

The reality of digital transformation in Algeria: an analysis of international indicators

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Abstract:

This study aimed to identify the digital transformation and its technologies that form the basis of digital transformation and to highlight its significance. Additionally, a theoretical model was proposed to analyze the efforts made towards digital transformation in Algeria and to determine its current state. The study utilized an analytical descriptive approach to elucidate the various facets of the topic and analyze a collection of international indicators pertaining to digital transformation. According to the study's findings, the Algerian government is still achieving poor results and ranking poorly in the field of digital transformation.

Keywords: Digital Transformation; Information and Communication Technology; Digitization; Information and Communication Technology Infrastructure.

Jel Classification Codes: O32, O33, L86, L96.

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1. Introduction

Many scientific, economic, and social transformations occurred throughout the world, beginning with the first industrial revolution, which was based on industrialization and steam power, and continuing through the second industrial revolution, which was based on physics and chemistry, and the beginning of the emergence of computers, which led to the spread of the Internet and processing power. Which was regarded as a radical transition in the world, followed by the fourth industrial revolution, also known as the era of digital transformation, in which the world witnessed a new phase of emerging and accelerating technological transformations, in which digital transformation became an urgent necessity.

Because of the link between digital transformation and the tremendous development in information and communication technology (ICT), ICT generated a massive revolution of data, information, and digitization, making countries unable to be isolated from what is happening globally. As a result, these countries rushed to achieve development leadership and excellence in the field of digital transformation, which was not limited to developed countries alone, but began to spread and expand in developing countries as well. Algeria is one of the countries that works to promote and support digital orientation by attempting to adopt modern technologies and accelerate digitization processes in a variety of sectors in order to compete with other countries and lead in international indicators.

1.1 Study problem

The problem of this study can be formulated in the following main question:

Does Algeria currently rank among the world's most digitally transformed countries?

1.2 Study Hypothesis

This study proceeds from the following hypotheses:

- The Algerian government is attempting to direct various sectors and institutions toward digitization.

- It can be said that the Algerian government's efforts have led to a trend toward digitization but have not yet resulted in digital transformation.

1.3 Study objectives

This study seeks to achieve the following objectives, which can be summarized as follows:

- Defining the various concepts of digital transformation and the predominant technological techniques upon which it is founded.
- Analyzing a set of indicators related to the digital transformation's actuality.
- Evaluate how Algeria's digital transformation journey aligns with a specific set of global indicators.

1.4 Study Approach

The descriptive analytical approach was used to understand the various aspects of the subject, answer the problem at hand, and achieve the desired results. This approach allows us to present the phenomenon under study and analyze its various aspects represented in analyzing the reality of digital transformation in Algeria based on a set of indicators and their analysis.

1.5 Study Structure

The study is divided into two parts: the first deals with the conceptual framework of digital transformation, and the second with the analytical reality of Algeria's digital transformation efforts.

2. Digital transformation theoretical framework

Digital transformation is now pervasive. It's one of the most popular buzzwords in recent years; just Google "digital transformation" and see how many results you get. Everyone, including the C-suite, governments, policymakers, and academia, is talking about digital transformation (Siebel, 2019, p. 38).

2.1 Concept of digital transformation

Because digital transformation is a modern topic and concept, researchers and those interested in it have a global focus on it. It has been defined as follows:

The intersection of cloud computing, big data, IoT, and AI results in digital transformation, which is critical to industries across the market today. Some describe it as the application of digital technology to all aspects of the organization. Some call it leveraging digital technologies and advanced analytics to increase economic value, agility, and speed (Siebel , 2019, p. 35).

(wade, 2015, p. 3) Defined digital transformation as organizational change resulting from the use of digital technologies and innovative business models to improve performance.

Digital transformation is also defined as: At its most fundamental level, digital transformation involves modifying a business process using digital technologies to make it more efficient or effective. The idea is to use technology not only to replicate an existing service in digital form, but also to use technology to significantly improve that service (mark, 2022).

(Florian & Julian, 2019, p. 3) defines digital transformation as: the use of technology to dramatically improve an organization's performance or reach. Digital technologies enable improved processes, engaged talent, and new business models in a digitally transformed business.

All of these definitions lead us to the conclusion that digital transformation refers to a radical shift in management method, whether it is related to the human element or various other resources, by changing existing business models and transforming them into innovative models based on modern technology. In addition, digital technologies such as cloud computing, big data, and artificial intelligence will be introduced.

2.2 digital transformation technologies

Many advanced technologies that lead to digital transformation have arose with the emergence of the fourth industrial revolution, the most important of which are as follows:

2.2.1 Cloud Computing:

Cloud computing is the first of four technologies that drive digital transformation; digital transformation would be impossible without cloud computing. It is a method of gaining access to shared pools of configurable hardware and software resources, such as computer networks, servers, data storage, applications, and other services that can be rapidly provisioned with minimal management effort, typically via the internet (Siebel , 2019, p. 47). The cloud paradigm can be delivered using one of three service models: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) (SaaS) (Soldatos, 2017, p. 12).

