The Relation between digital transformation and sustainable Development study Egypt case

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الملخص:

استعرضت الدراسة لمحة عامة عن التحول الرقمي عالمياً وعربياً بصفة عامة ؛استناداً إلى مُؤشرات مُعترف بها دولياً، تُبين تصنيفات بعض دول العالم، فضلاً عن تصنيفات الدول العربية المُتقدمة في مجال الرقمنة، كما استعرضت حالة التطور الرقمي في مصر بصفة خاصة؛ استناداً على عدة مُؤشرات منها مُؤشر الحكومة الإلكترونية(EGDI) E-Government evolution Index، ومُؤشر المُشاركة الإلكترونية (EPI) E-participation index ، ومُؤشرالجاهزية الشبكية Network Readiness Index (NRI)، كما قامت تلك الدراسة بدراسة أثر التحول الرقمي في مصر مُمثلاً في مُؤشر الجاهزية الشبكية على التنمية المُستدامة في مصر مُمثلة في مُؤشرات (متوسط نصيب الفرد من الناتج المحلى بالأسعار الثابتة ، متوسط العمر المتوقع عند الميلاد ،متوسط نصيب الفرد من الانبعاثات الكربونية) باستخدام المنهج العلمي الحديث(ARDL) Auto -Regressive Distributed Lag Model ، حيثُ أشارت نتائج الدراسة بوجود تكامل مشترك بين التحول الرقمي والبعد الاقتصادي للتنمية المُستدامة في الأجل القصير دون الطويل ، حيثُ بلغت قيمة معامل الارتباط97% = R^2 ، كما أكدت نتائج الدراسة على وجود تكامل مُشترك بين التحول الرقمي والتنمية المستدامة في جانبها الاجتماعي(العمر المتوقع عند الميلاد)

في كل من الأجلين القصير والطويل حيثُ بلغت قيمة معامل الارتباط R^2 =99%، كما أكدت نتائج الدراسة على وجود تكامل مُشترك بين التحول الرقمي والتنمية المستدامة في جانبها البيئي (متوسط نصيب الفرد من الانبعاثات الكربونية) في كل من الأجلين القصير والطويل حيثُ بلغت قيمة معامل الارتباط R^2 = 97% .

الكلمات المفتاحية: العلاقة، التحول الرقمي، مؤشر جاهزية الشبكة، التنمية المُستدامة، مصر.

Abstract:

The research reviewed an overview of digital transformation globally and in the Arab world in general, based on internationally recognized indicators, showing the classifications of some countries in the world, as well as the rankings of advanced Arab countries in the field of digitization. It also reviewed the state of digital development in Egypt in particular; Based on several indicators, including the e-government index, e-participation index, and network readiness. This study also studied the relation between digital transformation, represented by the Network Readiness Index (NRI) and sustainable development in Egypt, represented by indicators (average per capita share of GDP at constant prices, life expectancy at birth, average per capita carbon emissions) using the modern scientific method (ARDL) Auto-Regressive Distributed Lag Model, where the results of the study indicated the existence of a co-integration between digital transformation and the economic dimension of sustainable development in the short term without The value of the correlation coefficient reached R^2 = %97 percent, and the results of the study confirmed the existence of a co- integration between digital transformation and sustainable development in its social aspect (life expectancy at birth) in both the short and long term, where the value of the correlation coefficient reached R^2 =% 99 percent. The results of the study also confirmed the existence of a co- integration between digital transformation and sustainable development in its environmental aspect (the average per capita share of total emissions). R^2 = 97%.

Key words: Relation, Digital transformation, Network Readiness Index, sustainable development, Egypt.

1. Introduction:

Countries in general, whether developed or developing, strive for sustainable development due to the social, economic, and environmental consequences. Egypt's Vision 2030 has emphasized the importance of achieving sustainable development, and there is no doubt that embracing innovation, developing education, and investing in scientific research improve the quality of infrastructure and digital institutions. Facilitating access to digital services creates societies with high digital competitiveness, which leads to sustainability, which is formed by creating new job opportunities and contributing to the growth of digital services' domestic products. This, in addition to the environmental impact of digitization and efforts to reduce carbon emissions and preserve resources (particularly non-renewable resources), brings prosperity and improves the quality of life.

This study was based on studying the impact of digital transformation on sustainable development in its three dimensions (economic, social, and environmental) during the period 2000–2020 in Egypt. The results showed a co-integration between digital transformation and the economic dimension (per capita GDP at constant prices) in the short term but not the long term, where the value of R^2 = 97%, while there was a co-integration between digital transformation and sustainable development in its social dimensions (life expectancy at birth) and environmental (average per capita carbon emissions) in the short and long term over the same period.

