The Role of Digital Transformation in Achieving Economic Well-being the Case of Algeria

KADRI NOURIA
Department of Economic,
University of Mascara,
ALGERIA

Abstract: - The continuous and rapid development of digital technology has led to the emergence of cyberspace, comprising the Internet and its related advanced technology and smart applications. The latter has evolved into a conduit for the ongoing digital transformation of human life and activities across diverse sectors. Economic advancement now hinges closely on nations' capacity to align with this swift-paced progress., which achieves prosperity for individuals and society. Based on this basis, this research aims to study the impact of digital transformation on economic well-being through a standardized study of two indicators, the Information and Communication Technology Development Index (IDI) and the Economic Well-being Index (IDH) in Algerian society. The study has shown a positive long-term impact.

Key-Words: - Digital transformation, information and communication technology, technological development index (IDI), economic well-being, well-being index (IDH), economic prosperity, Algeria.

1 Introduction

The world is currently undergoing a revolution in communications and information technology. This has brought about fundamental changes in various aspects of life, directly influencing the methods and means of conducting economic activities. As a result, a new type of economy known as the digital economy has emerged, positively impacting society as a whole. Consequently, the economy is increasingly shifting towards this new economy, which is built on the use of information technology and modern communication methods. Economic growth has become one of the primary objectives pursued by nations, and currently, the issue of economic growth is closely linked to a country's readiness for digital transformation and reliance on new means instead of traditional production elements. This requires the establishment of essential infrastructure for the telecommunications and information technology sector, as well as the legal and legislative framework required for electronic business operations.

Information and communication technology (ICT) has had a significant impact on all levels due to its remarkable achievements, the most important of which is providing the necessary information at the right time and place, according to the principle of efficiency in quantity and quality. This has brought about a fundamental change in the lives of individuals and organizations. The functions and tasks of the latter have changed, leading them to continuously rebuild themselves in line with rapid developments. E-business has been adopted, leading to significant and extensive changes in interaction patterns, communication methods, and the provision of necessary information for making various decisions and delivering services. All of this is made possible by qualified human resources with technological literacy and information awareness, capable of keeping up with technological advancements and making a qualitative leap for the organization to achieve benefits, minimize damages and risks, and thus achieve societal well-being

From this perspective, we pose the following problem:

What is the role of digital transformation in achieving economic well-being in Algeria?

Therefore, the following sub-questions are raised:
- What is the concept of digital transformation?
- What are its objectives and indicators?
- What are the factors for achieving economic well-being?
- What are its most important indicators?
- What is the current situation in Algerian society?

As an initial attempt to address the research issue, we suggest the following hypothesis:

There is no role for digital transformation in the economic well-being of Algeria.

In terms of the research methodology, we employed the descriptive analysis approach to gain familiarity with the study variables and enhance the theoretical aspect. Additionally, the standard analytical method was utilized to measure the impact of ICT on achieving economic well-being in Algerian society.

The importance of research lies in the necessity of adopting digital transformation through the use of ICT in practical and scientific life. Its significance stems from its ability to create value for businesses by facilitating data transfer, information sharing, and remote communication to achieve the goals of organizations in various forms and patterns. Moreover, the study of well-being and the analysis of factors that can achieve the highest possible level of psychological, material, and social stability for individuals within a specific society have led us to connect it with information and communication technology. This connection has become essential in achieving stability and well-being as it enables access to information at the right time and place to make various decisions, thereby improving living conditions and eliminating poverty.

The study was divided into three primary sections, outlined as follows:
First : The literature review of the study
Second : The study's reality in Algeria
Third: A standard study

2 The Literature Framework of the Study

Scientific and technological advancements have contributed to achieving individual well-being. Among the continuous developments is digital transformation, which refers to the advancement of ICT. This advancement aims to integrate various fields such as education, healthcare, and entertainment easily while saving effort and money. Additionally, it facilitates communication and connection among individuals and groups in different and distant environments, enhancing the exchange of information between them

2.1 Concepts Related to Digital Transformation

a- Definition of digital transformation:
Digital transformation refers to the use of computer technology and the Internet to create economic value more efficiently and effectively. In a broader sense, it refers to the changes brought about by new technology in general, including how work is done,

how interactions occur, and how wealth is generated within this system

Previous studies have provided multiple definitions of digital transformation. It has been defined as a process of fundamental changes within a company's value creation chain or internal structure, which can be either a cause or a prerequisite for technology utilization, [1].

The topic of digital transformation has been extensively addressed with new strategic concepts, especially digital business strategy and digital transformation strategy. The main idea of digital business strategy lies in understanding information technology as a fundamental requirement for innovation and achieving competitive advantage. Many studies have defined digital transformation as a process aimed at improving entities and institutions through significant changes in their characteristics using a set of information technology, computing, and communication techniques. In light of these efforts, there are internal and external users of digital services that must be included in digital transformation efforts through four aspects, [2].

- Dynamic capabilities as a prerequisite for digital transformation.
- User participation in the design of digital services.
- Co-production and co-creation to enhance the legitimacy of digital services.
- Collaborative creation with open records to improve the delivery of digital services.

Furthermore, digital transformation is a requirement for institutions and companies, particularly those facing challenges and barriers when seeking innovative business models and their implementation for digital transformation, considering their experiences. They are often forced to deal with conflicts and trade-offs between current and new ways of conducting business.

Hence, it revolves around adopting disruptive technologies to increase productivity and create value and social well-being. Many national governments and multi-stakeholder organizations have presented foresight studies and long-term policy adoption strategies. A study addressed the goals of digital transformation at the social and economic levels in the following points, [3]:

- Enhancing the development of more innovative and collaborative technological systems and financial culture at the institutional and societal levels.
- Changing the education system to provide new skills and guide individuals towards achieving excellence in digital work and society.

