



Developments in Information Technologies and Artificial Intelligence in the Post-pandemic Period

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Abstract

The goal of this article is to discuss the COVID-19 pandemic and its impact from a perspective of information technologies. The article first discusses and gives examples relating to the use of information technologies in the fight against the COVID-19 pandemic. Second, the article discusses the role of information technologies in defining the social and economic new normal that is expected to emerge in the post COVID-19 period. The article proposes that information and communication technologies have been transforming every aspect of social and economic life, independent of the COVID-19 pandemic; and that COVID-19 only accelerated this transformation.

Keywords

COVID-19, informatics, artificial intelligence

¹ This study is a translation and updated version of the paper previously published in the book titled "Küresel Salgının Anatomisi: İnsan ve Toplumun Geleceđi" by TÜBA in June 2020.

Introduction

The COVID-19 epidemic that started in China in the last months of 2019 turned into a pandemic in a few months and took the whole world under its effect. An important factor in the rapid transformation of the epidemic to a pandemic is the increased airline traffic as a result of globalization. Since giving up globalization is not a realistic option, the humanity must now be prepared against such types of pandemic risks. One frequently expressed opinion during these days of the pandemic is that some things will not be the same after the pandemic; new normals will occur in many areas. These new normals will protect the welfare of individuals on one side, and the welfare of the societies on the other. The purpose of this article is to examine the role of information and artificial intelligence technologies in the construction of this new normal. Before passing to the main topic of the article, it is useful to draw the main frame of the topic in more details.

The COVID-19 pandemic caused more than 5.5 million people to get ill and more than 350.000 people to die by the end of May 2020. The quarantine measures were applied in order to slow down the speed of the pandemic and curfews were implemented. Shopping centres were closed, schools started distance education, institutions and enterprises left their normal working order and directed their employees to work from home. The economies of the Countries got heavily damaged, and unemployment rates have reached the highest levels since 1929 economic crisis.

The wheels of the economy must turn despite the pandemic; prevalent unemployment and closed workplaces are not sustainable cases. After recovered from the first wave of the pandemic with quarantine measures, the public administrators are looking for ways to reinvigorate the economic life. Each country is spending effort to bring life back to normal within the framework of a calendar determined according to the distance taken in

curbing the pandemic. However, there is a risk that the pandemic may come back more violently with a second wave. It is obvious that there is a need for some behavioural changes in order to prevent the reignition of the pandemic.

The common belief is that a new normal will prevail in the world after COVID-19. This new normal has many aspects. One aspect is related to individual behaviours. It is very likely that some individuals will continue their meticulousness on social distance and hygiene they gained during COVID-19 for a longer period of time. Probably they will not travel unless they have to, they will stay away from crowded places; they will prefer to do their shopping and meetings online rather than face-to-face.

Another aspect of the new normal is related to the public health. In this regard, the new normal will probably come out of the practices of Asian countries, such as China, Korea, Singapore that achieved to control COVID-19 pandemic in a short time. The public authorities will take a series of measures for early detection and follow-up of pandemics; an important part of these measures will include the close monitoring of the health status of citizens, isolating the individuals with a risk of disease, and preventing them from travelling, etc.

Another aspect of the new normal will be related to the economic life. During the COVID-19 pandemic, each country's economy has been heavily damaged. Unemployment reached unprecedented levels, companies closed and forced into bankruptcy, and international trade and supply chain interruptions occurred. Internet technologies became a life-buoy that prevented the wheels from completely stopping during this economic overturn. Education in schools could be made remotely, and in many companies, business could continue to be done remotely and efficiently by means of internet. After COVID-19, undoubtedly the most important changes will occur in business and economy. This article is particularly related to the role of informatics and artificial intelligence technologies in the construction of the new normal in the economic area.

In the article, initially some information gathered about COVID-19 pandemic and its effects will be provided. Some examples are given about how information technologies are used particularly in struggling with the pandemic. Then, the social and economic new normal expected to come after the COVID-19 pandemic is discussed from the perspective of information technologies.

Pandemic

COVID-19 pandemic is the world's greatest pandemic since 1918 Spanish Flu Pandemic. However, the world is late in taking the measures against this pandemic, perhaps did not take the pandemic seriously at the beginning. How can it be explained that organizations, such as World Health Organization (WHO), responsible for public health have not timely addressed the danger associated with this pandemic?

