

# Information Technologies and the Impact of SARS-COV-2 in the Angolan Context: A Study on the Role of Technology in Times of Emergency and Public Calamity

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**Abstract:** In Angola, Information Technologies have gained space in recent years, despite to the costs of acquisition and maintenance given the asymmetries experienced by most families. However, the use of Information and Communication Technologies generated several epicenters in the main cities, towns and even quimbos (small communities that reside in small neighborhoods in rural areas in houses with rudimentary constructions and distanced from each other) of the country in the period that the state of emergency and public calamity was heavy, in view of the restriction of mobility of people throughout the national territory, as well as the departure and entry into national territory and consequently the confinement of people in their homes. The study aimed to analyze the impact of information technologies in Angolan context due to the intense era of SARS-CoV-2. The investigation was empirical using qualitative and quantitative research, with a questionnaire being applied to 481 respondents from the main cities in the country. It was divided into two parts. The first addressed the appearance of the SARS-CoV-2 and COVID-19 viruses as well as the updating of virus prevention and control measures referenced from the presidential decrees in Angola, the second addressed the role played by technologies of Information in the era of the pandemic, namely in periods of emergencies and public calamities. A link between Information and Communication Technologies and Artificial Intelligence was also made in this investigation, since the performance of any technology is integrated in human intelligence.

**Keywords:** Virus SARS-CoV-2, Artificial Intelligence, E-Commerce, Internet of All Things, Molecular Biology

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## 1. Introduction

SARS-COV-2 is a pandemic that has hit the entire world, the effects of which have been quite severe, affecting millions of people with respiratory illnesses and causing the daily deaths of tens, hundreds and thousands of people in different countries around the globe.

The SARS-COV-2 and Covid-19 virus viruses began with the report of the first case in the city of Wuhan, in the province of Hubei, People from Republic of China, on December 1, 2019, and the following months extended all around the world. It is an ease transmitted virus through the air breathed through the mouth and nose from one person to another within a distance of less than 2 meters.

With the circulation of people and goods, their transmission was and is inevitable. The virus that originated in Wuhan has

spread to the entire planet, despite to the measures to prevent and control the spread of the SARS-COV-2 virus, countries were instrumental in halting the spread and, as a consequence, hospitals filled with cases of infections and records of thousands of deaths around in the world.

The pandemic caused the greatest devastation on the American and European continents; In Europe, the countries that recorded the highest numbers of infected cases and deaths were: Italy, the Netherlands, France, England, Germany, Russia, Poland, Romania, Ukraine and Turkey; In America they were the USA, Canada, Brazil, Mexico, Argentina, Chile, Colombia and Peru.

The Asian continent was hit but not as devastated as Europe and America. In Asia, the most affected countries were China, South Korea, Turuukey, Iran, Saudi Arabia, Turkmenistan, Mongolia, India, Pakistan, Cambodia, Indonesia and Japan.

The continents with the lowest number of infected cases and death were the African continents and Oceania. In Africa, the countries with the highest cases were Algeria, Egypt, Morocco, Libya, South Africa, Democratic Republic of Congo, Sudan and Mauritania.

At the level of the PALOP Portuguese-speaking Countries, at the time of the investigation Mozambique registered the highest number of cases of morbidity and mortality, followed by Angola, Cape Verde is third, followed by Guinea Bissau while São Tomé and Príncipe registered the fewer infections and deaths were last in the community; In terms of the CPLP Community of Portuguese-speaking Countries, Brazil has the highest number of infected cases and deaths, followed by Portugal, Mozambique, Angola, Cape Verde, Guinea Bissau, São Tomé and Príncipe, Equatorial Guinea and finally the Republic of East Timor with less than a hundred infected cases and less than half a dozen deaths.

As a result of the pandemic, the world almost stopped, there were voices that admitted a kind of Third World War due to the fact that every person, man, woman, child, young, old, rich or poor is exposed to the risk and susceptible to infection and death at any time:

1. The economies of countries were devastated by the economic recession;
2. The level of unemployment has increased drastically, particularly in poor countries, namely on the African and Asian continents;
3. The movement of people and goods was partially paralyzed between continents, countries and even within territories of the same country;
4. International markets such as oil, which is the mainstay of many producing countries, fell due to the drastic drop in the price of a barrel of oil;
5. The aeronautical market was completely affected, there was no mobility of people due to the closure of borders in almost all countries;
6. The pandemic crisis led many large, medium and especially small companies to declare bankruptcy, putting thousands of employees out of work and, accentuating the social crisis within thousands of families.
7. The drug market became more expensive, as it was the most requested for the acquisition of essential drugs and biosafety materials, such as gloves, alcohol gel, masks and others.

Internally, Luanda was the first province in Angola to notify the first three positive cases of the SARS-COV-2 Virus on March 2nd; about twenty days later the city of Ndalatando (Cuanza -Norte province) notified the first case outside the country's capital, followed later by other capitals of provinces and towns.

In Angola, sports were suspended and others cancelled, such as the internal championships that were taking place in the 2020 season, the Girabola-National Football Championship of the First Division and the BIC-Basket-National Senior Men's Basketball Championship.

For the national flag aviation industry TAAG (Angolan Air

Transport) as well as foreign companies operating in and to Angola, domestic and international flights were suspended, except those of a humanitarian nature to the provinces of Angola and beyond the border, the same happened with interprovincial and transport and maritime transport.

## 2. Controlling the Propagation of the SARS-COV-2 Virus in Angola

Each country in its own way enacted prevention and control measures to counteract the spread of the SARS-COV-2 virus. In a rapid response to the SARS-COV-2 virus and COVID-19 disease pandemic crisis, the Angolan authorities took timely measures to address the challenges arising from the COVID-19 shock.

