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FULL LENGTH ARTICLE

The Applications of Digital Transformation Towards Achieving Sustainable Development Goals: Practical Case Studies in Different Countries of the World

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ABSTRACT

Digital transformation is steadily changing states and organizations, making them more competitive while creating opportunities for economic growth and prosperity. It enables expanded educational opportunities, universal Internet access, and a supportive environment for development. This paper highlights the role of the Communication and Information Technology industry in achieving sustainable development. It reviews the 17 Sustainable Development Goals (SDGs) and explains how information technology affects each goal. It also tracks progress toward the SDGs and existing e-governance and big-data initiatives in four countries, before examining digital transformation in Egypt and its contribution to sustainable development.

Keywords: Digital transformation ▪ Sustainable development in Egypt ▪ Sustainable Development Goals ▪ ICT in SDGs

1. INTRODUCTION

In 2015, the Sustainable Development Goals (SDGs) were adopted, indicating that world leaders sought a more sustainable approach to inclusive and equitable growth. The 17 SDGs, also known as Agenda 2030, consist of 169 targets and 304 indicators and cover a wide range of development-related topics. The SDGs build on progress made through sustainable-development efforts over recent decades and on the Millennium Development Goals (MDGs), the first example of global objectives, which were active from 2000 to 2015. They also continue and scale up the goals of Agenda 21 (A21), approved at the 1992 Earth Summit in Rio de Janeiro. At that summit, senior government officials recognized that many development and environmental issues stemmed from local activities. This led to Chapter 28 of A21 (LA21), a special mandate describing the important role of local authorities in addressing these challenges and supporting local action on sustainable development [1].

The universality of the 2030 Agenda is one of its most important features: the global goals are intended to matter at every level, from local to global. Localizing global goals and sustainability efforts has advanced sustainable development by engaging local stakeholders in processes that affect local, national, and global development. Technology and innovation have played an increasingly significant role in both global sustainable-development efforts and their localization.

Databases are increasingly replacing oil as a source of wealth in the digital economy and information age. Whereas oil derives value from scarcity, information derives value from accessibility and the capacity to manage and use it. Countries should invest in acquiring data through both conventional and novel approaches. The Fourth Industrial Revolution is

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underway, and the world is moving toward a new paradigm of digital transformation: a strategy-oriented change in the infrastructure and processes of modern societies based on current information and communication technologies (ICT) [2]. This paradigm is led by innovation in digital devices and information technology (IT). To present the full picture of "Globalization 4.0," global economic sectors and systems are expected to undergo substantial transformation. Data collected in the form of algorithms does not, by itself, provide a competitive advantage; skills turn algorithms into useful tools and thereby give data a competitive advantage. Countries, particularly developing nations, need modern infrastructure, institutions, skills, and streamlined ways of thinking to take advantage of new opportunities while avoiding disruption [3]. This paper first introduces the topic, then discusses the relationship between digital transformation and sustainable development, and finally examines digital transformation's contribution to the SDGs.

2. DIGITAL TRANSFORMATION IN SUSTAINABLE DEVELOPMENT

The proper networking of all economic sectors during digital transformation requires actors to adapt to the new circumstances of the digital economy. Digital transformation is characterized as "a method for remaking business models following the requirements of customers by utilizing new technologies" [4]. The European Commission describes it as new ways of working with stakeholders, building new service-delivery frameworks, and creating new forms of relationships [5]. It is also defined as the significant transformation of business and organizational activities, processes, capabilities, and models to fully leverage the changes and opportunities created by digital technologies and their accelerating influence across society [6].

These definitions make clear that digital transformation is associated with novel technologies, including automated decision-making systems, augmented and virtual reality, additive manufacturing, deep learning, robotics, big data, artificial intelligence (AI), and the Internet of Things (IoT) [7]. According to TWI2050, digital transformation reshapes work, behavior, leisure, education, and governance. It can also improve carbon productivity, energy and resource efficiency, access to services, and circular-economy activity while lowering production costs and dematerializing production.

