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Original Research Article

The Role of Digital Transformation in Sustainable Development in Egypt

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ABSTRACT

Digital transformation is gradually transforming governments and businesses, and making them more competitive, as well as it offers several opportunities for economic growth and prosperity, as it enables countries to including, more diversified educational opportunities, universal access to the internet and a comprehensive and helpful environment to the development process. This paper discusses highlights the concept of the sustainable development and how the Communication and Information Technology industry contributes to achieving the sustainable development; therefore, this paper reviews the 17 SDGs (sustainable development goals) and explains how information technology has affect each goal and then it displays the endeavors of Egypt's government to utilize ICT in achieving sustainable development. These endeavors are represented in the digital projects and initiatives that were launched by the "Ministry of communication and information technology" in collaboration with other partners whether government entities or the private sector. In this context, this paper consists of five parts. The

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first part presents the introduction, while the second one presents the relationship between the information technology and sustainable development in addition to the contribution of digital transformation in achieving sustainable development goals. While the third part reviews the digital transformation in Egypt and its contribution in achieving sustainable development in Egypt. In addition, the fourth part displays the conclusion of the study and the fifth on presented the recommendations. From the literature review, it clears that Egypt has taken a tremendous steps forward the digital transformation and utilizing it in the sustainable development.

1. Introduction:

In view of the response to the fast shifts in technology, population and consumption patterns, there is an increasing consensus that the sustainable development is the only approach to avoid the social and environmental disasters. Consequently, in 2015, the "United Nations Member States" committed to the Sustainable Development achievable 2030 Agenda, in addition to chart a new balance path for both planet and humanity (United Nations, 2019). This 2030 sustainable development agenda consists of "17 SDGs including 169 targets and 304 indicators", which cover a broad range of development-related issues (ElMassaha. & Mohieldin, 2020), such as water, poverty, education, energy, gender equality, biodiversity, economy, climate action and many more (Teri, 2019). The successful implementation of the Sustainable Development 2030 Agenda relies on the collaboration between the private sector, governments, civil society, institutions, and agencies across various sectors, levels, locations and borders. In addition to, their engagement and understanding of the scientific realities that enhance the relations between the natural world and human activity (United Nations, 2019).

Additionally, achieving the "Sustainable Development Goals" (SDGs) requires data, (UNCTAD, 2019), as data revolution created a new and unprecedented age of information and statistics and an unprecedented high demand for many diversified packages of statistics, data, and indicators; which are characterized with quality, comprehensiveness, comparability, integrity, and creditability at all levels from global to local (ElMassaha. & Mohieldin, 2020). As well as, data represents a national asset and a tool to create sustainability, wealth and value to promote competitiveness, and the direct contribution to create knowledge and digital economies overall the world. As well as, it provides many promising capabilities and opportunities, which contribute to human activities and all life aspects development globally, in addition to, support decision making at different levels (UNFPA Egypt, et al., 2018). Furthermore, the new technologies of collecting data for evaluation and monitoring purposes, offer real-time, cheap data and it can also increase the engagement and participation of citizens in the decision-making process, while the classic methods are often time-consuming and expensive (UNCTAD, 2019).

Consequently, digital transformation supports achieving SDGs through inclusive data collection and analyze it by the computational techniques to reveal patterns and trends on environment, human behaviors and experiences that help policy makers to monitor progress, establish the proper programs of development and dynamic improvement (ElMassaha. & Mohieldin, 2020). Therefore, digital transformation becomes a mandate for governments to shape the future, as government officials, business leaders and policymakers are more aware of the technology value and its importance for achieving the desired socioeconomic development (Siddiquee, 2016).

In this context, the Egyptian Government committed to achieve the "Sustainable Development Goals" in the framework of its first sustainable development strategy, that is; "Sustainable Development Strategy: Egypt Vision 2030", which was launched in February 2016. This strategy aligns with the 17 SDGs, reflects the sustainable development dimensions: economic, social and environmental, and involves projects and programs that are planned to be implemented until 2030 (Ministry of Planning, Monitoring, and Administrative Reform, 2018). As well as, the emerging and new data communities in Egypt are positively interacted with developments of data revolution and internet to develop its community and development roles (UNFPA Egypt, et al., 2018).

1.1. Study problem:

Due to the global tendency achieving Sustainable Development Goals and the Egypt's commitment to achieving Sustainable Development Goals in its 2030 vision, as well as its endeavors to implementing digital transformation, it becomes of important to review the digital transformation initiatives in Egypt and their contribution in achieving Sustainable Development Goals. Although many studies have discussed the digital transformation initiatives in Egypt and others have discussed the Sustainable Development Goals and Egypt's 2030 vision, but there is a lack in the studies that review all ICT initiatives and its contribution to achieve Sustainable Development Goals. So, this paper try to give a comprehensive review about this.