According to a source from the International Monetary Fund, "Public health protection measures included quarantine, social distancing, closing borders with limited exceptions, closing schools, restaurants and public events, as well as limiting transport [1]". According to the same source, the government recently approved a prudent amending budget for 2020 using a conservative oil reference price. It also introduced a comprehensive set of fiscal and monetary measures to support economic activity.

In Angola, before the first positive cases of SARS-COV-2, previously reported, on February 28th, the government, by order of the Minister of Health, prohibited the entry into national territory of foreigners from countries with indigenous cases China, South Korea, Iran and Italy, as well as African countries with registered cases Algeria, Egypt and Nigeria with immediate effect from March 3<sup>rd</sup> [2]; From then on, the government tightened the measures to prevent the vertiginous spread of the virus to the population with a presidential decree of State of Emergency, the first of fifteen days on March 27th and extended from fifteen and thirty days to six months (March-August 2020) and later presidential decrees of public calamity (October 2020-May 2022).

On March 18th, 2020, the President of the Republic of Angola issued a provisional decree law n° 1/20, in its articles 1 and 2, suspending the fundamental rights of citizens, namely: travel, closing borders, docking and disembarking of ships of passengers, and agglomerations of people with a number superior to two hundred.

Suspends all commercial and private passenger flights from Angola to abroad and vice versa, which may be extended for an equal period of time, depending on the global behavior of the COVID-19 pandemic, and prohibits the movement of people at land borders, docking and the disembarkation of passenger ships and their crews, coming from outside the country, in all national ports, for 15 days, starting at 0:00 am on March 20th, 2020 [3].

On March 19th, through a joint directive by the Ministries of Higher Education, Science, Technology and Innovation and Education, classes were closed in general education schools, higher education institutions and nurseries for an initial period of 15 days, depending on developments in of the

epidemiological situation in the country, periodic evaluations of the epidemiological situation were carried out, which delayed the start of classes for September and October 2020 in higher education and general education respectively. Cancellation of scheduled cultural, political and recreational events.

On March 25th, the President of the Republic decrees in accordance with the combined provisions of articles 57 and 58, paragraph p) of article 119, paragraph 3 of article 125, paragraph h) of article 161° and article 204°, all the Constitution of the Republic of Angola, the state of Emergency with the approval of the National Assembly [4]:

1. A State of Emergency is declared, based on the fact that the Republic of Angola is currently experiencing a situation of imminent public calamity.
2. The State of Emergency declaration must be observed throughout the national territory.
3. The State of Emergency lasts for 15 (fifteen) days, starting at 0:00 (zero) hours on March 27th, 2020 and ending at 23:59 (twenty-three and fifty-nine) hours and minutes on April 11th, 2020, which may be extended under the terms of the law.
4. This decree declares partial suspension of the following rights:
5. Right of residence, movement and migration to any part of the national territory:
6. Right of international movement:
7. Property rights and private economic initiative:
8. General rights of workers:
9. Right to strike:
10. Right of assembly and demonstration:
11. The right to freedom of worship, in its collective dimension:

The presidential decree issued on the State of emergency consisted, among several measures, of the confinement of families in their respective residences, with the slogan, “stay at home”, for a period of approximately six months. Schools of all education subsystems closed their doors; public services reduced their operation by up to 25% in some cases and others closed their doors or employees worked on alternate days to reduce the flow of people where services could not close. Therefore, the government was forced to enact measures leading to the mitigation of the SARS-COV-2 virus:

1. Provincial or municipal sanitary fence;
2. Home or institutional quarantine, isolation and testing;
3. Special protection of vulnerable citizens;
4. Reduction in the workforce;
5. Approval and implementation of distance learning (EAD) in all education subsystems;

Many public and private bodies resorted to teleworking to maintain their functioning and minimize the impact of the pandemic; Luanda, the capital of the country, was under a sanitary fence for a period of two years; The interprovincial movement of people and goods was carried out on a reduced scale through selective criteria set out in successive decrees; Air, sea and land borders were closed, the mobility of people and goods was only for exceptional or humanitarian cases,

such as the transport of essential goods such as medicines, biosafety materials, food; internally all commercial establishments closed except those considered essential, such as supermarkets, energy agencies, parallel markets, canteens, pharmacies, hospitals, in short, all small and large surfaces that supplied necessities.

Funerals were carried out under strong biosecurity measures regulated by successive presidential decrees, with those who died from covid being buried in the same period as other deceased people in separate cemeteries through police escorts and health professionals, without tribute from their loved ones.

In the same period, the only ministerial departments that had their human resources 100% operational during the state of emergency were the defense, security and internal order bodies, as well as the National Health Services (hospitals and health centers), as the professionals in this organ were considered frontline warriors.

The ministerial departments of the education subsystems suspended classes, coincidentally or not, in the same period, as a way of mitigating the effects of confinement, the government recognized the modality of distance learning, which had been postponed for more than two decades, enacted by the presidential decree No. 59/20. According to the *Diário da República* published on March 23rd, as distance and blended learning to arrive in Angola, the Executive alleges the need to expand the educational offer and achieve greater equity in access to higher education (Republic, 2020). Higher education has changed the teaching paradigm, from face-to-face to coexistence with other modalities such as semi-presential and distance learning (EAD). Second [5]

The new trends of Angolan society and the dynamics of the Ministry of Higher Education, Science, Technology and Innovation (MESCTI), given the limitations imposed by the COVID-19 pandemic, which paralyzed classes in the Angolan higher education subsystem, meant that the attendance rate was affected with a cumulative frequency of 253,287 students who missed classes as a result of the social confinement measures applied to prevent contamination.

According to Arnaldo, Cuesta, Blanco and Gongula (2022), higher education institutions in Angola were forced to devise strategies such as dividing students into small groups to attend face-to-face classes, redesigning curriculum plans and readopting the contents planned for use on digital platforms (e-learning, Moodle, Zoom, Google Drive, Google Classroom, email, Webinar Center, Team Viewer, Basecamp, WeTransfer, For Learn, Youtube) and this time an attempt was made to control the risk of contagion from the outbreak for students.