These technologies are powerful tools for supporting transformation in all facets of society and the economy [8]. They are increasingly used in planning, improving the ability to understand the implications of decisions in complex socio-ecological systems, and supporting better decisions through multiple perspectives [9]. Artificial intelligence can produce a new generation of sustainable-development solutions by processing large amounts of data. It can guide manufacturing processes and financial flows, manage traffic, transform medical diagnostics and treatment, forecast behavior, and change organizational decision-making. It also raises the need to balance privacy, human dignity, and technological advancement [10]. Digital transformation is therefore a key driver of the transition to sustainability, as technological change is essential to economic growth and sustainable development [11]. It also changes the interpretation of the sustainability paradigm and offers substantial benefits across all 17 SDGs [12].

Table 1. The Main Sustainable Development Pillars

Dimension	Corresponding Pillars
Economic	Economic development
	Efficiency and transparency of government institutions
	Energy
	Innovation, knowledge, and scientific research
Social	Social justice
	Health
	Education and training
	Culture
Environmental	Environment
	Urban development

Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It can also be understood as using resources without exhausting them [13]. It addresses challenges arising from societal and economic transformations. Sustainable development rests on three interdependent dimensions—social, environmental, and economic—which should be transformed and connected to support societal health, human well-being, and reduced environmental impact [14]. The 2030 Agenda's SDGs cover education, the environment, health, security, peace, equality, and justice. Achieving them requires transformation across six fundamental hubs: (i) human well-being and capabilities; (ii) sustainable and just economies; (iii) sustainable food systems and healthy nutrition; (iv) decarbonization and energy; (v) smart cities; and (vi) protection of the global environmental commons. Stakeholder focus and collaborative action can accelerate progress toward the goals. Combining collective and individual action, economy and finance, governance, and technology and science across these hubs creates integrated pathways to transformation and sustainable development.

A comprehensive science, technology, and innovation roadmap should be developed and implemented locally and globally to facilitate progress, accelerate implementation, and encourage broad adoption of the SDGs. Technology must be appealing and accessible. Every nation therefore needs a robust ICT sector and a foundation across the three dimensions of sustainable development. The Ministry of Planning, Monitoring, and Administrative Reform identifies the pillars shown in Table 1 [15].

3. DIGITAL TRANSFORMATION CONTRIBUTIONS TO THE SUSTAINABLE DEVELOPMENT GOALS

New advances can provide significant benefits for sustainable development because they affect how people live, work, interact, move, and experience the world. Their benefits depend on equity, inclusion, accessibility, global collaboration, human dignity, and sustainability. According to the Huawei report, ICT development and progress on the SDGs are complementary and highly correlated, with $R^2 = 0.86$. This section presents digital transformation's contribution to the SDGs, following the International Telecommunication

Union [16, 17].

3.1 ICT Contributions by Goal

3.1.1 SDG 1: No Poverty

End poverty everywhere and in all its forms. Around the world, two billion people do not have financial accounts. New technologies provide access to finance [18] and facilitate financial inclusion, which can help lift people out of poverty by enabling unbanked people to access digital financial services through mobile devices [19].

3.1.2 SDG 2: Zero Hunger

End hunger, improve nutrition, achieve food security, and promote sustainable agriculture. ICT-enabled solutions, such as satellite and remote-sensing technologies, make agricultural practices more data-driven and efficient. They help farmers improve productivity, reduce energy use, and access market updates and weather forecasts.

3.1.3 SDG 3: Good Health and Well-Being

Promote well-being and ensure healthy lives for people of all ages. Digital technologies expand healthcare coverage, help manage pandemics and infectious diseases, and strengthen healthcare delivery by improving access to facilities. They can also support low-cost, high-volume models that expand access to medicines, diagnostic tests, vaccines, supplements, and family planning in low- and middle-income countries [20]. E-health applications such as Be Healthy and Be Mobile help governments provide mobile services for non-communicable diseases. Better connectivity also supports telemedicine, health informatics, and direct patient interaction. In Tanzania, Rwanda, and elsewhere, robots are used to transport lifesaving blood and medicines to remote areas. China uses AI, big data, and other applications to identify COVID-19, drones and robots to support quarantine areas, and 5G to connect doctors and patients during diagnosis.

3.1.4 SDG 4: Quality Education

Advance lifelong-learning opportunities and ensure equitable, inclusive, quality education for all. E-learning provides access to knowledge regardless of where people live or how much they earn. It can also improve quality of life for people with disabilities and those in rural areas.

