# CONTRIBUTIONS OF INFORMATION AND COMMUNICATION TECHNOLOGIES TO TECHNICAL-TECHNOLOGICAL ADAPTATIONS CAUSED BY THE COVID-19 PANDEMIC

Muhamed Ćosić, email: muhamed.cosic@iu-travnik.com
International University of Travnik
Hadžib Salkić, email: hadzib.salkic@ceps.edu.ba
CEPS College - Center for Business Studies Kiseljak,
Nešad Krnjić, email: nesad.krnjic@unvi.edu.ba
"Vitez" University

**ABSTRACT**                                                    *Rewiev article*

*The global pandemic caused by the rapid spread of the COVID-19 virus has caused in addition to the loss of human lives and other consequences for both individuals and states. It brought with it new patterns of behavior such as the application of social and physical distancing, and intensified the use of technology for communication, surveillance and monitoring of infected people, online learning, and the like. The pandemic has caused a crisis that has affected almost all areas of human activity. It has caused the collapse of health systems, an unprecedented disruption of education systems around the world, and made business difficult and brought economic systems to their knees. The resulting crisis has called into question the preservation of the social order. Comprehensive crisis management implies a synergy of different sciences and technologies. Information and communication technologies play a very important role in this context.*

*Key words: information communication technologies, COVID-19, pandemic, health, education, business.*

## 1. INTRODUCTION

The new virus from the coronavirus family identified in 2019, SARS-CoV-2, caused a pandemic of respiratory diseases, called COVID-19. On January 30, 2020, the World Health Organization (WHO) declared a global emergency against this corona virus, and on March 11, 2020, a pandemic was declared. A crisis of global proportions ensued. In addition to health, the crisis has manifested itself in many other fields, such as the economy, education, transport and the like. The state faced the need to manage the crisis. The word crisis refers to the situation or case faced by the decision maker in one of the administrative entities (state, company, family project ...), where events come from successively and where reasons are intertwined with results and therefore the decision maker will lose control of this situation and future trends (Lekrini, 2014). ICTs play an important role in creating global crises, such as the COVID-19 pandemic.

Information and communication technologies (ICT) are a term that refers to all communication technologies, including the Internet, wireless networks, mobile phones, computers systems, software, middleware, v i d e o  c o n f e r e n c i n g, social networks and other media applications and services that allow users to access, download, store, transmit and manage information in digital form. Information and communication technology is a means used to store or send and receive and process various information. It is usually based on electronics, especially computer systems and networks, so it involves the use of hardware and software. The essence of ICT is in line with what Manueli et al. described as all forms of technology such as computers, internet, web pages, such as and fixed telephones, mobile phones and others, wireless communication devices, networks, broadband networks and various specialized devices (Manueli et al., 2007). The COVID-19 pandemic also affected the development of awareness of the importance of information and communication technologies in crisis management, and according to Aydiner et al. can serve as a facilitator of crisis management and knowledge management, thereby helping organizations achieve their goals (Aydiner et al., 2019). The following is an overview of the contribution of information and communication technologies in several key areas for any modern society in the context of the fight against the COVID-19 pandemic.

## 1. The contribution of ICT to health in the context of the COVID-19 pandemic

Information communication technologies are one of the primary technologies that help health care prevent the spread of the COVID-19 pandemic. For example, ICTs are sometimes crucial in supporting the management of medical emergencies when it comes to bridging the gap between the local and global community by establishing an appropriate communication link and ensuring the provision of timely and reliable information. According to Xie et al. this global health crisis is seen as an information crisis (Xie et al., 2020). Also, artificial intelligence (AI) and the Internet of Intelligent Things (IoT), health information systems, the Internet and other networks that pool human, technical and technological resources provide the necessary support in the fight against health workers to prevent the spread of the pandemic. WHO in 2005. identified ICT as a technology useful in responding to health disasters and recovery (WHO, 2005). The fight against the COVID-19 pandemic is digital in its own way

revolution in healthcare through the expansive expansion of telemedicine and similar digital health tools, as they have imposed on healthcare institutions the challenge of rapidly adopting digital solutions and advanced tools. The following is an overview of several contributions of ICT to health in the context of the COVID-19 pandemic.

