021). AI enhances decision-making by identifying patterns in data, automating administrative tasks and personalizing service delivery. Yaiprasert and Hidayanto (2024) highlight AI's role in optimizing government operations by reducing costs and improving efficiency.

2.4 Application of Big Data and AI in Bangladesh

In Bangladesh, the government employs Big Data primarily in financial management through the Integrated Budget & Accounting System (iBAS++). iBAS++ is an integrated financial data platform that consolidates real-time financial information to support economic planning and budgetary control. This system enables the government to monitor expenditures, forecast financial trends and improve fiscal transparency. The implementation of IBS++ demonstrates the potential of Big Data in enhancing financial governance by providing data-driven insights for policy formulation (Finance Division, 2025).

2.5 AI in Public Sector Decision-Making

AI applications in Bangladesh's public administration are emerging, particularly in data analytics and decision support systems. AI-driven analytics assist in identifying inefficiencies, fraud detection and risk assessment in various sectors. For example, AI tools analyze large volumes of economic data to predict inflation trends, assisting policymakers in making informed economic decisions. Additionally, AI-powered chatbots and virtual assistants are being explored to improve citizen services by offering automated responses to public inquiries (Mazumder & Hossain, 2024).

2.6 AI and Big Data in Social and Economic Development

Beyond financial management, AI and Big Data are instrumental in addressing social and economic challenges in Bangladesh. The National Board of Revenue (NBR) utilizes data analytics to improve tax collection efficiency, while AI-driven predictive models help the health sector track disease outbreaks. Similarly, AI-powered agricultural monitoring systems analyze satellite imagery to optimize crop yield predictions, benefiting farmers and policymakers alike (Rahman, & Parvin, 2024, & Mohammad, & Derbali, 2024).

2.7 Challenges in Implementing AI and Big Data in Bangladesh

Despite the potential benefits, Bangladesh faces several challenges in the adoption of AI and Big Data in development administration:

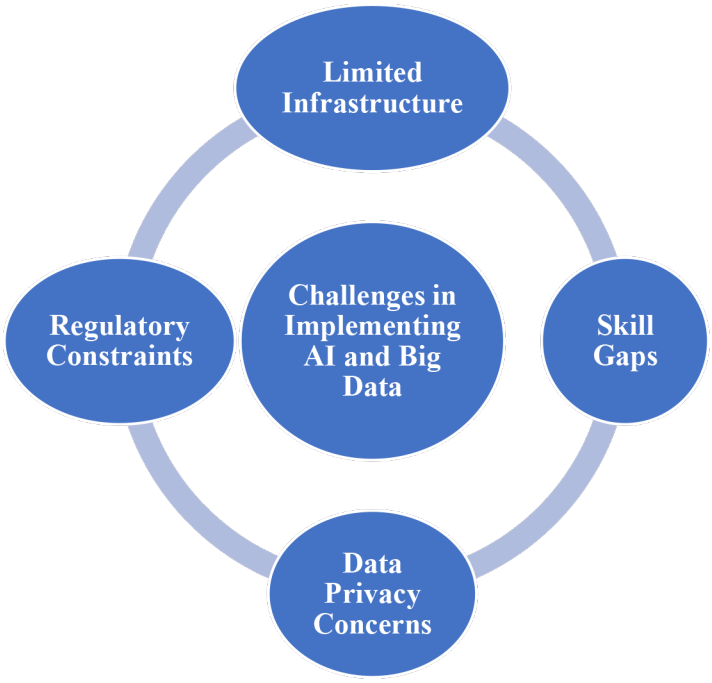

Figure-2.1: Main Challenges in Implementing AI and Big Data

Among the above-mentioned components, Data privacy and Skill Gaps are very crucial for Bangladesh (Mazumder, & Hossain, 2024).

2.8 Opportunities for Future Development

Since it is a new area for Bangladesh, however, present study has been explored different scholarly works in the field of Big Data and AI, particularly in the context of Bangladesh. Consequence of which most of the scholars emphasized the following arena in the aspect of AI and Big Data for future public administration of the country:

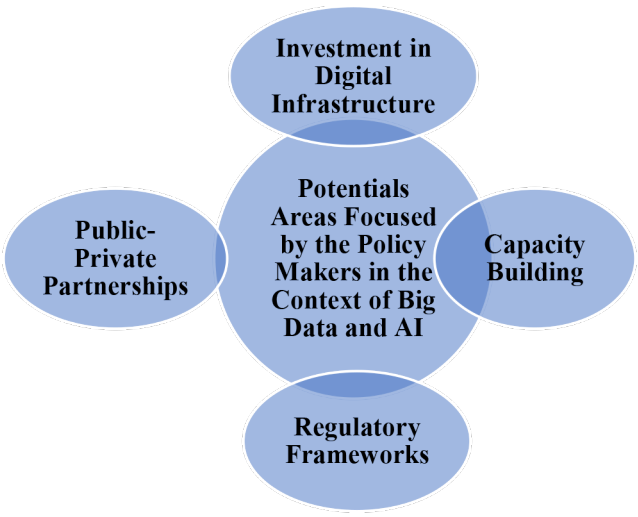

Figure-2.2: Potential areas of the country for further investing in the context of AI and Big Data

AI and Big Data have significant potential to transform development administration in Bangladesh. While the country has made strides in utilizing Big Data for financial management through IBS++, broader adoption of AI-driven solutions remains in its early stages. Addressing infrastructure limitations, skill gaps and regulatory challenges will be critical in harnessing these technologies for improved governance and socio-economic development. With strategic investments and policy support, Bangladesh can fully leverage AI and Big Data to drive innovation in public administration and ensure efficient service delivery (Tamim et al., 2024, Haque et al.,2021& Alam et al., 2023)

2.9 AI Adoption in Bangladesh

Though the AI seems very new concept in the present world, indeed it is very is very old concept. The "automatons," was a machine which was invented long before by the ancient inventors and it was able to operate without intervention of human beings. In the 1st phase of 20th century (1900-1950), media focused heavily on the idea of human being with artificial brain which influenced and instigated scientist to innovate the artificial brain for human being so that they can work as like super human being. Some even developed simple versions of "robots" or artificial people, marking the first known use of the term (Karel, 1923). In 1949, Edmund Callis Berkley, a computer scientist, published Giant Brains, or Machines that Think, for comparing innovated moder computer with real brain of human (Berkeley, 1952). This work encouraged a scientist named 1 Alan Turing to further develop the work of Edmund Callis Berkley. Therefore, in 1950 he presented Turing Test to assess computer intelligence through the publication of Computer Machinery and Intelligence (Turing, 2009). The term "artificial intelligence" subsequently gained popularity, especially after computer scientist Arthur Samuel developed a checkers program in 1952 that could learn independently. In 1955, John McCarthy formally defined "artificial intelligence" at a Dartmouth workshop, a term that has since become widely used (PwC and ASSOCHAM, 2017). However, the world has observed a breakthrough in the area of AI research and developing since the government around the world funded heavily on this sector during 1980.

This era, known as the "AI boom," since the machine, particularly advance computer machine, able to learn from their mistake and take reasonable decision by using expert techniques that is deep learning autonomously. This period also marked as broader adoption of AI in various industries, leading to

significant changes in the workforce, the rise of automation and advancements in robotics and autonomous vehicles (Tableau, 2024).

Recently, we have witnessed a significant progress of automation development because of advanced level using and advancement of AI technology across the globe. Thus, notable progress in case of production and efficiency are visible since we are using substantially AI technologies in our industries and other purposes. By automating repetitive tasks that are often undesirable for humans, AI has become a widely adopted tool in fields such as healthcare and transportation.

As a result, countries like the UAE have appointed a state minister for AI, while others, including neighboring India, have made substantial investments in AI research, establishing AI task forces and institutes. China aims to become a leading hub for AI technology and Japan, in 2016, established the Strategic Council for AI Technologies to advance AI research, education, skills and business (Wahid-Uz-Zaman, 2019).

Now, scientists, around the world, are trying to innovate such type of machine which will be able to work like a human brain. Therefore, this industry is one of the most growing sectors in case of developing complex algorithm as like brain of human. Consequence of which huge investment in this sector both in terms of policy and financing. Many attempts were taken to develop AI that can learn, comprehend and operate in ways similar to human cognition. It is estimated that between 2022 and 2030, the global AI market will grow from $38.1%. to $93.5 billion (CAGR) as ongoing research on AI is enhancing operational efficiency of critical business areas.

In Bangladesh, AI research is still in its early stages, with only a limited number of applications across various areas or sectors. However, impassive is being given both by the government and private sectors for investing more on AI research along with initiatives are being developed to increase its use all over the country. At present, agriculture, health sector and banking sector are the main users of AI in Bangladesh. In the medical field, AI is used for personalized treatment plans and improved disease diagnostics. In the financial sector, AI helps reduce fraud and optimize investment portfolios. In agriculture, AI contributes to better crop yields and precision farming techniques.