3.1.5 SDG 5: Gender Equality

Empower girls and women to achieve gender equality. The source reports a 250-million-person gender gap in Internet access. ICT is a key pathway to closing the digital gender gap and advancing equality and empowerment. Gender-equality initiatives aim to improve women's access to technology, develop relevant digital and other skills, and promote women's leadership in the technology sector.

3.1.6 SDG 6: Clean Water and Sanitation

Ensure sustainable management and availability of water and sanitation for all. ICT supports smart water-management systems, sanitation, and hygiene. New technologies also enable water recycling and purification using smaller, more portable equipment [21].

3.1.7 SDG 7: Affordable and Clean Energy

Ensure universal access to sustainable, affordable, and modern energy. Smart grids, green standards, and technology help create more controllable and efficient energy systems and reduce fossil-fuel emissions.

3.1.8 SDG 8: Decent Work and Economic Growth

Promote inclusive and sustainable economic growth, decent work, and productive employment for all. Digital finance, business, technology SMEs, e-commerce, and digital trust can support this goal. Online work platforms can also provide new earning opportunities to people with adequate connectivity and skills.

3.1.9 SDG 9: Industry, Innovation, and Infrastructure

Build resilient infrastructure, encourage innovation, and promote inclusive and sustainable industrialization. A specific target is to increase access to information and communication technology and provide affordable, inclusive Internet access in the least developed countries [22]. ICT is essential infrastructure for the 21st century and for access to services and applications.

3.1.10 SDG 10: Reduced Inequalities

Reduce inequality within and among countries. Enabling disadvantaged groups to access technology and information can help narrow the digital divide, empower communities, and reduce inequality among populations, communities, and countries [23].

3.1.11 SDG 11: Sustainable Cities and Communities

Make cities safe, inclusive, sustainable, and resilient. Smart sustainable cities, the Internet of Things, 5G, and intelligent transport systems can contribute to this goal [24].

3.1.12 SDG 12: Responsible Consumption and Production

Ensure sustainable consumption and production patterns. ICT can support sustainable production and consumption through cloud computing, smart grids, and smart metering, while enabling cheaper and faster service delivery.

3.1.13 SDG 13: Climate Action

Take urgent action to combat climate change and its effects. ICT and new technologies generate better information to support greener lifestyles, forecasting, environmental monitoring, and early-warning systems. Better information can also contribute to SDGs 14 and 15.

3.1.14 SDG 14: Life Below Water

Conserve the seas, oceans, and marine resources and use them sustainably. Radio-frequency spectrum and satellite orbits enable satellite observation and monitoring, increasing scientific knowledge of the oceans.

3.1.15 SDG 15: Life on Land

Protect and restore terrestrial ecosystems and promote their sustainable use. Radio-frequency spectrum and satellite orbits enable observation and monitoring of terrestrial ecosystems, helping to protect biodiversity.



Figure 1. An overview of the UN Sustainable Development Goals (SDGs).

3.1.16 SDG 16: Peace, Justice, and Strong Institutions

Promote inclusive and peaceful societies, build effective, inclusive, and accountable institutions at all levels, and provide access to justice for all. Open data increases transparency and empowers citizens through smart, sustainable cities. It can support economic growth and key performance indicators of social inclusion, such as citizen participation and the number of electronic public services. Countries can also develop ICT applications and provide broadband access to enable low-cost or free digital services for schools, hospitals, and underserved populations.

3.1.17 SDG 17: The Power of Partnerships

Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development. ICT tools support and integrate all SDGs through innovative cooperation and capacity building. Public-private partnerships are important for bringing ICT to people, communities, and countries: they help build the physical infrastructure needed to provide Internet services to underserved populations and hard-to-reach areas, and to support the innovation, inclusion, and investment required by the SDGs.

4. CASE STUDIES

4.1 Colombia

Colombia has a high degree of decentralization and ranks highly on the ADI index (42). It illustrates the importance of strong local institutions in localizing the SDGs. The country demonstrated its commitment to the SDGs and the 2030 development agenda through its 2014–2018 National Development Plan, which sought ambitious changes across three pillars: peace, equity, and education. It promoted collaboration and coordination among local stakeholders to strengthen local capacity and public-finance institutions, improve service delivery, and enable local districts to thrive.

