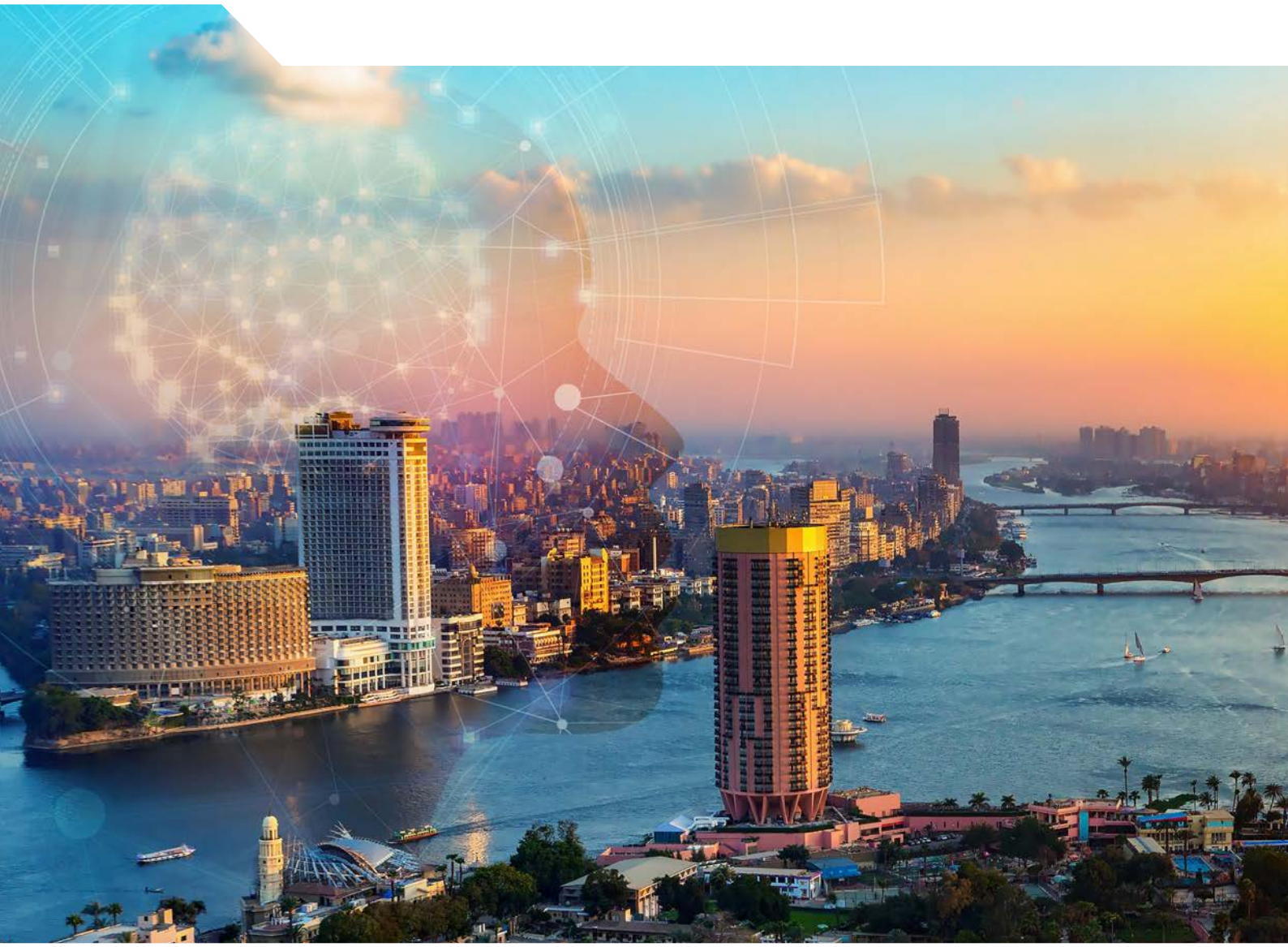
OECD Artificial Intelligence Review of Egypt



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EGYPT-OECD COUNTRY PROGRAMME

OECD Artificial Intelligence Review of Egypt

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Please cite this publication as:
OECD (2024), *OECD Artificial Intelligence Review of Egypt*, OECD Publishing, Paris, https://doi.org/10.1787/2a282726-en.

ISBN 978-92-64-43777-7 (PDF)

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Foreword

The *OECD Artificial Intelligence Review of Egypt* explores the state of implementation of the 2019 OECD Recommendation on Artificial Intelligence AI Principles [OECD/LEGAL/0449] to which Egypt adhered in March 2021. It provides a mapping of Egypt's AI governance and policy implementation through gap analysis, comparative analysis and benchmarking. The report is structured along the ten OECD AI Principles set in the Recommendation, drawing on qualitative and quantitative data and insights from the OECD.AI Policy Observatory. It highlights key findings and recommendations to strengthen Egypt's AI ecosystem.

The Review was undertaken as part of the Egypt Country Programme (ECP), under Pillar 2, "Innovation and digital transformation." The ECP will support Egypt's closer alignment with OECD standards and serve as guidance for implementing the recently revised sustainable development strategy, Egypt Vision 2030.

Acknowledgements

The Review was carried out by the OECD Directorate for Science, Technology and Innovation (STI) under the auspices of the OECD Digital Policy Committee (DPC) and the OECD Working Party on Artificial Intelligence (AIGO). Celine Caira and Lucia Russo prepared the Review, Economists/Policy Analysts of the Artificial Intelligence (AI) Unit, with the guidance of Karine Perset, Head of the Artificial Intelligence Unit of the Digital Economy Policy Division as well as oversight by Audrey Plonk and Jerry Sheehan, respectively Deputy Director and Director of STI. The report also benefitted from the inputs of Hanna-Mari Kilpelainen and Gallia Daor. Lucy Russell, consultant to the OECD, provided research support and Laura Galindo, former Policy Analyst of the AI Unit, provided early input. The authors are grateful to John Tarver for editing the report and to Andreia Furtado for editorial and publishing support.

The authors owe much to the support and co-operation of the Ministry of Communications and Information Technology (MCIT) of Egypt, in particular Eng. Mohamed Nasr, Assistant Minister for Global Information Government Infrastructure, Dr. Hossam Osman, CIT Minister Advisor for Technology Innovation and Vice Chairman of ITIDA, Ms. Samah Aziz, Head of International Relations Division, Samar Sobeih, former AI Partnerships and External Relations Manager, Mr. Mohamed Attiyah, Unit Manager in charge on the United Nations organisations and OECD, International Relations Division, and Dr. Heba Youssef, Head of Country Programme Unit, Ministry of Planning and Economic Development (MPED).

The Review draws on the results of a series of interviews with a wide range of stakeholders carried out online in 2022 and during a mission to Egypt in November 2022, including Golestan “Sally” Radwan, Dr. Suzan El Akbawi (Minister’s Advisor for Data Governance), Eng. Rania Abdel Hady (Ministry of Water Resources and Irrigation), Eng. Khaled Radwan (Ministry of Manpower), Eng. Walid Zakaria (CERT Egypt), Counsellor Omar El Mahdi (Ministry of Justice), Dr. Nermine Abou El Atta (Ministry of Trade and Industry), Mr. Marwa Abd El Tawab, Mr. Ahmed El Kenany, Mrs. Rehab Essam, and Ms. Rana Ezz (Representatives from Micro Small & Medium Enterprises Development Agency, MSMEDA); Mr. Marwan Tag, Mr. Seif Mostafa, Mr. Tarek Hashem, Mr. Nader Kamel, and Eng. Ahmed Noamy (representatives from the Economic Zone of Suez Canal); Dr. Samhaa El Beltagy (New Giza University); Dr. Talal El Shabrawy; Mr. Sherif Shalaan (Pianat.IA), Mr. Ahmed Abaza (Synapse Analytics), Mr. Nour Taher (Intella), Mr. Karim Amer (Vais), Mr. Omar Abdelwahed (Valify), Mr. Mahmoud AbdelAziz (Devision X), Dr. Naglaa Rizk (American University of Cairo), Dr. Aliaa Youssef (Arab Academy for Science and Technology), Ms. Alaa Abuelella (DELL), Dr. Ahmed Tantawy and Dr. Ahmed Moussa (Applied Innovation Centre, AIC), Eng. Khaled Hammouda and Hany El-Assar (Teradata), Dr. Heba Shahin (Erada), Yamama Kenawy (AIC – Information Technology Institute), Gen. Mohamed Abdel Azim (MPED), Eng. Tarek Saad (Ministry of Health), Dr. Mohamed El Qersh (Ministry of Agriculture), Dr. Samhaa El Beltagy (New Giza University), Dr. Maged Ghoneima (Ministry of Higher Education), Mr. Islam Zikry (CIB).

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Acronyms and abbreviations

AI	Artificial intelligence
AIC	Applied Innovation Centre
AIDA	Canada's AI and Data Act
AIGO	Working Party on Artificial Intelligence Governance
AITC	Artificial Intelligence Technology
AI-Pro	Artificial Intelligence Professional programme
AISG	Singapore's AI Centre of Excellence
ARC	Agriculture Research Centre
AU	African Union
AWS	Amazon Web Services
CAI	Committee on Artificial Intelligence (Council of Europe)
CDEP	Committee on Digital Economy Policy
COP27	United Nations Conference on Climate Change
DoI	Declaration of Intent
DPC	Data Protection Centre
ECP	Egypt Country Programme
EUI	Egypt University of Informatics
EuroHPC	European High Performance Computing Joint Undertaking
FCA	Financial Conduct Authority
GDP	Gross domestic product
GDPR	General Data Protection Regulation
GPAI	Global Partnership on Artificial Intelligence
GPU	Graphics processing unit
HPC	High-performance computing
ICT	Information and communication technology
IGO	Intergovernmental organisation
ILO	International Labour Organization
IoT	Internet-of-Things
IT	Information technology
ITI	Information Technology Institute
ITIDA	Information Technology Industry Development Agency
MCIT	Ministry of Communications and Information Technology
MENA	Middle East and North Africa
ML	Machine learning
MoU	Memorandum of Understanding

MPED	Ministry of Planning and Economic Development
MSMEDA	Micro Small & Medium Enterprises Development Agency
NAIRR	National AI Research Resource
NAIS	National AI Strategy
NCAI	National Council for Artificial Intelligence
NGO	Non-governmental organisation
NLP	Natural language processing
NSRP	National Structural Reform Programme
OECD	Organisation for Economic Co-operation and Development
ONE AI	AI Network of Experts
PwD	Persons with Disabilities
R&D	Research and development
SDG	Sustainable Development Goals
SME	Small and medium-sized enterprise
STDF	Science and Technology Development Fund
TPU	Tensor processing unit
UNDP	United Nations Development Programme
VC	Venture Capital

Executive summary

The 2019 Egyptian National Artificial Intelligence (AI) Strategy (NAIS) is considered a key catalyst for digital transformation in Egypt. It sets out a strategic approach for harnessing AI's potential to achieve Egypt's sustainable development goals. As North Africa's largest economy, Egypt holds a prominent position in Africa, serving as a vital link between Africa, Europe, and the Middle East. Egypt faces economic challenges, including high inflation and a high youth unemployment rate. The NAIS aims to further align innovation activities with the 2021-2024 National Structural Reform Programme and chart a trajectory for the post-COVID-19 economic recovery.

As the first Arab and African country to adhere to the OECD Artificial Intelligence Principles [OECD/LEGAL/0449] in 2021, Egypt has made progress in their implementation. This country review provides a mapping of Egypt's AI governance and policy implementation through comparative analysis and benchmarking. It highlights key findings and recommendations to strengthen Egypt's AI ecosystem.

The 2023 Egyptian Charter for Responsible AI is the primary document articulating Egypt's commitment to implementing the values-based components of the OECD AI Principles (Principles 1.1-1.5). The Charter aims to adapt international frameworks for responsible AI to Egypt's local context, reflecting key OECD AI Principles, such as human-centredness, accountability, fairness, security and safety, transparency and explainability.

Investment in AI research and development (R&D) and innovation is crucial to a competitive national AI ecosystem, as acknowledged in the Egyptian NAIS (Principle 2.1). AI scientific publications in Egypt have grown over the past decade. Still, the development of a broader AI ecosystem is limited without a dedicated national AI funding programme. The Applied Innovation Centre promotes AI solutions to national challenges in areas such as healthcare, urban and agricultural planning, and natural language applications, and is viewed as the primary implementation arm of the NAIS. Despite such efforts, there are limits to scaling such initiatives without a clear funding mechanism. There is also untapped potential in text and speech applications in the Arabic Egyptian dialect for domain-specific uses. With the Egyptian AI start-up landscape still in its early stages, the government could support its growth by providing international exposure, facilitating market access, and incentivising the procurement of AI solutions to promote innovation in public services.

Egypt's NAIS recognises AI infrastructure as a key enabler for AI, but there is a lack of local cloud providers, AI compute access, and talent (Principle 2.2). Some public sector compute capacity exists, such as supercomputers in the City of Knowledge or the Egyptian Meteorological Authority and in universities like Cairo University and Bibliotheca Alexandria. The Egyptian private sector market for data centre infrastructure includes local, regional, and international operators. Recent years have seen a shift from on-premises data centres to colocation and managed facilities by small and medium-sized enterprises and larger organisations. Cloud computing infrastructure is a reported bottleneck to AI diffusion due to the absence of domestic AI cloud infrastructure options. Partnerships with cloud providers could help close this gap. Egypt's ability to train and retain skilled talent to use AI compute efficiently and effectively is also a bottleneck. Egypt's NAIS does not include details of Egypt's AI compute capacity and needs. A

stocktaking of national AI compute capacity would help address this gap by examining the needs of different AI user groups. OECD work on measuring AI compute can assist in this endeavor.

While there is no AI-specific legislation in Egypt, existing laws and regulations on data protection, cybersecurity, and fintech provide elements supporting AI governance (Principle 2.3). As the lead ministry overseeing the NAIS, the Ministry of Communication and Information Technology (MCIT) strives to provide elements of AI governance through various strategies, soft laws, and hard laws, and by adhering to several internationally recognised principles-based approaches to AI governance, such as the OECD AI Principles. This approach aims to encourage domestic and foreign investment in AI at a time when Egypt's AI ecosystem is still emerging and growing. However, implementation actions remain to be taken for key pieces of legislation, particularly for the Personal Data Protection Law (2020), for which Executive Regulations have yet to be issued.

To build capacity and promote skills development, the NAIS includes initiatives targeting several demographic groups (Principle 2.4). Eight public and private Egyptian universities have AI faculties with AI ethics in their computer science curricula. The Information Technology Institute plays a critical role in widespread AI upskilling. However, it is challenging to retain employees who seek opportunities abroad, driven by limited prospects for local R&D. To reverse the trend, Egypt could establish AI research centres to foster a robust domestic AI industry and strategic partnerships with domestic and international companies. As in many countries, gender disparities persist in the information and communications technology (ICT) sector. Focused efforts to promote gender inclusivity and equal opportunities in the AI field could help to close the gaps.

Egypt is leading international co-operation efforts in the Arab and African regions (Principle 2.5). The country is Chair of the African Union's AI Working Group, tasked with drafting a continent-wide AI strategy. It is also Chair of the Arab League's AI Working Group and is establishing bilateral collaborations on AI with several countries.

As Egypt's digital transformation takes shape, trustworthy and responsible AI can be a reliable and positive force, especially in addressing social and economic challenges. As the leading Ministry for the NAIS, MCIT commendably managed collaboration between relevant Egyptian ministries and stakeholders to design the NAIS. To effectively implement the next phase of the NAIS, it will be critical to allocate an appropriate budget and establish streamlined mechanisms for expenditures amid a rapidly evolving technological landscape. To better understand the short, medium- and long-term implications of AI, interdisciplinary collaboration with AI ecosystem actors is key, including engaging in dialogue and collaboration with government and AI researchers, policymakers, practitioners, industry partners and civil society groups in addition to multistakeholder fora such as the OECD.

1 Egypt in the age of artificial intelligence

Harnessing artificial intelligence to achieve Egypt's development goals

Launched in 2019, the Egyptian National Artificial Intelligence (AI) Strategy, the NAIS, is considered one of the key catalysts for the country's digital transformation, setting out a strategic approach for harnessing AI's potential to achieve development goals. It supports Egypt's sustainable development agenda, Vision 2030, and the United Nations Sustainable Development Goals (SDGs) (National Council for Artificial Intelligence, 2019[1]). Given Egypt's changing economic and demographic context, a strategic approach to AI in Egypt aims to further align activities with its 2021-2024 National Structural Reform Programme (NSRP), outlining a trajectory for the post-COVID-19 economic recovery as it aims to tackle a variety of economic, social, and development challenges in the years ahead.

In October 2021, the OECD and Egypt signed a Memorandum of Understanding (MOU) in support of a three-year Egypt Country Programme (ECP) to advance Egypt's development goals. The ECP was recognition of Egypt's active role as one of the most engaged Middle East and North Africa (MENA) countries in OECD bodies and its efforts towards alignment with OECD standards, and the outcome of a long-standing relationship between Egypt and the OECD (OECD, 2022[2]).

Egypt's Ministry of Communications and Information Technology (MCIT) leads many reforms to advance digitalisation, including launching the NAIS in 2019. The NAIS aims to harness AI to modernise the country, achieve Egypt's development goals, and to improve the quality of life for Egyptians across the country. Such efforts are reflected in slight improvements of Egypt's 2023 rankings in international AI indexes (Oxford Insights, 2023[3]; TortoiseMedia, 2023[4]), notably thanks to its good performance in the government pillar.

This report is a deliverable from Pillar 2 of the ECP which focuses on innovation and digital transformation. and includes a comparative study of Egypt's implementation of the 2019 OECD Recommendation on Artificial Intelligence [OECD/LEGAL/0449]. This study identifies ways AI-enabled innovation can contribute to Egypt's development and structural reform agenda across the four pillars of the Egyptian AI Strategy (AI for government, AI for development, AI for human capacity building, and AI for external relations) and takes stock of Egypt's implementation of the OECD AI Principles and offers recommendations for future AI policy actions.

Egypt's digital transformation is unfolding amid macroeconomic pressures, a fast-growing and young population, and challenges from climate change

As North Africa's biggest economy, Egypt holds a prominent position in Africa, serving as a vital link between the continents of Africa, Europe, and the Middle East. It houses the Suez Canal, a crucial waterway for the world's maritime traffic (Suez Canal Authority, 2023[5]), is Africa's second-largest economy after Nigeria in terms of Gross Domestic Product (GDP) (International Monetary Fund, 2023[6]), and ranks

as the third-most populous country on the continent after Nigeria and Ethiopia (World Bank, 2022[7]). Egypt has a young and growing demography, with one-third of the population under the age of 15 (United Nations Population Division, 2022[8]). In 2021, 73.1% of the Egyptian population could read, which is below global literacy rates, with the literacy rate differing among men (78.8%) and women (67.4%) (World Bank, 2021[9]).

Informal employment and unemployment in specific segments of the population are significant elements of the Egyptian economy and present development challenges. While Egypt has a relatively low unemployment rate according to their national estimates, youth unemployment, and youth female unemployment in particular, are very high (World Bank, 2021[10]). About 43% of the young female population is without work, a trend that persists for educated females. According to a survey carried out by the International Labour Organization (ILO), female graduate students face unemployment at up to triple the rate of their male peers in every sector except health and welfare (International Labour Organization, 2021[11]).

Egypt's implementation of the first phase of its Economic and Social Reform Programme helped to bolster against some of the impacts of the COVID-19 pandemic. This helped Egypt to be the only country in the MENA region to see positive GDP growth in 2020 despite the pandemic, with an economy reliant on agriculture, natural resources, and tourism, the latter of which was particularly impacted by pandemic-related travel restrictions (OECD, 2022[2]). The Russian Federation's aggression against Ukraine in 2022 put further pressure on food security in the MENA region, which impacted Egypt. The government responded by increasing food subsidies and conditional cash transfers (OECD, 2023[12]).