- Establishing and maintaining the infrastructure for digital communications, ensuring its management and accessibility, and achieving a balance between service quality and delivery costs.
- Enhancing the protection of digital data, transparency, ensuring independence requirements, and building trust.
- Improving accessibility to services and establishing controls and mechanisms for the quality of digital services provided to the community.
- Implementing new and innovative business models and improving the regulatory framework and technical standards.

b- The importance of digital transformation in society:

Economic institutions operating in a dynamic environment need to adopt modern and advanced technology to maintain their position, achieve excellence, and ensure the well-being of their members. From this perspective, economists and experts in the field of technology have attempted to define digital transformation due to its strategic importance for business organizations in various activities and fields.

In all fields, the changes instigated by globalization have expanded the scope of media and communication, where media, with its advanced technologies, has emerged as the catalyst for transformations in politics, economy, ideology, art, and culture. It has had the power to shape knowledge, create new standards, and destroy previous traditional value systems, [4].

Scientific and technological advancements have contributed to the well-being of individuals, and among the ongoing developments are those related to ICT, which achieve goals for both institutions and individuals, including achieving integration in various areas such as education, healthcare, and entertainment with ease and cost-effectiveness. It also facilitates communication and connectivity for individuals and groups in different and distant environments, facilitating exchange processes between them.

The latter contributes to economic development by providing information and communication, allowing information to be available at the right time and place without any hassle.

ICT also helps in sharing and collaboration among communities, including marginalized, isolated, and sometimes shadowed areas, regardless of social classes and levels. In addition to its role in enhancing various types of development, including human, economic, social, and cultural, due to its

greater efficiency and effectiveness compared to traditional communication methods, [5].

c- Characteristics of information and communication technology:

The characteristics of ICTs include the following, [6]:

- Interactivity: It is defined as the future of this technology can be both sender and receiver at the same time, as participants in the communication process can exchange roles, allowing for a type of interaction between individuals and institutions.
- Asynchronization: The ability to receive messages or information at any time, as participants are not required to use the system simultaneously.
- Decentralization: The property that allows for the independence of ICT, such as the internet, to ensure its continuous operation. No entity can disable the internet globally. As there is no single computer controlling it, a single or multiple nodes may malfunction without jeopardizing the entire internet.
- Compatibility: The ability to connect various communication devices regardless of their manufacturer, irrespective of the company or country of origin.
- Mobility: It represents the benefits users have from its services while on the move, i.e., in any location.
- Connectivity: The ability to transfer information from one medium to another, converting an audible message into a printed or electronic readable message, also known as electronic reading.
- Demassification: The ability to direct communication messages to an individual or specific group instead of necessarily targeting a large audience. This means having control over the message, which reaches the consumer directly from the producer.
- Ubiquity and proliferation: The expandability of this network to encompass increasingly larger and unlimited areas of the world. It gains strength from the systematic proliferation of its flexible system.
- Universality and globality: Allowing capital to flow electronically, meaning that its decentralized nature has made the global environment its working environment, especially considering the ease of cross-border commercial transactions driven by informational capital.

d- ICT Indicators:
The total number of experts in the field of ICT was announced in a report related to the measurement indicators (EGTI : Expert Group on Telecommunication ICT Indicators) during the 51st session, which is renewed annually to collect and modify these indicators per the data collected and obtained from statistics and updated reports for each year and according to the data of each country. The International Telecommunication Union (ITU) has defined the framework for ICT indicators according to the stages that any economy goes through in the transition towards a knowledge society, and it defines them in three stages as follows, [7]:

- **Readiness,** which is determined by the network infrastructure and access to ICT
- **Intensity,** which is determined by the extent of ICT usage
- **Impact,** which is determined by the efficient and effective utilization of ICT

Based on this, three sub-indicators were identified as components of the overall ICT development index, the Information and Communication Technology Development Index (IDI), which aims to monitor the progress recorded in the rates of ICT development and growth, identify the digital divide between countries, as well as determine the developmental capabilities of digital technology and the extent to which countries can benefit from it to enhance growth and development within the available capacities and skills.

The first sub-indicator focuses on the Access Sub-index and includes five indicators for infrastructure and access, which are, [8]:
Fixed telephone subscriptions
- Mobile cellular telephone subscriptions
- International internet bandwidth per internet user
- Number of households with a computer
- Households with internet access

The second sub-indicator focuses on the Use Sub-index and includes three indicators for ICT usage intensity, which are the number of internet users among households and individuals, the use of ICT in business (goods and services), and the use of ICT in education, e-government, and e-waste, Fixed broadband subscriptions and mobile broadband subscriptions.

The third sub-index focuses on the skills necessary to efficiently utilize ICT in the Skills Sub-index and includes three approximate indicators: average years of schooling, total secondary school enrollment, and total enrollment in higher education.

Overall, the countries that rank higher according to the ICDI (ICT Development Index) belong to advanced nations, while most of those ranking lower are low-income countries from the least developed category, [9].

2.2 Nature of Economic Well-being
The increasing disparity among individuals within a society or across multiple societies has led to the emergence of class distinctions, typically delineating society into upper and lower classes as a result of income inequalities.

These reasons have been a strong impetus for the emergence of concepts related to equality and justice in income distribution, and subsequently to the pursuit of well-being for every individual regardless of the type of society they belong to.

The term well-being generally expresses happiness and living standards and has been given various linguistic and terminological concepts, including:

A- Definition of Well-being in Economic Terminology
Economic well-being is an economic state characterized by individuals and communities, representing the extent or need that each person, family, group, or society reaches in providing their material and service needs. From this perspective, we observe that the notion of well-being aligns closely with the concept of livings standard.

In economics, well-being means the social outcomes that can be objectively measured and addressed in economic theory, such as national income. That is, the flow of goods and services is directly associated with well-being, and the greater the national income and equality in its distribution, the greater the economic well-being of society.

Welfare economics also specializes in studying and evaluating economic efficiency and systems related to resource allocation, resulting in attaining the maximum social advantage and establishing conditions whereby economic policies can foster societal well-being. These policies require intervention to encourage productive projects and equitable distribution through taxation to increase production and satisfy needs.