Certificates and diplomas issued by foreign institutions in the Distance Learning (EAD) modality are now recognized and valid throughout the national territory; Thus, initiatives emerged in some general education institutions and others in the public higher education subsystem (universities, higher institutes and schools), as well as in the private education segment (colleges, high schools, higher institutes and universities).

The Ministry of Education (MED), in order to mitigate the situation, took the first steps with the Distance Learning modality through the transmission of radio and tele-classes by public social media: Public Television of Angola (TPA) and National Radio of Angola (RNA). The initiative of this modality helped children and adolescents at the primary and secondary levels of the 1st cycle to recover the contents and consolidate the levels of learning, but it also served as leisure in the airtime of knowledge transmission.

The organic units of higher education tested distance learning, wherever possible based on ICT, although the higher cost of technological infrastructure for students and also for teachers were not favorable for all families in Angola given the asymmetries in access to resources technological support for EAD (such as the internet, electricity, and computers), did not help the intended success. This time, the Ministry of Higher Education, Science, Technology and Innovation in Angola generalized a strategy that focused Higher Education Institutions HEIs on the need to share face-to-face teaching with other modalities through the aforementioned digital platforms and social networks

The MESCTI strategies that have been generalized throughout the country and adjusted to the needs of HEIs in Angolan society in accordance with the aforementioned digital platforms and social networks (WhatsApp, Messenger, Instagram), which allow adding to academic needs, support networks formed by academic communities to face crises in the use of ICT for the development of the teaching-educational process in distance education [5].

After the state of emergency ended, the Angolan government declared a state of public calamity on several occasions with “exceptional and temporary measures to be in force during the Public Calamity Situation Declared Due to Covid-19 [6]”.

The state of public calamity was decreed by the President of the Republic on a monthly basis and revised extraordinarily whenever the trend of a vertiginous rise in infections of the SARS-COV-2 virus was registered. For example, in October 2020, the government issued two presidential decrees due to the worrying evolution of the epidemiological situation experienced at the time.

### **2.1. Angola, in Counteroffensive to SARS-COV-2**

The country and people mobilized under the leadership of their heads of state with measures to prevent and control the spread of the virus, as well as the recovery of infected patients. Emergency hospitals were built or rebuilt in the main population centers with an emphasis on Luanda, as well as the constitution of rapid response teams for testing cases and searching for people with suspected COVID-19 infection.

In such a short time, four laboratories for testing the SARS-COV-2 virus were set up in Luanda, Benguela, Uíge and Lunda-Norte with the capacity to perform up to five to six thousand tests a day and obtain results within 24 hours, with three thousand of RT -PCR and the rest of serology. Testing was mandatory in several population samples selected for this purpose, as well as in patients hospitalized in health units

when the symptomatic picture suspected the infection of covid-19.

On the other hand, campaign hospitals built to recover infected patients regularly received drugs and biosafety materials such as face masks and alcohol gel for use by all citizens on public roads and in closed spaces. Tens of tons of hospital supplies were purchased from the Republic of China to equip field hospitals and medical, nursing and other personnel such as: suits, aprons, boots, shoes, gloves, a veil (scarf and face covering) and visors.

Notwithstanding the measures announced in the previous paragraph, the commercial segment had open space to safeguard the food situation. According to the *Diário da República I* Series No. 169, it says that, “The execution of the commercial activity of goods and services in general, including in canteens and similar, can be carried out between 7:00 am and 8:00 pm, observing the rules of biosafety and physical distancing, (...)” [7].

To conclude this item, it is important to clarify some concepts that served as a highlight of the investigation:

1. SARS-COV-2: a virus of the coronavirus family that, when infecting humans, causes a disease called COVID-19.
2. COVID-19: disease that manifests itself in us, human beings, after infection caused by the SARS-COV-2 virus.
3. Coronavirus: name given to an extensive family of viruses that resemble each other [8].
4. Emergency situation: less serious, partially compromises the public power's ability to act; Public calamity: more serious, it is used in cases where the capacity of the public power is seriously compromised [9].

### **2.2. The Impact of Technologies and ICTs on Society During the Pandemic**

ICTs were very significant in society during the period when the pandemic reached its peak in society. According to *González* “ICT services have allowed us to support day-to-day life, even more relevant economic, productive and social activities such as education, work and e-commerce [10]”. The *Softter* website, in line with the same thought, considered that the increasing use of technology for practically everything created new digital habits, companies implemented changes with digital transformations to serve their clientele and telework, institutions used the non-classes resources face-to-face (online), customers made payments for Internet Banking products and services, such as *multicaixa express* [11].

The World Health Organization (WHO) regularly used ICT resources with the member countries to update the information inherent to the pandemic, crossing statistical data from the Health databases of the different countries with the WHO database.

Social networks are supported by information technologies and that they played a very important role in the period of confinement in Angola and in the rest of the world. According to *Malavé*, the internet and social networks have brought many benefits to a large part of the population in terms of the

possibilities of remote work, distance classes, non-face-to-face teaching and learning processes, new business strategies, maintenance of relationships affective and even as a means of fun and redefinition of culture. Although this has already occurred in recent times on smartphone and computer screens, but the social isolation derived from COVID-19 has increased its use to adopt certain customs during the pandemic period [12].

In the period of public calamity that runs until May 25th, 2022, the measures were lightened or intensified depending on whether or not the epidemiological situation slowed down. For example, the schools of all subsystems in force in Angola were opened under strong biosecurity measures, each ministerial department that oversees the teaching-learning process adopted its model for the functioning of its organic units, some adopted the model of face-to-face classes with groups distributed on alternate days of the week, others implemented semi-presental teaching and a few others implemented distance learning with ICT resources such as platforms Moodle, Google Classroom, Zoon and social networks Facebook, WhatsApp, Web meeting.