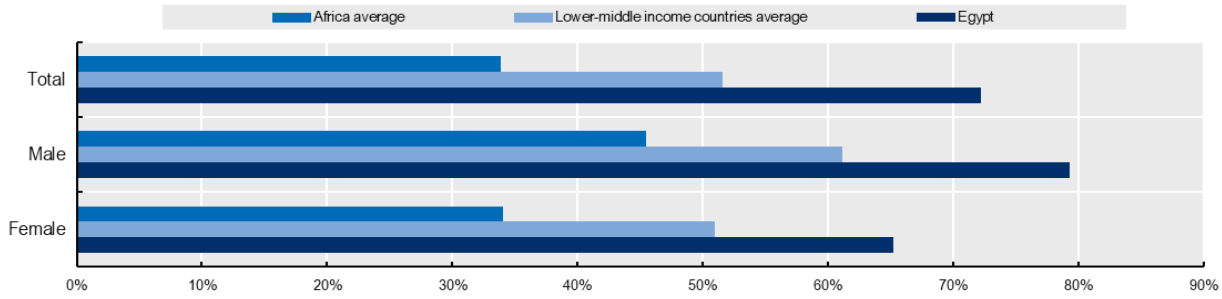
According to the 2023 OECD Economic Survey of Egypt, the country continues to face high inflation and balance of payment challenges. The Egyptian pound has lost about 50% of its value against the US dollar since early 2022, and core inflation stood at over 38% in October 2023 (OECD, 2023[13]). While household consumption levels were maintained thanks partly to energy price controls, food subsidies, and various fiscal packages, private investment contracted in 2023 as businesses faced tightened financial conditions and increased uncertainty (OECD, 2023[13]).

Despite macroeconomic and social challenges, Egypt has taken various steps to advance development outcomes and increase digitalisation across the country. In recent years, Egypt has reformed several governance and regulatory frameworks, particularly in areas related to attracting investments, advancing trade, and embracing digitalisation. This is part of the country's strategy to attract investors to choose Egypt as their destination for offshoring and outsourcing ICT activities. The Digital Egypt Strategy for Offshoring (2022-2026) aims to reach USD 9 billion in export revenue from digitally enabled offshoring services by 2026, i.e. a threefold increase compared to 2022 (ITIDA, 2022[14]).

To realise the full enabling benefits of AI, countries require a base level of digital skills, literacy, and access to digital resources such as connectivity. Compared to peer and regional countries in Africa and lower-middle-income countries, Egypt has relatively high Internet usage rates for both men and women (Figure 1.1) (ITU World Telecommunication/ICT Indicators Database, 2023[15]). When it comes to fixed broadband subscriptions, Egypt has 9.94 per 100 inhabitants, which is comparatively lower than the MENA and OECD averages of 11.89 and 34.9 per 100 inhabitants, respectively (Figure 1.1) (OECD Going Digital Toolkit, 2023[16]). For the last decade, mobile cellular adoption has been high in the country for both men (99%) and women (96%) (ITU World Telecommunication/ICT Indicators Database, 2023[15]). Egypt falls below the MENA average on the supply of digital skills (World Bank, 2020[17]). Over 56% of Egyptians have basic digital skills, while only 1.8% have advanced digital skills, ranking last among Arab states for this indicator (ITU World Telecommunication/ICT Indicators Database, 2023[15]).

Figure 1.1. Egypt has high Internet usage rates compared to peer and regional countries

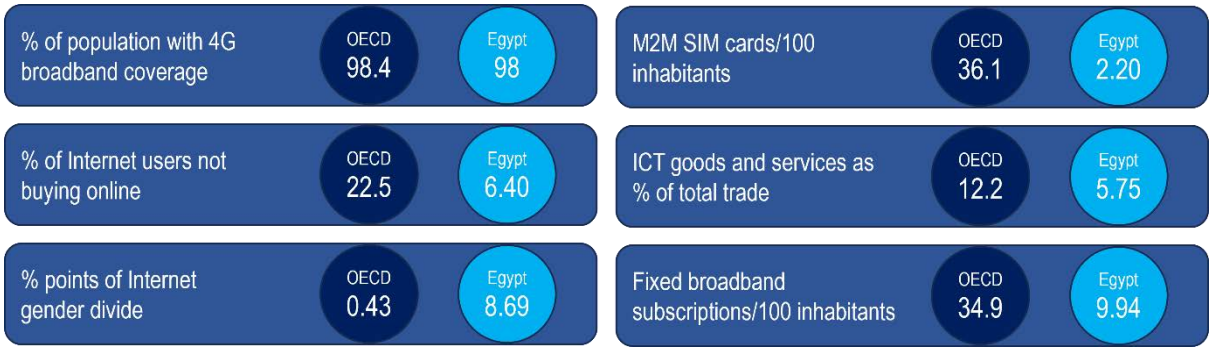
Internet usage, as a percentage of total population, male and female populations, 2022



Source: ITU World Telecommunication/ICT Indicators Database (2023), https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx.

Figure 1.2. Egypt has made progress in some digital transformation indicators, with room for improvement in others

Selection of digital transformation indicators according to the OECD Going Digital Toolkit, 2022



Note: OECD average is indicated in dark blue circles, compared to the Egyptian average indicated in coloured circles.
Source: OECD Going Digital Toolkit (2023), https://goingdigital.oecd.org/.

Egypt also faces environmental sustainability challenges from a changing climate. Due to its geographic location in Northern Africa, Egypt is vulnerable to climate risks such as increased heatwaves, rising sea levels, increased soil salination, and desertification. The impacts of climate change could have devastating implications for Egypt's economy, food security, and population health (Brookings, 2023[18]). With a heavy reliance on agriculture for both local farms and trade, Egypt is exploring alternatives to increase its water share, including desalinating sea water, improving irrigation techniques, renovating the national water canal network, and using treated wastewater in agriculture. In 2022, Egypt hosted the annual United Nations Conference on Climate Change (COP27) in Sharm El-Sheikh to facilitate discussions on climate and sustainable development. Digital tools like AI could be a means to manage, minimise, and mitigate Egypt's environmental challenges in the years ahead.

Egypt's National AI Strategy

The Egyptian National AI Strategy (NAIS) aims to leverage the benefits of AI for the economic and social development of all

Egypt has a keen interest in embracing digitalisation to keep pace with technology advancements. These advancements bring promising opportunities for Egypt to achieve leaps in development and well-being. AI could bring productivity gains, spur innovation, and fund new solutions to complex challenges. In November 2019, the Egyptian Cabinet approved the formation of the National Council for Artificial Intelligence (NCAI) to develop and govern the implementation of Egypt's NAIS. The NAIS was developed through a multi-stakeholder process, led by the MCIT and the NCAI, which helped to involve various government entities and representatives from business, academia, and the technical community. The NAIS is comprised of four fundamental pillars:

- **AI for Government** to increase efficiencies and transparency while reducing redundancies in the government and its services;
- **AI for Development** to fulfil internal goals and SDGs, supporting the economy, environment and people;
- **AI for Capacity Building** to address the educational and professional gaps that may slow the AI industry's uptake and growth, and;
- **AI for International Relations**, to place Egypt, the Arab world and Africa in the sphere of international AI activity and development.

Four categories of enablers support these four pillars: i) Governance: including ethics, laws and regulations, tracking and monitoring; ii) Data: including collection, management and monetisation strategies; iii) Ecosystem: including private sector, research and academia, and civil society; and iv) Infrastructure: including fair access to compute, storage, networking, and other assets.

The Strategy is ambitious, seeking to transform not only the AI sector but society at large. From streamlining entrepreneurship to optimising water usage, it recognises AI's capacity to enhance many aspects of life in Egypt. However, the NAIS also identifies challenges to the wide-scale adoption the four strategic pillars. First, data access, quality and availability continue to be challenging, as does insufficient infrastructure for data collection, processing, and dissemination. Second, economic recovery from COVID-19 continues to pose challenges, including reductions to government financing of AI projects during the pandemic. Finally, the NAIS recognises the challenge of attracting and retaining highly skilled AI labour, particularly as Egypt competes in the global AI talent race.

A key metric for the success of Egypt's domestic AI ecosystem will be to develop and retain highly skilled AI talent. It is seen as a means of creating new jobs within the field of AI and its capacity to stimulate job growth in the wider economy (Radwan, 2021[19]). Unemployment in general, youth and female unemployment and informal employment in particular, represent barriers to Egypt's further economic development. With a rapidly growing population, the incorporation of these demographics into the traditional workforce by leveraging AI technologies would strengthen the Egyptian economy and society.

The NAIS implementation plan includes government projects ranging from healthcare initiatives to a new government-funded centre, the Applied Innovation Centre (AIC), to support AI R&D projects. It also includes programmes to raise awareness about AI, introduce it into the classroom, and competitions to stimulate the AI ecosystem. During implementation, Egypt aims to target a wide audience to harness the full potential of "AI for all" and drive economic and social development.

The NAIS is to be implemented in three phases. The first phase (2020-2023) focuses on "proving the value of AI" in the different domains and build the foundations upon which to build AI at scale. This includes starting pilot projects within government in partnership with local and foreign entities, and training

graduates and professionals to fulfil market needs. The second phase (2024-2027) places emphasis on "research and expanding the market" by identifying further key sectors in which to implement AI strategically and on capacity-building amongst school and university students and preparing the next generation of AI researchers. Finally, the third phase (2028-2030) will aim to "expand research and grow the ecosystem" by strengthening core research capabilities through academic and industry collaborations and AI-focused start-up incubation and acceleration programmes. This phase will focus on completing the general awareness programmes and producing high-end data scientists and machine learning researchers in line with the capacity-building objectives (National Council for Artificial Intelligence, 2019[1]).

The Egyptian National Council of Artificial Intelligence guides the National AI Strategy's development and implementation

MCIT works with different partners and stakeholders to prepare, evaluate, and implement pilot projects (see section Principle 2.1: Promoting investment in Egyptian AI research and development). The NCAI, a group chaired by the Minister of MCIT who developed the NAIS, includes representatives from government entities, the private sector, and independent experts convened to guide recommended policy actions to strengthen Egypt's role in the regional and to become an active global player in AI.

The NCAI develops and governs the implementation of Egypt's National AI Strategy. In addition to the permanent members of the Council, the Members invite external experts to attend meetings depending on the topic being discussed. The NCAI model aims to promote effective partnerships between the government and other actors in the AI ecosystem, spur innovation, and support Egypt's digital transformation through AI applications.

Egypt's National AI Strategy would benefit from further budget allocation and a clear mandate to facilitate inter-ministry coordination for AI projects

The most effective national AI strategies around the world have a clear mandate and budget to facilitate effective implementation. According to Egyptian officials, a budget has been allocated since 2020 for the implementation of the NAIS. However, they also say it is primarily allocated to MCIT and there is no clear mandate on how other ministries and entities should contribute to AI projects. Furthermore, the existing budget would benefit from more transparency about allocation between projects and across the government. There could also be more clarity about how the budget should be used and how AI ecosystem stakeholders might access funding from relevant AI programmes.

Table 1.1. Key findings and recommendations on AI governance

Key findings	Recommendations
• The Egyptian AI Strategy (NAIS) of 2019 offers a good foundation to articulate Egypt's vision for harnessing AI to reach its development goals. • The NAIS does not include a public dedicated budget for its implementation. • The NAIS could be further developed to include funding programmes/action plans to support its implementation.	• Informed by insights from the Egyptian National Council for AI and Technical Committee of AI experts, Egypt should take stock of key AI ecosystem changes in context and domestic needs since the NAIS was launched in 2019. • Informed by this analysis, Egypt should build on the 2019 NAIS to develop and include funding and action plans to achieve goals articulated in the strategy, and to ensure alignment with internationally recognised standards for trustworthy AI, such as the OECD AI Principles. • Egypt should establish targets, monitoring plans, mechanisms and timelines for reporting interim NAIS results.

2 The OECD AI Principles in Egypt: State of implementation and gap analysis

Egypt's National AI Strategy in the global AI context

In 2022, AI took centre stage in policy discussions in Egypt and around the world, with generative AI tools like chatbots revealing AI's potential to mainstream audiences. AI tools continue to bring opportunities for transformative changes in many areas. At the same time, policymakers around the world are assessing AI's potential risks, such as the perpetuation of existing inequalities, risks to human rights such as privacy and intellectual property rights. Generative AI tools also have the potential to create manipulated content on an unprecedented scale.

As the first intergovernmental standard on AI, the 2019 OECD Recommendation on AI, which includes the OECD AI Principles, is a global reference point for trustworthy AI (Table 2.1). The Principles were subsequently updated at the OECD Ministerial Council Meeting in May 2024 (for the purpose of this analysis, the 2019 OECD AI Principles are used). Since their adoption in 2019, countries have developed policies, laws and frameworks based on them to tackle AI's risks and capitalise on opportunities. In 2016, only a handful of countries had national AI initiatives. In 2024, the OECD.AI Policy Observatory documents over 1 000 AI policy initiatives across 70 jurisdictions. Beyond OECD Member countries, Arab, African, and South American partner economies have also committed to actions that promote the OECD AI principles.

Table 2.1. The 2019 OECD AI Principles

5 value-based principles for trustworthy, human-centric AI	5 recommendations to governments for AI ecosystems to benefit societies
1.1 Benefit People and Planet	2.1 AI research and development
1.2 Human rights, privacy and fairness	2.2 Data, compute, technologies
1.3 Transparent and explainable	2.3 Policy and regulatory environment
1.4 Robust, secure and safe	2.4 Jobs and skills, labour transition
1.5 Actors are accountable	2.5 International cooperation and measurement

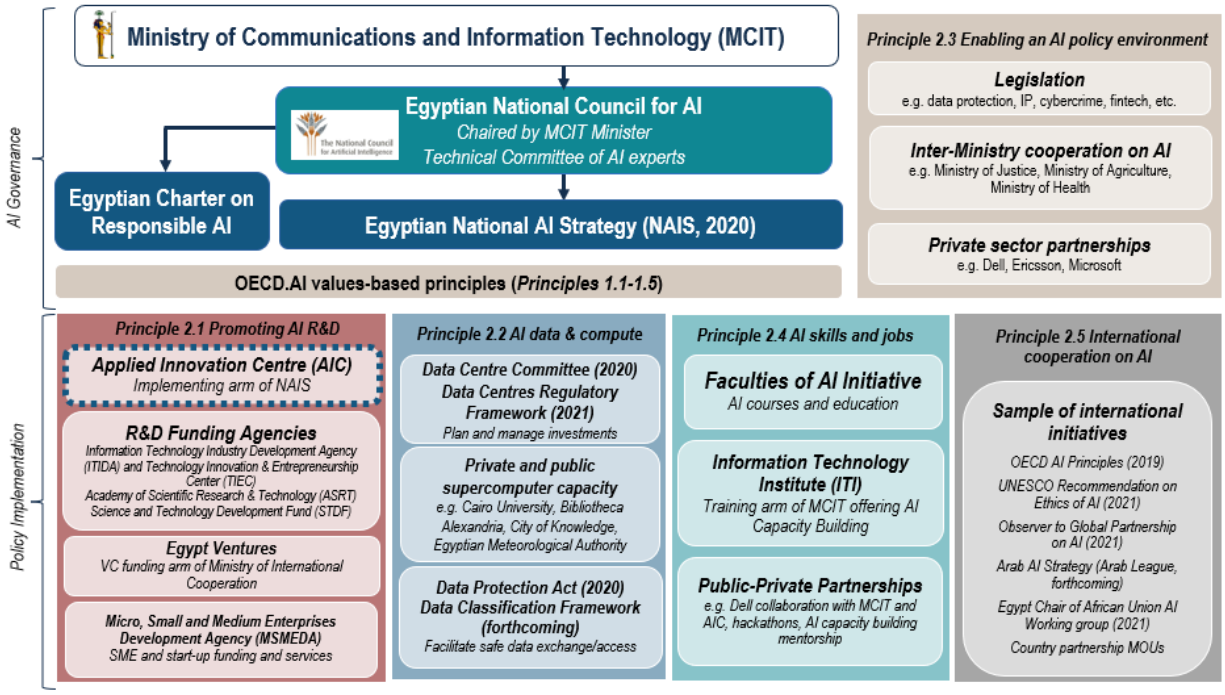
Note: The OECD AI Principles were adopted in 2019, and subsequently updated in May 2024 by the OECD Ministerial Council. For the purposes of this analysis, the 2019 OECD AI Principles are used.
Source: OECD.AI Policy Observatory, https://oecd.ai/en/ai-principles.

Egypt has led the way, being the first Arab and African country to adhere to the Recommendation in 2021. It plays a leadership role regionally as Chair of the African Union's (AU) Artificial Intelligence Working

Group. The Egyptian Charter for Responsible AI (the "Charter"), launched in 2023, is the primary document that articulates Egypt's commitment to implementing the OECD AI Principles, namely the values-based components (Principles 1.1-1.5). The Charter is divided into 13 general principles and 16 implementation guidelines that aim to adapt the OECD and other international frameworks for ethical and responsible AI to Egypt's local context.

This section provides a mapping of how Egypt is integrating the OECD AI Principles into its AI governance and policy implementation. Figure 2.1 offers a snapshot of key initiatives in Egypt to apply the OECD AI Principles across policy, programmatic, and governance initiatives, which are explored in this section. A gap analysis identifies areas where further action could be taken, for example, in the context of any second iteration of Egypt's NAIS. The analysis is structured along the ten OECD AI Principles and draws on qualitative and quantitative data and insights from the OECD.AI Policy Observatory, including international benchmarking and examples.

Figure 2.1. Mapping Egypt's AI governance and policy implementation along the OECD AI Principles



Note: The Applied Innovation Centre (AIC) is outlined in blue to signify that it is the implementing arm of the NAIS.
Source: OECD.AI based on information provided by Egypt.

How Egypt is implementing the values-based OECD AI Principles through initiatives like the Egyptian Charter for Responsible AI

In April 2023, the NCAI announced the launch of the Egyptian Charter for Responsible AI (Figure 2.2), a key element for the implementation of Egypt's NAIS. The Charter is an effort to translate and adapt various international guidelines and values on AI to their local context. According to Egyptian officials, the Charter serves two main purposes. First, it aims to increase awareness among citizens and stakeholders about responsible AI governance frameworks so they can incorporate them into AI adoption plans. Second, the Charter provides a positive signal that Egypt is committed to following responsible AI practices aligned with international best practices. This effort is meant to improve Egypt's investment attractiveness and better

communicate needs and priorities to AI developers looking to enter the domestic market (Ministry of Communications and Information Technology, 2023[20]). Each of the five OECD AI values-based Principles is mapped to the Charter in further detail below.

Figure 2.2. The 2023 Egyptian Charter for Responsible AI

General and implementation guidelines to advance values-based Principles for AI

Note: This graphic summarises key points from the Egyptian Charter on Responsible AI as they related to the five value-based OECD AI Principles. It is for illustrative purposes and is not exhaustive.
Source: Egyptian Charter on Responsible AI, https://aicm.ai.gov.eg//en/Resources/EgyptianCharterForResponsibleAIEnglish-v1.0.pdf.

Principle 1.1: Inclusive growth, sustainable development, and well-being

> *"Stakeholders should proactively engage in responsible stewardship of trustworthy AI in pursuit of beneficial outcomes for people and the planet, such as augmenting human capabilities and enhancing creativity, advancing inclusion of underrepresented populations, reducing economic, social, gender and other inequalities, and protecting natural environments, thus invigorating inclusive growth, sustainable development and well-being."*

Governments are pursuing different approaches to achieve inclusive growth, sustainable development and well-being, but most national AI strategies and AI ethics frameworks or guidelines for implementing AI refer to this principle. At the policy level, countries have launched initiatives to ensure vulnerable groups in the population are involved in and benefit from the development of AI systems, either through targeted initiatives or policy design. Governments are also funding projects that use AI to address environmental challenges (OECD, 2023[21]).

The NAIS AI for Development pillar aims to harness the benefits of AI to reduce economic and social inequalities by increasing innovation and growth opportunities for the country and promoting human development and the engagement of young people in AI-related activities. The NAIS was developed through a multi-stakeholder process, led by the MCIT and the NCAI, which helped to involve various government entities and representatives from business, academia, and the technical community. Further engagement with civil society in the policy design and implementation of the strategy, as well as citizen consultation and the inclusion of underrepresented populations, could further strengthen the NAIS as the NAIC reflects on future orientations for its work.