Some link the concept of economic well-being to the state, whether it is socialist (providing services) or guardian, [10].

B- Economic Well-being Index
The well-being index in a society is the sum of standards and factors through which we can measure the degree and level of quality of life in comparison with other countries.

Many global economic indicators have emerged that are concerned with measuring economic well-being, including in particular, [11]:

The Human Development Index was issued by the United Nations Development Program (UNDP).

The United Nations has developed an index to measure the level of well-being of nations worldwide, known as the Human Development Index (HDI). It has been published annually since 1990 to promote the development of countries and improve the living conditions of their citizens. This index is measured based on three indicators: life expectancy at birth, expected years of schooling, and individual purchasing power, [12].

The Global Happiness Index was issued by the United Nations Sustainable Solutions Network. In July 2011, the United Nations General Assembly issued a resolution calling on member states to measure the amount of happiness among their people to work to develop policies for each country and work to improve the conditions of its citizens, to issue a report. Global Happiness

On April 1, 2012, which is considered the first global happiness survey in the world, the report identified the global happiness status, the causes of happiness and misery, and the effects on policies.
The World Happiness Report classifies countries based on the levels they have achieved in areas related to per capita gross domestic product, social welfare, average lifespan, social freedoms, absence of corruption, quality of health and education, and labor market.

The Social Progress Index was issued by the American organization Social Progress Imperative in 2011.

The index measures the extent to which countries are progressing in meeting the social and environmental needs of their citizens. To assess the relative performance of world countries, the index utilizes 54 indicators that cover three main areas : basic human needs, foundations of decent living, and the extent of.

The availability of development opportunities is measured by this indicator, which directly assesses the well-being of society by monitoring social and environmental outputs, rather than economic factors. Social and environmental factors include public safety (health, shelter, and sanitation services), equality, inclusion, sustainability, as well as personal freedom and security.

Global Life Satisfaction Index

The World Prosperity Index, created at the University of Leicester, focuses on collecting and analyzing data to calculate a measure of satisfaction with life in different countries. It strongly correlates personal well-being with health, wealth, and access to basic education as an alternative to traditional measures of policy success such as Gross Domestic Product (GDP).

It also emphasizes social and economic development indicators.

The Global Prosperity Index, issued by the Legatum Institute in Britain since 2007, measures overall prosperity.

These specialized indicators of social well-being not only focus on economic aspects but also extend to social, environmental, and other dimensions. They share many sub-indicators. This research paper will discuss one of these indicators, the (HDI). It is a composite index that measures the average quality of life of a country's population. Theoretically, the index ranges from 0 to 1 and considers three dimensions of human development. Firstly, the ability to have a long and healthy life based on life expectancy at birth. Secondly, the level of education is assessed based on literacy rates and attendance at different levels of the education system. Lastly, the standard of living is calculated using the Gross Domestic Product per capita while considering purchasing power parity.

Purchasing power parity is used to measure the relative purchasing power of different currencies for the same types of goods and services. Since prices of goods and services can vary from one country to another, purchasing power parity allows for a more accurate comparison of living standards across different countries. For this estimation, prices of similar items are compared. However, since the available items in different countries and periods are not identical, these estimations are not always accurate.

3 The Reality of Economic Prosperity and the Development of ICT in Algeria

Undoubtedly, prosperity is a relative matter that depends on various variables, including natural, economic, social, and political factors, as well as technological levels and their development. Moreover, these variables are influenced by an endless series of factors and changing influences over time.

ICT can help accelerate the progress made in implementing each of the Sustainable Development Goals (SDGs), and the International Telecommunication Union contributes by trying to implement and implement Goal 9 of the Sustainable Development Goals in particular, which pours into

the crucible of well-being in general. This is embodied through the following, [13].

Building resilient infrastructure that encourages inclusive and sustainable industrialization and fosters innovation.

Efficient and affordable ICT infrastructure and services enable countries to participate in the digital economy and increase their well-being and overall economic competitiveness, and most developed countries are making tremendous progress towards achieving this goal while reducing poverty and improving health status and distance education.

- ICT can achieve wide and rapid results characterized by quality, accuracy, and unexpected costs.
- In the field of creating and achieving well-being, ICTs are means of delivering quality goods and services in the fields of health care, education, finance, trade, administration, and agriculture.
- Furthermore, it can help reduce poverty and hunger, strengthen health, provide new job opportunities, mitigate the effects of climate change, improve energy efficiency, and make cities and communities sustainable.

3.1 Digital Transformation Reality in Algeria

Success in the digital and information age is largely determined by the efficient utilization of information technology, communication, and connectivity to the global information network (the Internet), as well as the availability of fast information methods, digital broadcasting and television networks, mobile phones, computers, digital information exchange services, which have become the foundations governing all aspects of life and business performance, [14]. However, Algeria remains somewhat distant from responding to these standards, despite its efforts in this regard. This is shown in Figure 1.
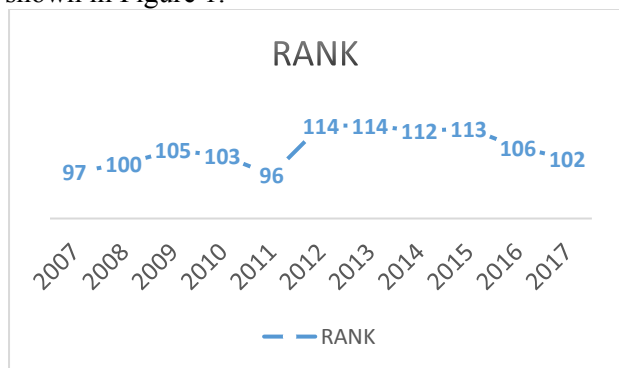

Fig. 1: Ranking according to the development of the (ICT) index in Algeria
Source : International Telecommunication Union (ITU) (2023a), [14]

Algeria ranked 97th among the world's countries in the 2007 Technological Development Index, attributed to several factors.