1.2. Study Purpose:

This paper was conducted with the aim of reviewing the role of digital transformation in achieving sustainable development in Egypt, through illustrating the digital transformation importance in the economic sectors and then determining the current ICT initiatives in Egypt, in the context of achieving Sustainable Development Goals. This paper consists of five parts; the first one was the introduction, while the second one highlights the importance of digital transformation in achieving sustainable development in general and presents the sustainable development pillars and goals. And the third part demonstrates the Egyptian efforts toward achieving sustainable development through presenting the ICT initiatives and projects in several fields. Moreover, the fourth part presents the discussion and conclusion. Finally, the recommendations.

1.3. Methodology:

This paper aims to present an overview of the digital transformation role in achieving sustainable development in Egypt, so, the researcher adopt the descriptive analytical method. The required information was collected from various researches, reports and websites in order to synthesize a comprehensive approach of Egypt's endeavors to achieve the sustainable development through the digital transformation.

1. Digital Transformation in Sustainable Development:

Digital transformation is a proper networking of all economic sectors where actors have to adapt to the digital economy new circumstances (Bondar, et al., 2017). Digital transformation is defined as "a way to rebuild business models following the needs of customers

by using new technologies" (Berman, 2012). Or "new ways of working with stakeholders, building new frameworks of service delivery and creating new forms of relationships" (European Commission, 2013). It also is defined as "the profound transformation of business and organizational activities, processes, competencies and models to fully leverage the changes and opportunities of a mix of digital technologies and their accelerating impact across society in a strategic and prioritized way, with present and future shifts in mind" (i-SCOOP.eu, 2016).

From the previous definitions, it clears that digital transformation is mostly associated with the use of new technologies such as; augmented reality (AR) and virtual reality (VR), additive manufacturing (AM), deep learning and automated decision-making systems. As well as, artificial intelligence (AI), Internet of Things (IoT), robotics, and big data (TWI 2050, 2019), to stay competitive in the internet age, (Mergel, et al., 2019). This means that digital transformation changes the way people life through reshaping work, behavior, leisure, education, and governance, which have positive impacts on energy, labor, resources, and carbon productivity, as well as, it contributes to expand access to services, lower production costs, dematerialize production (TWI 2050, 2019). Also, it raise productivity, expand access, improve resource efficiencies and support the circular economy (Sachs, et al., 2019).

These technologies are the powerful tools for supporting transformation processes in all areas of society and economy (DiPLo, 2019). As they are increasingly being used in planning processes, building better decision through multiple perspectives, and improving the cognitive capacity in order to understand the decisions implications in complex socio-ecological systems (Villani, 2018). As well as, by

processing enormous volumes of data, artificial intelligence promises to bring a new generation of solutions for sustainable development (United Nations, 2019). As it can steer production processes; financial flows and traffic, revolutionize medical diagnostics and treatments, generate behavioral forecasts for groups and individuals, change the way a company make decisions (Domingos, 2015). Provide decision documents to governments and parliaments (TWI 2050, 2019), and seeks to realize a proper balance between people's privacy and human dignity and technological progress (United Nations, 2019). Therefore, digital transformation becomes a key driving force in transforming toward sustainability (Craglia et al, 2018), as technological change is essential for economic growth and sustainable development (UNCTAD, 2018). In addition to change the sustainability paradigm interpretation (WBGU, 2018) and brings huge benefits for all 17 SDGs, which is considered as mid-points toward achieving sustainable development (UNCTAD, 2018).

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Or "Sustainable development is a way for people to use resources without the resources running out" (Awad & Elnady, 2020). It cares for the common good and debates on the civilization challenges that connected with the society and economies transformations (Adamczyk, et al., 2019). Furthermore, these definitions clear that sustainable development based on three interdependent dimensions; social, environmental and economic systems in which should be transformed and interlinked with each other to ensure societal health, human well-being, and limited the environmental impact (United Nations, 2019 and Silvestre & Tîrca, 2019).

The Sustainable Development Goals -in 2030 Agenda- cover all aspects of development and human life including education, environment, health, security, peace, equality, and justice (United Nations, 2019). So, achieving the SDGs requires transformations in six fundamental hubs; (i) Human well-being and capabilities, (ii) Sustainable and just economies, (iii) Sustainable food systems and healthy nutrition patterns, (iv) Decarbonization and Energy, (v)Smart cities, (vi) Securing the global environmental commons (TWI2050, 2019; United Nations, 2019 and Sachs, et al., 2019). Where the stakeholders' focus and collaborative action can accelerate the progress toward the Goals. As well as, the combinations between, collective and individual action, economy and finance, governance, and technology and science through these six fundamental hubs create integrative pathways to transformation and achieve the sustainable development (United Nations, 2019).