The Charter's general and implementation guidelines reference SDGs, including protecting the environment and the guidance that government AI projects undertake impact assessments, including obtaining information about the environmental impact of deploying the AI-related project (Ministry of Communications and Information Technology, 2023[20]). Box 2.1 explores considerations around how AI can be harnessed to advance environmental sustainability and sustainable agriculture in Egypt.

Box 2.1. AI applications can help address Egypt's environmental sustainability and agricultural challenges.

Egypt has explored ways to leverage AI for environmental sustainability. In strategic documents, it recognises AI as a critical tool for advancing sustainable development across various sectors. Egypt's Vision 2030 Sustainable Development Strategy emphasises the importance of technology to achieve the SDGs under its third pillar on innovation and scientific research (Vision 2030, 2016[22]). The Egyptian government and MCIT's Applied Innovation Center (AIC) work with the United Nations Development Programme (UNDP) to use AI in national sustainable development initiatives (UNDP, 2022[23]).

With substantial arid and desert geography, harnessing AI for climate mitigation and adaptation is crucial for Egypt as it prepares for the adverse effects of climate change. Egypt is vulnerable to more intense heat waves and can expect a "significant increase in electricity demand due to more frequent extreme heat events coupled with urbanization and population growth" (IEA, 2023[24]). It is also at high risk of flooding in the North of the country and the Nile delta faces "severe risk of hazards such as coastal erosion, storm surge and flooding" (IEA, 2023[24]).

Egypt's NAIS includes specific provisions to promote environmental sustainability. In agriculture, the government has implemented AI-driven solutions to optimise crop yields, conserve water and to address food security. Egypt also leverages AI applications to optimise renewable energy production, enhance grid efficiency, smart cities and energy-efficient urban infrastructure.

Egypt also has begun employ some use cases for environmental monitoring and conservation to help with climate change mitigation and adaptation (Government of Egypt, 2021[25]). The AIC of the MCIT plays an important role for R&D in this area. For example, the AIC works with the Agriculture Research Center (ARC) to develop an "AI system for land use management, crop yield prediction, water use optimisation, and crop health monitoring" (Ministry of Communications and Information Technology, 2022[26])

AI can also help Egypt reduce greenhouse gas (GHG) emissions across sectors. While Egypt's per capita GHG emissions (3.5 tonnes CO2e) are lower than the world average (6.62 tonnes CO2e), its total GHG emissions are still rising and have increased by over 160% from 1990 to 2019 (European Parliament, 2022[27]). In 2023, Egypt committed to reduce emissions "by 37% in the electricity sector (80 Mt CO2e), 65% in the oil and gas sector (1.7 Mt CO2e), and 7% in the transportation sector (9 Mt CO2e) by 2030 compared to business-as-usual, conditional on external support" (UNDP, 2023[28]).

AI can also be used for solid waste management processes, including for forecasting waste generation, collection, segregation, and classification of waste (I. Ihsanullah et al., 2022[29]). AI algorithms can analyse historical and real-time data on waste generation patterns, traffic conditions, and collection capacities to optimise waste collection. AI-enabled robotics and machine vision systems can automate the sorting and processing of waste materials at recycling facilities. This is particularly relevant to help tackle plastic waste in Egypt, which is a growing area of concern that affects land and water pollution (World Bank Group, 2022[30]).

In 2022, Egypt hosted COP27 in Sharm-El-Sheikh, where the MCIT announced a sustainability partnership with Microsoft Egypt. The partnership includes the establishment of a Government Centre of Excellence for Emissions Accounting and Reporting digitally, the support for "greentech" start-ups, and the use of AI to enhance the efficiency of the agricultural sector (Edge, 2022). Agriculture was also the focus of a 2022 multi-stakeholder dialogue in Cairo that brought together Egyptian and European digital actors to work on leveraging AI for resilient agriculture and smart cities (D4D Hub, 2022[31]).

Source: Sources indicated in-text.

Principle 1.2: Human-centred values and fairness

> *"AI actors should respect the rule of law, human rights and democratic values, throughout the AI system lifecycle. These include freedom, dignity and autonomy, privacy and data protection, non-discrimination and equality, diversity, fairness, social justice, and internationally recognised labour rights. To this end, AI actors should implement mechanisms and safeguards, such as capacity for human determination, that are appropriate to the context and consistent with the state of art."*

Some uses of AI systems risk deliberately or accidentally infringing on human rights, as defined in the Universal Declaration of Human Rights. These include privacy, freedom of expression, and others. To avoid this, countries are implementing policy initiatives to ensure AI systems respect human-centred values and fairness (OECD, 2023[32]). For example, governments have issued guidelines and initiatives to reduce AI biases and promote fairness, human rights and human-centred values (e.g. through human rights impact assessments). Countries are implementing policies to protect privacy in AI through existing privacy and data protection legislation, guidance on data protection in AI applications, regulatory sandboxes to promote privacy-friendly use of AI solutions (OECD, 2023[21]), and promoting Privacy Enhancing Technologies (PETs) to prevent privacy infringement in developing or operating AI technologies and services (OECD, 2023[33]).

The use of surveillance technologies, such as closed-circuit television (CCTV) cameras and facial recognition, has raised concerns about possible privacy violations with potential implications for exercising democratic values in many jurisdictions. AI technologies could exacerbate these concerns by removing the need for human review of video and audio footage. Facial recognition, a key application enabled by computer vision, has received significant attention in public debate and in policy circles as countries move to create laws to govern AI. In many jurisdictions, facial recognition has been central to discussions on "high-risk" AI applications, including use by law enforcement. Risks of algorithmic bias and data privacy concerns have resulted in various calls to limit certain uses of facial recognition technology (OECD, 2021[34]).

Egypt's Charter for Responsible AI addresses human-centeredness and fairness through general and implementation guidelines, reflecting elements in OECD AI Principle 1.2. For example, the Charter promotes using AI in government to advance citizen well-being, including "combating poverty, hunger, inequality, illiteracy, and corruption" (Ministry of Communications and Information Technology, 2023[20]). It also notes that AI systems should complement rather than replace human labour except in cases that pose danger or risk to human wellbeing. The Charter states that governments and relevant actors should take measures to ensure a fair transition for workers in cases where job displacement has occurred. It also outlines that appropriate mechanisms should be implemented to allow those adversely impacted by an AI system to challenge its outcome. This should be based on "plain and easy-to-understand information on the factors, and the logic that served as the basis for the prediction, recommendation, or decision" (Ministry of Communications and Information Technology, 2023[20]). Provisions that introduce considerations beyond those outlined in the OECD AI Principles include collaboration with end-users to develop AI products and observance of local customs and norms by foreign AI systems (Ministry of Communications and Information Technology, 2023[20]).

The guidelines also focus on minimising bias within datasets and throughout the AI system lifecycle, reducing harm, and protecting privacy. Regarding data protection, the Charter states that "the use of any data must be pre-authorised by the data owner except in the case of data available in the public domain. Personally identifiable data must be anonymised and/or encrypted depending on the domain, and express written consent from the data owner must be obtained according to applicable laws". While Egypt has constitutional protections for the right to privacy and introduced a Data Protection Law in 2020, Executive Regulations for its enforcement and the establishment of a Data Protection Centre are still pending (see Principle 2.3: Providing an enabling policy environment for AI in Egypt). This raises uncertainty regarding the Charter's implementation in practice, as key related legislation remains unenforced.

Principle 1.3: Transparency and explainability

> *"AI Actors should commit to transparency and responsible disclosure regarding AI systems. To this end, they should provide meaningful information, appropriate to the context, and consistent with the state of art: to foster a general understanding of AI systems, to make stakeholders aware of their interactions with AI systems, including in the workplace, to enable those affected by an AI system to understand the outcome, and, to enable those adversely affected by an AI system to challenge its outcome based on plain and easy-to-understand information on the factors, and the logic that served as the basis for the prediction, recommendation or decision."*

Around the world, most national AI strategies, ethical frameworks, and general principles for the implementation of AI list transparency and explainability among the key properties of a trustworthy AI system. Transparency and explainability also figure prominently in several non-binding guidelines for ethical AI implementation. However, despite broad agreement on the need for transparent and explainable AI, operationalising these concepts is complex, due to their multifaceted nuances. AI transparency entails clearly communicating to users that they are dealing with an AI system, interpretability of decision-making processes, and explainability of decision-making logic.

The Charter for Responsible AI includes an obligation to disclose the presence of AI when interfacing with an end-user and that the developers of AI systems must prioritise interpretability. Since challenging AI outcomes relies on the explainability of the system, accessibility of information and its ability to be understood correctly, the Charter calls for cross-disciplinary cooperation to boost awareness and develop adequate literacy around AI uses and interactions.

Principle 1.4: Robustness, security, and safety

> *"AI systems should be robust, secure and safe throughout their entire lifecycle so that, in conditions of normal use, foreseeable use or misuse, or other adverse conditions, they function appropriately and do not pose unreasonable safety risk.*
>
> *To this end, AI actors should ensure traceability, including in relation to datasets, processes and decisions made during the AI system lifecycle, to enable analysis of the AI system's outcomes and responses to inquiry, appropriate to the context and consistent with the state of art.*
>
> *AI actors should, based on their roles, the context, and their ability to act, apply a systematic risk management approach to each phase of the AI system lifecycle on a continuous basis to address risks related to AI systems, including privacy, digital security, safety and bias."*

AI robustness, security, and safety are interlinked. For example, digital security can affect the safety of connected products like automobiles and home appliances when risks are poorly managed (OECD, 2023[35]). Therefore, they are analysed together. However, there are different ways in which countries can operationalise them that are not mutually exclusive.

The Charter prioritises security and safety by requiring "final human determination" and limiting safety risks and harm under various conditions, including adverse ones, especially for "sensitive or mission-critical" AI applications (although such applications are not further defined). To achieve this, developers of expert systems are called to integrate risk management methods within the standard AI system lifecycle. Under the Charter, data use must also adhere to acquisition, privacy, and representativeness standards (Ministry of Communications and Information Technology, 2023[20]).

Principle 1.5: Accountability

> *"AI actors should be accountable for the proper functioning of AI systems and for the respect of the above principles, based on their roles, the context, and consistent with the state of art."*

Accountability refers to the expectation that organisations and individuals will ensure and be held responsible for the proper functioning of the AI systems that they design, develop, operate or deploy throughout their lifecycle, in accordance with their roles and applicable regulatory frameworks. They are also accountable for demonstrating this through their actions and decision-making processes. In the case of a negative outcome, it also implies taking action to ensure better future outcomes (OECD, 2023[21]).

There is increasing demand in the public and private sectors for tools and processes to document AI system decisions and ensure accountability. This includes major AI standardisation initiatives led by organisations like the International Organization for Standardization (ISO), Institute of Electrical and Electronics Engineers (IEEE), International Telecommunication Union (ITU), NIST, European Telecommunications Standards Institute (ETSI), Internet Engineering Task Force (IETF), and European Committee for Electrotechnical Standardization (CEN-CENELEC). These initiatives focus on areas such as AI design (like trustworthiness by design), impact assessments, conformity evaluations, and risk management frameworks for AI. There are also governmental and intergovernmental standardisation efforts, such as the EU's proposed AI Act, the UK's AI Standards Hub, the European AI Alliance, the Council of Europe's Committee on Artificial Intelligence (CAI), and the EU-US Trade and Technology Council (OECD, 2023[21]).

The Charter promotes accountability around AI systems through the existing Egyptian legal frameworks (in particular, data privacy laws), certification mechanisms, and assigning responsibility for AI outcomes to human actors. For example, it clarifies that all stages of the AI system lifecycle are subject to the relevant Egyptian laws, such as laws on consumer protection, personal data protection, and anti-cybercrimes. As previously mentioned, however, the 2020 Data Protection Law still requires executive regulations for its enforcement and the establishment of a Data Protection Centre (see Principle 2.3: Providing an enabling policy environment for AI in Egypt), raising questions about the practical implementation of such elements of the Charter in practice.

Implementing values-based principles for AI (Principles 1.1-1.5)

Several countries have made efforts to implement values-based principles for AI. For example, AI Verify is Singapore's government-led compliance toolkit for the private sector to simplify adherence to 11 AI principles articulated by Singapore (transparency, explainability, repeatability/reproducibility, safety, security, robustness, fairness, data governance, accountability, human agency and oversight, inclusive growth, societal and environmental well-being). The toolkit is a web-based portal that is deployed locally within the user's environment to test AI models and record process checks. The software toolkit produces a report that can be shared with relevant stakeholders to signal transparency and best practices.

Table 2.2. Principles 1.1 to 1.5: AI values-based principles - Key findings and recommendations

Key findings	Recommendations
• The Egyptian Charter on Responsible AI is an effort to adapt high-level, internationally accepted AI principles into the local context and provides general and implementation guidelines to advance values-based principles for AI. • Egypt is taking steps towards implementing elements of the OECD AI values-based principles through the Egyptian Charter for Responsible AI.	• Provide more detailed guidance to AI actors on how to implement the Charter as they develop, deploy and use AI systems, including guidance specific to a given sector (e.g. a relevant international example is AI Verify (Singapore), a government-led compliance toolkit for the private sector to simplify adherence to AI principles). • Continue to take steps to implement the Egyptian Charter for Responsible AI in practice, and to monitor its impact. For example, by ensuring the Charter's values are reflected in implemented and enforceable legislation, regulations, and standards across government. • A roadmap could also be developed for further engaging stakeholders in the implementation of the Charter, for example by organising awareness-raising activities with key stakeholders such as universities, civil society and the start-up/business community.

Principle 2.1: Promoting investment in Egyptian AI research and development

> *"Governments should consider long-term public investment, and encourage private investment in research and development, including inter-disciplinary efforts, to spur innovation in trustworthy AI that focus on challenging technical issues and on AI-related social, legal and ethical implications and policy issues."*
>
> *"Governments should also consider public investment and encourage private investment in open datasets that are representative and respect privacy and data protection to support an environment for AI research and development that is free of inappropriate bias and to improve interoperability and use of standards."*

Investing in R&D is crucial to advancing AI at the national level. This is considered the cornerstone for national AI strategies to shape the future of technology, drive economic growth, and secure a nation's position in the global AI landscape. Most national AI strategies include R&D as a key pillar for government action in AI (OECD, 2023[21]). R&D initiatives provide the necessary resources and infrastructure to foster innovation. They also strengthen economic competitiveness by fostering a skilled workforce and attracting talent. According to Principle 2.1, governments should consider long-term public investment and encourage private investment in AI R&D, while facilitating the development of open datasets that are representative and respect privacy and data protection and supporting AI R&D that is free of inappropriate bias.

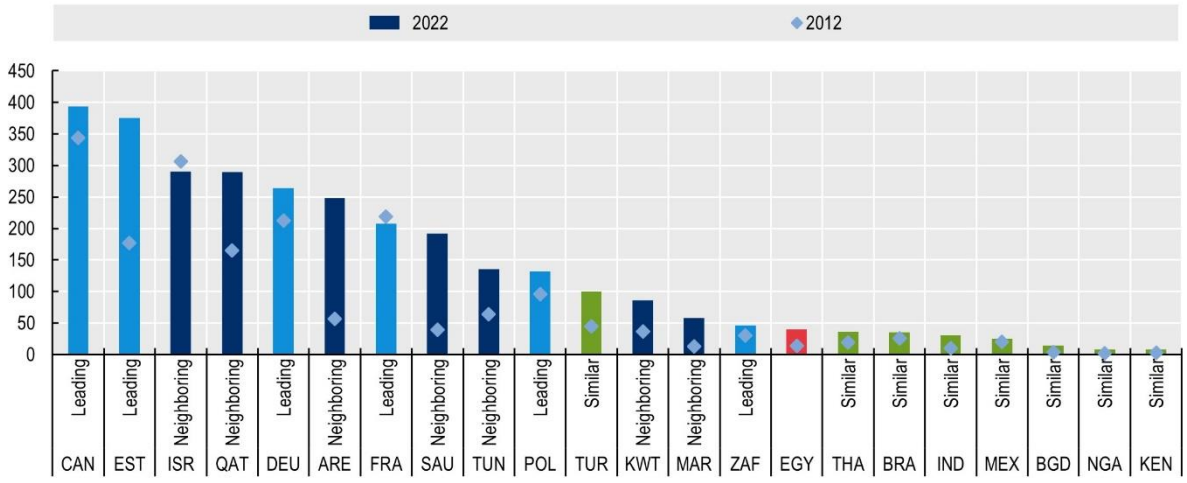
The NAIS acknowledges the importance of fostering investment in AI research and innovation as a pivotal aspect in establishing a competitive and sustainable AI industry in Egypt. This objective will be pursued through collaborative efforts involving public-private partnerships and initiatives with universities, research centres, and the private sector. The NAIS also distinguishes between R&D investments in basic and applied research, describing a phased approach for policy, with priority given to AI applied to real-world applications in the short term and building competitive capacity in basic research in the medium term (National Council for Artificial Intelligence, 2019[1]).

The number of Egyptian AI publications has consistently risen over the past decade

One way to measure progress in AI R&D is to examine how much AI research countries publish. AI publications in Egypt have been steadily growing over the past decade. While the country compares well in the number of AI publications per capita with countries of similar economic development, such as Brazil, India and Thailand, it lags behind smaller neighbouring countries, notably Israel and Qatar (Figure 2.3).

Figure 2.3. Egypt compares well to similar countries for AI publications per capita but lags behind neighbouring and leading countries

AI publications per capita, 2012 and 2022

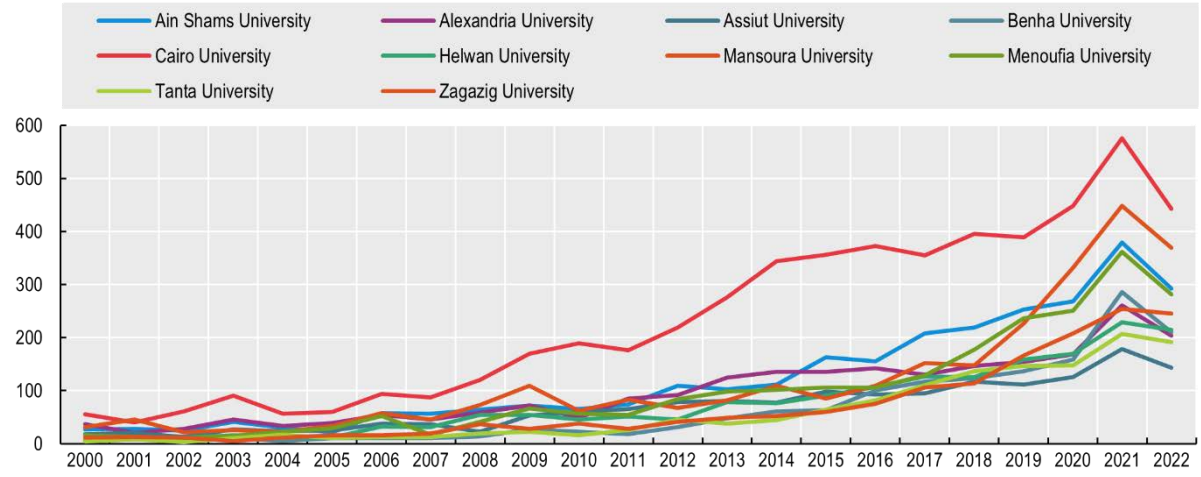


Source: OECD.AI (2023), using data from OpenAlex, accessed on 15/9/2023, www.oecd.ai.

The main institutions spearheading research and publications in the field AI in Egypt are concentrated in the capital city of Cairo and its region, namely Cairo University, Ain Shams University, and Helwan University (Figure 2.4).