At an institutional level, when face-to-face meetings were not possible, they were held virtually on webinar, Zoon, Skipe and other digital platforms. The President of the Republic participated in several meetings, via videoconference, with his counterparts and with the UN and its agencies. Likewise, the meetings of the Ministerial Departments with their international counterparts were held in virtual mode.

The Angolan legislative power, the National Assembly (AN), during the state of public calamity and the final part of the state of emergency, held its plenary meetings and specialized work committees in the face-to-face modality, simultaneously with a virtual environment with its deputies scattered throughout several rooms in the parliament building, others in their residences and other deputies residing in the provinces scattered in the AN provincial core. According to the Union of Portuguese-speaking Capital Cities UCCLA, the first registration in Angola of taking office, using electronic means, as a result of measures to prevent and combat COVID-19, parliament conferred virtual office on the new Secretaries of the Local Support Offices for Provincial Electoral Circles of Deputies from Lunda Norte and Moxico.

In the same vein, the meetings of the ministerial department that manages health in Angola with WHO were also virtual. There are numerous events that this ministerial department and others put together with homologous international organisms or related at a distance through technological solutions.

The teleworking modality was activated, since people, due to the pandemic, avoided crowds and, therefore, physical contacts. The worldwide communication network, commonly known as the internet, has become a lifeline as a means of communication between people, organizations and governments.

Integrated Center for Public Security CISP under the auspices of the Ministry of the Interior, participated in the reception of messages and the location of suspected cases of

COVID-19 on public roads and within the families and served as a vehicle for notifying the rapid response teams to COVID-19 from MINSA, who were responsible for field trips to collect cases for the hospitals designed to treat the pandemic;

It should be noted that, due to the management of the pandemic, MINSA modernized its technological infrastructure, including a COVID-19 database that allowed this Ministerial Department to manage the population's vaccination intake. The solution opens up the possibility of the respective user obtaining a digital vaccination certificate in real time. Anyway, the positive impacts that ICTs have provided people during period of confinement and public calamity are enormous.

### ***2.3. Artificial Intelligence Support Technologies***

When we mentioned that ICT was used in many countries, particularly in Angola during the period of emergency and public calamity, for meetings (meetings, telework, teleclasses and other activities) in circumstances where physical presence was not recommended, it was not explained that the various technologies used are embedded with Artificial Intelligence, or AI. To better explain that the technologies and ICTs used in AI are present in AI, concepts from some authors are presented:

Thus, Winston states that AI "is the study of concepts that allow computers to be intelligent" [13];

According to Costa and Simões, Artificial Intelligence is the discipline that aims at 'the study and construction of artificial entities with cognitive capacities similar to those of human beings [14];

Rich and Knight define AI, as the ability to solve difficult problems or even, "AI is the study of how to make computers do things that, at the moment, people do better" [15];

For Luger the branch of computer science that deals with the automation of intelligent behavior". Luger considers that AI is a part of computer science, so the problem of defining artificial intelligence turns into defining intelligence in the first instance: "intelligence is a unique faculty, or is it just a name given to a collection of distinct abilities that are uncorrelated? To what extent can intelligence be learned as opposed to its prior existence [16]?"

The researcher in this investigation assumes the concept of AI, according to which it is a branch of Engineering, that seeks to build instruments that incorporate the thinking of experts and cognitive phenomena to leverage machines (computers, smartphones, tablets, notebooks, etc.) with capable knowledge to assist man in problem-solving and decision-making.

### ***2.4. The Main Contributions of AI in the Time of the COVID-19 Pandemic***

There are countless contributions from this area of knowledge in social and economic life, with the performance of systems using technologies in the phase when the pandemic reached its highest point, for example, telemedicine services, vaccine production, studies, assisting patient support centers,

and setting up laboratories. AI was also present in many sectors such as mobility, e-commerce, education, health, telecommunications, insurance, finance, banking and other sectors.

In Angola during the pandemic period, for example, the media had restricted services. The provision of services to commentators was carried out remotely using Zoom, Skype and social networking technologies; Families confined to different homes and places also resorted to the same technologies to communicate, in short, these were the benefits of AI.

The Softter website highlights the benefits of AI as a management tool during the pandemic "(...), it was possible to identify Big Data patterns, predict human behavior and image and voice recognition, support health systems and control the spread of viruses through the tracking software" [11]. The website also added that AI systems can learn on their own and adapt successively, considering their capabilities as valuable as business organizations adapt and deal with the new post-COVID era.

RT-PCR molecular test for the detection of the SARS-COV-2 virus. Well, the molecular biology used in testing the SARS-COV-2 Virus worldwide is the main technology (or more precisely) and the laboratories for testing were developed with the help of artificial intelligence.

In Africa, namely Angola, Gabon, Togo and Benin, four laboratories were set up to test the SARS-COV-2 virus with the capacity to carry out up to five thousand tests per day for Gabon, Benin and Togo and six thousand tests for Angola and obtain results within 24 hours, three thousand of which were for RT-PCR and the rest for serology. These laboratories to fight COVID-19 were set up by a team of scientists from the Chinese company BGI Genomics headed by a young Angolan, who graduated in Biotechnology at the Normal University of Zhejiang, China. Biotechnology is the perfect marriage of biology and technology, the latter part of which is artificial intelligence knowledge.

According to the Portuguese News Agency LUSA, the young Angolan graduate in biotechnology in the Republic of China coordinated the team of scientists who set up four COVID-19 testing laboratories in Luanda, Lunda-Norte, Cabinda and Uíge. In addition to setting up the laboratories, the Angolan who was in his homeland on a mission for his company also prepared the human capital that processed the samples at the Luanda Laboratory Diagnostic Center in Viana [17].