The number of internet subscribers has reached 1.2 million subscribers who own mobile phones.

- The number of websites reached approximately 5,000 websites
- The number of internet providers increased to 80 providers in 2007
- Algeria ranked tenth in terms of internet penetration in the Arab world (with the United Arab Emirates ranking first).

We observe a decline in its ranking between 2008 and 2011, its global ranking stood at 100 in 2008, but it rose to 96 by 2011, primarily attributed to the adoption of modern technologies, notably second-generation technologies. Furthermore, by 2013, the incorporation of third-generation technologies further contributed to its advancement. In 2015, it adopted fourth-generation (G4) technologies. In recent years, until 2018, the Ministry of Communication and Information Technology has shown increased interest in providing access to the Internet in remote areas, villages, and rural areas, due to their necessity and importance, which includes all fields, especially education. As for its rate of development compared to other countries in the world, the following figure 2 illustrates this increasing growth in information and communication index in Algeria.
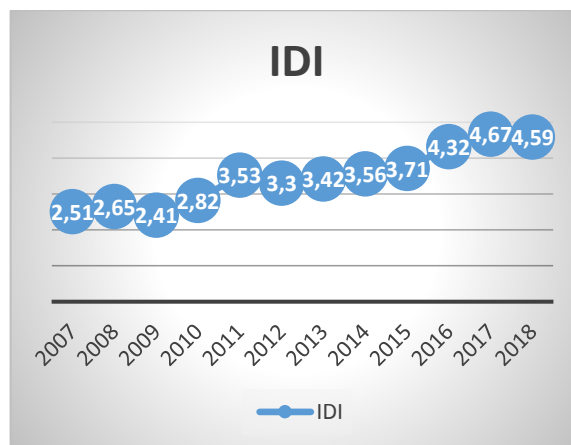

Fig. 2: Development of the ICT Index in Algeria
Source : International Telecommunication Union (ITU) (2023a), [15]

From the above figure, we observe the continuous increase in the development index of ICT over time. In 2007, the rate reached 2.5 due to the increase in the number of computers to 429,167 computers. The percentage continued to rise, with the number of computers reaching 1,450,000 in 2013. The index increased from 4.32 in 2016 to 4.92

in 2019. Additionally, it is higher compared to the average level of African countries. However, it is still far from the desired level, as it is lower than the global average level of 5.17. Despite Algeria's classification by the International Telecommunication Union as the top-ranked Arab country and 22nd globally in terms of the dynamic development of ICT index, its ranking was 106 between 2016-2017, then moved to 102 during 2018-2019. This change is confirmed by the ICT Development Index (IDI). This is attributed to the sub-index related to readiness, which branches from the main IDI index.

3.1.1 Network Readiness Index

This index was issued by the World Economic Forum and measures the ability of countries' economies to leverage information and communication technologies to increase competitiveness and prosperity. This index is based on a set of data from the International Telecommunication Union, the World Bank, the United Nations Educational, Scientific and Cultural Organization (UNESCO), and other organizations. The index consists of four main pillars, which are:

A- Environment Index : It includes two sub-indices, the Legislative and Regulatory Environment Index and the Business Environment and Innovation Index.

B- Readiness Index : It includes the Infrastructure Index, the Affordability Index, and the Skills Readiness Index.

C- Usage Index : It consists of three sub-indices, which are the Individual Usage Index, the Business Sector Usage Index, and the Government Usage Index.

D- Impact Index : It includes the Economic Impact of Technology Index and the Social Impact of Technology Index.

It is evident from the table that Algeria ranks very low in terms of the Network Readiness or Digital Readiness Index, ranging from 117/139 to 131/144 globally during the period from 2012 to 2016. The only improvement recorded during this period was in 2016 compared to other years, where Algeria ranked 117/139 in the Network Readiness Index compared to 131 in the Environment Index, 95 in the Readiness Index, 125 in the Usage Index, and 129 in the Impact Index. The reason for Algeria's bottom ranking is the significant delay in enacting laws and regulations governing modern media and communication technologies, as well as the severe deficiency in the usage of ICT in businesses, ranking 133/147. Additionally, there has been a sharp decline in the Economic Impact of

Technology Index and the Social Impact of Technology Index, which were ranked 124/139 and 132/139 respectively. Table 1 describes this

Table 1. Evolution of the Network Readiness Index for Algeria according to the World Economic

Sub indicators	2012		2013		2014		2015		2016	
	Value (1-7)	Order (142)	Value (1-7)	Order (144)	Value (1-7)	Order (148)	Value (1-7)	Order (143)	Value (1-7)	Order (139)
Legislative and regulatory environment	2.7	132	2.5	141	2.6	140	2.9	127	3.0	123
Business environment and innovation	3.0	127	2.7	143	2.9	145	3.1	136	3.2	133
Environment Index	2.8	136	2.6	143	2.8	143	3.6	134	3.1	131
Infrastructure	3.1	105	2.6	119	2.4	127	3.7	83	3.9	80
Cost effectiveness	5.5	51	5.3	64	6.0	42	4.5	94	4.4	99
Skills readiness	4.4	97	4.0	96	4.1	101	4.2	97	4.3	95
Readiness Indicator	4.3	88	4.0	96	4.1	101	4.2	97	4.3	95
Individual use	2.7	89	2.5	100	2.5	104	2.7	102	2.8	103
Employment in the business sector	2.6	140	2.1	144	2.5	147	2.7	137	2.9	133
Government use	2.8	135	2.7	139	3.0	134	2.7	134	2.7	130
Usage Indicator	2.7	127	2.4	140	2.7	134	2.7	129	2.8	125
The economic impact of technology	2.1	140	2.1	143	2.4	133	2.5	127	2.6	134
The social impact of technology	2.4	135	2.1	140	2.3	140	2.6	136	2.7	132
Impact indicator	2.2	140	2.1	142	2.4	137	2.5	134	2.6	129
Network readiness index	3.0	118	2.8	131	3.0	129	3.1	120	3.2	117

Source : Portulans institute (2020), [16]

We conclude from the above that despite the efforts made by Algeria to strengthen the information and communications technology infrastructure, global measurement indicators classified it among the countries least prepared and least connected to the electronic network.