Figure 2.4. AI publications have increased since the early 2000s, primarily concentrated in universities in Cairo

AI publications by institution, 2000-2022

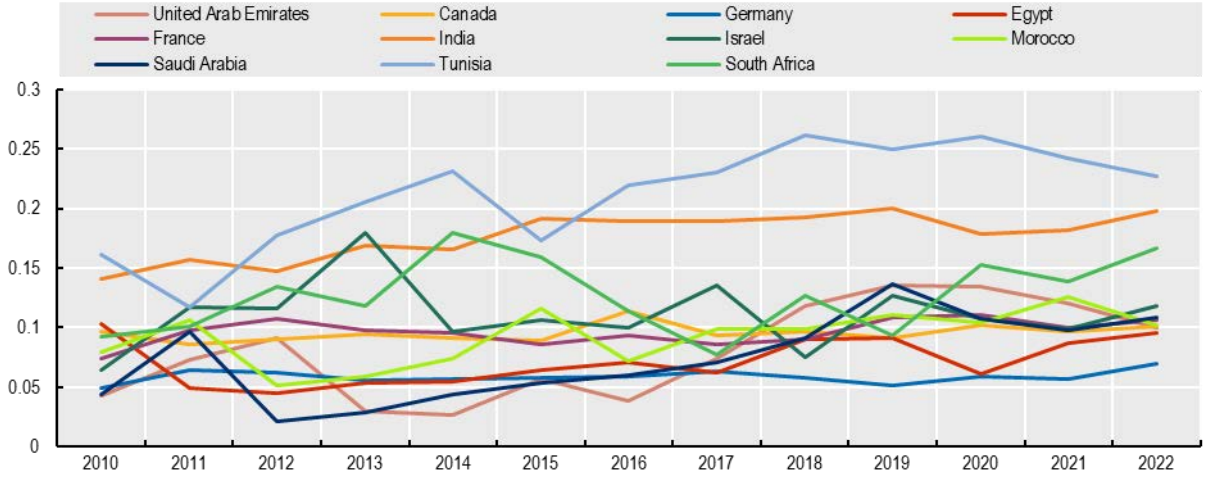


Source: OECD.AI (2023), using data from OpenAlex., accessed on 15/9/2023, www.oecd.ai.

Although women are authoring AI publications (Figure 2.5), AI researchers are still predominantly male. From 2010 to 2022, women have authored between 5% and 10% of AI publications in Egypt. In 2022, 10% of publications were written exclusively by women, compared to 23% and 20% in Tunisia and India, thus signalling a relatively high gender gap in AI research in the country.

Figure 2.5. A gender gap remains in AI research

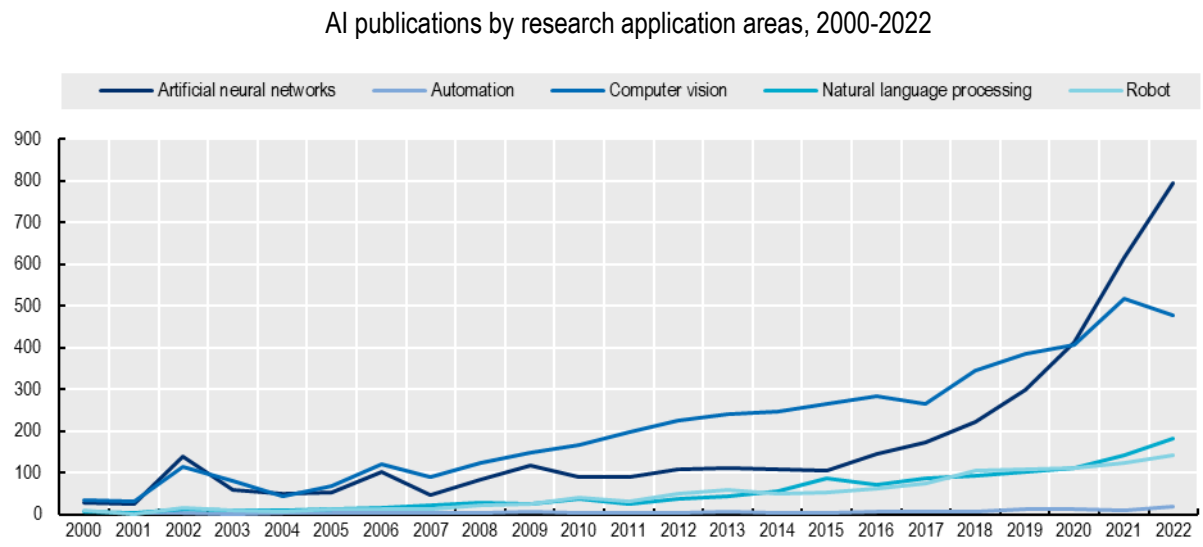
Share of AI publications authored exclusively by women by country, 2010 to 2022



Source: OECD.AI (2023), using data from Elsevier (Scopus), accessed on 15/9/2023, www.oecd.ai.

Consistent with global trends in the distribution of AI topics, Egyptian research primarily focuses on artificial neural networks and computer vision. While global research output across all topic areas dipped from 2021 to 2022, Egypt has maintained an increase in publication outputs in four out of the five topic areas (Figure 2.6).

Figure 2.6. AI publications by Egyptian institutions mainly focus on artificial neural networks and computer vision



Source: OECD.AI (2023), using data from OpenAlex, accessed on 15/9/2023, www.oecd.ai.

Significant untapped potential remains in text and speech applications in Egyptian dialect of the Arabic language for domain-specific uses

NLP systems for the Egyptian dialect of the Arabic language are being developed. The Applied Innovation Center (AIC) has developed an automatic speech transcription module used in the judicial system (see section below) and a number of start-ups are emerging in this field (Table 2.4). However, significant untapped potential remains in text and speech applications, spanning dialects, nuances, and domain-specific uses.

There are a number of challenges for NLP in Arabic. While English NLP generally follows strict grammatical rules, there are no such equivalent rules for Arabic, only norms that vary significantly by country. Further, the letters themselves change depending on their placement within the word causing additional complications. From orthography to syntax, the number of challenges is vast (Shaalan, 2018[36]). There are social and business needs for better tools related to Arabic NLP, such as machine translation, text summarisation, and semantic information retrieval. The NAIS recognises that it is important for Egypt to work towards establishing further NLP tools for the government and other entities (Government of Egypt, 2021[25]).

The need for advanced NLP applications has increased since the release of ChatGPT in late 2022. The most advanced large language models (LLMs), including GPT-4 (powering OpenAI's ChatGPT), Google's PaLM (behind the Bard chatbot), and Meta's open-source model LLaMA, possess the capability to process and generate text in Arabic. Still, answers appear to be optimised in Modern Standard Arabic (MSA) and not in the different Arabic dialects. Efforts are underway to develop LLMs in Arabic in Arab-speaking countries, namely in the United Arab Emirates (UAE). The model Jais was reported to outperform previous models (Falcon) and other open-source models like LLaMA in Arabic accuracy benchmarks. Jais is also considered to incorporate a more precise understanding of the culture and context of the region, diverging from the predominant US-centric models (The Financial Times, 2023[37]).

Moving forward, Egypt should research, construct, and fine-tune LLMs that provide applications to several priority industries and use cases. Investing in Arabic LLMs suitable for the Egyptian dialect could provide dedicated support for AI start-ups and SMEs developing Arabic language NLP applications. This could

include the development of Arabic language foundation models, specialised Arabic language datasets, and chatbot applications. Support could come in the form of grants/loans, curated datasets with public sector data, and opportunities in government procurement contracts, such as chatbots for better delivery of public services.

Egypt lacks a specific funding programme for AI R&D

While on an increasing trend in recent years, public funding for R&D in Egypt was below 1% of GDP in 2021 (0.9%), above the average of Arab states (0.6%), but notably lower than other countries such as Türkiye (1.4%), the United Arab Emirates (1.5%), and the top AI innovating countries (UNESCO Institute for Statistics (UIS), 2023[38]). Most of the science, technology and innovation, as well as R&D spending in Egypt, is concentrated in public sector research institutions and universities, while business investment in R&D is relatively low.

The Science and Technology Development Fund (STDF), established in 2007 as a result of a major reform of the scientific research system in the country, is the largest funding body for scientific research in Egypt. STDF implements its objectives within the context of the National Science and Technology Development Strategy, which is established by the Higher Council for Science & Technology. Egyptian ministries with the strongest impact on the country's economy are represented in the council to direct research initiatives towards the science and technology activities which have a direct influence on national development plans.

The STDF has issued two AI-specific calls in 2019 and 2020, supporting AI applied research projects in number of AI topics, targeted at applications primarily in health, agriculture, energy, and industry. The two calls within the AI targeted programme provided grants to individual Egyptian researchers – encouraged to collaborate with foreign institutions - of about USD 100 000 (EGP 3 million) over a maximum period of three years (Science and Technology Development Fund, 2019[39]; Science and Technology Development Fund, 2020[40]). However, there is no information of the total amounts allocated to the AI specific calls.

The Information Technology Industry Development Agency (ITIDA) is a public-private partnership between the MCIT, and the private sector aimed at developing Information Technology in Egypt. Founded in 2004, ITIDA promotes collaboration between industry, government and academia. The agency has established a number of collaborations with major foreign companies to promote capacity building and access to infrastructure, although the scope of activities is broader than AI. Examples of collaborations promoted by ITIDA in the field of AI include a 2019 R&D agreement with the French company Valeo for research on AI in vehicles (Enterprise, 2019[41])and two MoUs with Chinese telecommunications company Huawei in 2022 and 2023 to support start-ups and to provide training activities (ITIDA, 2023[42]). ITIDA also supports capacity building in young students by funding collaboration between industry and academia in the form of AI hackathons, i.e. competitions focused on using AI to solve societal challenges.

Although these initiatives signal increased attention to financing AI R&D in the country, AI-specific funding from the STDF was limited to two calls and not repeated after 2020. While it is not possible to estimate public funding to AI R&D in Egypt, interview participants noted that this is currently limited and not commensurate to the country's ambitions in AI. Funding to AI R&D should be increased, both through local funding and through programmes financed by international funding agencies. Furthermore, Egypt lacks a national programme or body responsible for funding and coordinating AI research efforts, as well as a comprehensive mechanism connecting knowledge with innovation to solve real-life challenges.

Several governments have established national AI research institutes and centres by tasking specialised institutions or organisations to promote research, development, and innovation in AI. Such centres typically have a mandate to advance AI technologies, foster collaboration between academia, industry, and government, and contribute to the broader AI ecosystem in the country (Table 2.3). The NAIS suggests establishing new centres for AI research in Egypt to "boost AI research output, improve the ICT and AI

ecosystem, and provide a vehicle to hire researchers from abroad". However, this policy has yet to be enacted.

An example of a recently established AI research centre in the region is Morocco's AI Centre of Excellence, AI Mouvement. The centre was founded in 2022 to stimulate the AI ecosystem, consult different stakeholders to develop technologies, facilitate inclusive training, leverage R&D and entrepreneurship to maximise the economic and societal benefits, and finally, analyse transformations brought about by AI. There are currently nine ongoing R&D projects at the centre which range from using AI to identify a link between neural activity and behaviour, to Arabic NLP, to smart city waste management. In addition to R&D activities, the centre hosts two programmes: the AI Governance & Practice Executive Master programme and the Women in Tech & AI programme.

Table 2.3. Countries with national AI research centres

Country	Centres
Canada	Amii, the Vector Institute, and Mila; Innovative Solutions Canada (ISC) scale-up R&D programme using government procurement as a tool
France	The National Institute for Research in Digital Science and Technology (INRIA), the AI for Science and Science for AI (AISSAI), LaborIA, and four interdisciplinary institutes for AI (3AI)
Germany	6 AI Excellence Centres
Australia	National AI Centre
Korea	Research Data Centre of AI Innovation Hub
United States	The National Science Foundation (NSF) funds various AI research institutes across the country
Brazil	Applied Research Centres in AI
Morocco	Morocco AI Mouvement, Centre of Excellence

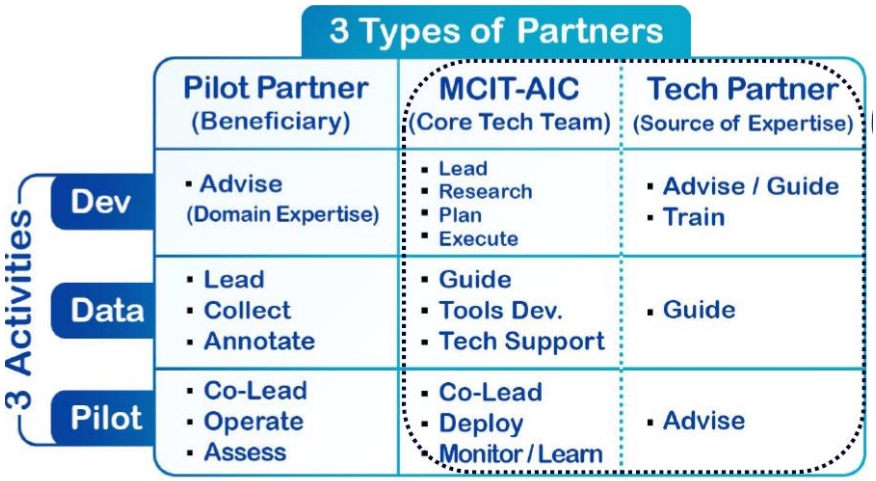
Source: Research by OECD.AI

The Applied Innovation Centre promotes the use of AI to solve national challenges, but implementation at scale is hindered by the lack of a clear funding mechanism and varying levels of AI readiness across government entities

Housed within MCIT, the AIC supports NAIS implementation by identifying innovative AI-enabled solutions to the challenges faced by Egyptian society, developing human capital, and creating an environment for innovative enterprises to form and succeed. The AIC operates under a tripartite partnership model between a ministry partner, MCIT/AIC, and a private sector technology company to implement demand-driven projects (Figure 2.7). The three parties identify a project of mutual interest and set up a team to implement it. The technology partner provides training and knowledge transfer, while the beneficiary organisation contributes domain expertise. The resulting pilot is a shared Intellectual Property (IP) and a separate commercial agreement, by which usually the Egyptian government gets the right to use the product inside Egypt while the technology partner is free to market it abroad.

So far, the AIC has developed a telemedicine platform and an application that uses AI for screening diabetic retinopathy and is currently developing an initiative to early detect diabetic retinopathy for one million citizens. The AIC also developed an automatic speech transcription system for Arabic, which is being used in tribunals to transcribe sentences given by judges. In the agricultural sector, the AIC has developed several AI modules and GIS/Aerial systems for capturing actual land use and crop distribution, as well as generating various real-time statistics for decision support at the national and regional levels. Six additional projects are currently ongoing, and five are in the final stages of negotiations in the fields of healthcare, agriculture, judiciary, law enforcement, natural resources and infrastructure.

Figure 2.7. The AIC Partnership model



Source: MCIT (2022), Applied Innovation Center - Overview November 2022.

Key for the successful functioning of the AIC and for the uptake of AI solutions in the government is awareness about AI and its potential use cases in the specific domains, as the AIC partnership model is demand-driven, and pilot projects are initiated upon the initiative of domain-Ministries or other Egyptian entities. Currently there appears to be different levels of understanding of AI potential use cases and applications within the government entities in Egypt, ranging from advanced comprehension to lack of basic awareness. For the AIC to achieve its objective and for the government to seize the benefits of AI across sectors, increasing awareness on AI through AI literacy programmes to be delivered in all Ministries will be essential.

Furthermore, while this tripartite model has developed some successful projects and fostered inter-Ministry collaboration, scale-up challenges remain. The lack of a clear mechanism for partner Ministries to mobilise budget for the AIC projects is a limiting factor for the centre to operate at scale. Interview participants highlighted that the approval process for budgets is required for each project. For example, in some instances, a project may face an unexpected halt, despite having a budget, due to a cumbersome approval process. An effective approach would involve assigning a mandate and a dedicated budget to each government entity, mirroring the successful model implemented for the Digital Transformation programme. Under the “Our Opportunity is Digital” Initiative, MCIT is setting aside at least 10% of public digital transformation projects for SMEs and start-ups, thus ensuring budget is available to finance projects from these companies (OECD, 2021[43]). Such a streamlined process would ensure that there is a clearly defined 'bucket' from which entities can draw funds, eliminating the need for a protracted approval process for each project. Additionally, advocating for the approval of the entire budget in a consolidated manner, rather than in fragmented pieces, is essential for rapid project execution.

AI start-ups are still nascent in Egypt and government support lacks an AI focus

A vibrant start-up ecosystem is taking root in Egypt. In 2021, with 562 active technology start-ups, Egypt had the fourth-largest ecosystem in Africa by number of companies, behind South Africa, Nigeria, and Kenya (ITIDA, 2021[44]). According to the same report, however, only 21 AI start-ups were active in the country (or 4% of the total) in 2021, and all except two were founded after 2016.

As with other populous countries, such as South Africa and Brazil, start-ups in Egypt are mostly active in e-commerce, fintech, transport, and logistics (Magnitt & ITIDA, 2022[45]), providing platform solutions in highly fragmented markets. Egypt has an emerging fintech industry, and the government has been

promoting this sector through a regulatory sandbox (see Principle 2.3: Providing an enabling policy environment for AI in Egypt), as well as with a dedicated USD 64 million Fintech Innovation Fund backed by the Central Bank of Egypt (CBE).

Most Egyptian AI start-ups operate domestically and in line with the overall trends for start-ups, and are active in Business to Consumer (B2C) services, such as financial and consumer services. Examples are the Blnk Consumer Finance start-up, a digital lending platform, Elmenus Egypt, which provides personalised food recommendations to users through its AI-powered food recommendation engine, and Synapse Analytics (Fintech). Some start-ups are also active in Business to Business (B2B) markets, providing solutions for digital identity (Datify) and integrated data management (Pianat), and a platform to automate ML process (Devision X) to label and train data, and deploy AI-vision applications, including for the manufacturing sector. In addition, some AI start-ups provide sector-specific solutions, for example in agriculture (Visual and Artificial Intelligence Solutions, VAIS), providing AI solutions to farmers to address climate change challenges. Several start-ups focusing on NLP are also emerging (Table 2.4).

Table 2.4. Egyptian start-ups leveraging natural language processing (NLP)

Examples of start-ups using NLP in Egypt

Name of start-up	Location	Year of establishment	Short description of activities
Botitapp	Cairo	2022	Botit app employs NLP and neural networks to optimise the e-shopping experience. From pharmaceuticals to clothes to groceries, the phone application allows the consumer to place a consolidated order on a range of items, all with same-day delivery.
Botme	Giza	2017	Botme builds NLP-driven chatbots for a diverse client base.
DXwand	Cheyenne, Wyoming & Cairo	2018	Using deep learning and NLP, DXwand created a “conversational AI software” geared towards ameliorating the client’s customer experience.
intella	Giza	2021	Contributing data insights, business intelligence, chatbot analytics and Arabic voice transcription for 25 dialects, intella leverages AI and NLP models to provide cutting-edge solutions.
MerQ	Ismailia	2018	Focusing on the financial sector, MerQ has four key chatbot products: the credit card assistant, Sally; the loan assistant, Sara; the e-wallet assistant, LaRa; and finally, the accounts assistant, Nancy.
WideBot	Cairo	2016	WideBot is a chatbot platform which harnesses NLP to identify anything from language and dialect to intent and sentiment.

Source: Information provided by Egypt during the country mission.

Several initiatives aim to foster start-up innovation in Egypt, but none of them have a specific focus on AI

The start-up community in Egypt is supported by several incubators and accelerators, promoted and financed by the private sector, universities, the government and non-governmental organisations (NGOs) (African Development Bank Group, 2022[46]). Examples of university structures include the Centre for Entrepreneurship at the Arab Academy for Science and Technology (AAST), and the AUC Venture Lab Accelerator at the American University in Cairo. MCIT, together with its agencies ITIDA and the Technology Innovation & Entrepreneurship Center (TIEC), also provides full support for start-ups in the ICT sector, from seed capital to incubation services, business consultancies and networking opportunities. The MCIT has also recently partnered up with the Silicon Valley Plug and Play programme and launched to date three rounds of “Plug and Play Egypt Innovation Platform” in partnership with the National Bank of Egypt (NBE), Egypt Post, and USAID, providing mentorship and support to Egyptian start-ups in Cairo.