2.2.2 Artificial Intelligence:

Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks that are typically associated with human activities. AI is the study of how to make computers do things that, at the moment, humans are better at (Stuart & Norvig, 2003). This term is frequently used to describe the development of systems with human-like cognitive abilities, such as the ability to reason, discover meaning, generalize, or learn from past experience (Kraus, et al., 2022, p. 1888).

2.2.3 Internet of things:

The internet of things (IOT) refers to the network of physical objects (things) embedded with sensors, software, and other technologies to exchange data with other devices and systems via the internet (Ahmed & Sakr, 2023).

2.2.4 Big Data:

Big data are high-volume, high-velocity, and high-variety information assets that necessitate innovative, cost-effective forms of information processing for enhanced insight and decision making. (Raguseo, 2018, p. 3).

2.2.5 Blockchain:

A Blockchain is a digital distributed ledger that records transactions in real time. These transactions are not limited to monetary transactions, but are applied virtually across diverse domains and sectors, as well as to anything of value.(Ugle, 2022, p. 2).

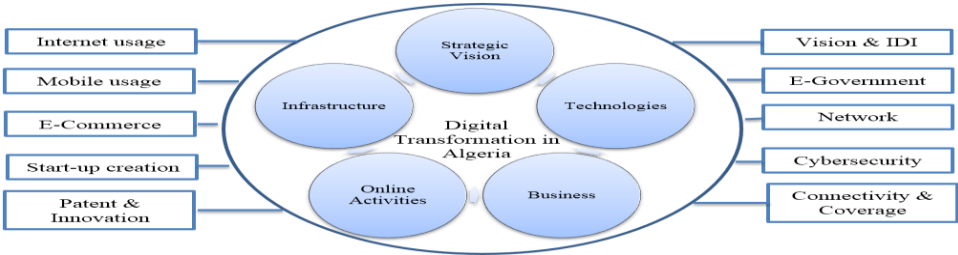
2.2.6 Cybersecurity:

Cybersecurity is a collection of technologies and procedures designed to protect computers, networks, programs, and data, and it has undergone massive technological changes. Its operations in computing and data science are driving the change, with machine learning, a core component of artificial intelligence (AI), playing a crucial role in discovering insights from data (Parichat, Sutithev, Patcharavadee , & Tamonwan, 2022, p. 5).

3. The analytical reality of digital transformation efforts in Algeria

The reality of digital transformation in Algeria can be analyzed and evaluated using the following model:

Fig.1. Algerian digital transformation reality analysis and evaluation model:



Source: prepared by the researchers.

3.1 Strategic Vision

3.1.1 Algeria’s Vision:

Algeria's first step is digitization, which is required to acknowledge the existence of a digital transformation. The Algerian government relied on the electronic Algeria strategy for the years 2008-2013 (e-Algeria 2013), which called for the adoption of a

coherent plan to improve the performance of the national economy, departments, and companies, as well as to improve the capabilities of education, research, and innovation, and to improve citizens' lives by encouraging the dissemination and use of information and communication technology. The following are the main steps in this strategy (Algerian government, 2008, p. 7):

- Accelerate the use of information and communication technology (ICT) in public administrations;
- Develop mechanisms and incentive measures that permit citizens to benefit from ICT equipment and networks;
- Promoting the growth of an economy based on knowledge;
- Enhancing the infrastructure for high-speed communications;
- Supporting research in the fields of innovation and development;
- Reconstruction of the legislative and regulatory framework;
- Dissemination of information and enhancement of communication;
- Valuing international cooperation;
- Activating evaluation and monitoring mechanisms;
- Streamlining regulatory processes;
- Supplying financial resources.

However, it cannot be denied that these goals were not met on the ground during the period of this strategy, and there was no actual application of integrating information and communication technology in various aspects of economic life. As a result, the E-Algeria strategy was extended until the end of 2018, when signs of digitization began to emerge in a variety of industries. However, the actual spread of digitization in Algeria emerged during the country's health pandemic (COVID-19) at the end of 2019, which served as a true catalyst for the adoption of technology and the development of the digitization sector in all aspects of life. In this context, the government has established the Ministry of Digitization and Statistics in order to ensure the success of the digital approach.

Beginning in 2021, the Algerian government directed its efforts

and endeavors toward:

- Permitting all Algerians access to information and communication technologies, including networks and services;
- Developing innovative services and national digital content;
- Strengthening capabilities in the field of information and communication technologies and promoting their use in all fields;
- Improving E-government and bolstering and enhancing the ecosystem for digital transformation;
- Developing a foundation for digital trust.

To ensure complete digitization by 2023, the Algerian government worked in 2022 to digitalize all sectors, especially those related to tax interests and individual property. This was accomplished by developing a real strategy that would allow Algeria to be digitally ready in the medium term, laying the groundwork for the new Algerian digital society and the digital citizen.