Another contribution of technology in the era of the COVID-19 pandemic, AI was the development of a technological solution to prevent cases positive for the virus, which is the case with the discovery of vaccines and the respective manufacture of millions of dozens to immunize the entire world. According to the Weg Museum of Science and Technology, "Some technological trends are no longer just trends and have become allies in the fight against Sars-CoV-2" [18].

The same Museum also adds, "Technological tools such as Artificial Intelligence (AI), Big Data, cloud computing and the Internet of Medical Things (IoMT) are some of the resources

that can be used to find forms of treatment, prevent the spread of misinformation and even the public's misinformation."

In this regard, molecular biology technology has allowed scientists from various parts of the world to produce vaccines with speed never seen in other pandemics that have already occurred in other times in the world, such as the cases of AstraZeneca (developed by a team from the University of Oxford and British-Swedish pharmaceutical company) [14], Pfizer-BioNTech, Modern and Johnson & Johnson (USA), Sputnik-V (Russia), Covishield, Covaxin and Biotech (India), Sinopharm and Sinovac (China), CoronaVac - Sinovac, and AstraZeneca (Brazil), AstraZeneca - produced locally by SK Bioscience and others (South Korea), AstraZeneca - in collaboration with the University of Oxford (United Kingdom) and BioNTech - in collaboration with Pfizer (Germany).

All these vaccines are the result of the technologies used to manufacture them and are intrinsically linked with molecular biology and/or genetics, which are areas of AI. According to Lima (2013) "Molecular biology is the area of biology that seeks to study organisms from a molecular point of view, focusing mainly on the basis for all organisms, the nucleic acids, which form RNAs (ribonucleic acid) and DNAs (deoxyribonucleic acid) that later give rise to proteins" [19].

Other areas of technologies that were and are used, without the consumer realizing it, before, during and perhaps after the pandemic and that fall into the field of AI are:

#### *Internet of Things (IoT)*

The Internet of Things (Internet of Things, IoT) is a concept that refers to the interconnection of digital artifacts with the internet, connecting artifacts more than people such as Smartphone, iPad, the smart TV used to access film and series platforms, as well as the watch that measures heartbeats and connects this information with other applications, etc.

#### *Digital marketing*

In marketing, although already used before the pandemic, it contributes to the advertising of products and services, as well as allowing the diagnosis of trends, behaviors and opportunities with the public, in addition to anticipating demands. The advertising of services and products reached the consumer through social networks.

#### *E-commerce*

Part of the consumer, due to the restrictions of people and well-opted for e-commerce technology that consisted of online payments and home delivery of the product, gained ground in the Angolan reality in the peak period of the pandemic, despite being a recurring practice in the so-called first world countries.

#### *Cloud computing*

Cloud computing is a concept that idealizes data storage outside the computer and in the internet environment. In a secure way, files and programs are accessed by various fixed and mobile devices at any time and place, thus promoting communication between employees, customers and companies.

According to the blog COMSTOR [20] "The Cloud can give the AI the information they need to learn, and the AI can give the Cloud more data. This symbiotic relationship has

made massive transformations possible, including personal assistants like Apple Siri, Amazon Alexa and Microsoft Cortana (...)"'. In the pandemic era with the use of teleworking, employees and employers maintained a the connection between themselves and these with their customers at any time based on cloud computing.

In short, technological tools such as AI, IoMT, cloud computing and Big Data, were some of the resources used to treat, minimize the spread and also prevent public misinformation, therefore, some technological trends have become allies in the fight against SARS-COV 2.

### 3. Research Materials and Methodology

The investigation was empirical using qualitative and quantitative research, with a questionnaire being applied to 481 respondents from some cities in five provinces of the country, namely Benguela, Cuanza-Norte, Malanje, Luanda and Zaire. For data collection, a questionnaire consisting of four dimensions was prepared. The instrument was applied to a random population sample between 8 years old and over 60 years old, randomly with a level of schooling ranging from

primary education to a Doctor's degree in an unquantified population. The sample collected was accidental empirical (not accidental probabilistic).

The investigation had its genesis in document analysis, as a set of information was studied and absorbed in several presidential decrees reflected in diaries of the Republic of the Republic of Angola, as well as dispatches from MINSAs and WHO regarding prevention measures for the SARS-CoV 2 pandemic. Likewise, the investigation was supported by a bibliographical analysis with the synthesis of the theoretical-empirical knowledge about the appearance, coexistence and prevention of the SARS-CoV-2 virus and COVID-19 in other parts of the world, as well as aspects inherent to different technologies with AI.

### 4. Results and Discussion

Below is an analysis of the opinions of the interviewees who participated in filling out the questionnaire. Given the diversity and amount of information processed, some sample graphs and tables were selected in order to help understand the investigation carried out.

*Table 1. Sampling selection by age.*

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	8 a 14	34	7,0	7,0
	15 a 21	109	22,5	29,5
	22 a 28	129	26,7	56,2
	29 a 40	111	22,9	79,1
	41 a 50	62	12,8	91,9
	51 a 60	35	7,2	99,2
	Over 60	4	,8	100,0
	Total	484	100,0	100,0

Regarding sampling, as mentioned in the methodology item, it is non-probabilistic, covering age groups with education levels and reading and interpretation abilities to fill in the Questionnaire. This time the selected ages ranged from 8 years to over 60 years.