- ➢ **Telemedicine** has significant remote health services using access to doctors, for the purpose of counseling and diagnosis as well as in terms of reducing the impact on the cultural and educational consequences of the epidemic, especially for children and their physical and mental health. It also provides an alternative to face-to-face communication between people and health care providers, as well as the control and treatment of psychological problems such as depression and stress.

- ➢ **Systematic decision support** assist in risk assessment for potentially infected persons, provide assistance to general practitioners, in particular in characterizing and assessing the severity of COVID-19 virus infection, and in the triage of infected patients.

- ➢ **Internet of things (IoT)** provide assistance in remote counseling between patients and healthcare providers, screening and monitoring of health data using smart sensors in various places such as airports, buses, terminals, etc. They also facilitate real-time data exchange, real-time monitoring, diagnosis, prevention and control.

- ─ **Cell phones** and mobile telephony also provide many useful services that are of great importance in the fight against the pandemic. They can be used to collect data related to the travel history of infected persons, as well as their subsequent monitoring. They can serve as a teleconsultation tool such as mental health counseling, as well as in the early screening

and identification of persons potentially infected with the COVID-19 virus. Also, they are useful in triage to avoid unnecessary face-to-face visits.

- ─ **Artificial intelligence and machine learning** offer many solutions to maximize safety and prevent the spread of COVID-19, and are primarily reflected in the diagnosis and early detection of infection, mass screening and detection of suspicious cases, therapeutic surveillance and the like. Also, artificial intelligence is useful in predicting disease and mortality projections of infected individuals. They greatly influence the improvement of the speed of CT diagnosis, collection and integration of data and information, resource allocation, modeling and simulation, and robotics for medical quarantine.

- ─ **Robotics** is primarily aimed at protecting the safety of healthcare providers and performing hazardous actions on patients infected with the COVID-19 virus instead of healthcare providers. It is also used for the purpose of sterilizing touch-sensitive surfaces, for autonomous or remote-controlled disinfection, for repetitive monitoring of individuals 'temperatures in order to ensure the exchange of data between hospitals' hospital information systems. They are especially useful when performing tasks instead of quarantine health professionals.



*Picture 1: Application of robotics in the care of patients infected with COVID-19 virus*

*Source:*
*https://www.latnames.com/science/story/2020-04-11 / overcoming-coronavirus-with-help-of-robots*

There are many digital solutions for COVID prevention such as Interactive FM radio that through radio broadcasts offers the necessary information to rural and remote communities in local languages, in order to increase the level of knowledge, change attitudes and practices. Interactive radio interventions can answer listeners 'questions, offer information, allay fears, dispel myths, and explore listeners' attitudes. Also worth mentioning is inclusive e-learning for people with intellectual disabilities, which also contributes to pandemic prevention.

## 2. The contribution of ICT to education in the context of the COVID-19 pandemic

COVID-19 pandemic it has caused an unprecedented disruption to education systems around the world. According to available data, nearly 1.6 billion students in more than 190 countries have been more or less hindered from attending classes regularly. Schools and universities had to adapt to the new situation in a short period of time and provide alternative ways of teaching, because one of the fundamental human rights - the right to education - should not be questioned. In doing so, care had to be taken that changes in the way education was provided did not affect its quality. Educational institutions organized classes in the conditions of the COVID-19 pandemic on one of the following three models:

➢ teaching in school - classical teaching with observance of epidemiological measures;
➢ combined teaching- part of the teaching in the classical form, and part online;
➢ online teaching-two-way communication pupil (student) / other pupils (students) / teacher (professor).

Focus on adjusting educational The COVID-19 pandemic system is focused on distance learning and work. Due to space and time constraints, distance learning can be divided into synchronous and asynchronous learning.

### 1.1. Synchronous e-learning systems

Synchronous learning is a general term used to describe forms of education, teaching, and learning that occur at the same time but not in the same place (Glossary, 2013). The main feature of this e-learning model is that, using the Internet, the course leader and students have the possibility of two-way communication with each other in real time. The synchronous e-learning work environment involves mimicking a traditional classroom in which the course leader has control over the teaching process. The advantages of this model of e-learning are the ability to monitor and record classes, continuous monitoring and debugging, global connectivity and cooperation of course participants, and scalability of the course in terms of adaptation to different users. Some forms of synchronous communication are:

➢ internet phone,
➢ educational video conferencing,
➢ video chats,
➢ web conferences and conversations (Skype, Windows Live Messenger),
➢ chat etc.