As previously stated, the aforementioned strategy should be divided into two strategies (Abderrahmane, 2022):

- The first strategy is to equip Algeria (Digital Algeria I) (2022-2025).
- The second strategy (Digital Algeria II) will designate Algeria as a regional digital hub for the next five years (2026-2030).

These two strategies will address:

- Enhancing electronic governance, modernizing and reforming management, and developing technological capabilities;
- Upgrading infrastructure
- Constructing a fixed fiber optic network;
- Increasing international network connectivity via submarine and satellite cable links;
- Developing the mobile network through full 4g coverage, considering 5G service expansion, and launching competition for internet service providers (ISP) activities;
- Encourage investment in cloud computing technology and make electronic signature and authentication devices more

widely available.

- Creating online payment services, investing in cybersecurity, and spreading blockchain technology.

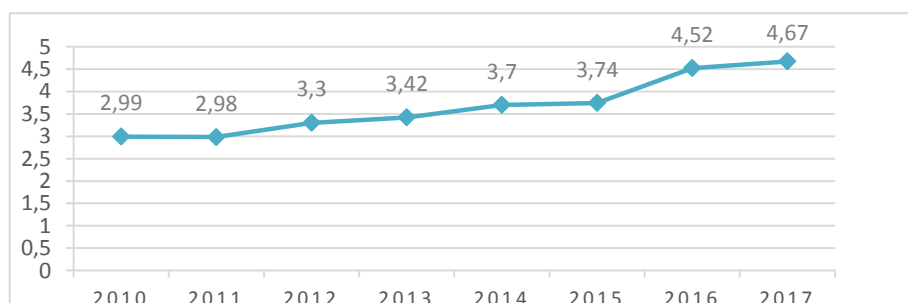
Given the Algerian government's emphasis on the development of the information and communication technology sector, the following indicator can be used to demonstrate this.

3.1.2 Information and Communication Technology Development Index (IDI):

Since 2007, the United Nations International Telecommunication Union has published an annual ICT development index (IDI), which uses 11 internationally agreed ICT indicators divided into three clusters: Access, Use, and Skills (Ministry of Digital Development and Mass Media of the Russian Federation, 2012).

As this indicator is regarded as the most comprehensive way to measure the level of information and communication technology and draw conclusions about the current state of a country's digital development, and as its values are constrained between (0.96 and 8.98 as a maximum), the status of the indicator for Algeria can be clarified as depicted in the following graph.

Fig.2. IDI indicators in Algeria for (2010-2017) period



Source: prepared by the researchers based on (ICU, 2010-2017)

Figure (2) illustrates the rising trend of (IDI) values over time (2010-2017). This is primarily the result of efforts to develop the infrastructure for information and communication technology and increase investment levels. As the index reached its highest value of 4.67 in 2017, compared to 4.52 in 2016, Algeria's performance improved by an average of 0.21 points between 2016 and 2017. This

is due to the country's improvements in the sub-indicators of this indicator (Table 1), which resulted in a 0.34-point increase. This increase is attributable to the expansion of 3G coverage and the launch of LTE services, as well as the significant increase in mobile cellular subscriptions (which will be defined in the infrastructure component of TIC) and, to a lesser extent, mobile broadband subscriptions.

The following table shows the three sub-indicators of the ICT development indicator as follows.

Table 1. The three levels of IDI indicators in Algeria for the period (2010-2017)

Year s	General index		Three levels					
	Index value	Ran k	Access to ICT		Use of ICT		Skills of ICT	
			Index value	Ran k	Index value	Ran k	Index value	Ran k
2010	2.86	103	3.29	97	0.56	109	6.6	95
2011	2.98	104	3.53	96	0.62	115	6.6	95
2012	3.07	106	3.6	100	0.68	120	6.82	91
2013	3.42	114	4.46	107	0.73	131	6.72	98
2015	3.71	113	4.27	110	1.52	122	6.98	93
2016	4.4	103	5.02	98	2.92	108	6.1	86
2017	4.67	102	5.14	98	3.38	108	6.29	80

Source: prepared by the researchers based on (ICU, 2010-2017)

As for the values of the index, beginning in 2018, the attempt to calculate and publish it failed due to the difficulties that most countries encountered in collecting accurate data that reflects their digital development. Since the index is now dependent on 14 sub-indicators instead of 11, it will not be published until further notice, according to the professional authorities.

3.1.3 Digital government

Algeria has sought to achieve respectable ranks in terms of digital government services and to improve their digital orientation through efforts made in accordance with the e-Algeria strategy. The United Nations Digital Government Development Index (EGDI),

which assesses e-government development at the national level, can be used to illustrate the evolution of digital government in Algeria. This is accomplished through the use of a composite index based on the weighted average of three unified indices, the Telecommunications Infrastructure Index (TII), the Human Capital Index (HCI), and the Online Service Index (OSI), which classifies countries as shown in the table below:

Table 2. United Nations E-Government Development Index Categories (EGDI)

E-Government Development Index (EGDI)	Low index				Average index				High index				Very High index
	(0-0.25)				(0.25-0.50)				(0.50-0.75)				(0.75-1)
	L1	L2	L3	LM	M1	M2	M3	MH	H1	H2	H3	HV	V1

Source: prepared by the researchers based on (United Nations, 2022).