Though we have limitation in case of resource, several initiatives have been taken especially by the private sector to maximize the benefit of AI. Even, there are several policy interventions by the government for ensuring easy access to this AI technology so that all sectors of people can utilize this new technology for their betterment as well as country's development. High-Teck Parks, IT Parks and duty-free import of IT materials are some examples to support the growth of the technology sector (Iqbal, 2023) by the government.

Since, AI has the potentiality to protect lives and change the lives in a better way; its success story needs to be used repeatedly globally.

For instance, during the Covid-19 crisis, Bangladesh had only one RT-PCR laboratory for testing the virus of potential patience at the onset of the COVID-19 pandemic, Bangladesh had only one RT-PCR laboratory capable of detecting the virus which indicates the less capability of the country in case of detecting the virous. In a country with a population of around 170 million, this posed a significant challenge. However, by repurposing the national toll-free helpline and feeding the collected data into an AI algorithm, the country effectively tracked and managed the disease for the first four months,

showcasing AI's potential in developing nations like Bangladesh. The contribution of AI, in healthcare system, other than Covid-19 crisis, has tremendous positive impact country like Bangladesh where five doctors have served 10,00 people. Hence, AI has been used to reduce the administrative burden on doctors.

The pregnancy monitoring app is another notable example where AI is using to maintain health and safety of the expected mother and their new born child. Through this app, all related information has been kept and maintained for the purpose of using and reusing when and where necessary in one platform. Besides, AI is also maintaining to store and use the personal data for education purpose by the teachers and management. In this case, Noipunno initiative can be mentioned. This app is able to record more than 2 million digital data related to students. Therefore, it reduces the burden of teacher in case preparing result, checking attendance and monitoring the students in real time base. Hence, more than 5 million students and 50000 teachers were involved under Noipunno (skillful talent) activities for supporting students and teacher as per their requirement which ultimately reduce the workload of educators.

Digital literacy is another important promising area where AI plays a crucial role for reducing digital divide. Digital literacy means empowering. Because, digitally sound people are running the business and playing importance role in all areas including politics and services to the citizens. AI tools that allow people to interact with computers through speech eliminate the need for traditional word-processing skills. For instance, rural people of the country are using AI for submitting their land registration forms or getting related documents through their smart phone. They do not need to fill in any form but speaking into phone. This development offers a significant opportunity for previously marginalized voices to be heard and included in the digital landscape, although it is still in its early stages (Chowdhury, 2024).

Thus, AI has brought about transformative changes in many sectors in Bangladesh. It offers numerous benefits and has the potential to significantly improve human life. However, AI's potential is highest in sectors such as high-tech/telecom, automotive/assembly and financial services, while media/ entertainment and consumer packaged goods show medium potential. Conversely, sectors like education, healthcare and tourism have seen slower adoption in the country (GoB, 2020a).

3. Methodology

This study employed a qualitative research approach, utilizing a literature review method to critically examine the role of Artificial Intelligence and Big Data in modern development administration. Given the rapid advancements in information technology over the past decade, this research focused on evaluating existing academic and policy-oriented literature to provide insights into how these technologies are shaping governance and administrative efficiency, particularly in Bangladesh. Therefore, in short, the present study was based on Desktop Research.

3.1 Research Design

The study has designed as a critical literature review, systematically analyzing existing scholarly works, policy documents and expert opinions to assess the application and implications of AI and Big Data in the public sector. The qualitative nature of this research allowed for an in-depth exploration of themes, trends and debates surrounding the integration of these technologies in development administration.

3.2 Data Collection

Data for this research were collected through a systematic literature search using academic databases such as Google Scholar, ResearchGate and institutional repositories. The selection criteria focused on peer-reviewed journal articles, government reports and policy documents etc. The review encompassed studies on AI and Big Data applications in governance, financial management and policy innovation, with a particular emphasis on their relevance to the Bangladeshi context. Special attention was given to literature discussing the implementation of Big Data in financial management through platforms like IBS++ and the broader implications for public sector decision-making.

3.3 Data Analysis

The collected literature was analyzed thematically, identifying key patterns in the adoption, benefits and challenges of AI and Big Data in public administration. The analysis involved synthesizing information from different sources to evaluate the impact of these technologies on decision-making, resource allocation and service delivery in government institutions. Additionally, the study incorporated insights from the researchers' professional experience in the public sector, allowing for an informed discussion on the practical applications and policy considerations of these technologies in Bangladesh.

4. Result and Discussion

The integration of AI and Big Data in modern development administration is a transformative phenomenon worldwide. However, Bangladesh is still in the early stages of adopting these technologies, particularly in the public sector. The study findings reveal that while the Government of Bangladesh (GoB) has taken initial steps, such as the implementation of the Integrated Budget and Accounting System (iBAS++), the overall utilization of AI and Big Data in public administration remains limited. This chapter presents the key findings of the study, discusses the implications for modern development administration and explores potential pathways for future progress.