3.1.2 Internet Use Index

It indicates the percentage of use of the Internet out of the total population. The following Table 2 shows the development of this indicator in Algeria.

Through our analysis of the data in the table, it is evident that the internet usage index has been evolving from 2010 to 2020. This is a result of the efforts made to provide a stimulating environment that allows access to the Internet in shared spaces

such as youth centers, cultural centers, public libraries, and mosques.

Table 2. Development of Internet use in Algeria compared to all countries of the world

Internet penetration rate (%)	The number of internet users	World Population Percentage (%)	Population	Region	
13.6 can be translated to English in financial terminology as "thirteen point six."	4,700,000	0.44 millions to "forty-four hundredths" in financial terminology.	34,586,184	Algeria	Year 2019
27.32	2,984,022,374	100	6,922,691,398	All countries of the world	
17.2 would be translated to English in financial terminology as "seventeen point two."	4,669,927	0.55 would be translated to "fifty-three hundredths" in English financial terminology	38,813,722	Algeria	2018
42.59	3,089,387,634	100	7,254,527,074	All countries of the world	
45.2	18,580,000	0.54 can be translated to English in financial terminology as "fifty-four hundredths."	41,063,753	Algeria	2017
51.7	3,885,567,619	100	7,510,020,970	All countries of the world	
57	24,428,159 (twenty-four million, four hundred twenty-eight thousand, one hundred fifty-nine)	0.57 can be translated to English in financial terminology as "fifty-seven hundredths."	44,616,624	Algeria	2020 fiscal year
76.00	3,895,018,958 (three billion eight hundred ninety-five million eighteen thousand nine hundred fifty-eight)	100	Seven hundred fifty billion three hundred sixty-five million five hundred eighty-six.	All countries of the world	

Source: DATAREPORTAL, DIGITAL 2023 : ALGERIA, [17]

The Ministry of Post, Information Technology, and Communication have adopted a sectoral plan based on the synergy of efforts and resource sharing. This plan has facilitated coordination and consultation with four other ministries, namely the Ministry of Culture, the Ministry of Youth and Sports, the Ministry of National Solidarity, Family, and Women's Affairs, and the Ministry of Religious Affairs and Endowments, to connect over two thousand institutions to the internet for the benefit of citizens as a first phase. Additionally, in collaboration with the Ministry of National Education, efforts have been made to connect primary schools to the Internet.

3.1.3 Percentage of Households with Computers

This indicator encompasses all households equipped with a computer accessible to all family members at any given time, considering it as a household asset. Table 3 presents the percentage of households with computers in Algeria in comparison to other countries worldwide.

Table 3. Comparison of households with computers in Algeria, Africa, and the rest of the world

Percentage of households with computers (%)				
Year 2019	Year 2018	Year 2017	Number of countries	Region
38.92	38.86	38.42	/	**Algeria**
9.78	9.74	9.60	38	**Africa**
47.98	47.36	46.61	176	**All countries worldwide**

Source : Prepared by the researcher based on data from Statista website, [18]

t is evident from the table that there is a significant disparity in the statistical ratios of households with computers in Algeria compared to Africa and the rest of the world. Despite the high rate of computer ownership in Algeria compared to African countries during the three years "2017, 2018, and 2019," it still lags far behind the rest of the world. This reveals a digital divide in computer penetration between Algeria and the rest of the world, making the lack of awareness about computer usage in Algeria a major obstacle to economic prosperity.

3.1.4 The Broadband Fixed and Mobile Phone Subscription Development Index

The Broadband Fixed and Mobile Phone Subscription Development Index consists of four sub-indices, which are as follows :

− Fixed Phone Subscription Index : Refers to the total active number of fixed phone lines, voice-over internet protocol subscriptions, and public fixed phones.

− Mobile Phone Subscription Index : Refers to the number of subscriptions to mobile cellular service that provides access to the Public Switched Telephone Network (PSTN) using cellular technology. It applies to all mobile cellular subscriptions that provide voice communications, excluding mobile radio services for private communications, radio paging, and remote metering.

− Broadband Fixed Internet Network Subscription Index : Refers to high-speed access to the internet network, with transmission control protocol/internet protocol speeds in the direction of the destination greater than or equal to 256 Kbit/s, in addition to digital subscriber lines and fibers used for internet acceleration.

− Mobile Broadband Subscription Index : Refers to the number of subscriptions to mobile cellular networks that can access broadband data communications, such as the internet, at broadband speeds in the direction of the destination.

Table 4 illustrates the development of fixed and mobile phone subscriptions and their broadband in Algeria compared to Africa and the rest of the world.

Table 4. Comparison of fixed and mobile phone subscriptions and their broadband in Algeria, Africa, and the rest of the world

Area	Number of countries	2017			
		Fixed phone subscription per 100 inhabitants	Mobile phone subscription per 100 residents	Fixed-line broadband per 100 inhabitants (kbit's)	Mobile broadband per 100 inhabitant s (kbit's)
Africa	38	1.00	74.60	0.40	22.90
Arab States	19	7.70	107.10	4.70	45.20
Asia and the Pacific	34	10.00	98.90	11.30	47.40
Cis	10	20.70	141.20	15.80	59.70
Europe	40	37.70	118.00	30.20	80.10
Americas	35	24.40	114.20	19.10	82.70
World	176	13.57	101.53	12.39	52.23
Algeria		8.24	117.02	6.92	46.81

Source : Prepared by the researcher based on data from Statista website, [19]

It is clear from the table that although fixed-line telephone subscriptions per 100 residents in Algeria (8.24) are more than the average of African countries (1.00), they remain fragile when compared to the European level (37.7) and the global level (13.57), and this is mainly due to The lack of competitiveness in the fixed telephone sector in Algeria. As for the mobile phone, it is one of the most developed sectors, as it exceeded the global average level by "15.49". This is due to the intensity of competition in the mobile phone market between several companies, which reflected positively on subscription prices and made them suitable for different segments—the community, as well as the variety and number of offers presented.