Most of the activities to support entrepreneurship, including awareness campaigns, accelerators, and incubators, are taking place in Cairo. The Egyptian capital city is the key pole for AI innovation in the

country and one of the main poles in Africa. While Giza is home to only 2 VC-funded AI start-ups, the city has brought in over one-third of all investment in the sector. To foster innovation across the country, the MCIT has created seven “Creativa Innovation Hubs” across Egypt in cooperation with public universities, but outcomes seem limited to date.

While a number of initiatives are flourishing in Egypt to support the innovative ecosystem, their scope is horizontal, without a clear sectoral or technology focus. There are opportunities to strengthen and expand incubation and acceleration programmes tailored for AI start-ups. These programmes should provide mentorship, infrastructure to scale up AI solutions, industry-specific guidance, and financial support in the form of grants to support pilot projects in the early stages of start-up development.

VC funding to AI start-ups has been increasing but Egypt lags behind regional leaders

VC investment in Egypt has risen since 2020 and reached USD 79.4 million in 2022 but remains insufficient to compete against global leaders in AI (Figure 2.8). Meanwhile, the country is catching up to regional leaders as many are experiencing dips in private investment (Figure 2.9). More broadly, Egypt has bolstered its VC portfolio with 160 deals closed and over USD 500 million in financing for start-ups in 2022 (Magnitt & ITIDA, 2022[45]). One-quarter of deals and around one-sixth of VC funding in Egypt are going towards AI-related start-ups.

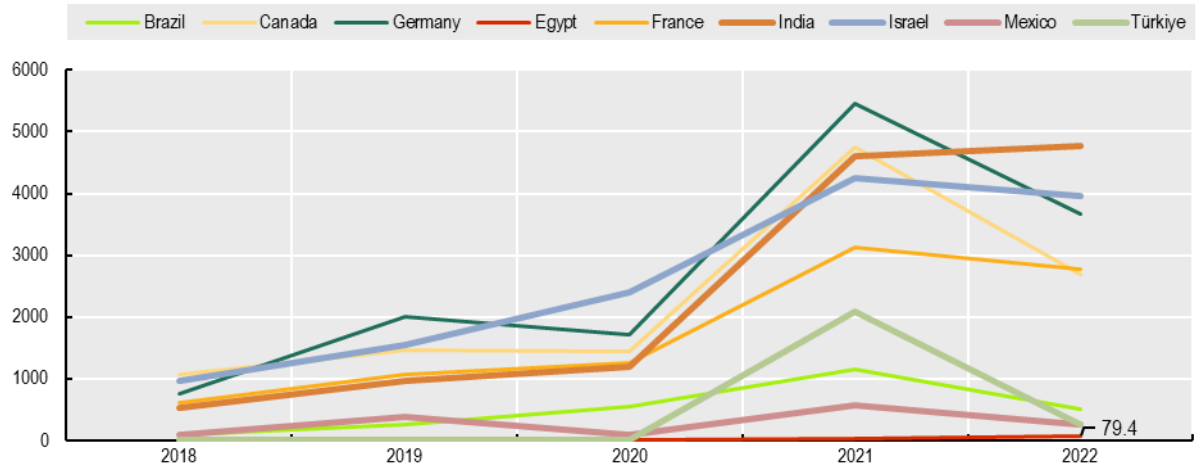
Egypt has been promoting investment in innovative start-ups through several initiatives in recent years. The SMEs and Entrepreneurship Law (2020) aims to support projects and enterprises that have been operating for less than seven years by providing tax, customs, and non-financial incentives. The law also provides monetary incentives for corporations, investment funds, incubators, accelerators and all entities supporting start-ups and SMEs. The Ministry of International Cooperation (MOIC) has partnered with the private sector to create Egypt Venture, which funds start-ups, accelerators and other funds, and also to set up two accelerators, Falak Start-ups and EPG EV Fintech. MSMEDA, the Agency for MSMEs established in 2017, has also created a VC unit and “funds of funds” with the support of the World Bank to support start-ups through direct investments in VC companies, incubators and accelerators, as well as loans to VC firms and early-stage start-ups that partner with a strategic investor. More recently, ITIDA signed a cooperation protocol with the General Authority for Investment and Free Zones (GAFI) and the Financial Regulatory Authority to encourage investment in Egyptian start-ups and facilitate international partnerships.

The main challenges encountered by AI start-ups relate to skills, data availability, and accessibility and access to financing

Across both the development and application of AI by start-ups, interview participants identified three main challenges for AI start-ups in the country, namely skills (see Principle 2.4: Building human capacity and preparing for labour market transition in Egypt), data and infrastructure (see Principle 2.2: Fostering a digital ecosystem for AI in Egypt), and regulatory and financial constraints (see Principle 2.3: Providing an enabling policy environment for AI in Egypt).

Figure 2.8. VC investment has increased since 2020 but is low compared to similar and leading countries

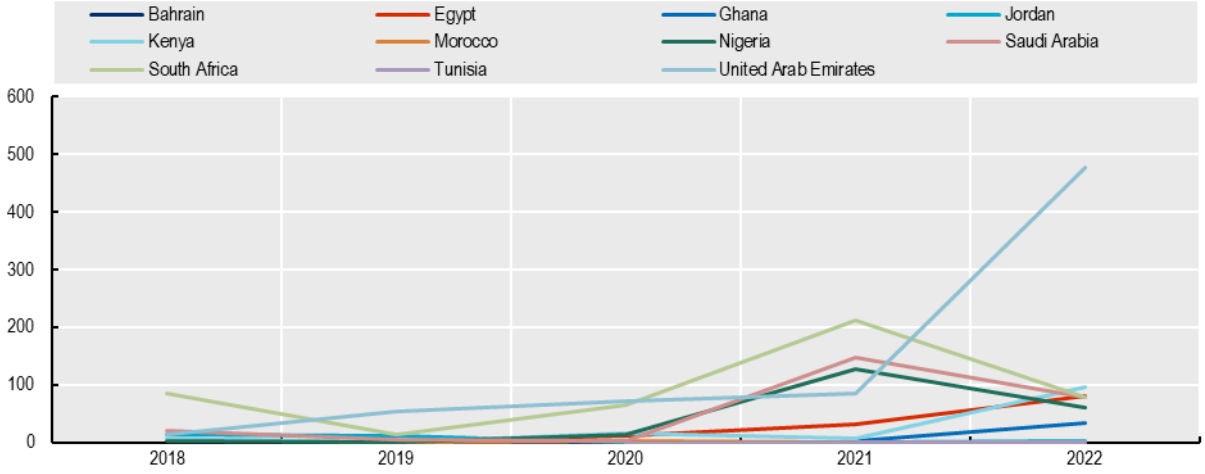
VC investment in USD millions, 2018 to 2022



Source: OECD.AI (2023), using data from Prequin, accessed on 15/9/2023, www.oecd.ai.

Figure 2.9. Egypt ranked second in Africa for AI-related VC investment in 2022 but lags behind regional leaders

VC investment in USD millions, 2018 to 2022



Source: OECD.AI (2023), using data from Preqin, accessed on 15/9/2023, www.oecd.ai.

Interviews with senior management members of AI start-ups highlighted that despite the supportive environment, access to finance remains one of the key obstacles to the further development of innovative firms in the country. Interviewees pointed out the lack of funding for software development and deep tech projects based in Egypt and noted that VC investors tend to look outside of the country for such opportunities, particularly in Europe. The financing gap for Egyptian start-ups appears to be more pronounced at the seed stage (African Development Bank Group, 2022[46]), which reduces the survival rate for many of the start-ups supported by the various accelerators and incubators in the country. In addition, AI start-up managers pointed to barriers to creating networks of exchange with foreign companies for knowledge transfer and crosspollination. They indicated that establishing an international customer

base remains challenging despite achieving some market presence within the region. This aligns with recent data on the inflow of VC investments in the country, revealing that the majority of VC investments in Egyptian AI start-ups originate from domestic sources, with Saudi Arabian investors following closely (OECD.AI, 2023[47]).

To strengthen the VC landscape for AI start-ups, the Egyptian government could facilitate start-up participation in international tradeshows and networking events. This exposure would provide a platform for start-ups to pitch their ideas to a global audience of potential investors and help attract international investors who may find promising opportunities within the local AI ecosystem. Furthermore, the government could facilitate initiatives that enable start-ups to explore and enter international markets, for instance, through programmes that provide guidance on international expansion and regulatory compliance in target markets.

To increase market access and provide opportunities for growth, the government could also establish challenges for academia and start-ups to come together and increase the transfer of AI research into innovations and solve priority challenges for the country. Another avenue for market growth could be encouraging public procurement policies that prioritise AI solutions, offering start-ups access to government contracts. While a recent reform gives start-ups an advantage of 15% on cost when bidding for public contracts, interview participants reported that granting a public contract to a start-up is still perceived by officials as riskier. As such, this provision remains insufficient to increase market access by innovative start-ups.

Table 2.5. Principle 2.1: Promoting AI R&D - Key findings and recommendations

Key findings	Recommendations
• Public funding for AI R&D is limited.	• Establish AI-specific tracks/programmes in funding agencies (e.g. STDF and ITIDA). • Establish a national AI fund through public-private joint investment. • Establish AI research centre(s) to promote R&D&I, support talent creation and retention, and promote collaboration and transfer between academia, industry and government.
• AI publications are mostly authored by male researchers.	• Introduce dedicated programmes to strengthen women's participation in AI research.
• There is untapped potential in both text and speech applications in the Arabic Egyptian dialect for domain-specific uses.	• Research, construct, and fine tune large language models that fit priority industries and scenarios.
• Some start-ups exist focusing on Arabic natural language processing (NLP) applications.	• Provide dedicated support for AI start-ups and SMEs developing Arabic language NLP applications (for example, possibly including the development of Arabic language foundation models, specialized Arabic language datasets, chatbot applications etc.). Support could include grants/loans, curated datasets with public sector data, opportunities in government procurement contracts (e.g. chatbots for better delivery of public services).

Key findings	Recommendations
• AI development is largely government-led through the AIC, but awareness about AI across Ministries is uneven. • There is a lack of a clear mandate and budget for Ministries to promote AI projects through the AIC.	• Establish AI literacy programmes to be delivered in all Ministries. • Assign a mandate (e.g. one AI project per Ministry) and dedicated budget to relevant government entities to promote AI R&D projects.
• Information on AI uptake by enterprises is lacking.	• Monitor AI uptake in enterprises by including ad-hoc questions/indicators in the ICT national usage survey.
• VC funding to AI start-ups has been increasing but Egypt lags behind regional leaders.	• Support start-ups through tradeshows/networking events to pitch to international investors and help spotlight Egyptian innovations on the international stage. • Improve access to domestic and international markets by strengthening links with companies and the public sector (public procurement). • Establish challenges for academia and start-ups to come together and increase AI research transfer into innovations and solve priority challenges for the country.

Principle 2.2: Fostering a digital ecosystem for AI in Egypt

> *"Governments should foster the development of, and access to, a digital ecosystem for trustworthy AI. Such an ecosystem includes in particular digital technologies and infrastructure, and mechanisms for sharing AI knowledge, as appropriate. In this regard, governments should consider promoting mechanisms, such as data trusts, to support the safe, fair, legal and ethical sharing of data."*

Infrastructure for AI, also known as "AI compute" is a substantial component of AI development. It is expected to be a continued driver of AI's improved capabilities over time. It is distinguished from other AI inputs like data or algorithms by being grounded in "stacks" (layers) of physical infrastructure and hardware, along with software specialised for AI (OECD, 2023[48]). Advancements in AI compute have enabled a transition from general-purpose processors, such as Central Processing Units (CPUs), to specialised hardware requiring less energy for more computations per unit of time. Today, advanced AI is predominantly trained on specialised hardware optimised for certain types of operations, such as Graphics Processing Units (GPUs), Tensor Processing Units (TPUs), and others.

AI research is becoming more computationally intensive and expensive, with many countries not having the AI compute capacity needed to implement their national AI strategies. The demand for AI compute has grown dramatically, especially for deep learning neural networks, with the compute required to train modern AI has grown substantially (OECD, 2023[48]). Securing specialised hardware purpose-built for AI can be challenging due to complex supply chains, as illustrated by bottlenecks in the semiconductor industry (Khan, Mann and Peterson, 2021[49]).

Egypt's National AI Strategy recognises AI infrastructure as a key enabler for AI, but gaps remain around the presence of local cloud providers, AI compute access, and the availability of skilled talent.

Along with data, AI governance, and developing an AI ecosystem in Egypt, the NAIS states infrastructure as an essential enabler, including "fair access to compute, storage, networking, and other assets" for the development and use of AI. However, the NAIS also identifies a key gap in domestic AI research, which is

that Egypt's "universities and national research institutions do not have enough computing power to run AI". From a talent perspective, the NAIS also identifies AI compute skills as a key bottle neck, with students often not having a sufficient "computing background that allows them to appreciate and use AI in their respective fields" (Government of Egypt, 2021[25]).

Although data centres and supercomputers are increasingly being updated with specialised infrastructure to enable the efficient execution of AI-specific workloads, many countries and existing data sets do not distinguish supercomputers according to workload capacity specialised for AI (e.g. the Top500 list). Thus analysis of data centres and supercomputers available within a country can serve as a proxy measure for national compute capacity, with the caveat that such infrastructure is not necessarily used solely for AI purposes.

MCIT is the primary Ministry responsible for government data centres and computing infrastructure, in coordination with other Ministries as relevant. MCIT has a tier III data centre located at the Smart Village in Cairo, with the capability to serve research, science, mathematics, and other computing needs, in addition to some AI applications. The supercomputer can be made available for the computing needs of AIC projects. The team of AIC engineers provide the skills and know-how to operate the supercomputing infrastructure to facilitate research and experiments for AI applications as part of AIC projects (Ministry of Communications and Information Technology, 2022[50]). According to Egyptian officials, there are also plans to acquire additional computing capacity, such as supercomputers for the City of Knowledge in the New Capital and the Egyptian Meteorological Authority.

Compute capacity also exists across Egyptian academic and research institutions. For example, universities like Cairo University and Bibliotheca Alexandria own and operate supercomputers for research and academic applications. One of the recent additions of powerful high-performance computing capacity in Egypt is the supercomputer at Bibliotheca Alexandrina, which upgraded its supercomputing facility to include a peak performance of nearly ten times the performance of its predecessor. This new supercomputing cluster supports research efforts at numerous Egyptian universities and research institutes, in addition to offering its capacity to regional projects through the European-funded VI-SEEM project (Bibliotheca Alexandria, 2023[51]).

Apart from university and government owned and operated data centres, the Egyptian market for data centre infrastructure management includes local operators, as well as other regional and international operators as the country is witnessing an increased shift from on-premises data centres to colocation and managed facilities by SMEs and larger organisations. Private sector owners and operators of data centres in Egypt include Telecom Egypt, GPX Global Systems, Etisalat Group, Raya, ECC Solutions, Vodafone, Egypt for Information Dissemination (EGID), and others.

MCIT has articulated the goal of leveraging Egypt's geographic location and available resources to provide an attractive environment for infrastructure investors, and hyperscalers, in particular to establish and operate data centres in Egypt. In December 202, MCIT established the Data Center Committee (DCC) to receive requests from local and international companies interested in investing, establishing, and/or managing data centres in Egypt. The DCC studies the land and infrastructure requirements for establishing data centres (e.g. secure energy sources, reliable telecommunications infrastructure etc). The DCC also establishes contracting frameworks with interested investors to manage such projects in Egypt. In 2021, Egypt issued the Data Centers Regulatory Framework clarifying the process for data centre and cloud providers operating in Egypt to provide market clarity for both the global and domestic data centre market.

Cloud computing infrastructure was identified by many in the AI ecosystem as a possible bottleneck to further AI diffusion, namely with the absence of domestic cloud infrastructure options for training and using AI systems. Partnerships with large and well established hyperscalers (e.g. Amazon Web Services (AWS), Google Cloud, Microsoft Azure) were identified as potential ways to close this gap to ensure that AI developers in Egypt can access computing infrastructure to train and use AI models. However, some obstacles were identified to using cloud services in Egypt for AI training, for example domestic data

localisation restrictions preventing data from being transferred to servers located outside of the country. As such, officials identified on-premise data centres and cloud services as a priority to facilitate computing infrastructure access to Egyptian AI developers and users. Avoiding "vendor lock-in" was identified as another imperative by officials, in order to diversify partnerships in favour of building local Egyptian capacity for both on-premise and cloud computing AI solutions.

Access to AI compute infrastructure and data are key gaps for the Egyptian innovation community, namely for start-ups and SMEs

Actors in the Egyptian innovation community face challenges accessing AI compute infrastructure and data, namely for start-ups and SMEs. Access issues can be seen across geographical divides, for instance between urban and rural areas, in addition to sectoral divides, such as between academia and large private sector companies. According to Egyptian officials, access to AI compute capacity in Egypt largely depends on who owns the infrastructure itself, which is largely in the private sector and in large city hubs like Cairo. This creates access challenges for start-ups and SMEs looking to gain access to compute capacity to train AI systems, as well as challenges for those seeking such access outside of large city centres.

Some in the Egyptian AI ecosystem also identified regulatory barriers to accessing AI compute, namely for obtaining the required data and hardware. Access to data specifically can be complicated by a lack of availability of domestic quality data, for example a lack of open datasets to begin with or poor quality and data labelling making it challenging to use for AI training. For hardware, some in the Egyptian AI community identified regulatory challenges for the import of specialised AI hardware, such as GPUs. The cost of obtaining and using such infrastructure was also raised as a barrier, namely due to the devaluation of the Egyptian pound in recent years and the energy intensity of such AI hardware for training large AI systems in particular.

Egypt is competing against global players to develop, attract, and retain specialised talent to efficiently and effectively use AI infrastructure

Specialised skills, often engineers or those with technical hardware expertise, are needed to use AI compute resources efficiently and effectively. However, with companies globally competing to attract the top AI talent, and considering the increasing compute demands of AI workloads and the evolving AI compute hardware stack, skilled labour specialised in AI infrastructure is a bottleneck globally (OECD, 2023[48]). Such skills are currently acquired through university courses, at research institutes, and through on-the-job training. Interviews with those working in Egypt's AI ecosystem pointed to a specialised talent gap for operating AI infrastructure efficiently and effectively. Some suggested the need for access to skilled labour in tandem with access to computing time.

As with many countries, Egypt could benefit from conducting an assessment of existing AI compute capacity, accessibility, and future needs

Many national AI policy initiatives, including Egypt's AI strategy, do not include detailed measures of AI infrastructure and corresponding to the needs of AI actors along the innovation continuum, focusing instead on general-purpose compute. Translating the AI ambitions contained in national AI strategies into more concrete considerations – such as reviewing current national AI infrastructure and the compute needs of public and private sector actors – would enable more efficient and targeted planning of AI infrastructure investments. Consideration should also be given to measuring whether national AI compute is owned domestically or rented from providers abroad, such as through cloud compute providers. Based on national needs, data localisation requirements, and security priorities, attention to building out domestic or regionally owned on-premise and/or cloud compute capacity could be warranted (OECD, 2023[48]).

A key challenge identified by Egyptian officials is the absence of knowing what AI-fit infrastructure exists within the country, both in terms of infrastructure owner by the private and public sector, including in domestic universities. Some countries are undertaking initiatives to increase the AI infrastructure available for research and academia, in addition to taking stock of their national AI infrastructure needs. Examining best practices from such countries could help to inform analysis and next steps for building a resilient and accessible base of AI compute infrastructure in Egypt to serve its growing AI ecosystem (Table 2.6).

For example, Canada's Pan-Canadian AI Strategy (2017, 2021) leverages a national network of AI research institutes and supports the acquisition of HPC capacity for AI research. In 2020, the first Canadian Digital Research Infrastructure Needs Assessment was launched to identify future digital research infrastructure and service needs (Digital Research Alliance of Canada, 2020[52]). In Germany, the Gauss Centre for Supercomputing combines the three largest national supercomputing centres in into the country's leading supercomputing institution: the High-Performance Computing Centre Stuttgart (HLRS), Jülich Supercomputing Centre (JSC), and Leibniz Supercomputing Centre, Garching/Munich (LRZ). It offers world-class computing infrastructure for research and academic applications, including for AI, and forms the basis of key computing infrastructure as part of the European High Performance Computing Joint Undertaking (EuroHPC), which is discussed in further detail below (Gauss Centre for Supercomputing, 2023[53]; EuroHPC, 2023[54]).