2. the study questions:

Egypt, like other countries, hastened to adopt digital transformation as one of the standards of international competitiveness. The state has digitized services in all sectors of education, health, and various departments according to a national plan for digitization, but there is a question that arises after the state has gone years of the digital transformation process, namely Are the country's steps on the right track?? Which is evident from the existence of a relation and integration

between digital transformation and economic, social and environmental development in Egypt, or is digital transformation going in a path that is contrary and unsupportive of sustainable development?

3. the importance of the Study:

The importance of the study is reflected in the recognition of digital transformation as a global necessity, and digitization has become a competitive advantage added to the balance of countries, as recent indicators have appeared that measure the strength of digital transformation, such as the Digital Development Index and the Digital Competitiveness Index, and there is no doubt that the power of the state in providing and developing infrastructure is driving it a lot towards digitization and making it at the forefront of countries' attracting investment, as well as increasing its ability to face crises.

4. study Hypotheses:

This study revolves around a main hypothesis:

-There is no relation between digital transformation and sustainable development in Egypt.

5. Limitation of the study:

This study measures the relation between digital transformation and sustainable development in Egypt during the period (2000–2020) according to available data.

6. Study Approach:

The researchers adopted the descriptive approach to review previous studies, using both the deductive approach and the inductive approach in analyzing the study variables, in addition to the modern scientific approach that relies on the use of econometrics in building and formulating a standard model by using EVIEWS 12 (ARDL) Auto -Regressive Distributed Lag Model to estimate and measure the relation between digital transformation and sustainable development in Egypt during the period (2000–2020).

7. Methodology:

The researchers examined the relation between digital transformation and sustainable development in Egypt by testing the relation between independent variables (Net Readiness Index), which represents digital transformation, and dependent variables (GDP per capita, co_2 emissions, and life expectancy at birth), which represent sustainable development, according to a scientific method.

8. Data sources:

The researchers relied on the data of:

- World Bank Economic Development Reports until 2020[1] .
-United Nations reports until 2020[2].
- the World Economic Forum, Cornell University, INSEAD, and Portolan Institute [3]
-International Telecommunication Union.

9. literature review:

The issue of digital transformation is a recent topic, as studies before 2015 did not address the relation between digital transformation and sustainability (Gomez-Valencia, 2021), but from 2016 until now, studies have accelerated towards finding the relation between digital transformation and sustainability, including the study (Ghobakhloo, M. (2020)), which emphasized the positive impact of the Fourth Industrial Revolution and sustainability, and the study (Zhao, M. et al., 2021), which was based on the study of the relation between digital transformation and economic development in China, including the thirty provinces, and the results showed a strong correlation between digital transformation and development during The study also attributed some failures in development during the period from 2010 to 2019 to the decline in investments in software in some Chinese provinces, and the study (Ufua DE et al., 2021) examined the role of digital

[1] https://data.albankaldawli.org/
[2] https://www.un.org/ar/esa/hdr/pdf/hdr06/indicators.pdf
[3] https://networkreadinessindex.org/

transformation in achieving sustainable development goals, especially the fourth goal (education) and the goal of The ninth (industrialization) is in Nigeria, where digital transformation leads to improving the quality of education, increasing digital manufacturing, and industrial innovation, with the need to activate the rules of governance to control the digital transformation process. The study (Gupta.A2019) showed the role of transformation in bringing about a boom in the Indian economy by creating a series of new digital jobs, increasing industrial innovation, government services, interactive digital platforms, and achieving sustainable growth goals. As for Egypt, a few studies dealt with the impact of digital transformation on development and sustainability, including the study (Mohamed. S. Farid, 2021). This study aimed to assess the "digital transformation" in Egypt and measure its impact on competitiveness. During the period (1996–2019), using a Distributed Autoregressive Model (ARDL), and results show there is a positive relation between the competitive performance variable and the slowing value of the same variable, the decelerated value of competitive performance increases by 1 unit, for an increase of 0.72 units in performance competition for the current year. and (Kamel. S., 2021), which aimed to identify Egypt's experience in building its infrastructure, information infrastructure, and human capital, which are the basic building blocks of digital transformation. Through several pillars, the most important of which is innovation, which creates new job opportunities, take advantage of the opportunities available from innovative technology platforms in light of the fourth revolution, and learn about the digital transformation strategy led by both the private and government sectors, which would represent the launch platform for comprehensive and sustainable economic development.

10. Contribution of the Study:

This study attempts to know the relation between digital transformation which represented in the network readiness index as an independent variable, and it is the first study, to the best of my knowledge, to use that indicator for sustainable development in Egypt with its three dimensions: the economic dimension represented by the average per capita GDP, and the environmental dimension represented by the average carbon emissions per capita. The social dimension is represented by the average life expectancy at birth, and the networked readiness index consists of four basic pillars: technology, the extent to which individuals use it, its impact on the economy and society, and the availability of infrastructure for digital transformation, which were not addressed by previous studies, some of which were addressed. Technological exports, the number of individuals who use information and communication technologies, and investment, so the gap here is a standard gap represented by the study variables.