Fifty-seven percent of Colombia's population has Internet access, and the country ranks 55 in technological readiness according to the Economist Intelligence Unit. Colombia has used big data and digital transformation to support the SDGs. Many households depend on agriculture, and climate change has made it difficult for farmers to decide what and when to plant. A public-sector initiative led by the International Center for Tropical Agriculture (CIAT) tested a big-data tool for Colombian rice farmers. It combines harvest and weather datasets to analyze relationships between climate factors and yield variability, helping predict favorable and unfavorable growing conditions in specific areas. The tool converts complex datasets into actionable information in an Android application, enabling data-driven agricultural decisions. It relies on machine learning, including random forests and clustering. The initiative supports SDG 13 as well as SDGs 1 and 2. It also demonstrates how local authorities can help governments collect big data and tailor products to agricultural households.

4.2 Egypt

Egypt ranks 85 on the decentralization score, indicating a comparatively low degree of decentralization. The 2014 Constitution defines the country's administrative units—governorates, cities, and villages—and grants them legal status. Each local unit elects a council to oversee its authorities, and the council can withdraw confidence from the head of the local unit [25]. In practice, however, progress on decentralization has been slow.

The country demonstrated its commitment to the 2030 Agenda by launching Egypt Vision 2030, which sets out SDG strategies and ways to implement them. The government assigned the Ministry of Planning, Monitoring, and Administrative Reform to monitor and report progress toward SDG targets [26]. Despite recognizing the need for decentralization, policies still lack coordination and national integration, and municipal-level training and data are insufficient. Local services remain inadequate, limiting local autonomy. Corruption and lack of transparency have also frustrated local political participation [27]. Egypt's main SDG challenges include sexual health and education (SDGs 3 and 4), water scarcity and agriculture under climate change (SDGs 6 and 13), industrial innovation (SDG 9), gender equality (SDG 5), and precarious employment (SDG 8).

Egypt ranks low in technological readiness (69) and has an Internet penetration rate of 33%. Its e-government development index was "medium" in 2016, after it left the group of high-EGDI countries. The official government portal, launched in 2004, focuses on institutional development, government

services, enterprise resource planning, and establishing and integrating national datasets [28]. These programs aim to provide comprehensive, accurate, and up-to-date information for decision-making in the public and private sectors and for long-term planning. Through the Government Services Development Program, the government seeks to accelerate service delivery through digitalization. It is automating and speeding up service processes, updating and expanding public and private data, and raising awareness of available resources and services through local government providers. This has improved e-participation and citizen engagement [29].

However, the information delivered is mostly national and individual, while local and regional e-government infrastructure and data remain limited. Virtual decentralization and local IT capacity-building are important for progress. Data collection, advanced analysis, and publication platforms require more collaboration with the private sector and civil society organizations. This could help the government implement ICT projects in underserved areas. Current e-government strategies show potential to increase local citizen engagement, mitigate political and economic crises (SDG 16), identify employment opportunities (SDG 8), build trust in local government and civil-society institutions (SDG 17), reduce gender inequalities (SDG 5), and support education (SDG 4). Capacity-building and consultation with local stakeholders could produce further results, particularly given the lack of trust in central government.

4.3 United Arab Emirates

The United Arab Emirates has made significant technological advances, and digital technologies have become an essential part of daily life across its social, cultural, and economic sectors. The National Information Authority was established in 1989 to introduce computers into government work. Integrated optical-fiber services followed in 1988. The Internet was introduced in 1997, and Dubai's e-government initiative began in 2002. Subsequent milestones included the e-Dirham payment gateway in 2001, the authority regulating the telecommunications sector in 2003, and assignment of digital-transformation oversight to the Telecommunications and Digital Government Regulatory Authority in 2009 [30]. The UAE government portal launched in 2010, followed by the Mohammed bin Rashid Smart Learning Program in 2011, federal mobile smart government in 2013, the federal electronic network (FedNet) in 2015, digital identity in 2016, and a blockchain-based digital wallet in 2018. The year 2021 was designated the Year of the Fiftieth.

