Pakistan

Building a robust, resilient digital ecosystem

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Key takeaways

- Pakistan is actively developing its use of AI in multiple sectors and has instituted many initiatives to facilitate progress.
- Programmes are prioritizing development of the necessary policies, research, skills and infrastructure to disseminate AI throughout the country.
- Challenges to the widespread adoption of AI technologies remain, particularly in the areas of data quality and availability, and responsible and ethical use.

Pakistan, like many low- and middle-income countries, faces four significant development challenges – meeting basic human needs, achieving rapid economic growth, enhancing quality of life and improving governance (Ministry of Science and Technology, 2022). Advances in emerging digital technologies such as artificial intelligence (AI) and machine learning (ML) can help address these challenges. Pakistan began adopting AI in various disciplines in 2010, with academia and research leading the way. The startup sector followed in 2015 and AI began to be promoted by the government in 2016. However, Pakistan's overall technological progress remains slow when compared with similar countries (Nazeer and Gil, 2023) and government commitment is needed to develop digital governance, digital infrastructure, innovation, integration and human capital, all of which are crucial for harnessing the potential of AI (Government of Pakistan, 2023). Without this, sectors heavily reliant on manual and traditional roles may miss out on the benefits of AI, leading to further economic divergence.

Science, technology and innovation and AI adoption

The Pakistan Council of Science and Technology (PCST) advises the government on the country's National Research Agenda (NRA) and policies for building a robust, resilient and sustainable science and technology system. Fifteen priority areas, including information and communication, and robotics, were identified in the 2017 NRA (PCST, 2017), in line with

Pakistan Vision 2025, under which Pakistan aims to be among the top 25 global economies by 2025 (Ministry of Planning, Development & Reform, 2014). The 2017 NRA highlighted that Pakistan's efforts towards adopting Industry 4.0 at the national level were unsatisfactory and that the country needed to expedite its endeavours in industrial automation and increase Internet penetration through the development of information and communication technology (ICT) infrastructure. However, it acknowledged that research institutes, academia and the private sector were helping Pakistan embrace the fourth industrial revolution through teaching and research activities in robotics, AI, ML and e-governance.

Also in 2017, the PCST conducted Technology Foresight Exercises to identify emerging trends in robotics, AI and ML, and their potential impact on society (PCST Newsletter, 2017). It made valuable recommendations for the diffusion and adoption of AI, including increasing research efforts in e-health, e-commerce, e-education and e-governance, and establishing robotics research and design laboratories, incubation centres, public ICT and technology parks, and centres of excellence in robotics and AI research at universities across Pakistan. It also recommended a specific budget allocation to support training and specialization in robotics and AI.

Pakistan's national Science, Technology and Innovation (STI) Policy places AI at the top of the NRA alongside other emerging and future technologies (Ministry of Science and Technology, 2022). It paints a comprehensive picture of the actors, activities and institutions involved in the national innovation system and presents 61 policies for strengthening the innovation ecosystem and improving Pakistan's global competitiveness through target-oriented research funding and skill development programmes.

The STI Policy acknowledges that digital infrastructure development, regulations and policies must be integrated into national policy. Such strategic interventions can shape the future of technology and the economy, focusing on developing digital infrastructure and skills, and incentivizing research and development (R&D) across all economic sectors (Government of Pakistan, 2023). Consequently, efforts have been made to rapidly advance AI and digital technologies in line with the Pakistan Vision 2025, Digital Pakistan Policy 2018 and STI Policy 2022. To further strengthen the digital innovation ecosystem and enhance the digital landscape, the Ministry of Information Technology & Telecommunication (MoITT) and the Ministry of Planning, Development and Special Initiatives are drafting an updated Digital Pakistan Policy (MoITT, 2023). Alongside this, multiple policies for facilitating the adoption of AI and digital technologies have been instrumental in structuring a cohesive national AI framework. Further, to ensure digitization of the economy and promote e-governance, the Digital Nation Pakistan Act 2024 was recently approved (Dawn, 2024).