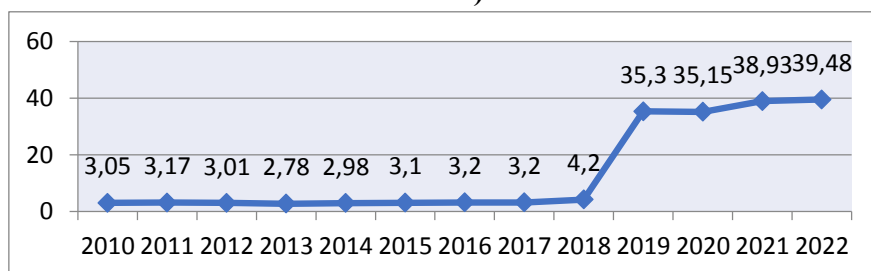
The graph above depicts the average values of Algeria's e-government development index from 2010 (0.31) to 2018. (0.42). this is due to the state's modest levels of investment in information and communication technology, as well as the near-absence of online services (2010, 2011, 2012, and 2013). However, beginning in 2019 and 2020, we see an increase in the index's value to 0.56 in 2022, which is close to the global average of about 0.56. (0.61). As this rise can be attributed to the development that occurred in Algeria during this period, particularly in the level of providing services via the Internet, which was related to the conditions that the country experienced, the most prominent of which was the health pandemic, which necessitated the digitization of most public services, particularly to facilitate the process for the citizen. During this time, the infrastructure of information and communication technology improved, as did the volume of Internet coverage and use by individuals and families.

3.1.4 Networked readiness

Networked readiness shows how ready each country is to reap the benefits of digital transformation (World Economic Forum, 2016).

The World Economic Forum's annual readiness index is one of the most important indicators, and it is regarded as a good basis for judging the extent of development and the trend toward digital transformation in countries. It is based on four sub-indicators: individual skills, governance, technology, and influence. These indicators, in turn, are subdivided into a plethora of other indicators. As a result, it is regarded as the most important indicator in assessing the status of digital transformation in countries. Algeria's network readiness can be determined using the following indicator:

Fig.4. Networked Readiness Index in Algeria for the period (2010-2022)



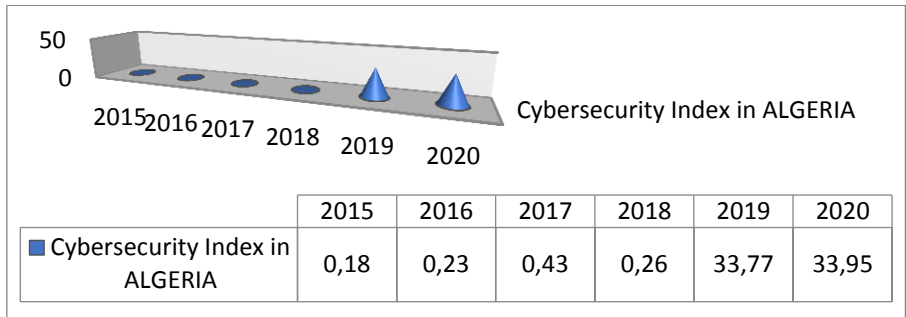
Source: prepared by the researchers based on (WEF, 2010-2022)

Figure (3) depicts the low values observed by the network readiness index in Algeria from 2010 to 2012. (2018). This is due to the country's inability to leverage information and communication technology to boost its economy's competitiveness. Whether it is about generalizing its use, improving the quality of government services, or even developing laws related to information and communication technology. However, beginning in 2019, we see an increase in the value of the index until the year (2022) reached a value of 39.48, which reflects the trend toward digitization that the country has experienced during this stage (the COVID-19 period) and the decisions and laws that recommend developing this trend in all sectors of the economy. Despite an increase in network readiness in Algeria during the period (2019-2022), it is still a long way from entering the digital transformation arena when compared to developed countries that rank first with values exceeding (89.60).

3.1.5 Cyber security in Algeria

Cybersecurity solutions are one of the most important technologies that have emerged during the period of digital transformations that the world is experiencing, and they reflect the country's digital orientation. The greater its value, the greater the shift toward automating processes and moving toward cloud computing technologies, blockchain, and other technologies, and according to (International Telecommunication Union, 2020), the global cybersecurity index (GCI) which measures countries commitment to cybersecurity as a dependable point of reference. Each country's level of development or engagement is assessed along five pillars: legal measures, technical measures, organizational measures, capacity development, and cooperation, and then aggregated into an overall score.

Fig.5. Cybersecurity index in Algeria for the period (2015-2020)



Source: prepared by the researchers based on (ITU, 2015-2020).