11. Theoretical backgrounds of Digital Economy:

There are many concepts of digital transformation, including the definition of the European Commission (2019), which defines it as "an integrated mix of advanced technologies and physical and digital systems, in which innovative business models and new processes dominate, resulting in smart products and services." The European Commission (2019) defines digital transformation as the social and economic effects of using technology and digital data, as defined by the Organization for Economic Cooperation and Development (OECD, 2018), whereas digitization is defined as the process of using data and digital technology, and thus distinguishes between digitization and digital transformation. While Schwertner (2017) defined it as "the application of technology to build new business models, processes, programs, and systems that lead to more profits, greater competitive advantage, and higher efficiency." While Deloitte (2018) defined it as "the use of technology to fundamentally improve performance, or transform businesses in

organizations into a digital image, which improves operations and contributes to the production of new business models."

12. Digital Transformation Metrics:

Although the digital economy has come to contribute a large percentage, estimated at about 4.5–15.5 of the world product, it has come to represent about 40% of the total GDP for some countries, such as Taiwan, Ireland, and Malaysia, and the United States and China together represent nearly 15.5% of the world's GDP (OECD, 2019, p. 5). The added value of the ICT sector is globally recognized, but the process of measuring the digital economy faces several difficulties due to its multiple definitions and the lack of a precise and specific definition (Lambin, 2014, p. 148). However, the widespread and rapid spread of digital transformation has imposed the necessity to measure it, and accordingly, a number of indicators that can be relied upon when measuring the size of the digital economy have been agreed upon, namely the digital development index and the networked readiness index, which are two global indicators, and there is an Arab indicator issued by the Fund Arab Monetary Fund. Arab Monetary Fund Evolution is a digital development indicator. They can be explained as follows:

12-1Digital Evolution Index (DEI):

The Digital Development Index is issued by The Fletcher School's Institute at Tufts University, USA, in cooperation with the MasterCard Company. (The Fletcher School & Mastercard, 2017, p. 16), This indicator expresses a comprehensive, data-driven assessment of the progress of the digital economy in 60 countries globally and includes more than 100 different indicators across four main pillars[4]:

- **Conditions of Offer**: Any infrastructure that enables digital interactions and transactions[5].

[4] http://www.thenextsiliconvalley.com/2017/07/21/4784-digital-evolution-index-maps-competitiveness-of-60-countries/#.XtA8BjozbIW

[5] https://knoema.com/DEI2018/digital-economy-digital-evolution-index-dei-2017

- **Demand conditions:** mean the ability of consumers to integrate into the digital system.
- **Regulations, government procedures**, and policies that support or impede the distribution of digital technologies are referred to as the institutional environment.
- **Change and Innovation**.

12-2 Network Readiness Index (NRI):

The Network Readiness Index has been issued by the World Economic Forum since 2001 and developed by the Information and Communication Technologies issued by the This indicator measures the ability of countries to take advantage of ICTs to increase competitiveness and well-being and considers many axes within the framework of the digital economy (World Economic Forum, 2016. p. 5)**.**

The network readiness index consists of four axes:

-Technological environment (regulatory policies:
business environment, innovation) Digital readiness, including infrastructure and the ability to invest Individual and institutional use of indicators

-The economic and social impact of the indicators

12-3 Arab Monetary Fund index of Digital Evolution:

It is an index issued by the Arab Monetary Fund, which studies the development of the digital economy in 14 countries based on official data issued by each country, in addition to statistics issued by international institutions interested in digitization. The index includes four main pillars, branching into 24 sub-variables, and the main pillars are:

- The foundation of the digital architecture
- The pillar of economic contribution
- The pillar of digital empowerment.
- The pillar of digital innovation and creativity

13. A look at global digital transformation:

The countries of the world, both developing and developed, seek to achieve a highly competitive advantage through improving their infrastructure and digital capabilities,

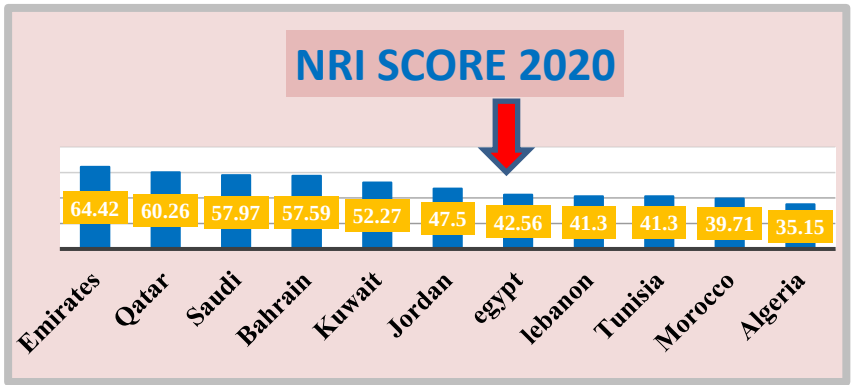
through which it is possible to attract foreign investments to finance the development process and even use modern technology to reduce environmental pollution processes and improve public health. Therefore, countries adopt improving and advancing digital transformation processes as they have become the hallmark of the era. As we find in the top ten countries according to the Network Readiness Index 2020, Sweden ranks first with a score of 78.9 points, followed by Denmark and Singapore. and the Netherlands, Switzerland, Finland, Norway, the United States, Germany, and the United Kingdom[6].