Emirati society is diverse, and people from different backgrounds live, interact, and do business through a range of channels, especially digital ones. The source reports 9.94 million people in total, 9.84 million active communications users, 9.84 million Internet users, and 17.06 million smartphone users. It also reports $18.50 billion in digital-transaction payments in 2021, 320 million pounds spent by UAE residents on smart applications in 2021, 320 million hours spent using smart applications, and an average of 7.24 hours per day spent online. The UAE Artificial Intelligence Initiative aims to improve government efficiency, accelerate progress, and create innovative work environments by relying on AI for data collection and analysis by 2031. Priority areas include transportation, health, space exploration, renewable energy, water resources, education, the environment, and traffic. The government continues to promote a knowledge-based economy through creativity, research and development, stronger regulation of key industries, and support for high-value sectors, thereby fostering business and attracting investment.

4.4 Philippines

The Philippines is highly decentralized, ranking 33 in the ADI and performing best among the seven country case studies discussed in the source. It pioneered decentralization in East Asia, with local-government reforms that began before the broader wave of decentralization in the 1990s and 2000s. Although a crisis initially prompted these efforts, implementation took time and was not planned or carried out rapidly.

The Philippines has made progress in implementing the SDGs. Its 2016 Voluntary National Review described lessons from the MDGs, including good governance, sustained accountability among stakeholders, and improved capacity to manage and deliver funding plans. Under President Duterte, the government introduced a ten-point economic agenda emphasizing institutions, governance, competition, and social-security programs for inclusive development. It also launched the AmBisyon Natin 2040 vision, which is closely linked to the SDGs. Initiatives such as Open Streets encourage local ownership of the 2030 Agenda and investment in safe, affordable infrastructure. Internet access reaches 43.55% of the population, and the country ranks 55 in technological readiness.

The Open Roads initiative demonstrates how big data can support the SDGs. It combines crowdsourced, geocoded video and image data from mobile phones with road data to track road networks and public infrastructure projects. Decentralization makes it difficult for policymakers to prioritize local projects and provide functional road networks. Large highways can also fail to connect communities when local last-mile roads, which account for 85% of roads in the Philippines, are in poor condition. The multimedia portal tracks public infrastructure projects intended to develop these last-mile connections by crowdsourcing information on public infrastructure (SDG 9) and combining data from government agencies. Residents and other stakeholders can comment on local road projects and track their lifecycle through a mobile video application. Photos and videos are geoprocessed into project information, supporting collaboration and the discovery of innovative development solutions.

5. EGYPT'S CONTRIBUTIONS TO SUSTAINABLE DEVELOPMENT THROUGH DIGITAL TRANSFORMATION

In light of Egypt's commitment to the UN Sustainable Development Goals, the country aims to establish itself as a safe, competitive destination for investors. Its approach includes an open-market policy, large construction projects, currency deregulation, and fewer barriers for foreign investors. Egypt's plan for sustainable development is to build a balanced, productive, and diversified economy based on technological progress and innovation, and grounded in social integration, justice, and participation. It also seeks a diversified ecology that uses the country's location and human innovation to improve quality of life and achieve sustainable

growth. The plan aims to place Egypt among the world's top 30 nations in combating corruption, economic growth, market competitiveness, living standards, and human development. It also emphasizes efficient resource use, equal opportunity, protecting future generations, and closing development gaps.

Digital transformation can support the SDGs and make government services more effective. Youth engagement is critical to Egypt's transition to the digital age and to developing the future digital workforce. Egypt therefore needs to invest in human resources and provide people with ICT knowledge and skills. To promote sustainable-development and SDG progress, the Ministry of Communications and Information Technology (MCIT) is launching initiatives with ministries, government organizations, and private partners. These initiatives cover seven tracks: e-government, online education, electronic readiness, e-commerce, e-culture, electronic healthcare, and ICT exports. Public-private partnerships (PPPs) are also part of reforms in sectors including housing, government, education, security, health, and the environment. These partnerships can promote social inclusion by addressing digital divides and improve public-sector working environments, productivity, and services. The Ministry of Planning, Monitoring, and Administrative Reform also introduced Sharek, a smartphone application that enables public participation in the review process, particularly by young people, and raises awareness of sustainable development. The following subsections describe MCIT programs and related partnerships.