Synchronous communication is always used in the classic way of teaching in the classroom. The course participant can interrupt the course leader (lecturer) at any time and ask him for an explanation. The mentioned communication can be implemented with courseware tools in three different ways:

➢ audio / video conferencing - course participants can see the course leader, and in some cases the course leader can see the course participants,
➢ audioconferencing - course participants can only hear the course leader, and the picture is given in

in the form of a presentation or a series of pages that change according to the choice of the course leader,

➢ textual conference - a typical example of this way of communication is chat.

In order to communicate as efficiently as possible, audio / video conferencing and chat are often used in various combinations.

### 1.2. Asynchronous e-learning systems

Asynchronous e-learning is the most revolutionary form of e-learning because it frees learning from temporal and spatial constraints. In order to use asynchronous e-learning systems, it is necessary for the institution that implements this concept of learning to provide a system or platform, to which users will have access from any location and at any time. Asynchronous e-learning systems allow course creators to set up learning materials in any form, which course participants, in accordance with their role in the system, will be free to access, use, supplement and modify. This way of using learning materials improves the pedagogical effects of learning, because it allows a very efficient way of teamwork on a task. Asynchronous e-learning systems allow course participants to communicate with other participants, and to learn at a pace that suits them best, without the simultaneous presence of the course leader. This concept allows system users to interact through a bulletin board or forum.

In terms of technological performance, asynchronous systems include computer-based e-learning (CBT) and web-based e-learning (WBT). The advantages of this model of e-learning are primarily reflected in the one-time cost of production, flexibility of access to materials (users choose when to adopt which material, at what speed and at what pace), and availability of information at the right time (JIT). In the model

synchronous e-learning for learning and communication are used:

➢ audio and videos on various devices (CD, DVD),
➢ electronic mail,
➢ printed materials,
➢ forums on the Internet (Message Board),
➢ blog,
➢ wiki (Wikipedia),
➢ podcasting (iPod, Broadcasting, RSS) etc.

Course participants have the possibility of private communication with the course leader using mail, but also public communication with the leader course and other participants using forums and discussion groups.

### 1.3. Most commonly tools used and conducting online classes

Dominant way of teaching u aggravated conditions caused by the COVID-19 pandemic through educational audio / video conferencing. Many aspects had to be taken into account when choosing a platform for online teaching. First of all, the key aspect was the age of the students. In the education of children of lower school age, the simplest possible platforms were used, sometimes even the Viber application. In the education of high school students and students, the most commonly used applications were:

➢ Zoom;
➢ Microsoft Teams;
➢ Google Meet.

The selection of the appropriate platform for video conferencing was influenced by several key elements:

➢ security measures e.g. to conduct online exams at colleges;
➢ possibility use of additional tools - e.g. file sharing, interactive chat or calendar integration;
➢ ☐ ease of use - e.g. simplifying meetings to ensure the participation of members of heterogeneous groups.

Table 1 provides an overview of the basic features of the listed platforms:

Table 1: Comparison of key features of Microsoft teams, Zoom and Google Hangouts

| Features | Microsoft teams | Zoom | Google Hangouts |
|---|---|---|---|
| Supported platforms | Web, iPhone apps, Android app, Windows app | Web, iPhone app, Android app | Web, iPhone app, Android app, Windows app |
| HD audio & video confrences | ✓ | ✓ | ✓ |
| Screen sharing | ✓ | ✓ | ✓ |
| Call recording | ✓ | ✓ | ✓ |
| Control of the second screen within the call | ✓ | ✓ | ✓ |
| Ability to integrate with other applications | ✓ | ✓ | ✓ |
| Comprehensive security controls | ✓ | | |
| Ability to integrate with Office 365 | ✓ | | |

Source: authors of the paper

Aspirations towards the quality and efficiency of education systems, productive teaching models or building infrastructure for lifelong learning, cannot be realized without appropriate modern information systems of e-learning (Ćosić, 2016), especially in the current situation that requires adaptation to the COVID - 19 pandemic.