The Digital Pakistan Policy 2018 emphasizes the establishment of innovation centres for modern technologies to promote homegrown talent in the Internet of Things (IoT), financial technology, AI and robotics. It seeks to encourage a highly integrated startup ecosystem through collaboration with public and private sector entrepreneurship support organizations, financial institutions, universities, government departments, industry consultants and associations (MoITT, 2018). Key features of the forthcoming Digital Pakistan Policy 2024 are expected to include strategies for the widespread adoption of AI and ML, the

implementation of blockchain for secure and transparent transactions, and the deployment of 5G networks to boost connectivity and support the IoT. The policy will also focus on digital skills development, cybersecurity measures and the promotion of digital entrepreneurship (ProPakistani, 2024).

In addition, Pakistan's draft AI Policy 2023 provides a holistic structure for addressing societal challenges around AI adoption by establishing the necessary ecosystem with specialized initiatives and organizational responsibilities. It also proposes a national AI fund to support the interventions (MoITT, 2023). A National Task Force (NTF) of experts in AI from academia, business and the government is now reviewing the AI Policy, which aims to harness the power of AI for transformative change, leading to economic development and growth while ensuring societal benefits. The NTF's key objective is to develop a ten-year roadmap for accelerated adoption of AI in the business, development, governance, education and healthcare sectors (Butt, 2023).

Infrastructure, stakeholders and research community

A number of initiatives have been introduced by public service organizations in Pakistan to enhance digitalization capabilities. The Special Technology Zones Authority was created in 2020 to develop the IT sector and establish Special Technology Zones in the country (Pirzada, 2024; Nazeer and Gil, 2023). Under the Pakistan Vision 2025, the government has developed 17 software technology parks; twelve are fully operational (with six predominantly focusing on AI, IT and IT-enabled services), and the remaining five will become operational soon (STZA, 2024).

To promote R&D and human resource development in AI and related technologies, Pakistan's Higher Education Commission (HEC) has established six national centres under the Public Sector Development Program (PSDP) 2018-19. These centres aim primarily to build national capacity to conduct R&D in modern technologies, solve local problems, provide high-value shared services to academia and industrial partners, and develop an advanced workforce through training and applied work. They will also provide technology and consultation to help businesses embrace Industry 4.0 (HEC Pakistan, 2024).

Additionally, two dedicated AI research centres have been established under the Pakistan Vision 2025. The National Centre of Artificial Intelligence (NCAI) offers services to local industry, the HEC and other government departments in the fields of AI, ML, deep learning, image recognition and automatic speech recognition, equipping them with the latest technology. Headquartered at the National University of Sciences and Technology (NUST) in Islamabad, the NCAI operates nine research laboratories in six major universities across Pakistan.
The second dedicated centre is the Sino-Pak Center for Artificial Intelligence, which offers solutions in intelligent biomedical applications, smart city urban planning, smart agriculture, applied neural interfaces, computer vision, robotics, deep learning, system designs, natural disaster management and the IoT. These efforts have enhanced research output by Pakistani scholars, who published around 18,365 research contributions between 2000 and 2024, including almost 11,000 papers in the field of computer science, more than 2,200 considering telecommunications and almost 750 on robotics (Web of Science database).

Strategic actions, activities and capacity-building initiatives

The Digital Pakistan Policy 2018 emphasizes active collaboration between the HEC, IT industry and other relevant institutions to modernize the education curriculum to meet industry's emerging technologies and requirements. The policy also highlights the importance of capacity-building measures such as awareness campaigns, trainings, seminars and workshops to digitize key socio-economic sectors (MoITT, 2018).

Curriculum development

The curriculum for postgraduate programmes in AI was first developed by the NCAI and approved by the HEC in 2019 (NCAI, 2019). Since then, the HEC has approved 38 universities in Pakistan to offer AI programmes (Nazeer and Gul, 2023).