14. A look at digital transformation in the Arab countries:

Although the digital transformation in the Arab countries is proceeding at a fast pace, as the volume of communication between the Arab countries and the West has multiplied more than 150 times, and digitization fees for smartphones have doubled, especially in the Arab Gulf countries, the Arab countries' digital investment is the lowest, According to the 2016 Arab Digital Economy Report, the volume of investments in the Middle East's digital economy is the lowest, reaching $120 million, after the United States, Asia, and Europe, whose investments amounted to $2300, 640, and 370 million dollars, respectively. (Al-Masry, T. et al., 2016.) The ranking of Arab countries according to their digital development can be clarified according to the Networked Readiness Index for the year 2020, as shown in Figure No. (1).

Arab countries ranked
According to the Network Readiness Index (NRI) 2020.

[6] Portulans Institute ، Network Readiness Index2020 https://public.knoema.com/ljisicg/network-readiness-index-2020-digital-transformation-at-a-glance



Source: Portulans Institute ،Network Readiness Index2020 https://public.knoema.com/ljisicg/network-readiness-index-2020-digital-transformation-at-a-glance

It is clear from the previous figure that the United Arab Emirates tops the list of Arab countries with a score of 64.42, and it represents the first Arab position of 30 globally, followed by Qatar with 60.26 points (the second Arab) and ranked 38 globally. While Egypt ranks seventh among the Arabs and 84th globally, with a rate of 42.56,

Although there is a huge demand for digital services, only 6 percent of the population of the Middle East lives under an intelligent digital system. It represents the digital capabilities exploited in the Middle East. 8.6% was exploited, while the digital capacity exploited in Europe was 15.2%, and in the United Nations it was 18%. This means that Middle Eastern countries still have a lot to do to accelerate the pace of digital transformation, both in terms of investment available to finance and in terms of the digital workforce, professions, and industries. Accordingly, there have been several calls for the adoption of clear strategies in Arab countries for digital transformation.

The Arab strategy for the digital economy is based on five main pillars: digital foundations, digital innovation, digital citizens, digital business, and e-government (Qaaloul, Sufian & Talha, 2020, p.7).

15. Prospects for digital transformation in Egypt:

Egypt has an opportunity to benefit from digital transformation and achieve the goals of its Vision 2030 development strategy by:

(a) releasing the private sector's potential;

(B) digitization of government services, increased efficiency, and anti-corruption efforts

(C) utilizing human capital (Kamel, 2020a).

Where transformation is an enabling environment that can make a difference, it must be supported by the required infrastructure, skilled human capital, appropriate legal, regulatory, and investment environments, governance, education, security, and other supporting environments necessary for an integrated ecosystem (Al-Aees2019).

Digital transformation can also help reshape and improve economies and societies. Competitiveness is enhanced by encouraging creativity and innovation, increasing efficiencies, improving various services, and providing a comprehensive and long-term platform for development and growth (Berman and Marshall, 2014; Matt et al., 2015).

It is important to note that while digital transformation will result in many jobs being replaced by new machines in the future, technology-related jobs will be created (Matt et al., 2016). There will be an increase in the need for highly skilled labour. Therefore, policies must be in place to provide sufficient human capital development, healthcare, and social welfare to enable the workforce to incubate and adapt to the ever-changing environment and have the capabilities and skills to understand and make the most of the prospects enabled by emerging innovative technology platforms. In short, there will be a greater need for people who can better handle machines that use advanced technologies (Schwab, 2018).

The digital transformation in Egypt can be evaluated through several pillars; the most important of them are:

- The E-Government Index (EGI) assesses the performance of e-government in terms of e-government and e-government.
- The E-Participation Index (EPI)
- NRI stands for Network Readiness Index.

These indicators can be reviewed as follows:

15-1 E-Government evolution Index(EGDI) in Egypt during the period (2000-2020):

Egypt's ranking in the e-government index (EGDI) also advanced globally, from 114th place with a value of 0.488 points in 2018 to 111st place with a value of 0.552 in 2020, out of 193 countries, advancing by three places at the global level. As shown in the following table:

Table (1):

Indicator of E-government development in Egypt from 2000 to 2020.