Figure (5) Illustrates Algeria's low cybersecurity index values for the period (2015-2018). This explains the government's ineffective efforts to develop legal procedures for the protection of electronic data, as well as the failure to implement national cybersecurity strategies. However, beginning in 2019, the value of the index increased to 33.77, with the goal of reaching 33.95 out of 100 points in 2020, as a result of efforts made during this period to generalize digitization and improve the country's digital orientation.

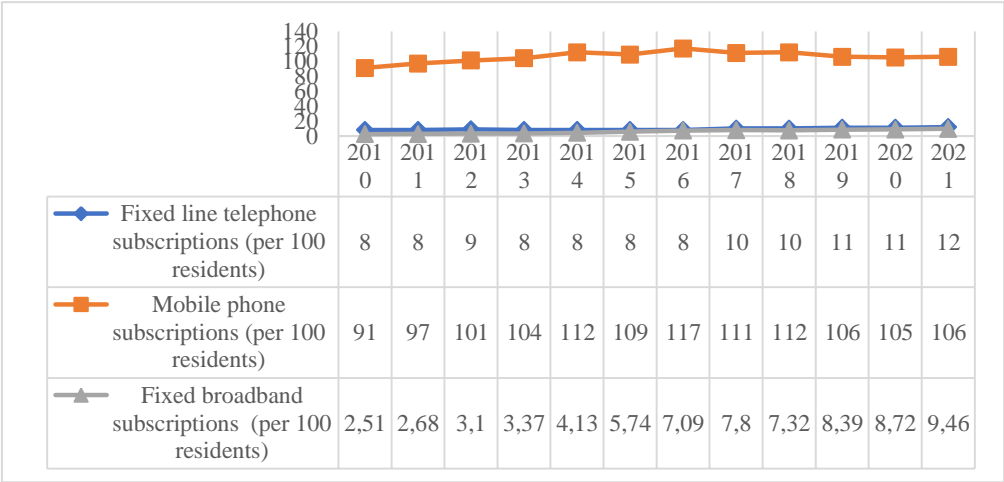
3.2 Infrastructure

The foundation for creating a strong digital orientation is the information and communication technology infrastructure. The indicators of this infrastructure, along with the growth of the Internet market, can be used to assess the infrastructure reality in Algeria.

3.2.1 Evolution of ICT Infrastructure Indicators

Fixed line telephone subscriptions (per 100 residents), mobile phone subscriptions (per 100 residents), and fixed broadband subscriptions are the three most significant indicators of ICT infrastructure (per 100 inhabitants). The following figure serves as an illustration of them:

Fig.6. The development of ICT infrastructure indicators in Algeria for the period (2010-2021)



Source: prepared by the researchers based on (ITU, 2010-2021).

The above figure shows the modest growth in fixed and mobile phone subscriptions per 100 inhabitants, as well as broadband subscriptions per 100 inhabitants, in Algeria over the period (2010-2021).

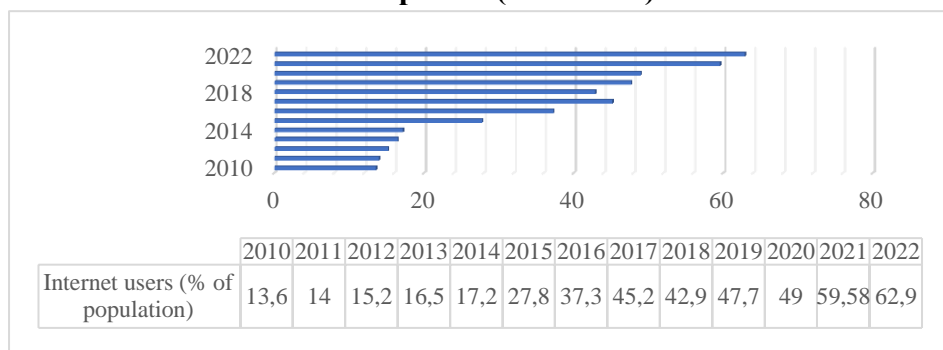
In terms of mobile phone subscriptions, we see that they have surpassed fixed line subscriptions per 100 inhabitants, owing to subscribers' attitudes toward mobile services, as well as the lower cost of mobile service compared to fixed service, which explains the

increase in mobile subscriptions. The decrease in 2019 from 112 per 100 people to 106 per 100 people was caused by the country's population increase during that time period. As shown in Figure (6), fixed broadband subscriptions increased, reaching 9.46 per 100 inhabitants, reflecting Algeria's preference for developing high-speed Internet access in the first place. Despite this upward trend, fixed broadband subscriptions remain low in comparison to Arab countries in particular, and developed countries in general.

3.2.2 Algeria's Internet market development over the period (2010-2022)

Access to Internet service is one of the most important determinants of a country's digital transformation. Algeria is working hard to increase the flow of Internet traffic and provide access to as many users as possible. The graph below depicts the evolution of Internet use in Algeria.