*Table 2. Description of the sampling by qualifications literary qualifications.*

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Primary education is incomplete	33	6,8	6,8
	Primary education is completed	14	2,9	9,7
	Incomplete first cycle of secondary education	37	7,6	17,4
	Completed first cycle of Secondary Education	12	2,5	19,8
	The second cycle of incomplete Secondary Education	18	3,7	23,6
	The second cycle of secondary education was completed	13	2,7	26,2
	Secondary School incomplete	43	8,9	35,1
	Secondary School completed	70	14,5	49,6
	Frequency of Higher Education	92	19,0	68,6
	Bachelor	45	9,3	77,9
	Graduate	86	17,8	95,7
	Master	14	2,9	98,6
	PhD	7	1,4	100,0
	Total	484	100,0	100,0

Below are the graphs and respective descriptions by dimension:

The Impact of Information Technologies and Artificial Intelligence on interpersonal relationships in the SARSCOV-2 Era

Information technologies and AI impacted interpersonal relationships during the pandemic period. According to the

indicators in Figure 1, it is notable that respondents said yes to 76.24%, no to 13.64% and were indifferent 10.12%. In accordance with the percentage analysis in the graph, this means that these technologies minimized the compulsive isolation of families and adapted them to another form of relationship with resources such as the internet, social networks, cell phones, computers, tablets, smartphones, iPods

and others. that replaced interfamily relationships in a the face-to-face format..

a-In your opinion, were information technologies decisive for keeping families in their homes?

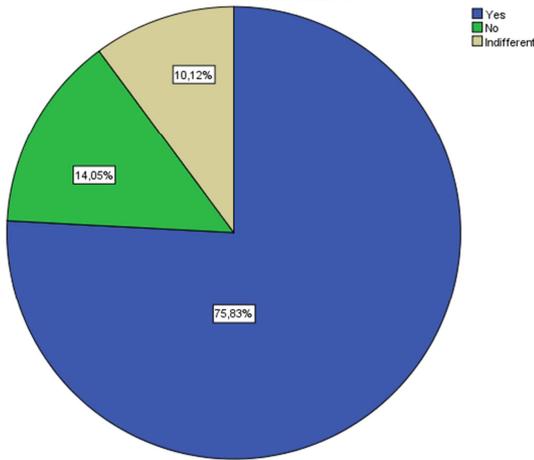


Figure 1. A representative graph of interpersonal relationships minimizes ICTs and AI.

Connecting IT with Artificial Intelligence, Intelligent Systems and Molecular Biology

b2-Do you believe that information technologies in the period of confinement caused changes in the interpersonal relationships of workers in the Angolan context?

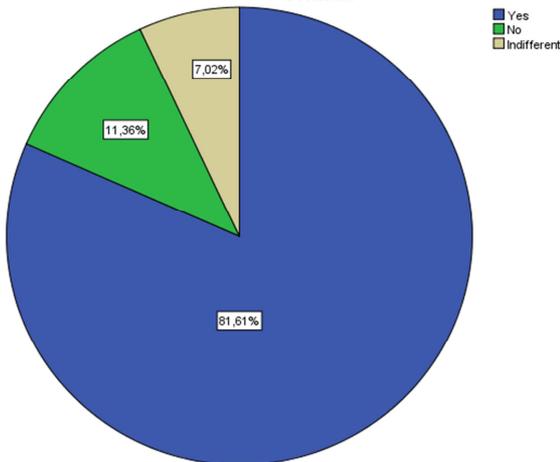


Figure 2. Representative graph on workforce interpersonal relationships.

Regarding indicator b2, do you believe that information technologies in the period of confinement caused changes in the interpersonal relationships of workers in the Angolan context? The interpretation resulting from the analysis shows in the graph in figure 2 that the respondents agreed with 81.61%, while 11.36% said no and were indifferent with 7.02%. Therefore, based on the indicators, it is clear that the majority of public and private employees have adopted a new work format through teleworking, and institutional and business meetings in a virtual format.

Relationship or Impact of Technologies in the SARSCOV-2 pandemic era and Artificial Intelligence

Figure 3 shows the indicators of respondents who stayed at home with the action of technologies and AI positively

impacting teir ability to face social isolation at that pandemic time. As can be seen, 80.99% of respondents said yes to the use of technologies in the pandemic period, 13.51% of respondents said no, and 8.88% were indifferent. The proportions of respondents who are of the opinion that technologies have had positive impacts on their lives, those who are opposed and who are indifferent indicate that these technologies have positively influenced the maintenance of families in their homes.

c1-Please tick which of the listed technologies were linked with one of the following areas used by me in the era of the SARSCOV-2 pandemic, including covid-19 tests as well as the respective vaccines are inextricably linked with one of the areas below:

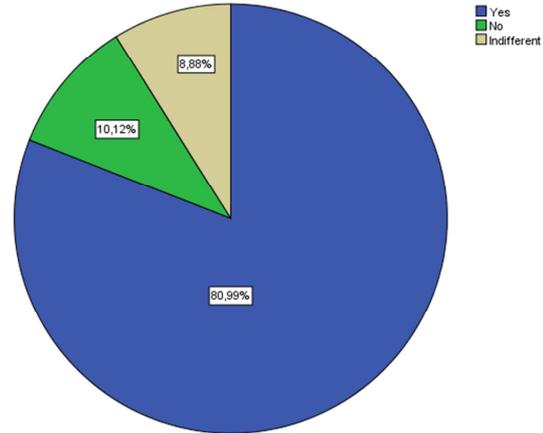


Figure 3. A representative graph shows the opinions of those surveyed around the impact of technologies and Artificial intelligence.

As for the question posed to the respondents according to which (...) which of the technologies used by him in the era of the SARSCOV-2 pandemic, including the COVID-19 tests as well as the respective vaccines, are inextricably linked with one of the following areas: Artificial Intelligence, Intelligent Systems, Molecular Biology, and Electronic Commerce (e-commerce).

In this sub-indicator c1, the respondents confirmed that they used molecular biology with 40.29%, SI with 24.17%, AI with 18.80% and 16.74 for electronic commerce. Therefore, these technologies had their place in the lives of Angolans during the pandemic period. AQUI

c2-Can you conclude that AI was instrumental in reversing the critical situation of the pandemic?