As for the fixed-line broadband index, it is higher than the average for African countries, but it remains very weak compared to the global average. This is mainly due to the weak infrastructure of the fixed network and the high cost of investment in it, as well as the lack of competition in the service, which negatively affected the quality of the service provided and its prices despite Fixed phone broadband providing speed and quality compared to mobile broadband.

As for the mobile broadband index, although it is higher than the average of African countries, it remains relatively weak compared to the global average. Algeria also hopes to raise its readiness to keep pace with the development of smartphone devices.

3.2 The Reality of Economic Prosperity in Algeria

Our analysis of the state of well-being in Algeria has been based on criteria including education, health, safety and security, personal freedom, and social institutions. As a result, Algeria ranked fourth in the Arab world and 60th globally in the 2012 Well-being Index. However, it experienced a decline in 2015, where it ranked 96th globally, and in 2016, it occupied the 111th position globally and the eighth position in the Arab world. The Well-being Index classifies.

Luxury ranked 91st globally and 7th in the Arab world out of 191 countries in 2022, according to a report issued by the United Nations based on 8 indicators: economy, entrepreneurship, investment opportunities, government performance, education, health, security, individual freedom, and social communication. The British Institute confirms that luxury is not only related to individual income or GDP, but also to the quality of life, comfort, and happiness of citizens.

Through the health criterion, which defines the well-being index, we can thus link health to domestic production and achieve higher rates of economic growth, which proves that workers who enjoy good health are more productive. Good health also raises per capita income, which is an incentive for national savings and increased longevity - encouraging foreign investment, so that investors avoid environments in which the workforce suffers from severe disease burdens. In addition to what was mentioned, there is the standard of education, as the healthiest children enjoy high rates of school attendance and educational attainment.

In the analysis, we presented health over education because of what we mentioned in the last lines and because of what the literature has proven in this field, there is a close relationship between health and education, and if the relationship between education and health is causal, that is, transferring some of the expenses from health care to education, it is a procedure. It is effective in improving both the educational level and the health aspect of society. Educational policies also have a significant impact on the health aspect, and this is what required the state to invest in the two sectors and increase spending rates on them, as they improve the lives of the individual and society and thus increase their well-being. The next Figure 3 shows the development of this indicator in Algeria.
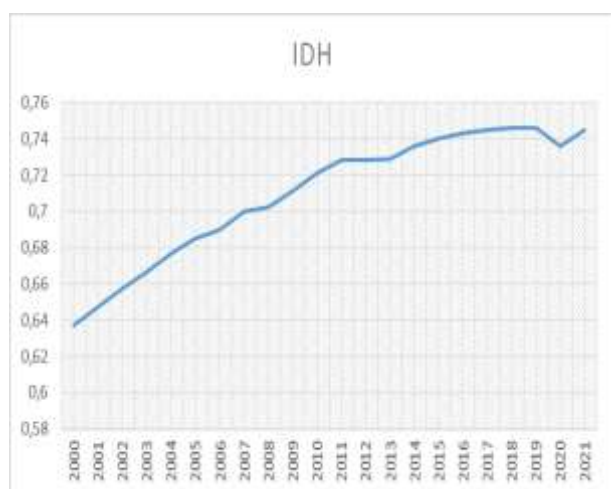
Fig. 3 : Development of the Human Development Index in Algeria
Source : Data collected by the researcher from United Nations Development Programme (2023), [20]

Through the above curve, we observe that the slope at which the human development rate grows in Algeria is relatively high, while in terms of the (HDI) associated with gender, it reached a level of 0.679 in 2001 and ranked accordingly.

Algeria ranks 90th out of a total of 146 countries, reflecting a decrease in gender disparities. The parliamentary participation of women reached 6% in 2001, with a 2% increase in 2000. Additionally, women have a strong presence in the private sector as well as other social sectors such as education, healthcare, and the judiciary, representing :

More than 60% of the total number of teachers in the national education sector.

More than 60% are in the healthcare sector.

Approximately 50% of university professors.

More than 50% of the total number of judges.

The National Center for Commercial Registration estimates women's integration in economic responsibility at 100,000.

A woman registered in 2008 as a trader and contractor, and despite the advancements, female participation in political decision-making and elected councils remains modest.

According to the 2023 Human Development Report, Algeria ranked 91st globally in the international Human Development Index, advancing by 6 points. It moved from 96th to 91st in the global ranking, with a development index of 0.745. Life expectancy reached 76.4 years, average years of schooling were 14.6, and average individual income was $10,800.

Tunisia ranked second in the Maghreb region and 97th globally, despite dropping three places. The report stated that its development index declined to 0.731, with a life expectancy of 73.8 years, average years of schooling at 15.4, and average individual income of $10,258.

Libya ranked third in the Maghreb region and 104th globally, showing significant progress by moving up 13 places with a development index of 0.718. Life expectancy was 71.9 years, average years of schooling were 12.9, and average individual income was $15,336.

Morocco dropped one place, ranking fourth in the Maghreb region and 123rd globally, with a development index of 0.683. Life expectancy reached 74 years, average years of schooling were 14.2, and average individual income was $7,303.

Mauritania maintained its previous ranking in 2020, placing last in the Maghreb region and 158th globally, with a development index of 0.556. Life expectancy was 64.4 years, average years of schooling were 9.4, and average individual income was $5,075.

The UN report, titled "Time of Uncertainty, Life of Instability: Shaping Our Future in a Changing World," covered 191 countries and highlighted that multiple crises hinder progress in human development, which is declining in the majority of countries.