Fig.7. The development of ICT infrastructure indicators in Algeria for the period (2010-2021)

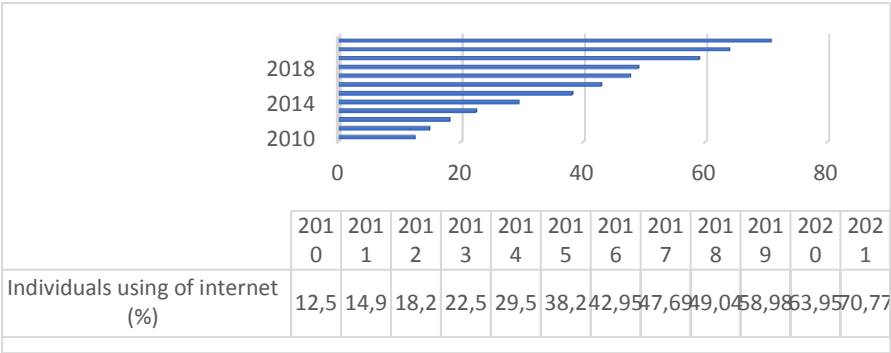


Source: prepared by the researchers based on (IWS, 2010-2022) (MPT, 2010-2022).

Figure (7) depicts the increase in the population using the Internet in Algeria relative to the total population, which can be attributed to the increase in the outcome of subscriptions to mobile phones, particularly cellular phones, due to their ease of use and Internet connection. Algeria also worked to develop mobile phone services in 2014, introducing 3G and 4G technology, which resulted in the percentage of the population using the Internet reaching 62.9

percent of the total population. Figure 8 depicts the individual development of Internet use in Algeria in relation to the total population:

Fig.8. Individuals using the internet in Algeria for the period (2010-2021)



Source: prepared by the researchers based on (WB, 2010-2021).

4. Online Activities

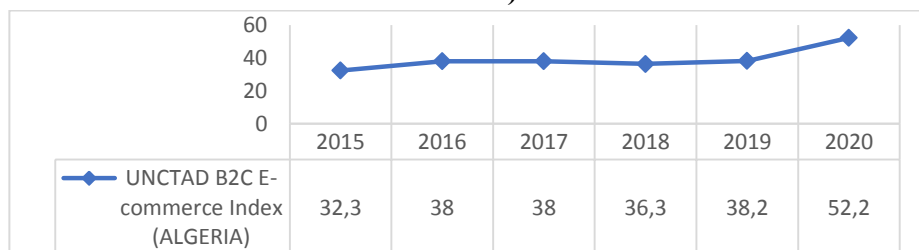
The Algerian government has worked on digitizing various public administrations in order to simplify procedures for citizens and integrate them into the digital orientation, with 454 public services already operational via the Internet, as well as 178 public services in the process of being digitized. Among the most significant works that reflect digital activities are:

4.1 E-commerce in Algeria

The B2C e-commerce index of the United Nations conference on trade and development can be utilized to assess the actuality of e-commerce in Algeria. This index reflects the processes that occur during a B2C online shopping transaction. To accept online orders, the seller must have some sort of web presence. In order to place an order, users must also have internet access. A payment method, such as a credit card, e-wallet, mobile payment, bank transfer, or cash on delivery, is required. Finally, the product must be delivered to the

customer's residence or a pick-up location (or directly to the purchaser online for digital product).

Fig.9. B2C E- commerce index in Algeria for the period (2015-2020)

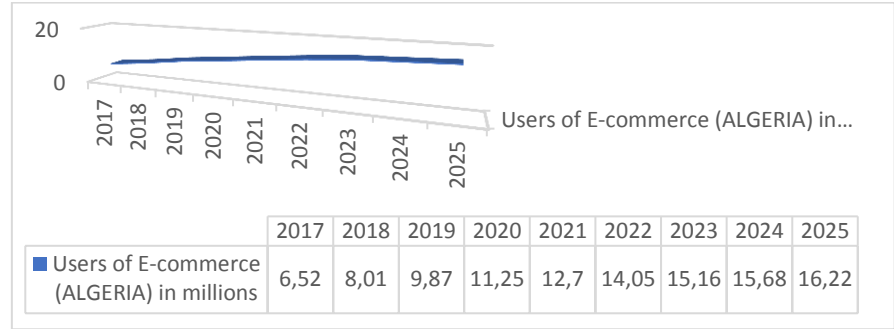


Source: prepared by the researchers based on (UNCTAD, 2015-2020).

The graph above depicts the upward trend of Algeria's e-commerce index, which ranged between (32.3 and 38.2) out of 100 points from 2015 to 2019. It is a low value due to the lack of shops and electronic stores during that time period, as well as the Algerian citizen's lack of interest in various buying and selling operations via the Internet. However, beginning in 2020, we see that the value of this indicator has increased to (52.2), owing to an increase in e-commerce sites and platforms as a result of the country's conditions during this stage (COVID-19 pandemic). And the increase in the number of users of Internet buying and selling sites, as well as the emergence of many e-commerce platforms in Algeria during that time period, all contributed to Algeria's digital trend.