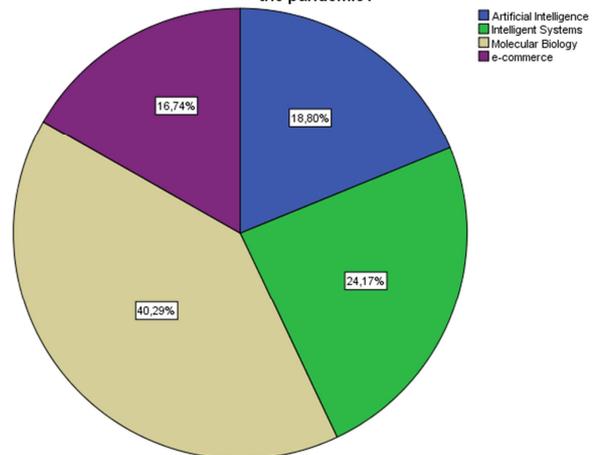


Figure 4. Description chart of technologies used during the pandemic.

Asked by the sample if the molecular biology technology used for the production of various vaccines, which joined the biosafety measures, was crucial to alleviating the impact of the SARSCOV-2 pandemic, the respondents said that they believe yes with 82.19%, they do not believe with 8.90% and they are indifferent with 8.90%, therefore, in this regard, the biosecurity measures in synchrony with the different vaccines twelves had a positive impact on saving Angolans.

Consideras que a tecnologia da Biologia molecular adicionadas as medidas de biosegurança foram determinantes para aliviar o impacto da pandemia SARSCOV-2?

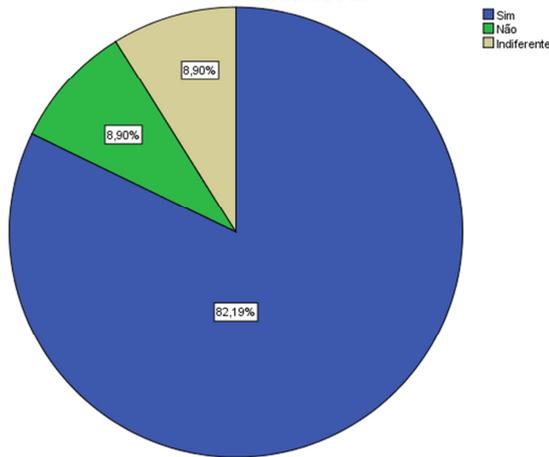


Figure 5. Opinion of respondents regarding molecular biology versus biosafety measures.

## 5. Results Obtained and Validation

In summary, the technologies and ICT listed in this investigation allowed fill filling a void with the resizing of coexistence habits at the time: With AI technologies such as television, email, social networks, for example, they allowed people to exchange information, thus reducing the gap in isolation; With IS and its platforms such as mobile phones, multicaixa express cards allowed solving problems; Molecular biology played its role with the production of materials to combat covid; e-commerce allowed the acquisition of means of survival with the help of the internet and social networks.

The tables below summarize the results of the technologies according to the point of view of the sample surveyed:

Table 3 expresses the use of information technologies in the era of the COVID-19 pandemic, according to the understanding of the respondents.

Table 3. Quantification of the use of technologies during the pandemic.

Dimension	Yes (%)	No (%)	Indifferent (%)
A	76.24	13.64	10.12
B (b <sub>1</sub> )	76.45	10.12	13.43
B (b <sub>2</sub> )	82.12	11.02	6.86
C (c <sub>2</sub> )	77.69	9.50	12.81
D	82.19	8.90	8.90

Table 4 responds to the expressions of respondents around the technologies they used during the pandemic period.

Table 4. Significant results for the use of technologies in the pandemic era.

	percentage	Valid percent
Artificial intelligence	19.8	19.8
Intelligent Systems	24.2	24.2
Molecular biology	40.3	40.3
Electronic Commerce (e-commerce)	15.7	15.7
Total	100.0	100.0

## 6. Conclusion

The most important lesson that the pandemic has taught us is to realize the need to use ICTs in all productive, economic and social activities, as well as the need to improve the telecommunications infrastructure so that the general population can have universal access and access to universal services to continue their activities in a new way of life, a new normality, which requires greater personal care due to the presence of COVID-19 and safe and agile communication channels.

Through ICTs, it was possible to share information to save human lives (examples, call from the Ambulance of the National Institute of Medical Emergence of Angola (INEMA) through its telephone number or the Integrated Center for Public Security (CISP)), maintain communication with families, friends and colleagues despite the distance and, with emphasis on the performance of tele-work, telemedicine, tele-education, e-commerce activities, among others.

Information and communication technologies today have made the world closer among its inhabitants, communication in the pandemic era has replaced face-to-face meetings in family, school, work and beyond. If we stop for a moment to think about what it is like to have access to technology in the time of the COVID -19 pandemic, surely any attentive person could realize that in addition to helping in the race to save lives by making new equipment and medicines available to the world, technology has given many people had access to information via the internet or mass media, this time, most of the population remained informed of the dangers and, the consequences of the virus infection as well as the mechanisms to care for and preserve the lives of their family, rigorously applying the biosecurity measures oriented by the health authorities.

Finally, the technologies that are references in this study and that served as a support to minimize the effects of the pandemic were designed by man through his intelligence, which makes it natural to link them with artificial intelligence, since this science in the area of Engineering is a branch of computing that proposes to develop devices that simulate the human capacity to reason, perceive, make decisions and solve problems, in short, the capacity to be intelligent.

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## Conflicts of Interest

The authors declare no conflicts of interest.