In 2022, the United Kingdom conducted the Future of Compute review to examine its digital research infrastructure needs, including for AI, calling for an integrated compute ecosystem and significant investment in public AI infrastructure (The Alan Turing Institute, 2022[55]). The United States aims to make world-class computing resources and datasets available to researchers through the proposed National AI Research Resource (NAIRR). Initiatives also exist further up the AI infrastructure supply chain, for example Korea's K-Cloud Project aims to manufacture and deploy world-class AI chips domestically, to provide improved national cloud computing infrastructure.

EuroHPC is another example of building compute capacity at a regional level, enabling a supercomputing ecosystem and research applications across Europe. Established in 2018 as European Commission initiative, EuroHPC brings together EU member states and private sector industry partners with a budget of about EUR 7 billion for 2021-2027. Only some of EuroHPC's infrastructure is used for AI applications, despite growing demand for infrastructure to support AI-related projects in recent years. This has prompted a shift in EuroHPC's eligibility requirements. As of November 2023, the European Commission committed to widening access to EuroHPC's infrastructure for European AI start-ups, SMEs, and the broader AI community as part of the EU AI Start-Up Initiative. This aims to support the further development and scalability of AI models in Europe by facilitating access to powerful supercomputers for AI training and testing, with the aim of "reducing training time from months or years to a matter of weeks" (European Commission, 2023[56]).

Table 2.6 Examples of international initiatives supporting Principle 2.2: AI compute infrastructure

Initiative type	Country	Initiative name
Mapping of national compute capacities and needs	Canada	Digital Research Infrastructure Needs Assessment (2020)
Mapping of national compute capacities and needs	United Kingdom	Review of digital research infrastructure needs (2023)
Policies to support HPC capacity and improve access for AI researchers and start-ups	Germany	Gauss Centre for Supercomputing
Policies to support cloud capacity and improve access for AI researchers and start-ups	United States	National AI Research Resource cloud supporting AI R&D (forthcoming)
Pooling regional resources for computing capacity	European Union	EuroHPC Joint Undertaking (2018)

Source: Research from OECD.AI

Table 2.7. Principle 2.2: Fostering resilient and accessible AI compute infrastructure in Egypt – Key findings and recommendations

Key findings	Recommendations
• Some infrastructure exists for AI in the public sector (i.e. MCIT Tier III Data Centre, universities), but it is often not used for AI-specific workloads and could require installation of specialised AI hardware (e.g. GPUs). • Infrastructure and access to public sector compute capacity for AI researchers, start-ups and SMEs is challenging due to availability, cost and know-how.	• Undertake a national stock taking of the available domestic computing infrastructure for AI, looking at the needs/demand of different AI user groups (e.g. government, academia, start-ups, SMEs, large companies etc.) and the existing national supply of compute infrastructure to meet these needs. • Based on the stock taking, create an AI compute action plan focused on increasing access to AI compute capacity for AI stakeholders, like the academic and research community, and start-ups/SMEs.
• Some private sector companies are active in the region, but not yet making notable AI compute capacity investments in Egypt. • The AI start-up and SME community receives some of its cloud compute capacity from large foreign-owned cloud providers (hyperscalers).	• Further establish partnerships with international cloud providers to facilitate access to AI compute for start-ups and SMEs. • Provide early funding for Egyptian hardware and cloud companies, to foster a homegrown AI compute infrastructure supply chain.
• Engineering and computer science courses are growing, but hands-on AI compute skills remain hard to find, with many skilled workers leaving Egypt to work for large technology companies abroad.	• Support training mentorship programmes or placements in domestic AI companies using hardware for training AI models. • Offer incentives to retain those with expertise in AI hardware domestically and help build the AI hardware ecosystem in Egypt.
• Data access and quality remains a key gap, with data that is accessible being difficult to use for AI.	• Continue implementation of the Data Classification Framework. • Promote open government data and quality to improve accessibility and enable data use by private companies/partnerships between public and private sector (e.g. through sector curated AI-ready datasets)
• Egypt's desert geography and hot climate makes operating data centres, including those used for AI, expensive and energy intensive (e.g. water for cooling).	• Conduct an energy efficiency assessment of existing AI compute infrastructure (e.g. energy intensity of data centres, AI algorithms) to identify areas for increased efficiency gains. • Based on this assessment, consider policy actions (e.g. fiscal incentives, regulation) to promote energy efficiency standards and methodologies, such as innovative cooling methods and heat re-use for data centres.

Principle 2.3: Providing an enabling policy environment for AI in Egypt

> *"a) Governments should promote a policy environment that supports an agile transition from the research and development stage to the deployment and operation stage for trustworthy AI systems. To this effect, they should consider using experimentation to provide a controlled environment in which AI systems can be tested, and scaled-up, as appropriate.*

> *b) Governments should review and adapt, as appropriate, their policy and regulatory frameworks and assessment mechanisms as they apply to AI systems to encourage innovation and competition for trustworthy AI."*

While there is no overarching AI legislation in Egypt, existing laws and regulations on data protection, cybersecurity, and fintech provide elements to support AI governance

Along with data, developing an AI ecosystem, and AI infrastructure, AI governance is a key articulated pillar of the Egyptian NAIS, including ethics, laws and regulations. Currently, there is no overarching AI legislation in Egypt, as is seen in other jurisdictions such as the European Union's AI Act (EU AI Act), Canada's proposed AI and Data Act (AIDA), and Brazil's proposed AI legislation. As the lead ministry overseeing the NAIS, MCIT strives to provide elements of AI governance through various strategies and soft laws, hard laws, such as the Personal Data Protection Law (2020) and the Data Centres Regulatory Framework (2021), and by adhering to several internationally recognised principles-based approaches to AI governance, such as the OECD AI Principles (Table 2.8). This approach is favoured rather than having one horizontal AI law of general application.

According to Egyptian officials, this approach aims to avoid discouraging domestic and foreign investment in AI at a time when Egypt's AI ecosystem is still emerging and growing. For example, Egyptian officials cite fears of overregulation or administrative burden through complex regulations that may hinder innovation, possibly putting SMEs and start-ups at a disadvantage compared to large and well capitalised private sector technology companies typically better resourced to handle regulatory and legal compliance. Egyptian officials view the country's current laws, such as those governing privacy, data, and consumer protection, as a sufficient regulatory regime around AI for the time being. However, implementation actions remain to be taken for key pieces of legislation, in particular for the Personal Data Protection Law (2020), for which Executive Regulations have yet to be issued. Given Egypt's AI ecosystem is still in the early stages of development, Egyptian officials view capacity building among policymakers and stakeholders in the AI ecosystem as a priority to provide a base of education and awareness about trustworthy AI. They view such awareness-raising as a prerequisite to facilitate the effectiveness of any laws, regulations, and policies related to AI governance.

Table 2.8. Several policies, laws, and regulations provide some elements supporting AI governance

Examples of national strategies and soft laws, hard laws, and international principles-based approaches supporting some elements of AI governance

National strategies and soft laws	Hard laws	International principles-based approach
Egypt National AI Strategy (MCIT, 2021)	Personal Data Protection Law (2020)	OECD Recommendation on AI (2019)
Charter for Responsible AI (MCIT, 2023)	Data Classification Framework (forthcoming)	UNESCO Recommendation on the Ethics of AI (2021)
National Strategy for Smart Cities (MCIT, forthcoming)	Data Centres Regulatory Framework (2021)	United Nations Sustainable Development Goals (SGDs)
National Strategy for Statistics (CAPMAS, forthcoming)	Cyber and Information Technology Crimes Law (2018)	
	Fintech Law (2022)	
	National Telecommunications Law (2003)	
	E-signature Law (2004)	
	Intellectual Property Law (2002, 2020)	

Notes: This table offers examples of various policies, laws, and regulations in Egypt. It is not exhaustive.
Source: Information provided by Egypt during the country mission and research from OECD.AI.

Egypt has proposed laws related to governing elements of digital technology in recent years, including on data protection and privacy

Egypt has proposed several laws related to governing elements of digital technology in recent years. This is in response to the country's increased digitalisation and its plan to build a comprehensive digital presence as part of Egypt's Vision 2030. Proposals include hard laws such as the E-signature Law (2014, 2020), the Cyber and Information Technology Crimes Law (2018), and the Personal Data Protection Law (2020), among others (Table 2.8). According to OECD AI Principle 1.2 (Human-centred values and fairness), AI actors should respect the rule of law throughout the AI system lifecycle, including key rights such as privacy and data protection. The legal framework for privacy protection in Egypt is anchored in Article 57 of the Egyptian Constitution (2014), which safeguards citizens' privacy rights. In 2020, Egypt enacted the Personal Data Protection Law, marking the first law in Egypt specifically dedicated to the regulation of personal data collection, retention, processing and transferring. It draws inspiration from the European General Data Protection Regulation (GDPR) and establishes data subject rights, including the right to erasure, information, access, rectification, and objection.

However, key elements of the law still need implementation, namely the requirement of an Executive Regulation from the MCIT, mandated within six months of the law's enforcement, in order for the law to be finalised and enforceable. This represents a critical gap in Egypt's governance framework for laws with relevant dimensions for AI. Namely, elements of data protection and privacy are critical to ensure that both privacy is protected while AI developers have access to sufficient amounts of quality data to train AI systems. Once the law enters into force, it is envisioned that financial sanctions would apply for relevant data breaches.

Egypt also plans to create a Data Protection Center (DPC), an entity linked to MCIT, as an independent authority for the law's enforcement. The Centre is envisioned to be mainly responsible for monitoring compliance with the Personal Data Protection Law, having the powers to issue licences, permits and accreditations for regulated activities and persons as well as to conduct investigations of data controllers and processors, and to issue administrative sanctions. However, the operational status of the DPC is pending, delaying the full implementation and enforcement of data protection measures outlined in the Personal Data Protection Law.

Prior to the introduction of the Personal Data Protection Law, the legal landscape relating to privacy and data protection in Egypt consisted of a variety of national legislation, including the Penal Code (1994) which imposes criminal sanctions for unlawful collection of images or recordings of individuals in private places, the Egyptian Constitution (2014) which provides for the protection of privacy related to communications, and the Cyber Security Law (2018) which places a duty on service providers to maintain the privacy of the data that they store. Once implemented and enforced, the Personal Data Protection Law aims to unify these various elements by bringing a new standalone data protection and privacy regime to Egypt.

Egypt's regulatory approach to data protection reflects the views of Egyptian officials weary of the over protection of data that may hinder the ability to train and use AI systems in practice. They highlight the need for balance within related laws and regulations to manage certain trade-offs, for example, between security and data availability and between data minimisation and data availability (e.g. for academic and R&D purposes). To help facilitate data access and availability for AI training, Egypt is aware of the need to promote open data, including from both private and public sector sources, as a driver for innovation and partnerships between different stakeholders.

Egypt aims to promote the use of AI tools across strategic sectors, including the financial services sector

In 2022, Egypt adopted the Fintech Law to regulate and develop the use of technology for non-banking financial institutions. This law explicitly mentions the use of AI in processing consumer data. This law is

part of the Egyptian Financial Authority's continued efforts to increase the digitalisation of Egyptian financial markets by encouraging the use of digital tools. According to some market analysts, as of 2023 only 2.6% of Egyptian adults used online banking in the past year that year, with men more likely to use a mobile phone or the Internet to send money (3.6%), compared to women (1.6%) (Galal, 2023[57]). The Fintech Law aims to provide clarity for companies working in the financial services, for example by requiring those using AI to obtain a license and adhere to several provisions in the law.

According to OECD AI Principle 2.3. (Shaping an enabling policy environment for AI) governments should consider using experimentation to provide a controlled environment to test and scale up AI systems. For example, tools like regulatory sandboxes or other regulatory experimentation methodologies can help governments test possible regulations and gain valuable feedback from stakeholders prior to regulatory implementation. In 2019, the Central Bank of Egypt developed a regulatory sandbox by which it can better enable and validate start-ups to serve the banking sector. The regulatory sandbox offers a live testing environment for those operating in the fintech ecosystem who are developing new business models and products. It aims to offer faster and easier access to new financial services while embedding good practices and compliance within the fintech ecosystem early on, to ensure consumers are protected while innovators are able to bring new products to market (Central Bank of Egypt, 2023[58]).

While the impacts of Egypt's fintech regulatory sandbox are still being evaluated, tools for regulatory experimentation have successfully been deployed in other jurisdictions around the world for AI regulation (Table 2.9). Egyptian officials reported that discussions are ongoing concerning the need for AI policy measures that include AI sandboxes.

Table 2.9. Examples of international initiatives supporting regulatory experimentation for AI (Principle 2.3)

Country	Initiative
Germany	Regulatory Sandbox Strategy (2019)
Norway	Data Protection Authority (*Datatilsynet*) Regulatory Sandbox (2020) to promote ethical, privacy-friendly, and responsible AI innovation
Singapore	FinTech Regulatory Sandbox established by the Monetary Authority, which has facilitated the live testing of AI applications
Spain	First pilot programme to test the future proposed EU AI Act with real AI applications
United Kingdom	Financial Conduct Authority (FCA)'s sandbox focused on FinTech while also admitting AI-related solutions applied in the financial sector

Source: Research from OECD.AI

Table 2.10. Principle 2.3: Fostering an enabling AI policy environment in Egypt - Key findings and recommendations

Key findings	Recommendations
• Egypt is implementing a variety of strategies, policies, hard and soft laws that impact elements of AI governance (e.g. privacy and data protection), but without specific legislation on AI.	• Conduct an assessment of whether existing regulations and laws are fit for AI. • Continue to track international developments in AI laws and regulation, to assess any necessary actions to facilitate increased interoperability in AI governance.
• In 2020, Egypt enacted the Personal Data Protection Law, marking the first law in Egypt specifically dedicated to regulating the collection, retention, processing and transferring of personal data. However, implementation actions remain to be taken as the law's Executive Regulations have yet to be issued to enable its enforcement.	• Assess whether the current Personal Data Protection Law is fit to facilitate data quality and access in Egypt, while protecting privacy. If gaps are found, a review of the law could be considered to ensure it is aligned with the needs of Egypt's AI ecosystem. • Take steps to swiftly implement the Personal Data Protection Law and to establish the Data Protection Center (DPC) to enable the law's enforcement.
• The Central Bank of Egypt established a regulatory sandbox in 2019 for FinTech, but it still does not use regulatory experimentation for learning in AI data sharing or other areas.	• Support AI regulatory experimentation as appropriate. This could be done by identifying a regulatory barrier in a given sector and piloting a sandbox for regulatory learning around an AI application.

Principle 2.4: Building human capacity and preparing for labour market transition in Egypt

> *a) Governments should work closely with stakeholders to prepare for the transformation of the world of work and of society. They should empower people to effectively use and interact with AI systems across the breadth of applications, including by equipping them with the necessary skills.*
>
> *b) Governments should take steps, including through social dialogue, to ensure a fair transition for workers as AI is deployed, such as through training programmes along the working life, support for those affected by displacement, and access to new opportunities in the labour market.*
>
> *c) Governments should also work closely with stakeholders to promote the responsible use of AI at work, to enhance the safety of workers and the quality of jobs, to foster entrepreneurship and productivity, and aim to ensure that the benefits from AI are broadly and fairly shared.*

Principle 2.4 states that governments should work closely with stakeholders to prepare for the transformation of the world of work and of society, including through training programmes, support for displaced workers, and access to new opportunities in the labour market. It also states that governments should work closely with stakeholders to promote the responsible use of AI at work, enhance the safety of workers and the quality of jobs, foster entrepreneurship and productivity, and ensure that the benefits from AI are broadly and fairly shared.

Capacity building is one of the four key pillars of the NAIS to create a sustainable and competitive AI industry in Egypt, an overarching objective. Activities under this pillar aim to "prepare the Egyptian population for the age of AI at all levels, from general awareness to school, university and equivalent

education, to professional training for technical and non-technical disciplines". The strategy is far-reaching and foresees initiatives to train specific groups of the population, recognising that a broad range of skills is needed to work with AI and that only a subset of jobs requires technical high-level education in AI. Egypt could consider further to promote AI awareness among the general population through things like a proactive media campaign, highlighting AI use cases and emphasising potential benefits for the economy and society at large.

Supply of advanced ICT skills in Egypt is lower than in the MENA region

Egypt's population starts from a relatively lower level of advanced ICT skills which are measured as the capacity to code using a programming language, compared to peer countries (Figure 2.10). The number of undergraduates in the ICT field has doubled from 2013 to 2019 in Egypt. However, ICT studies represent only 2.3% of the total number of graduate students (International Labour Organization, 2021[59]). Based on the findings of a World Economic Forum report , 13% of tertiary-educated MENA individuals specialised in ICT-related fields, putting Egypt well below the regional figures for ICT graduates.

The domestic market to absorb the skilled ICT labour force appears to be limited, with only 66.3% of ICT graduates employed in 2021 (International Labour Organization, 2021[11]), many highly educated people left the country. According to an analysis of LinkedIn job postings, in 2021, more AI-skilled workers left the country than came in, leading to a brain drain of AI talent from Egypt (Figure 2.11).

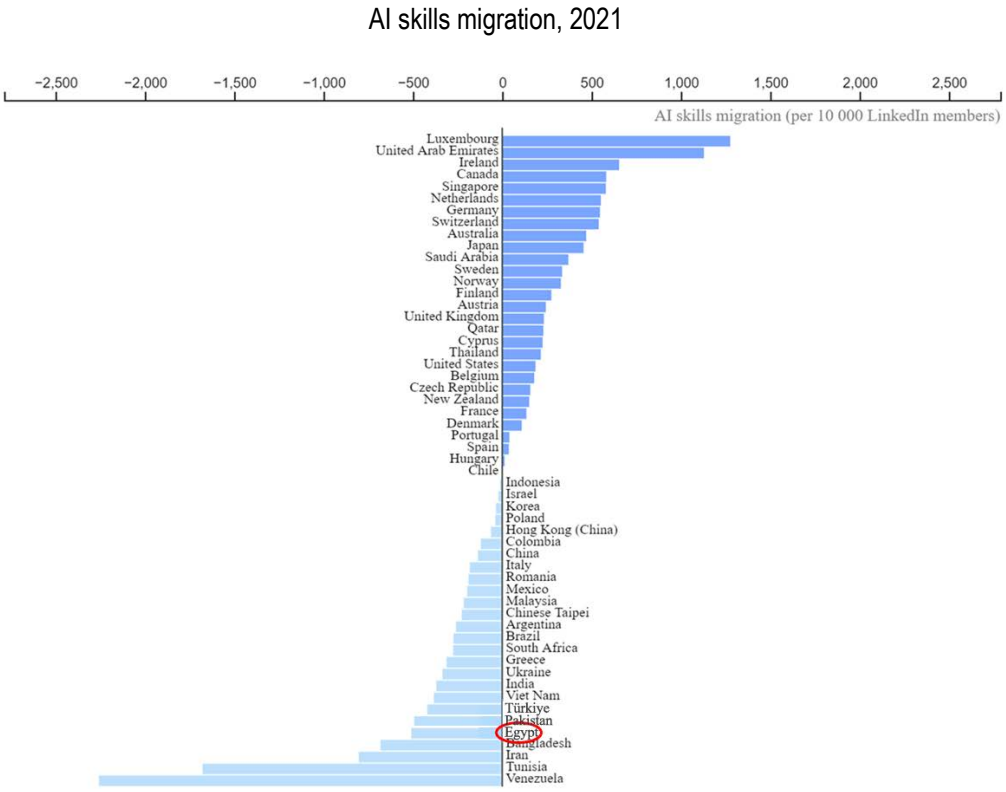
There are also wide gender gaps in the labour market outcomes of higher education graduates. According to an ILO survey of recent Egyptian graduates, men are three times as likely to find employment after finishing their tertiary education: 74.8% of the young men surveyed were employed but only 27% of young women (International Labour Organization, 2021[59]). This trend worsens in ICT fields, where men were employed at a rate of 73.7% while women at a rate of only 21%. The male-dominated disciplines, such as natural sciences and construction and engineering, have the highest overall employment rates but women consistently encounter the lowest employment rates in the same subjects. Further, women confronted the lowest wages in ICT sectors out of any sector (1 758 EGP per month). Men in Egypt are also more likely to engage in entrepreneurship than women (12.3% and 9.2%, respectively). Out of the 21 AI start-ups active in the country in 2021, only 2 had female founders (ITIDA, 2021[44]).