Moreover, in order to encourage the widespread adoption, facilitate progress and accelerate the implementation of SDGs, a detailed science, technology and innovation roadmap should be built and implemented at both, local and global levels (United Nations, 2019). Thus, technology must be made accessible, available and sufficiently attractive (Heeks, et al., 2013 & UNICTAD, 2014). Accordingly, each country seeking for real sustainable development and progress must have a strong ICT sector in place in order to drive the necessary changes, as well as building on ten pillars across the sustainable development three dimensions. Those pillars are as shown in table 1 (Ministry of Planning, Monitoring and Administrative Reform 2016):

Table 1: The Main Sustainable Development Pillars

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

Source: By author dependent of Ministry of Planning, Monitoring and Administrative Reform 2016

2.1. Digital transformation contributions to Sustainable Development Goals:

New technologies promise to deliver great benefits in achieving sustainable development as they change the way people live, work, interact, move and experience in countless ways, by prioritizing equity, inclusion, accessibility, international collaboration, human dignity and sustainability in a comprehensive and far-sighted manner (WBGU, 2019). So digital transformation contribute to the SDGs as according to (Huawei, 2019) report, the ICT development and the progress on the SDGs are complementary and there is high correlation between them with (R2=0.86). Table 2, presents the digital transformation contribution to the SDGs (ITU, 2018a and Awad & Elnady, 2020):

Table 2: The Digital transformation contributions to Sustainable Development Goals

Goal	Description	Digital transformation contributions
	End poverty everywhere, in all its forms	The number of individuals who donot have bank accounts achieved 2 billion all over the world. New technologies provide access to finance (Gaspar, et al., 2019) and facilitate the financial inclusion that can help in lifting people out of poverty by enabling mobile access to digital financial services for those unbanked people (Hove & Dubus, 2019).
SDG 2: Zero hunger	End hunger, improve nutrition, achieve food security and enhance sustainable agriculture	ICT-enabled solutions such as satelite and remote sensing technology make agricultural practices more data-driven and efficient and help farmers increase their business productivity by reducing the use of energy, as well as, access to market updates and weather forcasts (Mohamed, et al., 2019).
	Promote well-being and ensure the healthy live for all people at all ages	Digital technologies expand the health care scope, help to manage epidemics and infectious disease and strengthen the delivery of the public health care service, by supporting the comprehensive access to the health care facilities (Kumar, 2011). It can also develop models that are low-price and high-volume to expand the access to pharmaceuticals, diagnostic tests, vaccines, supplements, and families planning in the low- and middle-income countries (Hoek, 2018). As, e-helth applications such as Be He@lthy and Be Mobile help governments to provide healthcare services for non-communicable diseases in their countries through mobile phones, as well as, the better connectivity can improve telemedicine, health informatics and direct patient interactions (ITU, 2018a). For example; in Tanzania, Rwanda, and elsewhere, the technology of drones is used to transport lifesaving blood and medicines to remote areas (United Nations, 2019). As well as, china uses artificial intelligence (AI) technology, big data, and other applications to detect COVID-19 disease, uses drone and repots to achieve isolation zones, and uses 5G technology to connect doctors with patients to facilitate the diagnosis process (Elgohary, 2020)
SDG 4: Quality education	Promoting lifelong learning opportunities and	E-learning provides access to knowledge to all people regardless of where they live and how much they earn. It also Improves the life quality

	ensuring equitable and inclusive quality education for all	of disabled persons and those in rural areas. (OECD, 2015 & Helbing, 2016).
	Empower girls and women to achieve gender equality	There are two hundred fifty million men more than women are online. ICTs are the essential pathway to close the digital gender gap and achieve the gender equality and empowerment. There are number of gender equality initiatives to improve the women's technology access, build relevant digital and other skills, as well as, promote female leadership in the tech sector (ITU, 2018a).
SDG 6: Clean water and sanitation	Ensure sustainable management and availability of water and sanitation for all people.	ICTs facilitate smart water management systems, sanitation and hygiene. As new technologies offer water recycling and purification by using equipment that is smaller and more portable (Gehrke, et al., 2015).
	Ensuring the universal access to sustainable, affordable, and modern energy.	Using smart grids, green standards and technology help in building more controllable and efficient energy systems as well as reducing carbon emissions (ITU, 2018a).
SDG 8: Decent work and economic growth	Promote inclusive and sustainable economic growth, decent work and productive and full employment for all	Promoting the digital economic, entrepreneurship, tech-SMEs, e-commerce and cyber trust. As well as providing new earning possibilities for people through online labor platforms, provided they have adequate connectivity and the right skills (UNCTAD, 2017)
	Build resilient infrastructure, encourage innovation and enhance inclusive and sustainable industrialization	The specific target of this goal is to increase information and communication technology access, and affordable and inclusive internet access in the least developed countries by 2020 (Teri, 2019). ICTs are essential for the resilient infrastructure of the 21st century and for accessing services and applications, as they provide inclusive and affordable access to the internet (ITU, 2018a).
SDG 10: Reduced inequalities	Reduce inequality within and among countries	Enabling the disadvantaged segments of society to access technologies and knowledge help to narrow the digital divide, empower communities, and reduce inequality within and between populations, communities and countries (ITU, 2018a).
	Make cities safe, inclusive, sustainable and resilient	Smart sustainable cities, internet of things, 5G and intelligent transport systems (ITU, 2018a).