## References

- [1] Found, IM (09/21/2020). [www.imf.org/pt/News/Articles](http://www.imf.org/pt/News/Articles). Retrieved from [Articles: https://www.imf.org/pt/News/Articles/2020/09/18/na-angola-confronting-the-covid-19-pandemic-and-the-oil-price-shock](https://www.imf.org/pt/News/Articles/2020/09/18/na-angola-confronting-the-covid-19-pandemic-and-the-oil-price-shock)
- [2] Angola, CI (14 of 08 of 2020). [www.uccla.pt/sites](http://www.uccla.pt/sites). Obtained from [uccla: https://www.uccla.pt/sites/default/files/coronavirus\\_angola\\_200814.pdf](https://www.uccla.pt/sites/default/files/coronavirus_angola_200814.pdf)
- [3] Republic, D. d. (2020). Presidential Decree No. 59/20. Luanda: National Press. Republic, P. d. (March 18, 2020). Provisional Presidential Legislative Decree n° 1/20. Diariy of the Republic.
- [4] Nacional-EP, I. (March 25, 2020). Presidential Decree No. 81/20. Diário da República I Series- N° 35.
- [5] Faustino, A., Herrera Cuesta, SR, Blanco, DD, & Gungula, EW (21 Aug 2022). <https://doi.org/10.15359/ree.26-3.25>. Retrieved from Revista Electrónica Educare (Educare Electronic Journal): <https://www.revista.una.ac.cr/index.php/educare>
- [6] Nacional, A. (October 8, 2020). Presidential Decree No. 256/20- I Series - No. 159. Diário Da República, p. 8.
- [7] National, I. (March 11, 2021). Presidential Decree No. 62/21, Series I No. 44. Diário da República, p. 8.
- [8] Butantan, I. (s. a). [butantan.gov.br/covid/](http://butantan.gov.br/covid/). Obtido de Instituto
- [9] Butantan A serviço da vida: <https://butantan.gov.br/covid/butantan-tira-duvida/tira-duvida-noticias/qual-a-diferenca-entre-sars-cov-2-e-covid-19-prevalencia-e-incidencia-sao-a-mesma-coisa-e-mortalidade-e-letalidade>
- [10] Anónimo. (s. d de s. m de 2020). [www.significados.com.br/Obtido de Significados: https://www.significados.com.br/calamidade-publica/](http://www.significados.com.br/Obtido de Significados: https://www.significados.com.br/calamidade-publica/)
- [11] González, O. (23 de 04 de 2021). <https://brechazero.com.br/Obtido de brechazero.com.br: https://brechazero.com.br/o-impacto-das-tics-foi-muito-significativo-na-sociedade-durante-a-pandemia/>
- [12] Anónimo. (s.a). <https://softtek.eu/pt. Obtido de Softtek: https://softtek.eu/pt-pt/tech-magazine-pt/digital-transformation-pt-pt/tecnologia-o-verdadeiro-vencedor-da-era-pos-covid/>
- [13] Malavé, M. M. (2020 de 05 de 2020). Instituto Nacional Fernandes Figueira. Obtido de [fiocruz.br/index.php/8-noticias/675-papel-redes-sociais: http://www.iff.fiocruz.br/index.php/8-noticias/675-papel-redes-sociais](http://www.iff.fiocruz.br/index.php/8-noticias/675-papel-redes-sociais)
- [14] Winston, P. H. (1992). Artificial Intelligence. Addison-Wesley. Massachusetts: Library of Congress Cataloging - in Publication Data.
- [15] Costa, E., & Simões, A. (2008). Inteligência Artificial - Fundamentos e Aplicações (Segunda ed.). Coimbra: FCA.
- [16] Rich, E., & Knight, K. (1994). Inteligência Artificial. Brasil: Makron Books. Wesolowski, K. (Abril de 8 de 2021). Obtido de [SAÚDEGLOBAL: https://www.dw.com/pt-br/o-que-se-sabe-sobre-a-vacina-da-as-trazeneca/a-56552832](https://www.dw.com/pt-br/o-que-se-sabe-sobre-a-vacina-da-as-trazeneca/a-56552832)
- [17] Luger, G. (2004). Inteligência Artificial Estruturas e Estratégias Para A Solução De Problemas Complexos (4ª ed.). (A. J. Affonsoinha, Ed.) Albulquerque: Bookman.
- [18] Lusa. (12 de 10 de 2020). LUSA Agencia de Notícias de Portugal. Obtido de [LUSA: https://www.lusa.pt/article/BxJJVdWjUnmvMeS3sKhaQjMSZM5iuS11/covid-19-cientista-angolano-formado-na-china-lidera-laborat%C3%B3rios-de-diagn%C3%B3stico-em-luanda](https://www.lusa.pt/article/BxJJVdWjUnmvMeS3sKhaQjMSZM5iuS11/covid-19-cientista-angolano-formado-na-china-lidera-laborat%C3%B3rios-de-diagn%C3%B3stico-em-luanda)
- [19] Anónimo. (2020 de 12 de 29). Museu WEG de Ciencia e Tecnologia. Obtido de [Blog com Ciencia: https://museuweg.net/blog/a-importancia-da-tecnologia-em-tempos-de-pandemia/](https://museuweg.net/blog/a-importancia-da-tecnologia-em-tempos-de-pandemia/)
- [20] Lima, A.P.(2013).Biologia molecular. Obtido de [InfoEscola: https://www.infoescola.com/biologia/biologia-molecular/](https://www.infoescola.com/biologia/biologia-molecular/)
- [21] COMSTOR, S. (s.a). Quais as vantagens da relação entre cloud computing e inteligência artificial? Obtido de [O blog dos negócios de TI.: https://blogbrasil.comstor.com/quais-as-vantagens-da-relacao-entre-cloud-computing-e-inteligencia-artificial](https://blogbrasil.comstor.com/quais-as-vantagens-da-relacao-entre-cloud-computing-e-inteligencia-artificial)