Students, to students and complete educational institutions struggling with the current crisis, ICT offers extremely flexible and appropriate educational platforms that can be easily adopted and applied for educational programs, from primary school to higher education.

Although the mass transition to e-learning was imposed by the pandemic, it is expected that this modern way of learning will increasingly suppress traditional ways of learning and in the foreseeable future become a "new normalism" even in environments that did not, or to a lesser extent, used this form of learning.

### 3. Contribution of ICT to business in the conditions of the COVID-19

The pandemic caused by the COVID-19 virus is causing economic difficulties for consumers, businesses and communities around the world and, in general, makes business more difficult. Any form of organization or business, in order to be competitive, is forced to use information and communication technology (Ćosić, Krnjić, 2019), and the time of the pandemic further emphasizes the support of ICT business in overcoming the most extreme and unexpected challenges. The use of ICT, whether it is hardware (tablets, computers, smartphones, etc.) or software (email marketing, CRM systems, etc.), helps businesses overcome the difficulties caused by the pandemic. The following is an overview of several contributions of ICT to business in the context of the COVID-19 pandemic.

**Enabling online presence** through cheap and efficient management of Internet information exchange, including social networks, enables the transfer of content about products, brands, services, etc. Network presence includes:

a) web pages
b) profiles on social networks (LinkedIn, Facebook, YouTube, etc.)
c) corporate advertising profiles

➢ **Digital marketing** refers to achieving marketing goals through the application of digital technologies and media. Digital technologies and media include corporate websites, mobile applications, social networking sites, search engines, advertising, email marketing, digital partnerships and more. In a pandemic-laden business environment, unique channels and customer service are more important than ever, as many businesses have closed their doors to help slow the spread of the infection. This made digital marketing even more important because both retailers and customers had to turn to digital reality overnight.

➢ **E-commerce** also known as online commerce, refers to the purchase and sale of goods or services using the Internet and the transfer of money and data to execute those transactions. The COVID-19 pandemic accelerated the spread of e-commerce to new businesses, customers and new product types, resulting in a significant increase in the share electronic commerce in total sales in almost all states. COVID-19 could drive further digitalization of society and the development of policies and rules to regulate e-commerce (WTO, 2020).

➢ **Computing in the cloud** represents the delivery of computing services - including tools, storage, databases, networking, software, analytics and intelligence - via the Internet (Cloud) to provide faster innovation and flexible resources. The pandemic has caused an increase in the number of employees working from home using e.g. video conferencing services. Cloud computing with its robust and rich architecture allows you to manage this increased load.

➢ **Mobile technology** and pandemic mobile devices make it easier to provide employees with the tools and applications they need to remotely do their jobs. Digital applications were used e.g. to allow visitors to sign up for meetings to control the number and flow of people in the branch. Mobile payment for products and services enables digital transactions and reduction of unnecessary contacts even when the sale of products is done in a classic store.

Investing in information - communication technologies are often seen as too costly and businesses invest insufficient resources in terms of ICT infrastructure and training workers to use information communication technologies. Companies which had trained workers for the use of information and communication technologies, they adapted faster than others to the requirements of business in the time of the COVID-19 pandemic. In some cases, the only way to ensure business continuity was to use modern information and communication technologies.

# 4. CONCLUSION

In crises of global proportions such as COVID-19 pandemics application of information communication technologies play a very important role. Information and communication technologies can mitigate damage locally and globally.

The contribution of information and communication technologies in mitigating the damage caused by the pandemic is visible in the tools that ensured the teaching in the conditions of restrictions and blockades. One of the most important contributions of information and communication technologies in technical and technological adaptations caused by the coronavirus pandemic is the use of these technologies with the aim of supporting the fight of health workers to prevent the spread of the pandemic. In addition, the pandemic has intensified the use of information and communication technologies in business, thanks to which many businesses,

It can be concluded that there is clear evidence that the use of various information and communication technologies such as video conferencing, artificial intelligence, robotics, block chain, etc., has made a huge contribution in all phases of the fight against the COVID-19 pandemic. The governments of all countries, taught by the experience of the COVID-19 pandemic, should in the future make programs aimed at maximizing the benefits of information and communication technologies in crisis and emergency management, as they largely ensure the preservation of social order in these situations.

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