SDG 12: Responsible consumption and production	Ensure the sustainable consumption and production patterns	ICTs can enable sustainable production and consumption through cloud computing, smart grids, and smart metering. As it ensures cheaper and quicker service delivery (UNCTAD, 2018)
	Take urgent action to combat the climate change and its impacts	ICTs and new technologies generate better data supporting greener lifestyles, forecast, climate monitoring, and early warning systems. Moreover, generating better data help to achieving SDG 14 and SDG 15 (United Nations, 2019).
SDG 14: Life below water	Conserve the oceans, seas and marine resources and sustainably use them for sustainable development	Using the spectrum of radio frequency and satellite orbits allowing the satellite observations and monitoring that increase scientific knowledge of the oceans (ITU, 2018a).
	Protect and restore terrestrial ecosystems, and promote the sustainable use of them.	Using radio-frequency spectrum and satellite orbits allowing satellite observations and monitoring of terrestrial ecosystems help to protect biodiversity (ITU, 2018a).
SDG 16: Peace, justice and strong institutio ns	Promoting inclusive and peaceful societies for sustainable development, building effective, inclusive and accountable institutions at all levels, and providing access to justice for all people	The open data increases transparency, empowers citizens through their work on smart sustainable cities, drives economic growth and key performance indicators that measure social inclusion, for instance, voter participation, and the number of electronic government services. In addition, countries can develop ICT applications and deploy broadband connectivity to facilitate the provision of low-cost or free digital access for schools, hospitals and underserved populations (ITU, 2018a).
	Strengthen the means of implementing and revitalizing the Global Partnership for sustainable development.	ICT tools facilitate and integrate all SDGs through innovative collaboration and scaled-up capacity building. Public-private partnerships are the key to bringing ICTs to all peoples, communities and nations. As these partnerships are necessary to build the physical infrastructure that is required to deliver the internet services to currently disadvantaged populations and in hard-to-reach areas, as well as to facilitate innovation, inclusion and investment that is required by the SDGs (ITU, 2018a).

Source: By author dependent on (ITU, 2018a and Awad & Elnady, 2020)

3. Digital transformation in Egypt:

In the digital transformation era, access to many services, such as education and health services, requires access to mobile phones and internet (ITU, 2018b). Therefore, in alignment with Egypt's endeavors to achieve sustainable development goals (SDGs) according to 2030 Agenda, MCIT seeks to accelerate the digital transformation across Egypt, with the aim of building a strong digital economy and achieving digital society (MCIT, 2019a) through using ICT tools to provide prosperity, freedom, and social equity for all (MCIT, 2013). As, ICT can fight poverty, improve the individuals' everyday lives, and advance the different societies' growth and development agenda (Rizk & Kamel, 2013).

The mission of the MCIT is "enabling the development of a strong digital economy and a knowledge-based society relying on affordable and equitable access to knowledge, digital free, and develop the national ICT industry competitiveness and innovativeness" (MCIT, 2013). Subsequently, the Egypt's digital transformation strategy focuses on developing infrastructure, investing in human capital, creating a conducive business environment, supporting digital entrepreneurship especially by women and creating smart cities and communities with the aim of promoting innovative technologies and digital transformation (Daily News,2019a). Therefore, Egypt has invested heavily in building its national infostructure and infrastructure to be able to effectively use ICT for economy's development and growth, as well as, expand the economy's disposition in both global and regional economies.

According to (ESCP Business School, 2021) report Egypt is the top digital riser in the MENA area in the year 2021. While 2019 according to (Huawei, 2019) report, Egypt was in the early stages of ICT infrastructure build-out as its score was below 60 (52.6 out of 100), as well as it had lower levels of the targeted ICT investment that focused on areas relevant to the SDGs. The status of ICT sector in Egypt is as follows:

- The ICT sector has achieved the highest rate of growth in gross domestic product (GDP) 16.7% at the level of all sectors in 2019, which exceeded the target rate for the same year by about 7%. This is due to the efforts of the state towards financial inclusion. In addition, the sectoral share of investment in the information and communications technology sector reached 5.44% in 2018/2019 (Elgohary, 2020).

- The number of internet users in Egypt in January 2021 are 59,19 million users, which is about 57.3%, while the global rate of the internet users is 59.5% (DataReportal, 2021a and DataReportal, 2021b). While by July 2021 the mobile internet subscriptions in Egypt reached 60.10 million, with an annual growth rate of 20.65% (MCIT, 2021).

- High-speed Internet (ADSL) was introduced in 2530 public schools (high school) across Egypt. There are about 25.8% of school students using internet for educational purposes, and 27.4% of teachers using internet in preparing educational content and searching for information in 2018/2019 (MCIT, 2020a).

- The average of the fixed internet speed in Egypt is 42.42 MB in June 2021, and ranked as the third in Africa, while is ranked as 91st globally (Egypt today, 2021).