PhD scholarships

Understanding that industry in Pakistan lacks highly qualified professionals in emerging technologies, the HEC supports advanced skills development through international scholarships to equip participants with up-to-date, hands-on knowledge of AI and related technologies. As well as reducing the workforce skills gap, these trained scholars will also help raise the educational standards and rankings of universities in Pakistan (HEC Pakistan, 2024a).

Research grants

The HEC is also pivotal in promoting the research culture in higher education institutes (HEIs) through its grant programmes.

- **The Innovative & Collaborative Research Grant** supports partnerships between Pakistani and UK universities, research bodies and centres of excellence that focus on energy, climate change, AI, robotics, big data and cloud computing. The three-year grant is worth up to Rs. 50 million.
- **The Technology Development Fund** finances proposals from interdisciplinary applied research for prototype development and industrial value addition for tech-based product or process development. It has already funded 200 joint academia-industry projects and over 160 have been licensed to industry for mass scaling and commercialization.
- **The RAPID Technology Transfer Grant** is a fast-track funding mechanism to support time-sensitive technology transfer projects at an advanced stage of development. It encourages industry-academia collaborations to promote homegrown technologies (HEC Pakistan, 2024b).

Skills development

Some initiatives include the following:

- **Exam resources and certifications**. Introduced by the HEC in partnership with Microsoft, these free resources cover foundational skills and additional topics, including Azure, AI, data analytics and cybersecurity (HEC Pakistan, 2024).
- **Conferences and competitions.** HEIs in Pakistan regularly organize conferences and competitions to foster AI development and adoption. The annual National Engineering and

Robotics Contest organized by NUST highlights cutting-edge AI and robotic technology and encourages collaboration and creativity among Pakistan's budding engineers. Pakistani students and academics also participate in international competitions such as the ROBOCUP and Organisation of Islamic Cooperation-funded robotics and AI contests.

- **Mentorship.** Google for Startups has launched an AI Academy to support AI startups in Pakistan and the Asia Pacific region. It is designed to fast-track startups to market by enabling them to rapidly validate and enhance AI innovations through tailored mentorship and up to 350,000$ in Google Cloud credits (The News, 2024).
- **Leadership training.** The NCAI at NUST offers a two-day 'AI for leaders' workshop that aims to equip participants with skills to help their organizations act with agility and purpose and explores how AI technology can amplify leadership practices to improve individual, team and organizational capabilities (NCAI, 2024).

Product development

In Pakistan, the private sector and academia are leading the way in developing AI-enabled products and services. Some AI-based private sector firms are providing services to the global market. The NCAI has been particularly productive, establishing 37 spin-offs and developing more than 220 AI-based products and design solutions across multiple sectors.

Way forward

Despite improvements in its AI infrastructure, Pakistan faces particular challenges to widespread adoption of the technology. One critical challenge is the availability and quality of data to train and operate AI algorithms effectively. Ethical concerns surrounding AI adoption are also crucial. Although no national AI ethics framework currently exists, public and private stakeholders have been setting guidelines, rules and regulations to ensure the responsible and ethical use of AI technologies. These highlight the need to understand global best practices, emphasize responsible use of AI, safeguard user data, uphold privacy rights and address concerns related to AI biases and data security. Another challenge is the shortage of expertise in AI technologies. However, universities and research centres are introducing AI-focused courses to develop a talented cohort of AI specialists (Ahmed, 2023).

The recent economic survey of Pakistan highlights the implications of AI for productivity and growth in various sectors. The NTF's roadmap and implementation plan for the adoption of AI in Pakistan should be published by the end of 2024 (Butt, 2023); however, the country needs strategic large-scale policy interventions to shape digital infrastructure development, innovation, integration, research incentivization and human capital development and harness the potential of this global change (Government of Pakistan, 2023). To unlock the full potential of AI for economic growth, efficient products and services, and improved quality of life, continued government investment and collaboration with international organizations and the private sector are required in research, development and education.

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