Figure 2.10. Egypt lags behind in advanced ICT skills compared to regional jurisdictions

Share of the population capable of writing a programme using a programming language, 2022 or latest available year

Source: ITU (2023), Data Hub, www.datahub.itu.int (accessed in December 2023).

Figure 2.11. Egypt is experiencing a brain drain of AI talent



Source: OECD.AI (2021), visualisations powered by JSI using data from LinkedIn, www.oecd.ai.

This disparity calls for tailored action to increase female participation in the labour market. The Egyptian government should consider incentives, such as mentorship programmes, placements, etc., to promote women's work and exposure in AI-related roles (e.g., in AI companies, research institutes/universities, etc.) from entry-level positions to management and executive-level posts.

AI Faculties in eight public and private universities in Egypt

According to the NAIS, there are three skillsets that will usher Egypt into the AI era: i) AI-related skills, ii) managerial and soft skills, and iii) entrepreneurial skills. The first of the three skillsets is being addressed primarily through AI courses in higher education institutions. In recent years, seven public and private Egyptian universities have established AI Faculties. In 2021, the MCIT and the Ministry of Higher Education and Scientific Research established the Egypt University of Informatics (EUI) in the new administrative capital as the country's first university specialising in AI. Furthermore, AI ethics is taught in computer science faculties (Table 2.11). However, at the postgraduate level, many universities do not offer the option to specialise in AI, nor do they require a course in AI to complete a computer science programme. Furthermore, AI courses are offered in computer science faculties only, whereas several disciplines (e.g. medicine, law, communication) will increasingly require AI knowledge in the future, and multi-disciplinarity will be key to developing AI applications suited to needs of specific sectors.

Although not specific to AI talent, one study found that high-skilled emigration from Egypt is due to the lack of research facilities and opportunities for workplace R&D in the country (Kabbash et al., 2020[60]). Interviews with managers in AI start-ups revealed challenges in recruiting mid and senior-level employees with specialised expertise in AI. The scarcity of AI-specific postgraduate programmes within the country seems to be a key factor for the brain drain of AI talent, leading many competent undergraduates to pursue their PhDs abroad and subsequently choose to remain overseas. Establishing AI research centres can be

a means to reverse the brain drain by offering Egyptian researchers the opportunity to work on top AI research and innovation projects.

Table 2.11. Faculties of AI in Egypt

Several universities are integrating AI topics into curriculum and research agendas

Name of university	Description of relevant activities
Arab Academy for Science, Technology and Maritime Transport	The College of Artificial Intelligence, established in September of 2019, offers programmes in intelligent systems and data science with courses in, for example, artificial intelligence, machine learning, advanced programming in AI, deep learning, and computer vision.
Assiut University	The Faculty of Computers and Information proposes a degree in Computer Science with the ability to specialise in AI. Courses include Artificial Intelligence, Image Processing, Software Engineering, Analysis and Design of Algorithms, Neural Networks and Introduction to Computer Vision.
Port Said University	Through the Faculty of Engineering, the university delivers AI training, but there is no dedicated faculty of computer science (or other AI-relevant faculties). However, there does exist an "Innovation and Technology Transfer and Commercialization Support Office" which encourages and guides students through the process of creating their own technology-related products.
Nile University	The School of Information Technology and Computer Science presents a dedicated Artificial Intelligence programme, designed to equip students with programming techniques, foundational mathematics, knowledge of applications of AI, big data solutions, NLP and visual computing skills, among others. The University also houses the Center for Informatics Science (established 2008) which is dedicated to interdisciplinary research and development within the information sector. Many of the publications coming out of the centre depend on AI for meaningful outputs.
Ain Shams University	As of 2018, the Faculty of Computer and Information Sciences, partnering with the University of East London, implemented a dual degree Artificial Intelligence Bachelor of Science (BS) programme. This degree programme provides a broad introduction to AI and its subfields, with courses ranging from computer graphics to human-computer interaction to intelligent autonomous robotics.
American University of Cairo	The Computer Science and Engineering Department offers a BS in Computer Science that allows you to specialise in AI. This track covers artificial intelligence, machine learning, neural networks, computer vision, data mining and a few elective subjects.
Misr University	The Artificial Intelligence Technology Center (AITC) focuses on application research—as opposed to fundamental research—and is geared towards transforming the university into a smart campus, incubating spin-off projects, and AI training. AITC is organised into six units. In particular, the Embedded Systems Unit aims to convert existing campus technology infrastructure into smart systems, especially electricity and water systems. The centre includes additional research units to cover AI software development; intelligent robotic systems; AI research; AI training; blockchain technology; internet of things; and finally, network intelligence.
Egypt University of Informatics	Egypt University of Informatics was established by MCIT at the new administrative capital, inaugurated as the first ICT-specialised university in the Middle East and Africa. The Faculty of Computing and Information Sciences proposes the following AI courses: Introduction to Artificial Intelligence, Formal Languages and Automata Theory, Advanced Algorithms and Data Structure and more. Strikingly, the recommended plan of study also includes a course in entrepreneurship.

Source: MCIT (2022), information provided during the country mission.

Several OECD countries, such as Australia, Israel, Italy and the United Kingdom (Table 2.12) have introduced master's and PhD programmes in AI, often supported by government scholarships, to train the next generation of AI professionals. The Italian National PhD Programme in AI has a strong multidisciplinary component. The programme is made of five federated PhD courses that bring together 61 universities and research institutions. To promote innovation in key application sectors and foster the exchange of multi-disciplinary competencies, the five PhD courses share a common basis in the foundations and developments of AI, and each one has an area of specialisation in a strategic sector of AI application, i.e. health and life sciences, agrifood and environment, government and public bodies, industry, and society (phd-ai, 2023[61]). This is an example of how to educate and train specialists on AI technologies and applications for the needs of specific industries and governmental sectors.

In addition to establishing post-graduate AI programmes and research facilities to retain AI talent, the Egyptian government could consider incentives, such as immigration and tax measures, to retain trained

Egyptian talent domestically, applied to employees at entry, management, and senior level executive posts.

Table 2.12. Examples of international initiatives supporting Principle 2.4: skills development

Country	Initiative
Australia	Next Generation AI Graduates Programme (2021-2027): Industry-co-funded PhD scholarship programme to attract and train the next generation of specialist workers in AI by collaborating with industry on research projects and internships.
Italy	National PhD Programme in AI (PhD-AI.it) (2021): five federated PhD courses that bring together 61 universities and research institutions.
Israel	Master's, PhD and Post-doc students in AI – scholarships in 2022 and 2023.
United Kingdom	2 500 Master's conversion courses at 28 Higher Education Institutes across the country for applicants from near- and non-STEM backgrounds, providing 1 000 scholarships for students from underrepresented groups.

Source: Research from OECD.AI

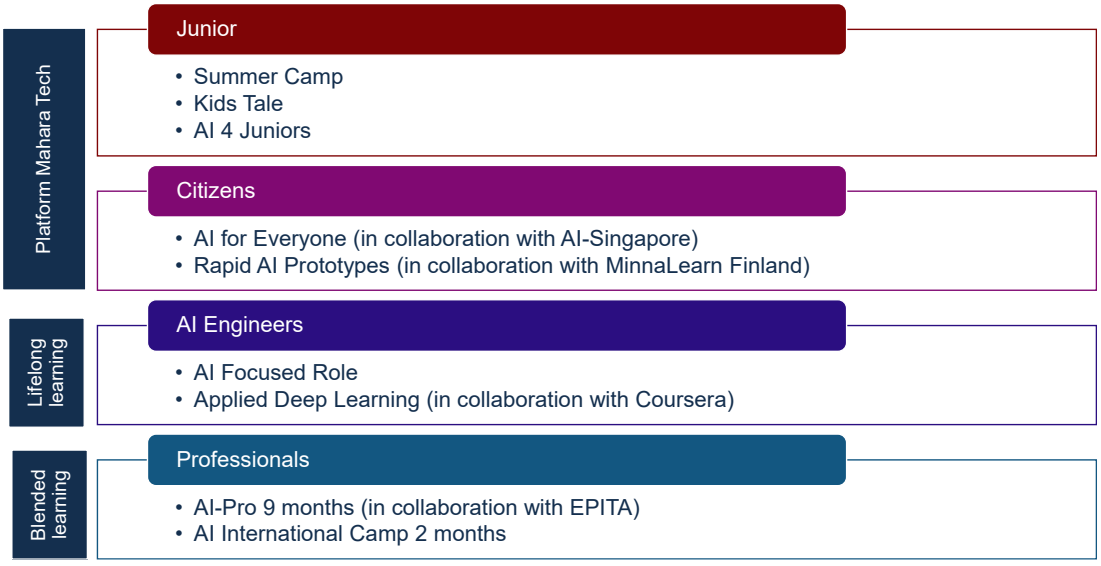
The Information Technology Institute offers programmes to enhance AI skills in different groups of the population

The Information Technology Institute (ITI) offers diverse programmes to extend existing proficiencies into AI and software skills and provide AI literacy to the wider population (Figure 2.12). Courses target children, citizens, AI engineers, and professionals.

ITI, in partnership with the French university EPITA School of Engineering and Science, hosts the Artificial Intelligence Professional (AI-Pro) programme, a 9-month, fully funded training programme designed to integrate college graduates into the workforce. As of the end of 2022, the programme had trained 600 students, with 100 enrolled and pursuing the course. ITI also organized the Artificial Intelligence Professional Programme (AI Pro) postgraduate diploma in partnership with Amazon Web Services (AWS) Academy, AWS Training and Certification, and AWS Education Programs. The programme helps equip learners with skills and certifications in AI, ML, and cloud computing, preparing them for industry-recognised certifications and in-demand, entry-level cloud computing jobs. Kicked off in April 2021, AI Pro attracted 1 000 learners up to the end of 2022. For those currently enrolled in university, there exists the Summer Code-Camps. At no cost, they provide summer-long, hands-on experience in subjects ranging from web development to IoT to motion graphics (Information Technology Institute, 2022[62]; Misr News, 2023[63]).

Interviews revealed that these initiatives have been very successful to date, with demand exceeding available training opportunities. This signals the need to continue and strengthen such activities. However, there appears to be a lack of specific initiatives aimed at promoting managerial and soft skills and seeking to foster interdisciplinary work, which is key to producing innovative AI products and services, combining technical AI skills with domain knowledge.

Figure 2.12. The Information Technology Institute offers AI capacity programmes for various skill levels



Source: MCIT (2022), information provided during the country mission.

The skills of AI professionals need to be better aligned to labour market needs

Thanks to these initiatives, the number of AI graduates seems to be increasing in the country. However, their readiness for market demands appears to still be underperforming. According to the managers of AI start-ups consulted, it is easy to find entry-level employees, but additional training is necessary to attain proficiency in ML and other AI areas. This highlights the need to better align university curricula with the current demands of the job market. Furthermore, retaining employees poses a challenge, as there is a strong financial incentive for young, entry-level workers to seek employment in other countries or work remotely for foreign companies while in Egypt once they have received training.

The MCIT has been partnering with major international enterprises to complement technology student's theoretical knowledge with practical training programmes and internships. The AI Capacity Building Initiative is a national programme initiated through cooperation agreements signed in December 2021 for building capacity in AI within universities (MCIT, 2021[64]). The initiative foresees curriculum development, training of trainers' courses, educational workshops, and student projects. As part of the programme, the MCIT also partnered with Dell Technologies Egypt for an AI hackathon with 500 students from the top five universities for AI research. Students came up with technical solutions to improve water efficiency in Egypt using AI (MCIT, 2023[65]). In 2022, the EUI hosted a pan-Arab, pan-African undergraduate climate-oriented hackathon, Climathon. Under the patronage of MCIT and the Ministry of Higher Education & Scientific Research, powered by AWS and sponsored by Egypt Post, intel and ITIDA,

These are positive examples of collaboration with industry which should be further pursued, together with establishing robust educational pathways, which could be designed and taught in cooperation with industry partners. An example of such collaboration with the private sector is the Australian Next Generation AI Graduates Programme, an industry-co-funded PhD scholarship programme which also foresees joint research projects and internships (Table 2.12).

A key to retaining AI talent is also the creation of job opportunities for skilled labour force in the local market. Strengthening the ICT sector is a key objective of Egypt's Vision 2030. To attract greater domestic and foreign investments, Egypt has introduced fiscal incentives through Law No. 72/2017, recently amended by Law No. 160 of 2023. Catering to the specific needs of smaller companies – constituting the

majority of Egyptian firms - the 2020 revised Micro and Small Medium Enterprises (MSME) law was issued, providing several fiscal and non-fiscal incentives for MSMEs, in addition to a simplified taxation scheme. However, the new MSME law has a narrow scope in that eligible enterprises are those in ICT or related sectors, digital transformation and AI. To foster broader AI use across sectors, incentives should be extended to companies beyond the ICT sector, and fiscal incentives should be provided for research and development and training of personnel related to AI.

Furthermore, there is a need to better track the digital transformation of companies in general and AI uptake in particular. While MSMEDA reported that a monitoring system is going to be put in place to track the implementation of the incentives from the new MSME law, it is unclear whether these will be granular enough to distinguish AI-related indicators. Moving forward, the MSMEDA should establish a monitoring framework to track the use of incentives to increase AI use in MSMEs. The National Statistical Office could also consider introducing a question related to AI uptake in firms in its national ICT usage survey in enterprises.

There is also untapped potential to further partner with international companies investing in ICT in the country. Of the nearly USD 10 billion dollars of ICTs investments made in the MENA region in 2019, approximately one-sixth of these investments were made in Egypt (International Telecommunication Union, 2021[66]), suggesting untapped opportunities for ICT graduates. The government could include conditionality clauses in large government procurement contracts that would require global and regional private sector players to build the capacity of local companies, source local components for their projects, and transfer some of their knowledge to local businesses (International Labour Office, 2021[67]).

Monitoring AI technology trends and anticipating labour market transformations are key to ensuring workers are re-skilled with the rights competencies

Successfully managing the AI revolution requires educating, training, and reskilling the population in order to minimise the potential job loss caused by automation and to seize new job opportunities brought about by technological developments. Crucial in this regard are activities aimed at monitoring labour market transformations induced by technological trends to be able to anticipate skill needs and design education and training accordingly. Such responsibility in Egypt lies with the Ministry of Labour (formerly the Ministry of Manpower). To support the Ministry of Labour in its assessment of skill needs related to AI and the fourth industrial revolution, a study was conducted in 2021 by the ILO (International Labour Office, 2021[67]). Beyond this ad-hoc assessment, there appears to be a lack of strategic vision with regard to the changing labour market needs induced by AI advancements. The Ministry of Labour is monitoring labour market developments and assessing shortages and future needs, but with a focus on craftworkers and robots.

Given the rapid changes and wide-ranging expected impacts of AI on the labour market (OECD, 2023[68]), there should be a more systematic skills anticipation research based on regular labour market assessments and sector studies to inform training policies and curriculum development to ensure that education and training are aligned with the skills demand for AI.

Table 2.13. Principle 2.4: Building human capacity and preparing for labour market transition – Key findings and recommendations

Key findings	Recommendations
• A very low share of the population has advanced ICT skills (programming), indicating progress to be made for establishing the pipeline of AI skills and talent in Egypt.	• Continue to introduce data science/AI courses across faculties and disciplines (beyond Computer Science). • Educate and train on AI technologies and applications including data management and analysis for governmental departments and various industries.
• Specialised AI courses do not yet exist widely across the country in educational institutions outside of top Egyptian universities in Cairo.	• Provide funding for higher education in AI specialisations. • Align curricula to AI job market needs (including university and vocational training and AI compute skills e.g. HPC) in cooperation with the private sector.
• Egyptian AI talent is experiencing a "brain drain", especially to neighbouring countries, or competition from international corporations hiring for remote jobs	• Establish AI research centres offering highly-skilled professionals research facilities and opportunities to work on AI-related projects in the country. • Consider incentives (e.g. policy, immigration, tax measures) to retain trained Egyptian talent domestically (for entry level, management, and senior level executive posts).
• Women, including highly-educated, are underutilised in the workforce	• Consider incentives, such as mentorship programmes, placements etc., to promote women's work and exposure in AI related roles (e.g. in AI companies, research institutes/universities etc.) from entry level positions to management and executive level posts.
• There is a gap in attracting senior and executive level talent in Egyptian AI SMEs and start-ups.	• Promote AI knowledge transfer to start-ups/SMEs from foreign companies operating nationally, especially for senior and executive level positions (e.g. by including conditionality in public procurement contracts). • Increase collaboration with industry (including through fiscal incentives) to increase students' work-based experience during their studies and create access to employment once they graduate. • Strengthen technology-oriented donor relationships and build out capacity within MSMEDA.
• AI-specific skills need assessment and anticipation activities could be undertaken.	• Investigate regularly the employment market and development trends of AI technologies, assessing the future demand for AI skills and adapt the education and training plans accordingly. • Support re-skilling of labour force, including through fiscal incentives (e.g. tax measures) for enterprises to provide on-the-job training.

Principle 2.5: Fostering international co-operation for trustworthy AI

> *a) Governments, including developing countries and with stakeholders, should actively co-operate to advance these principles and to progress on responsible stewardship of trustworthy AI.*
>
> *b) Governments should work together in the OECD and other global and regional fora to foster the sharing of AI knowledge, as appropriate. They should encourage international, cross-sectoral and open multi-stakeholder initiatives to garner long-term expertise on AI.*

> *c) Governments should promote the development of multi-stakeholder, consensus-driven global technical standards for interoperable and trustworthy AI.*
>
> *d) Governments should also encourage the development, and their own use, of internationally comparable metrics to measure AI research, development and deployment, and gather the evidence base to assess progress in the implementation of these principles.*

International relations are one of the main pillars of Egypt's NAIS. Egypt seeks to play a key role in unifying African and Arab voices around important AI issues and to participate actively in international fora focusing on AI ethics and impact and AI and development (Box 2.2). Egypt is also strengthening cooperation on AI at a bilateral level with several countries.

Egypt is positioning itself as a regional leader in AI

Egypt has taken the initiative on the African level to propose and lead an African Working Group on AI under the umbrella of the African Union (AU). The group has three main objectives: to define a common African stance on AI topics such as ethics, education and economic impact; to establish a common capacity-building framework to exchange expertise among African nations in AI education; to collaborate on large-scale projects in developmental sectors such as AI for agriculture. The group is also tasked with drafting a continent-wide AI strategy.

Similarly, Egypt has taken the initiative to launch a similar working group under the umbrella of the Arab League of States. The group's meetings resulted in the first draft of a common Arab AI strategy.

Egypt is also an active member of the International Organization of the Francophonie (OIF). In 2021, MCIT participated in the formulation of the OIF economic strategy and the strategy of the digital agenda, through participating in virtual meetings and a working group that consisted of selective member states, including Egypt. The Egyptian delegation contributed to the digital agenda, including pressing issues such as the use of ICT for Persons with Disabilities (PwDs), AI, developing capabilities in the field of cybersecurity, and fostering digital skills for various groups of workers.

Box 2.2. Egypt participates actively in international fora on AI governance

Egypt collaborates on AI governance at the OECD:

- Egypt contributed to the final drafting of the OECD Recommendation on AI, released in May 2019.
- Egypt adhered to the OECD Recommendation on AI in 2021.
- Egypt contributed to the drafting and acceptance of the G20 Recommendation on AI in June 2019, which was based on the OECD Recommendation.
- In 2022, the Egyptian Minister of MCIT participated in a ministerial panel discussion on "The OECD AI Principles" in Gran Canaria, Spain.
- Egypt regularly contributes to the work of the OECD Working Party on AI Governance (AIGO), relevant AI work of the OECD Committee on Digital Economy Policy (CDEP), and to the OECD.AI Policy Observatory.
- Egypt is a member of the OECD's AI Network of Experts (ONE AI).
- AI is part of the Egypt Country Programme (ECP) signed between the OECD and the Government of Egypt in October 2021.