- The number of new ICT companies reached 157 in Aug 2020 (MCIT,2021), as well as, the number of graduates whom are qualified to work in information technology services annually is more than 500 thousand graduates from Egyptian universities (Elgohary, 2018).

3.1. Digital Transformation contributions in the Sustainable Development in Egypt:

In context of Egypt's commitment to accomplish the United Nations Sustainable Development Goals, Egypt must be made a safe competitor country attracting investors all over the world, by adopting an open market policy, constructing mega infrastructure projects, deregulating the currency and easing hurdles and regulations for the foreign investors (Hussein & Environ, 2019). Therefore, the Egyptian strategy to achieve sustainable development is to "possess a balanced, competitive, and diversified economy, depending on knowledge and innovation, and based on social integration, justice, and participation. As well as, it is characterized by a balanced and varied ecosystem, using the place and humans' ingenuity in order to achieve the sustainable development and improve the citizens' life quality" (Ministry of Planning Monitoring and Administrative Reform, 2018). This strategy aims to place Egypt among the top 30 countries in the world, in terms of fighting corruption, economic development, market competitiveness, quality of life and human development (El-Megharbel, 2015). Furthermore, the strategy takes into account the optimal use of resources and supporting the fairness of their usage, the equal opportunities' principles, ensuring the rights of next generations and bridging some development gaps (Ministry of Planning Monitoring and Administrative Reform, 2018).

Since, digital transformation plays an important role in achieving SDGs and makes the government's services delivery more efficient (MCIT, 2019a). One of the major elements that help to transform Egypt into a digital society and enable the digital workforce of the future is the inclusion, engagement and participation of the younger generation that represents an invaluable and unique opportunity for Egypt. Thus, Egypt must invest in the human capital and provide them with the information and communication technology skillset and knowhow (MCIT, 2015). Therefore, the Ministry of Communications and Information Technology is launching several projects and initiatives in collaboration with the other Ministries, government agencies and other private partners to promote transformations in the sustainable development and achieving the SDGs (MCIT, 2019a), including seven major tracks; e-Government, e-Learning, e-Readiness, e-Business, e-Culture, e-Health, and ICT export initiative (Kamel & Rizk, 2019).

Furthermore, the public-private partnerships (PPP) is introduced in the reform process of various economic sectors such as housing, education, security, health, government and environment issues. It targets both intra and inter digital divides with the aim of promoting social inclusion, in addition to, its contribution to achieve SDGs (Kamel & Rizk, 2019). In this context, our opportunity is digital initiative was launched with the aim of establishing partnership between public and private sectors and contribute to implementing digital transformation projects in governmental entities. Which in turn improve the work environment that leads to enhance the work performance at governmental institutions, raise efficiency and improve the quality of services provided to citizens (MCIT, 2020b).

As well as, the Ministry of Planning, Monitoring and Administrative Reform launched a mobile application, “Sharek”, as a digital platform that allows citizens; specially the youth to participate in the review process. In addition to raise the awareness of sustainable development (Ministry of Planning, Monitoring, and Administrative Reform, 2018).

In the following section, the author displays the initiatives and projects of MCIT and other partners that contributing to achieve the SDGs in Egypt.

3.1.1. Education and Training:

Out of Egypt’s commitment to achieve SDGs, the government has adopted an e-learning approach at the higher and pre-university education that clearly improving the individuals’ lives, through transforming their lives, regardless of their social level, occupation or age (MCIT, 2019b).

Hence, the Ministry of Education and Technical Education tend to transform the educational system in Egypt, with a budget of $500 million in order to support the strategy of reforming education. This strategy aims to adopt technologies such as; interactive smart boards, online simulations, tablets and a digital library, to transform the educational system gradually to digital learning materials rather depending on textbooks. This transformation provides a comprehensive access to education, create a quality and relevant educational system according to the international standards, improve the quality of learning, and develop enthusiastic and passionate teachers and pupils who learn, think and innovate. Through this project, the digital learning resources will be provided to 1.5 million teachers and students over a period of five years (2018-2022) (MCIT, 2019a). Additionally, the

government implemented several education platforms such as, Egyptian Knowledge Bank (www.ekb.eg) and Edmodo Egypt (www.edmodo.com), which including several digital materials for higher and pre-university education, and creating a virtual community that simulate class rooms. While, the Egyptian Knowledge Bank provides -in addition to the higher and pre-university education- a community for researchers and university students that including several scientific resources such as; universal journals and books.

Furthermore, within the public-private partnership role in supporting the overall education reform efforts in Egypt, the World Economic Forum's IT members community launched the Egyptian Education Initiative (EEI) in cooperation with the Egyptian government. This project is an inclusive model as it is centered around four key work tracks; namely, Higher Education, Pre-university Education, ICT Industry Development and Lifelong Learning as well as, brings parents, students, teachers, community leaders, business, international organizations and government together.