(EGDI)	2003	2004	2005	2008	2010	2012	2014	2016	2018	2020
score	0.23841	0.26530	0.37929	0.47670	0.45180	0.46112	0.51293	0.45941	0.48800	0.55270
Rank	140	136	99	79	86	107	80	108	114	111

Source: https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/53-Egypt

15-2 E-participation index(EpI) in Egypt during the period (2000-2020):

Egypt's rank also advanced in the E-participation index globally from 109th rank with a value of 0.539 in 2018 to 106th rank with a value of 0.511 in 2020, up three ranks. As shown in the following table:

Table (2):

Indicator of E-participation Index in Egypt during the period **(**2000-2020**).**

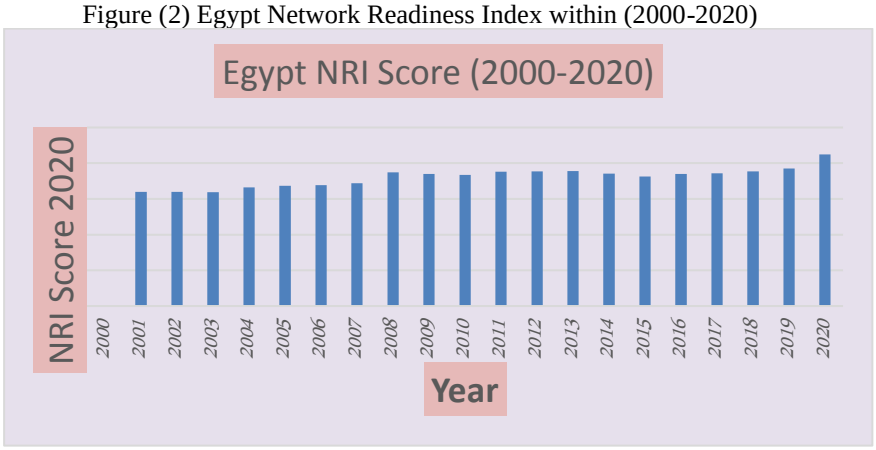
E-Participation Index	2003	2004	2005	2008	2010	2012	2014	2016	2018	2020
score	0.01720	0.01639	0.07936	0.25000	0.28571	0.68420	0.54901	0.40678	0.53930	0.51190
Rank	123	123	73	49	42	15	54	107	109	106

Source: https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/53-Egypt

15-3 Network Readiness Index in Egypt:

Egypt's ranking in the network readiness index also changed between 2000 and 2020, as shown in Figure No. (2):

Figure (2) Egypt Network Readiness Index within (2000-2020)



Source: Portulans Institute ،Network Readiness Index https://public.knoema.com/ljisicg/network-readiness-index-2020-digital-transformation-at-a-glance - the World Economic Forum, Cornell University, INSEAD reports for several years

The previous figure shows that Egypt ranks 84th with a score of 4.25 in the NRI index 2020, the individual index of technology and its impact on the economy and society, as it advances governance in the pillars of governance, technology, and the social and economic side[7].

figure (3) Top-ranked and bottom-ranked indicators of Egypt

Strongest indicators	Rank	Weakest indicators	Rank
Prevalence of gig economy	6	Internet domain registrations	101
R&D expenditure by governments and higher education	16	High-tech exports	101
Computer software spending	21	Internet shopping	112
Income inequality	24	SDG 5: Gender Equality	114
Cybersecurity	25	Socioeconomic gap in use of digital payments	115
Mobile tariffs	32	SDG 11: Sustainable Cities and Communities	115
Availability of local online content	34	Secure Internet servers	116
ICT skills	42	Happiness	116
SDG 7: Affordable and Clean Energy	42	Regulatory quality	120
Internet access in schools	43	Online access to financial account	121

Source: Network Readiness Index 2020 Egypt, Washington DC: Portulans Institute report, p:4. available at: https://networkreadinessindex.org/wp-content/uploads/2020/12/Egypt.pdf

[7] https://networkreadinessindex.org/wp-content/uploads/2020/12/Egypt.pdf

The previous figure also shows the strengths and weaknesses of the digital transformation process for Egypt, where the left side represents the strengths of spending on research and development, as it comes in the sixteenth rank among countries that spend on research and development and higher education, and spending on computer programs, where it comes in the 21st rank. Globally, digital skills and access to the Internet ranked 34 and 42nd, respectively, while on the right hand, we find that Egypt lags behind in several other pillars, including the export of high-tech products, representing the 101st rank, digital shopping, 112 rank, and the establishment of Smart Communities and Cities, 115 rank, which is the eleventh goal of the Sustainable Development Goals, as well as digital access to financial accounts and data protection, 121 rank, and the social and economic gap in the use of digital payments, 115 rank. This makes it imperative for Egypt to strengthen these pillars to improve the digital transformation process.