4 A Standard Study on the Impact of Digital Transformation on Well-Being in Algeria

In this study, we attempted to apply the theoretical aspects discussed by conducting a standard study on the impact or role of information and communication technologies on economic well-being in Algeria during the period 2007-2018, based on the availability of data for the same period and using Eviews 12 program.

4.1 Study Model and Variables
We will attempt to include the study models and analyze their variables.

A- Study Model :
We formulate a model representing the impact of the development of ICT on the economic well-being of individuals in Algeria, according to the available data, which was discussed in a descriptive study. To avoid the heterogeneity of the variables and the lack of a linear relationship between them, we enter the Napierian logarithm into the model.

lnIDI= f (lnIDI)

lnIdh: Niberian logarithm of the HDI in Algeria during the period 2007-2018

lnIDI: Niberian logarithm of the Information and Communication Technology Development Index in Algeria during the period 2007-2018.

After formulating the models, we begin studying their variables by examining their stationarity through unit root tests for time series. In this regard, we utilized the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests. Through these tests, we can identify the stationarity of time series and ascertain their order as follows:

Stable time series are characterized by the absence of both overall trends and seasonal fluctuations. However, economic phenomena in history seldom unfold in random patterns.

B- Testing the Stationarity of Time Series: To avoid falling into erroneous analyses, it is necessary to study the stationarity test of time series as a condition of joint integration. Unit roots are the most important method for determining the stability of the time series. Therefore, we will test the unit root based on two tests, the augmented Dickey-Fuller test.

Regarding the ascending ADF methodology of Dickie Fuller, we have followed the following methodology : The series (IDH) :

$$[M_1]$$
$$\Delta IDH_t = \lambda IDH_{t-1} \sum_{j=1}^{p} \phi_{j+1}\ \Delta IDH_{t-j} + c + bt + \varepsilon_i$$

$$[M_2]$$
$$\Box IDH_t = \lambda IDH_{t-1} - \sum_{j-1}^{p} \phi_{j+1} + c + \varepsilon_i$$

$$[M_3]$$
$$\Box IDH_t = \lambda IDH_{t-1} - \sum_{j-1}^{p} \phi_{j+1} + \varepsilon_i$$

We determined the degree of delay based on the three criteria Schwarz, AIC (Akaike Information Criterion), and Log-Likelihood.

We chose the smallest degree of lag, which was mostly zero, Lag = 0.

To assess the model, we have selected the following assumptions for most of the series.

[M1]
H0: λ=0, meaning we accept the hypothesis of the presence of a unit root in the series if the probability is greater than 0.05.
H0: b = 0, if the general trend coefficient differs from zero, i.e. Prob (Trend) is 0.05, indicating that the time series of type Ts is not stable.<
[M2]
H0: C = 0 We accept the hypothesis that the series does not contain a constant derivative if Prob > 0.05.
H0: λ = 0, we accept the null hypothesis that there is no unit root in the series Prob> 0.05.

[M3]
H0: λ = 0: We accept the hypothesis of the existence of a unit root.
Table 5, Table 6 and Table 7 present the results of the stationarity tests for the two series, respectively:

Table 5. ADF test results for the lnIDH series

-	ADF test for the lnidh series, number of lags: minimum value = 0.			
	H0: C = 0.	H0: b = 0.	H0: λ = 0.	Models.
The series is non-stationary.	Result.	(Prob).	(Prob).	(Prob).
	Non-stationary.	0.0158.	0.0235.	0.1967.	[M1].
	Non-stationary.	0.1826.	/.	0.7479.	[M2].
	Non-stationary.	/.	/.	0.9694.	[M3].

From the table, we observe that according to model [M1], the IDH series is non-stationary at the level. Therefore, we test the stationarity of the series after first differencing

Table 6. ADF test results for the lnIDH series after first differences

	ADF test for the lnIDH series, number of lags: minimum value = 0.			-
	H0: C = 0.	H0: b = 0.	H0: λ = 0.	Models .
The series is stationary.	Result.	(Prob).	(Prob).	(Prob).
	Non-stationary.	0.5509.	0.8911.	0.1619.	[M1].
	Stationary.	0.1352.	/.	0.0427.	[M2].
	Stationary.	/.	/.	0.0142.	[M3].

Table 7. ADF test results for the IDI series

-	ADF test for the lnIDI series, number of lags: minimum value = 0.				
Models.	H0: λ = 0.	H0: b = 0.	H0: C = 0.		
	(Prob).	(Prob).	(Prob).	Result.	The series is stationary.
[M1].	0.1265.	0.1540	0.0209	Non-stationary	
[M2]	0.0508 ".		0.0238	Stationary .	
[M3]	0.0372			Stationary .	

We observe from the table of ADF test results that according to model [M2], the lnIDI series is stable at the level. Through the tables, we observe that the lnIDH series does not contain the overall

directional compound, therefore there is a type of DS series.

We have lnIDH ϵ I(1) and lnIDI, which prompts us to apply the methodology of the autoregressive model for time series gaps.

C- Cointegration methodology using the Autoregressive Distributed Lag (ARDL) model for fractional time series gaps : The methodology requires conducting tests for joint integration, [21], that the variables be integrated at the same order. It cannot be performed when there are variables integrated in different orders. Hence, the Autoregressive Distributed Lag (ARDL) model, developed emerged as a solution, [22].

This model is considered an alternative to the well-known tests of cointegration. The developed test distinguishes it self from other tests in the following aspects :

It does not require all-time series to be integrated in the same order I(0) or I(1). The only condition for applying this test is that none of the variables have an integration order of I(2).

ARDL can be applied in cases where the sample size is small, which is contrary to most traditional cointegration tests that require a large sample size for more efficient results.

The ARDL model enables us to separate the short-term effects from the long-term effects, allowing us to determine the cointegrating relationship between the dependent variable and the independent variables in both the long and short runs within the same equation.