All of these projects enhance the e-education process as they provide virtual classes and labs, interactive e-books, thinking in 3D and drama based learning (MCIT, 2019b).

Moreover, concerning to training process, there are many programs and initiatives are launching by MCIT in collaboration with other Ministries in this purpose. These programs are provided to citizens to raise the competitiveness of the Egyptian calibers and improve their knowledge and skills, thereby youth is empowered to overcome the workforce shortages, find job opportunities and meet the demands of the labor market locally and internationally, in addition to

achieve gender equality (Dahroug, 2019; MCIT, 2019a & MCIT, 2020 b). these programs are as follows:

Gender equality:

Various programs are launched by both MCIT and the private sector - Google and Microsoft - to support, qualify and empower Egyptian women using the various tools of ICT in all life aspects to bridge the growing gap between the workforce and the required skills in the labor market. Such as; Qodwa-Tech initiative, Maharat training program, Hack4Girls initiative and Aspire Woman that has almost reached 60,000 young Egyptian women, in addition, it provided several economic opportunities for over 2,000 women through job placement opportunities, freelance work, and micro-entrepreneurship. (MCIT, 2020b and MCIT, 2019a).

Decent work and economic growth:

MCIT launched several training programs in collaboration with ITIDA, Information Technology Institute (ITI), Palo Alto and other partners to build on human capacity, qualify youth on the future skills and jobs and , create a wide range of job opportunities for young Egyptians. These training programs are provided through several platforms including (MCIT, 2020b): Future work is digital, Freelancing and Remote Work Initiative, Next Technology Leader (NTL), Mahara-Tech, Wazeefa-Tech, African App Launchpad

In addition, there are six technology innovation clusters inside a number of regional universities including, Mansoura, Aswan, Sohag, Minya, Menoufia and South Valley. Each cluster contains specialized technology labs in electronic design, software, business incubators, integrated systems and shared workspaces for startups. As well as, halls

for specialized training in various fields, such as, artificial intelligence (AI), data security, and data science.

3.1.2. FinTech:

Financial technology (FinTech) plays an essential role in achieving digital economy (MCIT, 2019a). Digital financial services are faster, cheaper, and more efficient than the traditional financial services, as well as, they are associated with the higher GDP growth (Sahay, et al., 2020). Consequently, Egypt's government seeks to extend the use of financial technology (fintech) to facilitate the services obtaining process as it lead to (Elgohary, 2019):

1. Promote and achieve the financial inclusion and thus, the inclusive growth through reaching (SMEs) small- and medium-sized enterprises and the lower-income households.

2. Improve the financial services' convenience, speed and efficiency.

3. Provide financial services that are affordable for underserved SMEs and unbanked populations.

4. Reduce corruption and enhance the transparency and efficiency of government operations that facilitate humanitarian and social transfers.

5. Reduce costs and delays in the cross-border remittances.

6. Provide solutions for many challenges such as; corruption, unbanked people, informal transfers and large remittance markets**,** undiversified economies, large income disparities, vulnerabilities to terrorism, and large displaced populations.

7. Enable existing banks to develop new business models.

8. Enable non-financial corporations such as; e-commerce companies (Amazon, Apple, Alibaba), large retail networks, mobile network

operators (MNOs) and mobile transfer companies (MTOs) to offer digital financial services, such as; online payment and online lending solutions.

Therefore, in the last two years, several government and startups initiatives, as well as, applications for different financial transactions were launched to solve the different challenges of financial that face businesses and individuals in Egypt (Menabytes, 2020).

Furthermore, startups are playing an important role in this field as they target the low-income segments as their primary customers and provide several applications for payment and different lending modes such as; Kashat, ValU and Qasatly, Raseedi, Capiter, and Creditgo. Additionally, they transform the HR and payroll space through several platforms that provide lending options and payment systems for employees such as; Dopay, Paynas, NowPay. and Khazna (Ghebrial, 2019).

According to CBE, the number of banks that provide online banking services increased to reach 32 banks out of 38 banks in 2018 (CBE, 2018). As well as, the number of fintech tools has witnessed a great jump between 2019 and 2021 as shown in table 3: (CBE, 2021)

Table **3.** Number of fintech tools

Fintech Tools	**June 2021**	**Dec 2019**
No. of Debit Cards	20,110,495	17,323,753
No. of Prepaid Cards	24,737,385	16,266,169
No. of Credit Cards	4,162,822	3,375,117
No. of ATM machines	16,962	13,331
No. of POS	173,401	88,380

Source: CBE, 2021

In addition, CBE gives a priority to payment solutions including ATMs, POS, online and mobile banking services such as the mobile wallets that include making payments, deposits, withdrawals, and transfers. They witnessed a growth rate of 300% over 2019 as its subscribers, reached 20 million in 2020 doing transactions that worth about EGP100 billion annually ((Daily news,, 2021).