16 Digital transformation and sustainable development in Egypt:

Egypt has adopted the "Strategy of Sustainable Development: Egypt Vision 2030", one of its most important goals "The new Egypt will have a competitive, balanced and diversified economy based on innovation and knowledge, based on justice, social integration and participation, with a balanced and diversified ecosystem, investing the genius of place and people to achieve sustainable development, It improves the quality of life of Egyptians, and this strategy also aims to make Egypt among the top 30 countries in the world in terms of indicators of economic development, human development, combating corruption, market competitiveness, and quality of life. To be a magnet for investments, most of which are heading towards digitization, it was necessary for Egypt to strive towards digital transformation, to keep pace with the developments of the outside world, and so as not to fall behind in the process of advancement and progress.

16-1 sustainable development strategy:

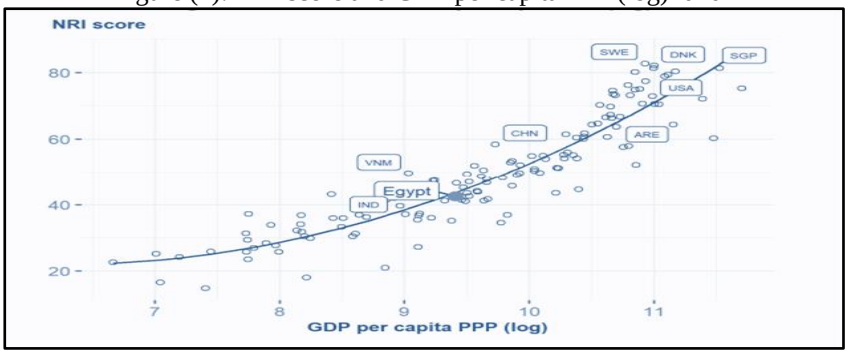
Societies' aspirations for sustainable development have grown, achieving economic and social growth while also preserving the environment (Al-Osaimi, 2015, p. 16), which achieves development goals without jeopardizing future generations' rights or depleting natural resources (Rabie, 2017, p. 5). Sustainable development must be long-term, economically efficient, desirable, socially inclusive, prudent, and environmentally balanced (Romeiro A.R., 2012), and the sustainable development strategy is based on three key dimensions: The first is the economic dimension, which focuses on improving citizens' living standards, increasing average per capita GDP, and encouraging innovation, knowledge, and scientific research; and the second is the social dimension, which focuses on improving citizens' public health and increasing life expectancy at birth, lowering the mortality rate, and achieving social justice.

16-2 The relation between digital transformation and sustainable development:

The extent of individuals' ability to deal with the Internet and access digital services, the use of digital technologies in social and economic activities, the purchase of goods and services, education, communication in social networks, and participation in political life are all affected by digital transformation.

The impact of digital transformation extends to economic and social activities, as it affects sustainable development (average per capita GDP), with a strong correlation between digital transformation and average per capita GDP, as each affects the other. It also has an impact on the labour market, as it creates jobs and improves the quality of services provided.

Figure (4): NRI score and GDP per capita PPP (log)2020



Source: Network Readiness Index 2020 Egypt, Washington DC: Portulans Institute report, p:2. available at: https://networkreadinessindex.org/wp-content/uploads/2020/12/Egypt.pdf

According to the previous figure, Sweden (SWE) is ranked first in the world, followed by Denmark (DNK), then Singapore (SGP), then China (CHN) comes in at forty-first rank, and Egypt (EGY) is ranked forty-first in the world, and Egypt also falls within the group of lower-middle-income countries, while Vietnam (VNM) is considered the highest country in this group in the Networked Readiness Index, while the United Arab Emirates (ARE)

The previous figure also depicts Egypt's position in terms of the relation between the degree of NRI and per capita GDP at constant prices (PPP), and it is worth noting that Egypt is slightly less than the trend line (slightly away).

17 Measuring the relation between digital transformation and Egypt's sustainable development:

In light of the foregoing, the researchers used both traditional and modern econometric methods. She describes the proposed model in light of economic theory in this regard and previous standard studies, as well as what she deems appropriate to the nature of this study, according to the traditional econometric approach. According to modern econometrics, the nature of the appropriate model is determined by performing unit root tests on the time series of the study variables and based on their degree of stability.

17-1 Study variables:

Because of the availability of data, the current study's variables are the digital transformation assessment index and the Network Readiness Index (NRI). This is a 2019 indicator prepared and developed by the Portolan Institute. It was previously known as the Information and Communication Technology Index (ICT) and was prepared by the Economic Forum beginning in 2001. This indicator, developed in collaboration with Cornell University and INSEAD, is built on four major pillars: technology, people, governance, and impact. It is in addition to indicators for measuring sustainable development in its economic, social, and environmental dimensions, as shown in Table No (3).