5.1 Education and Training

In keeping with Egypt's commitment to the SDGs, the government has implemented an e-learning strategy for post-secondary and pre-university education. The strategy aims to improve people's lives regardless of age, socioeconomic status, or occupation. With a budget of $500 million for the reform approach, the Ministry of Higher Education aims to transform Egypt's education system. Interactive whiteboards, virtual environments, tablets, and digital libraries are intended to replace textbooks with digital learning resources. This change offers broad access to education, develops a high-quality modern system aligned with international standards, improves learning, and supports motivated educators and students who absorb knowledge, think critically, and innovate. Over five years (2019–2023), the project aimed to provide 1.5 million instructors and students with digital learning resources.

The government also established online learning environments, including a Knowledge Bank that provides digital resources and an online community modeled on a classroom. The Knowledge Bank serves scholars, university students, and pre-university learners, offering scientific resources such as books and journals.

The Egyptian government and World Economic Forum IT members collaborated to develop the Education Initiative (EI) as part of the public-private effort to modernize education. Its four workstreams—higher education, pre-university education, ICT industry development, and lifelong learning—bring together students, educators, parents, local officials, businesses, international organizations, and government. The initiatives support e-learning through collaborative electronic publications, three-dimensional learning, virtual lectures and laboratories, and drama-based learning. MCIT is also implementing training programs with other ministries to develop citizens' expertise and skills, improve workforce competitiveness, empower young people to find work, meet local and global labor-market needs, and advance gender equality.

Table 2. Number of FinTech Tools (Source: CBE, 2023)

FinTech Tool	December 2023	December 2019
No. of debit cards	21,140,875	18,011,421
No. of prepaid cards	25,646,219	18,131,254
No. of credit cards	5,027,612	4,210,961
No. of ATM machines	17,812	14,201
No. of POS	180,023	90,153

5.2 FinTech

Financial technology (FinTech) is important to realizing the digital economy. Digital financial services can be faster, cheaper, and more efficient than traditional services and are associated with faster GDP growth. Egypt's government is seeking to expand FinTech to:

1. encourage financial equality and inclusive growth by serving lower-income households and small and medium-sized enterprises (SMEs);
2. improve the efficiency, speed, and convenience of financial services;
3. provide underserved SMEs and unbanked people with affordable services;
4. reduce corruption and improve the transparency and effectiveness of government operations supporting social and humanitarian aid;
5. reduce the cost and time required for international transfers;
6. address issues including terrorist risks, economic inequality, undiversified economies, unbanked populations, informal transfers and remittance markets, corruption, and displaced populations;
7. enable existing banks to develop new business plans; and
8. enable non-financial businesses, including e-commerce platforms, retailers, mobile-network providers, and mobile-transfer firms, to offer digital financial services.

Government and startup initiatives, together with applications for financial activities, have been introduced to address the financial challenges faced by Egyptian businesses and people. Startups are significant in this area, often targeting lower-income customers with financing options and payment applications. Platforms also provide financing alternatives and employee-payment systems in human resources and payroll. The source reports that, in 2022, 36 banks were offering online banking services, with a total of 40 banks. Table 2 shows the reported increase in fintech tools between 2019 and 2023.

The Central Bank of Egypt prioritizes mobile and online banking services, including mobile wallets for deposits, withdrawals, transfers, and payments. The source reports more than twenty million customers in 2022 and annual transactions exceeding EGP 100 billion, with a thirty-fold annual increase. MCIT aims to provide training, camps, and seminars across the financial value chain. The Information Technology Institute (ITI), together with the Egyptian Banking Institute, launched programs such as "Computer Networks Administration and Security" to train banking employees in data science, AI, data analysis, and information security. Recent graduates of ICT faculties are also targeted. The partners organize conferences and specialized competitions to share knowledge and experience in innovation.

5.3 Health

MCIT is working with the Ministry of Health to automate processes, build communication networks, collect data, and increase the capacity of medical and administrative workers. This work can help close healthcare gaps in remote areas, improve healthcare delivery, strengthen physicians' knowledge and skills, use ICT infrastructure to provide medical services, develop multi-partner business models, and promote an e-health culture. The sector is implementing an integrated strategy for the whole community, including telemedicine for patients, tele-awareness for communities, and tele-education for physicians.

Digital health initiatives aim to ensure access to healthcare, improve its scope, scale, and quality, save patients' time and money, and support the financial sustainability of health coverage. They include the Diagnostic Systems initiative, the National Network for Medical Therapies, the Universal Health Insurance program, and mobile applications that help control and prevent non-communicable diseases such as diabetes, hypertension, and hepatitis by sending patients short messages.