Egypt engages in AI governance work with other international organisations:

- Egypt was selected as a member and later elected as vice-chair of UNESCO's ad hoc expert group on AI Ethics charged with preparing the first document related to the ethics of AI.
- Egypt is an active member of the ITU focus groups on AI in Healthcare, Self-driving Vehicles and AI in the Environment as well as Machine Learning in Cybersecurity.
- Egypt also participates regularly in WIPO meetings on AI discussing the future of IP and innovation in the age of AI, with Egyptian experts recently giving a presentation on the topic.
- Egyptian experts participate in the Commercialization and Innovation, Data Governance, and Responsible AI working groups of the Global Partnership on AI (GPAI).

Egypt is forging bilateral AI partnerships

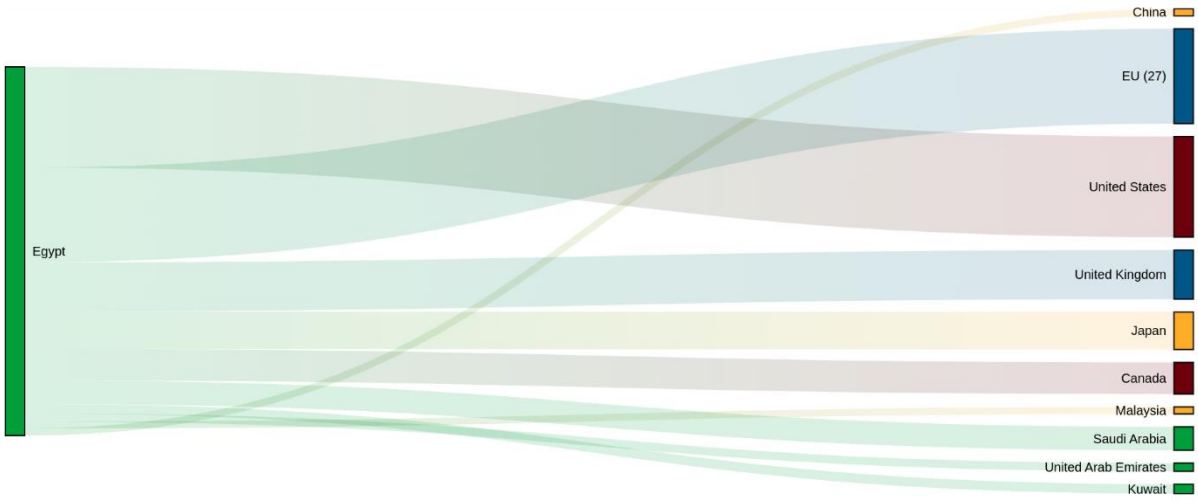
Over the past decade, Egypt has strengthened and diversified its international AI research collaboration. In 2010, Egypt's institutions primarily engaged with the European Union and the United States. In 2022, a higher number of collaborations took place with Middle East and North Africa (MENA) and Asian countries, most notably Saudi Arabia, People's Republic of China (hereafter "China"), and India (Figure 2.13).

Figure 2.13. Egypt has diversified AI research collaborations across MENA, the EU, and Asia

International collaboration in AI scientific publications, 2022

Source: OECD.AI (2023), visualisations powered by JSI using data from OpenAlex, accessed on 15/9/2023, www.oecd.ai.

International collaboration in AI scientific publications, 2010



Source: OECD.AI (2023), visualisations powered by JSI using data from OpenAlex, accessed on 15/9/2023, www.oecd.ai.

Egypt intends to strengthen its bilateral cooperation with different countries to exchange experiences and best practices. This cooperation is reported to be achieved through government-to-government collaboration agreements, study visits, workshops, invitations to experts from different entities to present at events organised by Egypt and by identifying and launching projects of mutual interest and benefit with countries on a bilateral or multilateral basis.

In this context, MCIT signed a twinning agreement with AISG, Singapore's AI Centre of Excellence, in July 2021. The agreement includes training sessions with Egyptian staff to transfer AISG's knowledge and methodology and establish its Egyptian equivalent, as well as ongoing monitoring and evaluation of its operations for one year.

In November 2021, Egypt and France signed a Declaration of Intent (DoI) between MCIT and the French Ministry of the Economy and Finance. Both parties agreed to cooperate in the AI field in several areas, including promoting AI digital services in government, developing AI applications in different domains, enhancing capacity building, fostering regional and international alignment and cooperation, and facilitating private sector cooperation with different sectors.

During 2020 and 2021, MCIT established several international partnerships and signed a number of agreements with similar entities in other countries to cooperate in fields related to ICT. These agreements involve Egyptian organisations specialising in AI to carry out projects using AI applications in different sectors. The main objective of these partnerships is to develop innovative solutions to the challenges facing Egyptian society, including in agriculture, health, culture, and tourism, and to develop competencies to use and work with AI.

Table 2.14. Principle 2.5: Fostering international co-operation for trustworthy AI - Key findings and policy recommendations

Key findings	Recommendations
• Egypt engages in international fora on AI governance.	• Continue deepening regional and international collaboration on AI, including joint projects, international fora, and joint initiatives featuring Egyptian companies and universities/college. • Continue leading by example to coordinate efforts for the development of AI strategies in African and Arab countries and in the region.
• Collaboration could be expanded from the government multilateral and bilateral levels to further private sector and university international collaboration and partnerships.	• Consider ways to showcase domestic AI talent in universities and the private sector, through government supported international initiatives like trade and technology agreements, tradeshows, and events, especially in priority areas and sectors (e.g. agriculture, climate change adaptation/mitigation etc.).

3 Conclusion

Egypt is seizing opportunities to ensure AI is a positive force for economic and social development

Building trustworthy AI and using it responsibly is crucial for addressing Egypt's societal and economic challenges, ensuring AI is a reliable and positive force in the country's digital transformation. Ensuring effective AI policies demands a whole-of-government approach, acknowledging the cross-cutting implications of this technology and considerations across policy domains. As the leading ministry for the NAIS, MCIT commendably managed collaboration among relevant Egyptian ministries and stakeholders to design the NAIS. In a rapidly evolving technological landscape, allocating an appropriate budget, and streamlined mechanisms for its expenditure will be crucial to the success of implementing the NAIS.

Interdisciplinary collaboration with AI ecosystem actors is critical to better understanding the short-, medium- and long-term implications of AI. This includes engaging in dialogue and collaboration with government and AI researchers, policymakers, practitioners, industry partners and civil society groups in a variety of ways like multistakeholder fora such as the OECD. These collaborations can foster mutual learning, trust, and cooperation among the government and stakeholders and facilitate the development of inclusive, responsible, and human-centric AI policies and practices in Egypt that support its development agenda and that stand the test of time.

References

African Development Bank Group (2022), *Entrepreneurship in Egypt - 2022 Ecosystem Overview*, https://www.afdb.org/sites/default/files/documents/publications/2022.05.27_afdb_-_entrepreneurship_in_egypt_003.pdf. [46]

Bibliotheca Alexandria (2023), *Projects & Activities*, https://www.bibalex.org/en/project/details?documentid=281. [51]

Brookings (2023), *Climate action in Egypt: Challenges and opportunities*, https://www.brookings.edu/articles/climate-action-in-egypt-challenges-and-opportunities/#:~:text=Egypt%20is%20highly%20vulnerable%20to,as%20people's%20health%20and%20wellbeing. [18]

Central Bank of Egypt (2023), *Regulatory Sandbox*, https://www.cbe.org.eg/en/financial-technology/regulatory-sandbox#FFFEEB993B2246BABEAEC243002BB304. [58]

D4D Hub (2022), *Two recommendations to boost Egypt's green technology sector*, https://d4dhub.eu/news/two-recommendations-to-boost-egypts-green-technology-sector. [31]

Digital Research Alliance of Canada (2020), *Canadian Digital Research Infrastructure Needs Assessment*, https://alliancecan.ca/en/initiatives/canadian-digital-research-infrastructure-needs-assessment. [52]

Enterprise (2019), *ITIDA, Valeo Egypt sign automotive artificial intelligence R&D agreement*, https://enterprise.press/stories/2019/02/17/itida-valeo-egypt-sign-automotive-artificial-intelligence-rd-agreement/. [41]

EuroHPC (2023), *About*, https://eurohpc-ju.europa.eu/about/discover-eurohpc-ju_en. [54]

European Commission (2023), *Commission opens access to EU supercomputers to speed up artificial intelligence development*, https://ec.europa.eu/commission/presscorner/detail/en/IP_23_5739. [56]

European Parliament (2022), *Egypt's climate change policies State of play ahead of COP27*, https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/738187/EPRS_BRI(2022)738187_EN.pdf. [27]

Galal, S. (2023), *Share of people who used mobile phone or internet to send money in the past year in Egypt as of 2023, by gender*, https://www.statista.com/statistics/1375994/share-of-people-using-mobile-phone-or-internet-banking-in-egypt-by-gender/#:~:text=As%20of%202023%2C%20only%202.6,banking%20in%20the%20past%20year. [57]

Gauss Centre for Supercomputing (2023), *Our Centres*, https://www.gauss-centre.eu/about-us/our-centres. [53]

Government of Egypt (2021), *Egypt National Artificial Intgelligence Strategy*, https://mcit.gov.eg/Upcont/Documents/Publications_672021000_Egypt-National-AI-Strategy-English.pdf. [25]

I. Ihsanullah et al. (2022), "Recent advances in applications of artificial intelligence in solid waste management: A review", *Chemosphere*, Vol. 309/1, https://doi.org/10.1016/j.chemosphere.2022.136631. [29]

IEA (2023), *Climate Resilience for Energy Transition in Egypt*, https://www.iea.org/reports/climate-resilience-for-energy-transition-in-egypt#. [24]

Information Technology Institute (2022), *ITI*. [62]

International Labour Office (2021), *The Fourth Industrial Revolution, Artificial Intelligence, and the Future of Work in Egypt*, https://www.ilo.org/wcmsp5/groups/public/---africa/---ro-abidjan/---sro-cairo/documents/publication/wcms_821305.pdf. [67]

International Labour Organization (2021), *Tertiary Education Graduate Survey in Egypt 2021: Towards Achieving Graduates' Full Potential*. [59]

International Labour Organization (2021), *Tertiary Education Graduate Survey in Egypt 2021: Towards Achieving Graduates' Full Potential*. [11]

International Monetary Fund (2023), *GDP, current prices*, https://www.imf.org/external/datamapper/NGDPD@WEO/DZA/ZAF/MAR/NGA/EGY (accessed on 14 October 2023). [6]

International Telecommunication Union (2021), *Digital trends in the Arab States region 2021*. [66]

ITIDA (2023), *ITIDA Press releases*, https://mcit.gov.eg/en/Media_Center/Press_Room/Press_Releases/67127. [42]

ITIDA (2022), *Digital Egypt Strategy for Offshoring Industry 2022 - 2026*, https://itida.gov.eg/English/Programs/Digital-Egypt-Strategy-for-Offshoring-Industry-2022-2026/Documents/Executive-Summary-of-Egypt-Strategy-fo-%20Offshoring-2022-2026.pdf. [14]

ITIDA (2021), *The Egyptian Startup Ecosystem Report 2021*, https://mcit.gov.eg/Upcont/Documents/Reports%20and%20Documents_26102021000_Egyptian-Startup-Ecosystem-Report-2021.pdf. [44]

ITU World Telecommunication/ICT Indicators Database (2023), *ITU Digital Development Dashboard, Egypt*, https://www.itu.int/en/ITU-D/Statistics/Dashboards/Pages/Digital-Development.aspx. [15]

Kabbash, I. et al. (2020), "The Brain Drain: Why Medical Students and Young Physicians Want to Leave Egypt", *East Mediterranean Health Journal, Vol. 26(4).*, https://pubmed.ncbi.nlm.nih.gov/34927714/. [60]

Khan, S., A. Mann and D. Peterson (2021), *The Semiconductor Supply Chain: Assessing National Competititveness*, Center for Security and Emerging Technology, https://cset.georgetown.edu/wp-content/uploads/The-Semiconductor-Supply-Chain-Issue-Brief.pdf. [49]

Magnitt & ITIDA (2022), *2022 Egypt Venture Investment Report*. [45]

MCIT (2023), *ICT Minister Witnesses Closing of 'AI Capacity Building Initiative' Round I*, https://mcit.gov.eg/en/Media_Center/Press_Room/Press_Releases/67113. [65]

MCIT (2021), *AI Capacity Building Initiative*, https://mcit.gov.eg/en/Human_Capacity/MCIT/AI_Capacity_Building_Initiative. [64]

Ministry of Communications and Information Technology (2023), *Egyptian Charter for Responsible AI*, https://aicm.ai.gov.eg//en/Resources/EgyptianCharterForResponsibleAIEnglish-v1.0.pdf. [20]

Ministry of Communications and Information Technology (2022), *Applied Innovation Center*, https://mcit.gov.eg/en/Applied_innovation_Center. [26]

Ministry of Communications and Information Technology (2022), *ICT Minister Inspects AIC Projects Powered by Modern Tech*, https://mcit.gov.eg/en/Media_Center/Press_Room/Press_Releases/65949. [50]

Misr News (2023), *ITI is accepting applications in Summer Code Camp for undergraduates at universities and educational institutes*. [63]

National Council for Artificial Intelligence (2019), *Egypt National Artificial Intelligence Strategy*, https://mcit.gov.eg/Upcont/Documents/Publications_672021000_Egypt-National-AI-Strategy-English.pdf. [1]

OECD (2023), "A blueprint for building national compute capacity for artificial intelligence", *OECD Digital Economy Papers*, No. 350, OECD Publishing, Paris, https://doi.org/10.1787/876367e3-en. [48]

OECD (2023), *Advancing Accountability in AI*. [32]

OECD (2023), "Advancing accountability in AI: Governing and managing risks throughout the lifecycle for trustworthy AI", *OECD Digital Economy Papers*, No. 349, OECD Publishing, Paris, https://doi.org/10.1787/2448f04b-en. [35]

OECD (2023), *Economic Outlook Note - Egypt*, https://www.oecd.org/economy/egypt-economic-snapshot/. [13]

OECD (2023), *Emerging privacy-enhancing technologies: Current regulatory and policy approaches*, OECD Publishing, https://doi.org/10.1787/bf121be4-en. [33]

OECD (2023), *OECD (2023), OECD Employment Outlook 2023: Artificial Intelligence and the Labour Market,*, OECD Publishing, https://doi.org/10.1787/08785bba-en. [68]

OECD (2023), *OECD-Egypt Country Programme First Progress Report - September 2022 to March 2023*, https://www.oecd.org/mena/economies/egypt/ECP%20first%20progress%20report%202023%20April.pdf. [12]

OECD (2023), "The state of implementation of the OECD AI Principles four years on", *OECD Artificial Intelligence Papers, No. 3*, https://doi.org/10.1787/835641c9-en. [21]

OECD (2022), *Egypt-OECD Country Programme*, https://www.oecd.org/mena/economies/egypt/. [2]

OECD (2021), *Production Transformation Policy Review of Egypt: Embracing Change, Achieving Prosperity*, OECD Publishing, https://doi.org/10.1787/302fec4b-en. [43]

OECD (2021), "State of Implementation of the OECD AI Principles: Insights from national AI policies", *OECD Digital Economy Papers*, No. 311, OECD Publishing, Paris, https://doi.org/10.1787/1cd40c44-en. [34]

OECD Going Digital Toolkit (2023), *OECD Going Digital Toolkit - Egypt*, https://goingdigital.oecd.org/. [16]

OECD.AI (2023), *Flow of VC investments in AI (from country of investor to industry and country of start-up)*, https://oecd.ai/en/data?selectedArea=investments-in-ai-and-data&selectedVisualization=flow-of-vc-investments-in-ai-from-country-of-investor-to-industry-and-country-of-start-up. [47]

Oxford Insights (2023), *Government AI Readiness Index*, https://oxfordinsights.com/ai-readiness/ai-readiness-index/. [3]

phd-ai (2023), *Dottorato Nazionale in Intelligenza Artificiale [National PhD Programme in Artificial Intelligence]*, https://www.phd-ai.it/en/359-2/. [61]

Radwan, S. (2021), *Egypt's AI strategy is more about development than AI*. [19]

Science and Technology Development Fund (2020), *STDF Grants for Targeted Program Artificial Intelligence*, https://stdf.eg/web/grants/archive. [40]

Science and Technology Development Fund (2019), *STDF Grants for Targeted Program Artificial Intelligence*, https://stdf.eg/web/grants/archive. [39]

Shaalan, K. (2018), *Challenges in Arabic Natural Language Processing*, https://doi.org/10.1142/9789813229396_0003. [36]

Suez Canal Authority (2023), *Why Suez Canal?*, https://www.suezcanal.gov.eg/English/About/Pages/WhySuezCanal.aspx. [5]

The Alan Turing Institute (2022), *UK AI Research Infrastructure Requirements Review*, https://www.turing.ac.uk/work-turing/uk-ai-research-infrastructure-requirements-review. [55]

The Financial Times (2023), *UAE launches Arabic large language model in Gulf push into generative AI*, https://www.ft.com/content/ab36d481-9e7c-4d18-855d-7d313db0db0d (accessed on 22 November 2023). [37]

TortoiseMedia (2023), *The Global AI Index*, https://www.tortoisemedia.com/intelligence/global-ai/#rankings. [4]

UNDP (2023), *Egypt*, https://climatepromise.undp.org/what-we-do/where-we-work/egypt. [28]

UNDP (2022), *Egypt 2030: A new decade towards sustainable development*, https://www.undp.org/sites/g/files/zskgke326/files/migration/eg/English_Full-Report_Sep-12-287-298.pdf. [23]

UNESCO Institute for Statistics (UIS) (2023), *Research and development expenditure (% of GDP)*, http://data.uis.unesco.org/. [38]

United Nations Population Division (2022), *World Population Prospects: 2022 Revision, Population ages 0-14 (% of total population)*. [8]

Vision 2030 (2016), *Sustainable Development Strategy (SDS): Egypt Vision 2030*, https://arabdevelopmentportal.com/sites/default/files/publication/sds_egypt_vision_2030.pdf. [22]

World Bank (2022), *Population, 2022*, https://databankfiles.worldbank.org/public/ddpext_download/POP.pdf (accessed on 14 October 2023). [7]

World Bank (2021), *Literacy rate*, https://genderdata.worldbank.org/indicators/se-adt/?gender=total. [9]

World Bank (2021), *Unemployment, female (% of female labor force) (national estimate)*. [10]

World Bank (2020), *Egypt Digital Economy Country Assessment*, https://thedocs.worldbank.org/en/doc/b7a35868206ace761909f9bd2daa1f91-0200022021/original/Digital-Economy-Country-Assessment-May-26-Final.pdf. [17]

World Bank Group (2022), *Blue Skies, Blue Seas: Air pollution, marine plastics, and coastal erosion in the Moddle East and North Africa*, https://enterprise.press/wp-content/uploads/2022/02/Blue-Skies-Blue-Seas-Air-Pollution-Marine-Plastics-and-Coastal-Erosion-in-the-Middle-East-and-North-Africa.pdf. [30]

OECD Artificial Intelligence Review of Egypt

The 2019 Egyptian National Artificial Intelligence (AI) Strategy is a key catalyst for digital transformation in Egypt and supports the country's sustainable development agenda. As North Africa's biggest economy, Egypt faces a challenging economic and demographic context, including high inflation and a high youth unemployment rate. As the first Arab and African country to adhere to the OECD Recommendation on Artificial Intelligence in 2021, Egypt has made progress in implementing the OECD AI Principles. This country review explores the state of implementation of the OECD AI Principles in Egypt by providing a mapping of Egypt's AI governance and policy implementation through gap analysis, comparative analysis, and benchmarking. It highlights key findings and recommendations to strengthen Egypt's AI ecosystem and facilitate the development of inclusive, responsible, and human-centric AI policies and practices that support Egypt's development agenda and stand the test of time.

PDF ISBN 978-92-64-43777-7