MCIT is seeking to offer a new set of training, camps and workshops in all financial value chain aspects, to empower the potentials of entrepreneurs and banking human resources in this field. Therefore, ITI started several programs in cooperation with Egyptian Banking Institute (EBI) including "Computer Networks Administration and Security" to qualify the banking sector staff in the latest technologies in that field such as Artificial intelligence (AI), Data Analysis, Information Security, Data Science and Data Visualization. These programs targeting the graduates of ICT specializations faculties. As well as, collaborate in holding specialized competition and conferences to exchange knowledge and innovation experiences (ITI, 2020).

3.1.3. Health:

MCIT is collaborating with the Ministry of Health with the aim of advancing the sector by automating procedures, building capacities for whether administrative or medical staff and creating developed networks that improve and transfer communication and collecting data. In addition to bridging the health gap in remote areas as it contributes to deliver better healthcare to remote regions, raises physicians' expertise and knowledge, harnesses ICT infrastructure in medical services provision, creates multi-partnership business model and spreads e-Health culture. Hence, the health sector adopting an

integrated approach targeting the whole community, that is, Tele awareness for community, Telemedicine for patients and Tele education for doctors. Several digital projects is implementing in the health sector with the aim of ensuring the citizens' accessibility to the healthcare services, improving its scope, scale and quality, saving the patients' time and money and the financial sustainability for health coverage services. These projects including Universal Health Insurance program, National Network for Public Health Treatment, Clinical Laboratory Information Systems project and many Mobile Applications in Health that help in spreading health awareness by sending patients short messages, as well as, controlling and reducing the non-communicable diseases spread, such as, hepatitis, blood pressure, diabetes and so on (MCIT, 2019a & Dahroug, 2019).

3.1.4. Energy:

Egypt has plenty of renewable energy resources; (hydro, wind, solar and biomass) with high deployment potential (IRENA, 2018). The Ministry of Electricity and Renewable Energy has adopted a new plan in collaboration with some Chinese companies to develop a smart energy grid based on innovative solutions in the communication and information technology fields that lead to construct a flexible, safe and strong electricity grid. In addition to, several hydropower stations, which are under construction from 2015 across Egypt. As well as, the ministry adopted, upon the National Council for Payments recommendation, a unified digital system to collect electricity bills, and digitalize all public services. Consequently, it has automated about 415 payment collection centers, which are affiliated to the "Egyptian Electricity Holding Company (EEHC)". In addition, the electricity bills payment will be available in all outlets of the banks, whether ATMs, Internet banking or bank branches.

Furthermore, the "Egyptian Electricity Transmission Company (EETC)" made a contract with Siemens company to supply the Egyptian market with the first digital power transformer. As well as, new reform policies are implemented by the electricity sector to launch the energy's digital transformation process, increase energy efficiency, and achieve the electricity sustainability and security. These policies are paving the way for the private sector to invest in the fields of smart networks, renewable energy, enhance governance and sector transparency. For example, KarmSolar is a solar integration and technology company that benefits from the Egypt's abundance of solar power. It delivers innovative solutions to various sectors including tourism, business, agricultural and industrial sectors (Daily news, 2019b & Ministry of Planning, Monitoring, and Administrative Reform, 2018).

3.1.5. Industry, Innovation and Infrastructure:

Egypt is made significant progress in the infrastructure of many fields, including ports, renewable energy, roads, and bridges, among many others. Also, the projects related to drinking water and wastewater are being increased, to cater to the population increase (Ministry of Planning, Monitoring, and Administrative Reform, 2018).

The infrastructure of ICT is the key factor that promotes economic activities in each sector across the nation, therefore, MCIT seeks to promote a cutting-edge infrastructure meeting the growing needs of individuals, government and business in the accelerating global communications era. As well as, MCIT continues to foster the new cutting-edge technologies, which assist the overall development of socio-economic and endeavor to improve and upgrade its

telecommunication infrastructure as traffic grows, technologies evolve, and usage increases and changes (MCIT, 2019a).

Furthermore, digital transformation has a strong impact on the Egyptian industry sector, by implementing the suitable digital technologies to improve and transform business processes, thereby, enhancing the companies' overall performance and increasing their competitiveness by creating new business models, digital services, products and solutions; achieving additional revenue and accomplishing the real-time quality control. Also, the existence of technological systems and data enable companies to better know their production distribution, clients, consumption, solutions and determine its target clients and markets.

In this context, the Egyptian ministry of trade and industry started to digitalize the industry sector, three years ago. It has Launched the "Digital Transformation and Technology Support Program Action Plan 2019-2020" through the Industrial Modernization Centre (IMC), to develop fintech and digital transformation in companies. In addition to, "Egypt Exports through Product Innovation (EEPI)" project that is implemented by The Engineering Export Council of Egypt (EEC) and funded by the European Union (Daily News, 2019b and RSM, 2020).

3.1.6. Peace, justice and strong institutions

Both big data and e-government highlight the five key dimensions of Peace, justice and strong institutions **(**SDG 16); inclusion, effectiveness, openness, accountability and trustworthiness (ElMassaha. & Mohieldin, 2020).