5.4 Energy

Egypt has substantial deployable renewable-energy resources, including biomass, solar, wind, and hydropower. To create a flexible, secure, and robust electrical grid, the Ministry of Electricity and Renewable Energy approved a plan with Chinese companies to develop a smart grid using communication and information technologies. Hydropower plants have also been under construction around Egypt since 2023. The ministry implemented a digital system for collecting electricity bills and digitizing public services, automating 415 payment-collection centers connected to the Egyptian Electricity Holding Company. Electricity bills can also be paid at banks, ATMs, bank offices, and through online banking. Siemens and the Egyptian Electricity Transmission Company (EETC) agreed to deliver the first digital power transformer to the Egyptian market. Further reforms aim to improve power sustainability and security, energy efficiency, and digital transformation in the energy sector. These regulations allow private investment in innovative connections, clean power, improved governance, and sector transparency.

5.5 Innovation, Industries, and Construction

Egypt has made progress in infrastructure, including ports, green power, highways, and bridges. Water-supply and wastewater projects are also being undertaken to serve the growing population. Because ICT infrastructure drives economic activity across sectors, MCIT works to develop advanced infrastructure that meets the growing needs of businesses, governments, and individuals. As traffic, technology, and usage change, MCIT promotes new technologies to support socioeconomic growth and upgrades and expands telecommunications infrastructure.

Digital transformation also affects Egyptian manufacturing by using technology to improve efficiency and reshape business processes. It can strengthen companies' competitiveness and performance, create revenue streams, and enable real-time quality control. It also supports new digital services, products, and solutions. Access to data and systems helps businesses understand production, distribution, customers, and consumption and identify target markets. The Ministry of Commerce and Industry began digitizing the industrial sector through the Manufacturing Reconstruction Centre's Digital Revolution and Technological Support Programme Action Plan 2019–2023, intended to advance financial and technological development in businesses. The European Union also funds the Egypt Exports through Product Innovation initiative, implemented by the Technical Export Council.

5.6 Strong Institutions, Justice, and Peace

Big data and e-government support five essential components of SDG 16: inclusion, effectiveness, openness, accountability, and trustworthiness. MCIT initiates projects to streamline services provided by legislative bodies, improve and expedite citizen services and court rulings, and support access to justice. These projects include automating the Ministry of Justice's legal departments, developing the Africa Constitutional Court Digital Portal, issuing personal-status documents, and automating family courts.

5.7 Responsible Production and Consumption

New technologies can reduce trade-offs between production and the environment. The productivity-enhancement initiative uses cloud computing to reduce the need for specialized human resources and provide innovative, cost-effective services, lowering the costs of maintaining and operating data centers. Since its inception, the project has provided services to more than 150 government organizations, including 18,250 email addresses and 1,500 online portal accounts. It supplements the 600 accounts offered through the integrated communication system, which supports video conferencing.

5.8 Clean Water

The Egyptian government is replacing outdated methods for monitoring Nile water contamination with technical alternatives. Twenty-one stations have been established to monitor the Nile's cleanliness and industrial effluent discharged directly into the river. The source anticipates 95 monitoring sites by 2030.

6. CONCLUSION

Digital transformation affects society as a whole. It makes new technologies more accessible and supports informed, competitive, and agile organizations. It also facilitates better decision-making, accelerating growth and progress toward the SDGs through efficient resource use, cost savings, and time savings. Egypt is using ICT to support sustainable development. Public-private partnerships are crucial to implementing digital development projects and initiatives, and the Egyptian government has formed alliances with public and private organizations to improve the economy, society, and environment. These programs aim to develop human resources by providing digital skills and employment opportunities. People are central to every industry and bear primary responsibility for business success. The initiatives span business, legislation, energy, healthcare, education, and infrastructure, and progress in one area can support progress in others.

Despite Egypt's achievements in digital transformation, the country remains at an early stage and has invested relatively little in ICT targeted at the SDGs. Internet connectivity quality and usage rates also remain below the global average. Future research could examine the barriers and opportunities associated with integrating technological advances in this domain and identify the information-technology components most likely to succeed.

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