Determining the magnitude of the impact of each independent variable on the dependent variable.

In this methodology, we can also estimate the parameters of the independent variables in the short and long run. Its estimated parameters in the short and long run are more consistent compared to other methods such as Engle-Granger, Johansen, and Johansen-Juselius methods. To determine the length of distributed lag periods, two criteria are usually used, namely Akaike Information Criterion (AIC) and Schwarz Criterion (SC), where the length of the period that minimizes both AIC and SC values is chosen. The ARDL model for equation (1) is written as follows :

$$d(lnidh_t) = c + \beta_0 lnidh_{t-1} + \beta_1 lnidi_{t-1}$$
$$+ \sum_{i=0}^{k} \alpha_{1i} d(lnidh)_{t-i}$$
$$+ \sum_{i=0}^{k} \alpha_{2i} d(lnidi)_{t-i}$$

The coefficient of the lagged dependent variable represents (β), the long-term relationship parameters. Meanwhile, the first difference parameters are represented by (α), which captures the short-term relationship. (C) and ($\mathcal{E}$) indicate the intercept and the random errors, respectively.

The ARDL model test first involves testing the existence of a long-term equilibrium relationship between the model variables and the parameters of the independent variables in the short term. For this purpose, the Fisher statistic (F) is calculated using the Wald test, where the hypothesis of no common integration (absence of long-term equilibrium relationship) is tested. Then, it is compared with the critical values for upper and lower bounds at significance levels

4.2 Study Results

After determining the model and study variables, we shed light on the results obtained from estimating the model.

First - Testing for cointegration using the bounds approach :

The following table shows the bounds test (ARDL) by calculating the Fisher statistic and comparing it with the upper critical values I(1) and lower critical values I(0), as mentioned before, to test the hypothesis of no common integration. The results are as follows Table 8:

Table 8. Bounds Test for Long-Term Relationship

Result	Calculated Fisher statistic FC		13
Existence of a common integration relationship	6.685608		Model
	Lower bound I(0)	Upper bound I(1)	Critical values
	5.77	6.68	At a significance level of 2.5%
	4.94	5.73	At a significance level of 5%
	4.04	4.78	At a significance level of 10%

Since the calculated Fisher value is significant and greater than the critical values at the 2.5%, 5%, and 10% significance levels, it is in the common integration region. Therefore, there is a long-term equilibrium relationship between the study variables (independent and dependent variables).

Second : long-term relationship inference
In Table 9 show the long-term relationship between the two variables as follows :

Table 9. Long-term parameter estimates (dependent variable LnIDH)

Significance	Coefficient	Variable
0.0004	10.7869	LnIDI
0.0000	4.6705	C

The lagged values (1,0) were selected

When we apply the natural logarithm to the study model, the parameters of this model become elasticities. This means that if one independent variable changes by one unit, the change in IDH will be equal to the parameter value. Therefore, based on this basis, the results of estimating the long-term parameters will be interpreted

The model is significant, as Prob(fisher) is estimated to be 0.00007.

We observe that in the long run, the contribution ratio of information and communication technology to individual well-being is significant at 1% and its effect is positive, which is consistent with the theory

Third; estimation of the Error Correction Model for the ARDL model (DLnIDH)
After confirming the long-term relationship, we will derive the short-term relationship between the variables using the non-structural Error Correction Model. The results are shown in the following Table 10.

Table 10. Results of UECM estimation for the ARDL model

Significance	Coefficient	Variable
0.0189	-0.6583	coinEq(-1)
0.0206	7.1011	DlnIDI
0.1665	0.3416	DlnIDH(-1)

We obtained the error correction model (ECM) coefficient with a negative and significant sign, confirming the existence of a long-term equilibrium relationship. This coefficient represents the speed at which imbalances are corrected in the long run. However, in the short run, the presence of information and communication technology has an impact on economic well-being, while there is no significant relationship between the study location variable and its historical value in the previous period. This is due to the short duration of the study (12 years) and the lack of sufficient data on the Information Development Index (IDI).

Fourthly: model diagnostic tests:
We conduct a series of diagnostic tests on the obtained model to ensure its reliability in economic interpretation. The results of diagnostic tests are in the folowing Table 11.

Table 11. Results of model diagnostic tests

Test result	Statistical value of the test	Null hypothesis (H0)	Test type
Prob=0.58 > 0.05 Fc > FT Accept H0	Fc: 0.87 Chi-square: 6.52	**No serial correlation between errors**	Serial correlation of errors (LM)
Prob=0.73 > 0.05 Accept H0	Jarque-Bera: 0.6095	**Residuals are normally distributed**	Jarque-Bera test for normality of residuals
Prob > 0.05 Fc > FT Accept H0	Fc = 3.76 Prob = 0.09	**Homoscedasticity of errors**	Test for heteroscedasticity Breusch-Pagan-Godfrey

From the above table, we observe that the diagnostic tests were positive, indicating the absence of autocorrelation and heteroscedasticity issues in the model, and the residuals are normally distributed

5 Conclusion

The well-being index translates to healthcare and sanitation for individuals, as well as prosperity. One of the important components of the latter is education and access to ICT. Digital transformation revolves around adopting disruptive technologies to increase productivity, create value, and enhance social welfare. Through a descriptive study of technological development and well-being indicators in Algeria, we have observed a continuous increase in both indicators over time. This can be attributed to the state's efforts in investing and spending in the three key sectors : education, health, and technology. Consequently, these sectors have experienced growth and development, especially in recent times. Digital transformation is a time-consuming process, usually implemented in multiple stages by developing a future vision that encourages innovation and utilizes digital and technological capabilities. This explains the positive long-term impact of digital transformation on Algeria's economic welfare.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

Kadri Nouria, Conceptualization Ideas; formulation or evolution of overarching research goals and aims. Data Curation, Formal analysis, methodology and writing ; review and editing of the original article.

Conflict of Interest

The authors have no conflicts of interest to declare.