4.1 Limited Adoption in Public Administration

The study indicates that AI and Big Data applications in Bangladesh's public sector are still in their infancy. The primary use case identified is iBAS++, an Integrated Financial Management

Information System (IFMIS) aimed at streamlining financial management and enhancing service delivery. However, other sectors, including human resource management, policy planning and service optimization, remain largely untapped.

4.2 Government Initiatives and Vision

The government has expressed a commitment to expanding AI and Big Data applications across various public services. The government initiative aims to modernize governance and public service delivery, yet practical implementations of AI-driven solutions remain sparse. Despite the government will, infrastructural and technical constraints hinder the full-scale adoption of AI and Big Data. The following AI initiatives were carried out by the government of Bangladesh:

Figure-4.1: Few AI Initiatives by the Government of Bangladesh (Modified and adjusted from Information and Communication Technology

4.3 AI-Driven Workforce Planning

In global contexts, AI and Big Data have significantly improved human resource (HR) management by enabling predictive analytics for workforce planning. Companies like Walmart and Unilever use AI to optimize staff allocation and recruitment processes. If implemented in Bangladesh's public administration, similar approaches could improve efficiency in government recruitment, workforce allocation and training programs.

4.4 Big Data for Strategic HR Decision-Making

Big Data analytics can help governments identify staffing needs based on service demand patterns. For instance, the Ministry of Public Administration could leverage data from citizen service requests, workforce performance metrics and demographic trends to allocate human resources effectively. This could enhance service delivery and reduce inefficiencies in government offices.

4.5 Enhancing Evidence-Based Policymaking

AI and Big Data provide valuable insights that can improve public policy formulation. In many developed nations, predictive analytics is used to assess social trends, economic shifts and citizen needs. Bangladesh could benefit from similar applications by using AI to analyze public sentiment, economic indicators and social service utilization patterns.

4.6 Case Study: AI in Disaster Management

Bangladesh, being prone to natural disasters, could leverage AI and Big Data for disaster response and management. AI-powered forecasting models could analyze historical data on floods, cyclones and landslides to predict future occurrences and prepare timely interventions. The Bangladesh Meteorological Department and disaster management agencies could use these tools to improve preparedness and response strategies.

4.7 Data Infrastructure and Accessibility

One of the significant barriers to AI and Big Data implementation is the lack of a centralized data infrastructure. Unlike developed countries, Bangladesh does not have an integrated data-sharing mechanism across government agencies, leading to fragmented and inconsistent datasets.

4.8 Skill Gaps and Human Capital Constraints

Another critical challenge is the shortage of skilled professionals in AI and data analytics. The study highlights a lack of technical expertise among government officials, which slows down the adoption and effective utilization of these technologies. Investment in specialized training programs and collaboration with universities and research institutions are necessary to bridge this gap.

4.9 Privacy and Ethical Concerns

Data security and ethical considerations pose significant concerns for AI and Big Data adoption. Government agencies must ensure robust cybersecurity measures and clear data governance policies to protect citizens' personal information from misuse.

4.10 Developing a National AI and Big Data Strategy

To accelerate the adoption of AI and Big Data, the government should formulate a comprehensive national strategy. This should include policy guidelines, investment plans and regulatory frameworks to facilitate a smooth transition to AI-driven governance.

4.11 Investing in Digital Infrastructure

The development of a robust digital infrastructure is crucial for AI and Big Data implementation. The government should invest in high-speed internet, cloud computing facilities and data centers to support large-scale data analytics.

4.12 Capacity Building and Training

Human resource development should be prioritized to enhance the skills of government officials and IT professionals. Establishing AI and data science training programs in collaboration with universities and international partners would be beneficial.

4.13 Piloting AI-Based Public Services

The government could initiate pilot projects in sectors like healthcare, education and law enforcement to test AI applications. For instance, AI-driven chatbots could be deployed in public service helplines to enhance citizen engagement and service efficiency.

5. Conclusion

While Bangladesh has taken initial steps toward adopting AI and Big Data in public administration, the journey is still at an early stage. The findings highlight the vast potential of these technologies in transforming governance, workforce management and policy planning. However, challenges such as infrastructure limitations, skill shortages and ethical concerns must be addressed for effective implementation. By adopting a strategic approach and investing in digital transformation, Bangladesh can harness the power of AI and Big Data to build a more efficient, transparent and citizen-centric public administration system.

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