Thus, the following graph depicts the quantity of individuals utilizing e-commerce in Algeria from 2017 to 2025:

Fig.10. Users of E-commerce in Algeria for the period (2017-2025)



Source: prepared by the researchers based on (Statista, 2022).

Figure (10) depicts the increasing number of e-commerce users as a result of various online buying and selling operations, as well as the establishment of electronic platforms and stores in Algeria. According to Figure 10, the year 2023 will see approximately 15 million users of e-commerce, and this increase will continue until the year 2025, reflecting the country's digital orientation toward electronic activities.

4.2 Online payment activities in Algeria

Online payment by CIB card became officially operational in Algeria in 2016, with the service initially available to major billers such as water and energy (gas and electricity), fixed and mobile telephone companies, insurance and air transport companies, and some departments. There were more than 291 online merchants using the interbank card until 2020 (GIE, 2020), and the total number of online payment transactions reached 21,958,103 in the same year (GIE, 2020). In the table below, the most important online payment transactions in Algeria are explained by activity sector.

Table 3. Algerian online payments by sector (2016-2022)

Year	Telephone and communication	Transport	Insurance	Invoice issuer	Administrative service	Services	Goods sale	Sports and entertainment
2016	6,536	388	51	391	0	0	0	0
2017	87,286	5,677	2,467	12,414	0	0	0	0
2018	138,495	871	6,439	29,722	1,455	0	0	0
2019	141,552	6,292	8,342	38,806	2,432	5,056	0	0
2020	4,210,284	11,350	4,845	85,676	68,395	213,175	235	0
2021	6,993,135	72,164	8,372	120,841	155,640	457,726	13,468	0
2022	7,490,626	195,490	23,571	302,273	153,957	705,114	24,169	152,925

Source: prepared by the researchers based on (GIE, 2020).

Table No. (3) Shows the evolution of online payment transactions in Algeria over the period (2016-2022) for the various sectors mentioned above. This, if anything, demonstrates the country's digital orientation in the context of achieving total sector digitization by 2023.

5. Business

The establishment of startups that rely on creativity, innovation, and community development through innovative business models is the most important business that leads to digital transformation. The following table summarizes the outcomes of startups in Algeria:

Table 4. Algeria's startup growth during (2010-2016)

Since its founding on 31/12/2010	2011	2012	2013	2014	2015	2016	Since its founding on 31/12/2016
6,858	451	616	591	750	655	628	10,549

Source: prepared by the researchers based on (ANADE, 2010-2016).

Due to a lack of data for the current periods (2017-2022) for start-up enterprises in Algeria, Table (4) depicts the growth of the

number of start-up enterprises for the period (2010-2016). It is clear that the number of startups has increased, with approximately 10,549 startups funded by the National Agency for Supporting Youth Employment in 2016. This explains the current trend toward innovative institutions that foster technological advancement.

6. Technologies

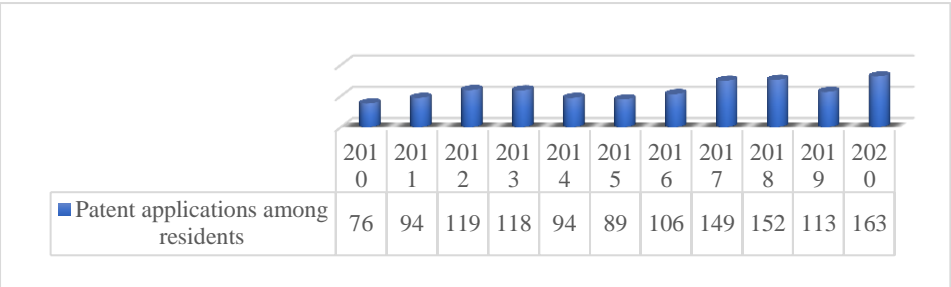
The Algerian government has been interested in the production of knowledge and technology as the first source and foundation for developing a digital orientation, as the development of this knowledge is limited to the amount of money spent in the country on research and development operations. Regarding Algeria, and due to the small numbers that the economy suffers from, it reached the year 2017, which is the most recent percentage related to Algeria (0.53%) of GDP, which is a very low percentage when compared to the volume of spending in other Arab countries.

As a result, each of the patents for Algerian residents will be addressed in this context, as will the analysis of innovation in Algeria via the Global Innovation Index.

6.1 Number of patent applications among residents

Patents are regarded as one of the most important determinants of technological development in countries, as economic growth in developed countries is expressed through the expansion of patents in economic activity. The number of patent applications for residents in Algeria is shown in the graph below.