17-2 The temporal and spatial limits of the study:

This study examines the relation between digital transformation and sustainable development in Egypt from 2000 to 2020, using data from the World Economic Forum, Cornell University, INSEAD, and the Portolan Institute, as well as World Bank data.

17-3 Data and method:

Table (3) Dependent and independent variables

independent variable (digital transformation index)	
Network Readiness Index (NRI) (x١)	It is one of the leading global indices on the application and impact of information and communication technology (ICT) in economies around the world. In its latest version of 2020, the NRI Report maps the network-based readiness landscape of 134 economies based on their performances in four different pillars: Technology, People, Governance, and Impact[8]
Dependent variables (Sustainable development variables)	
GDP per capita (y1)	gross domestic product with fixed prices divided by number of populations.
CO2 emissions (metric tons per capita) (y2)	carbon emissions per capita are measured as the total amount of carbon dioxide emitted by the country as a consequence of all relevant human, emissions are expressed in metric tons of carbon per Capita.
Life expectancy at birth, total (y3)	indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.

Table (4) data of digital transformation &sustainable development in Egypt (2000-2020)

[8] https://networkreadinessindex.org/wpcontent/uploads/2020/12/Egypt.pf

year	Network Readiness Index (NRI)score	Network Readiness Index (NRI)Rank	GDP growth (annual %)	GDP per capita, PPP (constant 2010 international $)	CO2 emissions (metric tons per capita)	Life expectancy at birth, total (years)
2000	0	0	6.37	1981.8	1.640	68.6
2001	3.20	60	3.54	2013.3	1.782	68.8
2002	3.20	60	2.39	2023.0	1.787	69.0
2003	3.19	65	3.19	2049.1	1.802	69.1
2004	3.32	57	4.09	2094.3	1.924	69.3
2005	3.37	63	4.47	2148.8	2.126	69.4
2006	3.39		6.84	2255.5	2.200	69.6
2007	3.44	77	7.09	2373.4	2.329	69.8
2008	3.74	63	7.16	2498.4	2.375	70.0
2009			4.67	2566.9	2.409	70.2
2010	3.67	70	5.15	2646.0	2.374	70.3
2011	3.76	74	1.76	2636.3	2.385	70.5
2012	3.77	79	2.23	2636.0	2.458	70.7
2013	3.78	80	2.19	2633.2	2.380	70.9
2014	3.71	91	2.92	2649.4	2.396	71.1
2015	3.63	94	4.37	2704.9	2.444	71.3
2016	3.70	96	4.35	2762.6	2.477	71.5
2017	3.72		4.18	2818.5	2.475	71.7
2018	3.77		5.31	2908.6	2.502	71.8
2019	3.85	92	5.56	3010.2		72.0
2020	4.25	84	3.57	3058.3		

Source: https://networkreadinessindex.org/
https://public.knoema.com/ljisicg/network-readiness-index-2020-digital-transformation-at-a-glance& https://data.worldbank.org/ Data. Country .EGY/En

17-4 Stationary Tests:

The Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests will be used to determine the degree of integration of the variables, and after performing the Unit Root Tests to determine whether the time series of the variable data is stationary or not, in order to avoid the problem

of Superior Regression (Pesaran, M.H. 1997), where the value of R2 is higher than the true, and the results of Based on that analysis, we can conclude that the time series are stable at the level (I0) and at the first difference.

Table (5)

stationary of time series (ADF) and (KPSS) analysis for Egypt (2000- 2020)

Var.	Augmented Dickey–Fuller						(KPSS)			
	level			First difference			level		first difference	
	intercept	intercept &trend	none	intercept	intercept & trend	none	intercept	intercept & trend	intercept	intercept& trend
X1(NRI)	-*12.2025	*-21.283	0.348318	-1.285653	*11.55154	*-22.64067	**0.5755	** 0.1502	0.294765	*** 0.129005
Y1(GDP)	*4.258533	1.908035	*4.178179	1.255173	-2.228129	**2.673602	0.549739	**0.19222	** 0.6357	0.109380
Y2(co_2)	-1.343975	0.196129	0.431256	-1.783566	***-4.128	-1.713514	*** 0.436	0.138950	0.219636	0.162974
Y3(age)	-4.420*	5.09780	2.517191	-2.200552	-3.391478	-0.541478	**0.5679	***0.1417	0.271695	0.098093
critical values (tabular)										
1%	-3.859	-4.578	-2.699	-4.004	-5.835186	-2.740	0.739	0.216	0.739	0.216
5%	-3.408	-3.699	-1.961	-3.098	-4.246503	-1.960	0.463	0.146	0.463	0.146
10%	-2.661	-3.286	-1.606	-2.690	-3.590496	-1.605	0.347	0.119	0.347	0.119

18 Results:

The researchers tested the relation between the independent variables represented in the Network Readiness Index (NRI) and the dependent variables represented in the indicators of sustainable development (GDP, CO_2, life expectancy) in Egypt, both in the short and long run within a period (2000–2020), and the result showed:

1. Measuring the relation between the **digital transformation represented by the** Network Readiness Index (NRI) and the average per capita GDP at constant prices

The results were as follows:

In the short term, an initial test showed that there is a significant relation between the GDP per capita and the Network Readiness Index (NRI) indicator, where the value of R^2 reached 97%, which means that the Network Readiness Index (NRI) in Egypt explains 97% of the changes in the average per capita GDP at constant prices. The Durbin-Watson statistic was 1.976147, and the F value was 29.37402, at Prob (F-statistic) = 0.000312 at level 1%.