Therefore, MCIT tends to launch several projects to automate the legislative entities services involved in the system, with the aim of developing an integrated system to facilitate procedures, improve and accelerate services for citizens, speed up the implementation of judgments and ensure justice. These projects including Citizen Security and Law Enforcement, Prompt Justice Initiative, Law Enforcement, Developing Notarization offices, Developing Supreme Constitutional Court, Africa Constitutional Court Digital Portal, Achieving Personal Status Documents, Administrative Prosecution Authority Lawsuits Electronic Management, Automating the Legal Departments at the Ministry of Justice, Automation of Family Courts (MCIT, 2019a).

3.1.7. Responsible consumption and production:

Many new technologies have the ability to mitigate trade-offs between the environment and production (United Nations, 2019). The initiative of Enhancing productivity, which is implemented by using the technologies of cloud-computing, provides services that are cost-effective and brilliant as well as releases the financial burden of data centers' maintenance and operation, in addition to reduce the need for the specialized human resources. Since the project was launched, a number of services have been provided to more than 125 government entities including the provision of 1500 accounts of the internet portal and 18,250 e-mails. This is in addition to 600 accounts were provided in the unified communication system, which facilitates the services of video conferencing (MCIT, 2019a).

3.1.8. Clean water:

Egyptian Government has made significant achievements in transforming the traditional techniques of monitoring water pollution on the Nile to the most advanced technological solutions. Whereas, until now 21 stations were installed with the aim of monitoring both the quality of the industrial wastewater that is released directly in the Nile River as well as the quality of the Nile River itself. It is expected that the number of monitoring stations will reach 95 by 2030 (Ministry of Planning, Monitoring, and Administrative Reform, 2018).

3.1.9. Digital projects scheduled to be achieved in the plan of 18/2019-21/2022:

The Medium-term plan of sustainable development 18/2019-21/2022, scheduled many digital projects in context of sustainable development so it targets: (Ministry of Planning and Economic Development, 2018).

- Automating many the Passports Information System, and issuing the electronic visa.
- Automating integrated databases to develop supervisory capabilities.
- Develop the information network in 10 hospitals and 900 curative care units, and automating the laboratories of 10 hospitals in Alexandria University.
- Sending 7 million messages to raise health awareness and reduce the spread of disease.
- Automating the National Tumor Registration Program.

- Technological development of the National Center for State Land Uses.
- Technological development of four transport entities.
- Automation of 295 real estate documentation office and public offices in ten governorates.
- Technological training for 25,000 government employees annually.
- Provide 800 community schools and 165 community centers with technology in addition to training 15000 people in these centers.
- Digital literacy for a 1000 teachers through the ICDL certificate.
- The complete automation of the criminal judicial offices.

4. Discussion and Conclusion:

Digital transformation is undoubtedly affecting the overall society, rendering new technologies more accessible, knowledgeable, agile and competitive, and help in making the better decision, so it plays a role as a catalyst for development and achieving the sustainable development goals (SDGs). As it helps in using resources effectively, decreasing costs, saving time, and so on. Therefore, Egypt is utilizing ICT for achieving sustainable development. As well as, the public-private partnership (PPP), plays a main role in achieving SDGs as it considered the most important actor in implementing the digital projects and initiatives for development.

Therefore, Egypt's government has created partnerships with different entities; whether government or private sector for launching digital initiatives and projects to enhance the social, economic, and environment sectors. These initiatives are to develop human resources

by providing them with the required digital skillsets and creating jobs opportunities, as human resources are the main actor in all sectors and have the main responsibility of the business success. In addition, these initiatives cover all sectors such as; education, health, energy, business, legislative, infrastructures, among others. As well as, the advancing in each sector can cause advancement in other sectors.

However, all the Egypt's achievements in digital transformation field, Egypt is still the early stages and has lower levels of investments of ICT that focused SDGs. As well as, the internet speed and using rate is still lower than the global rate.

5. Recommendations:

- Egypt's government have to give more attention to the ICT industry, innovation, research and development.
- Egypt's government must improve the digital infrastructure and infostructure to enhance the internet speed.
- The digital illiteracy need more attention in an effort to increase the internet users rate and enhance the digital awareness
- Providing data bases for all sectors that helping them in the development strategy.
- Activating the use of information technology and artificial intelligence in all sectors, to utilize them in data analyses and decrease costs.
- Encouraging investments in information technology sector particularly in the SDGs related-areas.

Limitations and Future Research Recommendation:

This research is limited on Egypt country in order to presents a comprehensive narrative of the Egypt's achievements towards SDG through digital transformation, so any other country can utilize from Egypt's experience in SDG. This paper collect data from various sources including researches, reports, and websites, and focused on determine the role of information technology in achieving SDG in various studies.

Future studies could examine the challenges and opportunities that encounter the implementation of information technology in such study. Also the future studies could examine the successful elements of information technology.

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