Fig.11. Number of patent applications among residents in Algeria for the period (2010-2020)



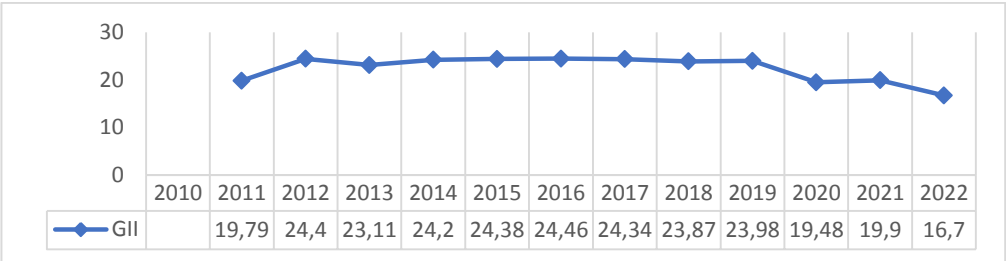
Source: prepared by the researchers based on (World bank, 2010-2020).

Figure (11) depicts the increase in patent applications for Algerian residents from 2010 to 2020, with the highest value reaching 163 applications in the year 2020. This explains the future trend of receiving inventions, which in turn contribute to technological development and progress in the context of digital transformation. However, when compared to developed countries, these values are very low, necessitating the Algerian government's support for this trend.

6.2 Innovation

Algeria has worked hard to improve its environment, particularly in light of the digital revolution, which is based primarily on innovation and creativity. This can be measured using the Global Innovation Index (GII-Algeria), a global reference for evaluating and classifying countries economies based on their ability to innovate. This indicator is based on two sub-indicators, innovation inputs and innovation outputs, as illustrated in the following figure for Algeria:

Fig.12. The development of the innovation index in Algeria for the period (2010-2022)



Source: prepared by the researchers based on (WIPO, 2011-2022).

Figure (12) depicts the Algerian innovation index values out of 100 points, and it is clear that the innovation index did not exceed 24 points. This fluctuation can be attributed primarily to the indicator's sub-indicators, which are concerned with the volume of spending on R&D, which was almost non-existent prior to 2017, as well as the degree of development in the information and communication technology infrastructure, and the most important element represented in intellectual capital, which is declining significantly in Algeria. As a result, in order to develop Algeria's environment, it is necessary to pay attention to innovation activities by assisting them with facilitating laws and procedures, as these values reflect Algeria's late ranks in this field.

7. Conclusion

Because of its continued role in bringing about massive technological revolutions, digital transformation has become a more pressing issue than ever. As a result, many developed and developing countries have identified it as a priority to keep up with emerging transformations while also achieving growth and development. Digital transformation is a continuous process that must be constantly developed and updated by utilizing various technologies such as cloud computing, artificial intelligence, big data, the Internet of things, blockchain, cybersecurity, and other Fourth Industrial Revolution-era technologies.

Algeria is one of the countries attempting to achieve the goals of digital transformation through its vision and initiatives in the field of digitization, owing to its numerous efforts aimed at achieving advanced indicators that place it among the leading countries. Algeria's most visible efforts include the digitization of many public services to ease the process for citizens and integrate them in this direction, as well as decisions aimed at reaching total digitization of all sectors by 2023, proving the validity of the first hypothesis. According to various international reports dealing with digital transformation, Algeria is still achieving the first wave of digital transformation, represented by digitization, until the year 2023, and Algeria is still achieving late ranks, proving the validity of the second hypothesis.

7.1 Results:

The study reached many results, the most important of which are:

- Due to its significance in attaining excellence and leadership, digital transformation is one of the topics that has garnered global attention.
- The Algerian government prioritized the development of the information and communication technology sector, achieving satisfactory results, but its results are still far behind those of developed nations and even Arab nations.
- The Algerian government has strived to implement e-government programs to facilitate digital transformation. Algeria is far from implementing e-government programs, according to international reports and verified numbers.
- One of the first pillars for countries to achieve digital transformation is networked readiness. Regarding Algeria, it continues to lag behind both in terms of the readiness indicator and in comparison to Arab countries.
- The Algerian government has worked diligently to develop the infrastructure of information and communication technology, improve the Internet's flow, and launch new advanced services, but the reality reflects this due to the rise in population, on the

one hand, and the lack of Internet coverage, on the other.

- Algeria's position at the bottom of the lists of knowledge indicators is largely attributable to a lack of qualified human capital.
- Considering Algeria's continued lag in implementing digital transformation technologies, it ranked last among Arab nations in terms of cybersecurity indicators.
- The lack of confidence among Algerian citizens as a result of their ignorance regarding the significance of electronic services is primarily attributable to the absence of the role of the media and the study of citizens' opinions regarding these services.

7.2 Recommendations:

- Algerian policymakers should recognize that digital transformation is not synonymous with the ICT sector.
- Attempting to provide national data and reports on the application of digital transformation techniques to the economy, which would enable accurate measurement of digital transformation in Algeria.
- Human capital must be rehabilitated, modernized, and modernized because it drives the digital transformation process.
- The world has progressed from e-government to smart government, so Algerian policymakers must expedite actual implementation of e-government programs.

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