Then, the Bounds test (ARDL Long Run Form and Bounds Test) showed a co-integration between the dependent variable and the independent variables, where the value of F = 4.650883, which is significant at the level of 2.5%, leads us to reject the null hypothesis and accept the alternative hypothesis, which states that **there is a co-integration** between **digital transformation and sustainable development in its economic dimension**, represented in the GDP per capita at constant prices.

NRI-(0.0000*GDP + 3.8922) = EC

As for the error correction methodology, the researchers conducted a Serial Correlation LM Test, which showed its insignificance as the value of Prob (F-statistic) = 1.629825, which is lower than I_0 (bound 0).

This means that there is no co-integration relation between the Net- readiness index and the GDP per capita share in the long term.

2. **Measuring the relation between digital transformation indicators represented in the in-Network Readiness Index (NRI) and life expectancy at birth**

The results resulted in the following:

In the short term, the initial test showed that there is a strong significant relation between the life expectancy at birth and the **Network Readiness Index (NRI)**, where the value of R^2 reached 99%, which means that the NRI indicator in Egypt explains 99% of the changes in the life expectancy at birth, and the statistical value reached Durbin-Watson = 3.565274, the value of F = 37.408. at a significant 1%.

Then, the Bounds test (ARDL Long Run Form and Bounds Test) showed the existence of a cointegration between the dependent variable and the independent variables, where the equation of the long run Bounds test was

EC = NRI-(-0.2802*AGE + 18.7528)

The value of F = 17.94037, which is significant at the level of 1% because it is greater than all values of Bound I_1, leads us to reject the null hypothesis and accept the alternative hypothesis, which states that there is a co-integration between NRI and the social dimension of sustainable development, which is expressed in the life expectancy at birth.

3. **Measuring the relation between digital transformation, represented in the** Network Readiness Index (NRI), **and the average per capita share of carbon emissions**

In the short term, the initial test showed that there is a significant relation between the average per capita carbon emissions and the NRI indicators, where the value of R^2 reached 97%, which means that the NRI indicators in Egypt explain 97% of the changes in the average per capita carbon emissions.

Durbin-Watson = 2.7869370 and F value = 49.731 were obtained as the statistical value

Then, the bounds test (ARDL Long Run Form and Bounds Test) showed the existence of a co-integration between the dependent variable and the independent variables, where the equation of the long-term boundary test was

EC = CO2—(35.0569*NRI-128.7708)

The value of F = 7.502, which is significant at the level of 1%, leads us to reject the null hypothesis and accept the alternative hypothesis, which states that there is **a cointegration between NRI and sustainable development in its environmental aspect**, which is expressed in the average per capita carbon emissions.

In terms of error correction methodology, the researchers ran a Serial Correlation LM Test, which revealed its insignificance with a value of Prob(F-statistic) = 0.959587, indicating error

correction from short to long term. The Heteroskedasticity Test: Breusch-Pagan-Godfrey confirmed the existence of error variance. And the presence of problems with the remaining morale. Through the equation

-0.042769 0.006610-6.470848 0.0001 (-)

which prompts us to measure the stability of errors by testing. method of least squares, which showed the stability of the results.

Discuss the results:

According to the previous results, the impact of digital transformation was clear on both the average per capita carbon emissions in the short and long term, as well as the average life expectancy at birth in the long and short term, which confirms the technological and digital role in achieving the dimensions of sustainable development, both the environmental and social dimensions. While the impact of digital transformation on the economic dimension has not been achieved in the long term, Egypt must therefore develop and support the digital transformation process so that it bears fruit in the long term on the economic aspect represented by the GDP per capita.

Recommendations:

The following recommendations were made by the researchers:

1. Increasing digital investments in the industry is a priority. As most Arab countries focus on digitization in the trade and services sectors, increasing the dissemination of knowledge and technology to meet the demands of an expanding population and increase the benefits of its impact on sustainable development is becoming more important.
2. boosting advanced technological exports and eliminating all export barriers.
3. reducing the gender disparity in the economic and social fields of digital payments.
4. increasing the activation of digital shopping operations and digital consumer data protection.
5. Increasing investment in digital infrastructure to meet the needs of a growing population.

6. Citizens' digital literacy and awareness should be improved.

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