They probably thought that the COVID-19 pandemic would be limited to China, as in the SARS epidemic that also emerged in China in 2002-2003. (In that epidemic, the number of cases was recorded as 8,096 and the number of deaths as 770) One factor that have not been taken into account could be that China's airline connectivity with the world has increased exponentially since the SARS epidemic. It is very likely that they were unable to gather the data on the spread rate of COVID-19 timely. It is certain that the world does not have a reliable package and policies to prevent such epidemics before they turn into a pandemic. Regardless from the political system and the economic development level, many countries from USA to Iran, from Italy to Brazil exposed to the destructive effects of this diseases. Some Asian countries constitute an exception. The countries such as China, Japan, Korea, Taiwan, Hong Kong, Singapore, etc. that have epidemic experience in the near past and high skill of using scientific methods made it to the top in stopping COVID-19 pandemic compared to the remaining part of the world. The number of cases in Canada (according to the official figures), which has a population of one-thirty seventh of China and has an income per capita that is 2.5 times of China, exceeded China (Şeker et al., 2020). A question that naturally reveals is that which methods have been used by China and above-mentioned Asian countries to stop the pandemic and what has been done incompletely in the remaining part of the world. One aspect of this question that's particularly of our concern is related to the information technologies. How did they benefit from the information technologies to control and extinguish COVID-19 pandemic, what are the best struggling examples? The main question looking for an answer in this section is this.

The strictest measures to stop the exponential increase of the pandemic have been applied in China. A very strict collective quarantine has been applied and people locked themselves in their houses for a period of 2 months in the main base of the epidemic - Wuhan city of 11 million population. Throughout China, the daily number of new cases have been dropped to almost zero as a result of the similar practices applied in everywhere with disease. As these quarantine measures applied in China became successful, the whole world started to apply, too (though not with the same strictness). Currently almost all of the countries met and recognized such collective quarantines. One of the aspects that should be noted first for the new normal is maybe this. The societies seem to be convinced on locking themselves in their houses by making self-sacrifice from their freedom to struggle with the pandemic. It seems that in the next pandemic, there will be collective quarantine practice in the new normal pandemic seen locations during the first phases of the pandemic where there is no sufficient data particularly on the dimensions and spreading speed of the pandemic and the hospitals have no sufficient preparation and equipment against the pandemic. When the damage caused by COVID-19 is taken into consideration, it is understood that collective quarantine is a very small pay to stand at the expense of preventing the pandemic.

Home confinement has been loosened and people have been allowed to return their jobs progressively after the speed of the pandemic in China slowed down. Referred to as reopening the economy, this phase carries the risk of a second wave in the pandemic and is full of challenges in each aspect. The phase that will provide the most advantages by means of using information technologies is this phase. By basing on the data in this phase, individuals must be distinguished from each other according to the risk and the free circulation of the ones who are not required to stay home must be allowed.

Concerning the reopening of the economy and allowing the people to work after COVID-19 pandemic is taken under control, different suggestions came from American Enterprise Institute, the Center for American Progress and Harvard University on the protocols to be followed up (Lichfield, 2020). The suggested protocols contain common points and basically consisted of two steps as quarantine process and return-to-work process. During the quarantine process, it is aimed to keep the majority of the population at home as much as possible and slow down the pandemic (“flatten the curve”). At the same time, the quarantine process is the process to gain time in order to improve the test capacity and enable the hospitals equipped as required. However, the objective is to end the quarantine process as soon as possible in a controlled manner, because this process is not sustainable in terms of economy. Can be passed to return-to-job process from quarantine when the test becomes accessible by everyone and the transmission process of the diseases becomes traceable. In order to be successful in the return-to-job process, the principle condition is the ability of reaching testing capacity on a mass scale. So robust data are obtained on who is infected (even does not show any symptom), who developed immunity by being exposed to the virus and who is clean. “Immunity certificate” is granted to the ones understood as developed immunity and they can return to their jobs. The ones whose test results are negative can return their job, too, however they are obliged to have tests in regular intervals. The ones with positive test results and the persons detected as in close contact with them are taken under supervision.

In the second phase of the above protocol, the inevitable role of informatics and data analytics is obvious. In order to be successful in returning to the job, a mechanism of data gathering, evaluation and decision-making per the case must have been established. The projections related to the progress of the disease can be performed by using the gathered data in epidemiological models; and if deemed necessary, the quarantine practices can be applied again regionally. If returned to the job without basing on data, then there is a risk of waxier return of the pandemic. A robust informatics and communication infrastructure is required in order to establish such data centred epidemic control system.

The mobile telephone system is sufficient as the communication infrastructure required to control the epidemic. For example, South Korea used the location data of the mobile phones to ensure that the persons under quarantine did

not leave the quarantine zone. The applications that use the Bluetooth close distance communication system of the mobile phones have been developed for the purpose of contact tracing. So, for example, it is possible to reach to the other in case one of the two in the elevator becomes ill. A mobile application similar to the one in South Korea started to be used in Turkey recently under the name HES. By means of HES, the health status of the persons can be followed and the persons willing to travel can get travel permit by using this application. A rightful doubt concerning the systems performing location and contact tracing via mobile phone is the loss of privacy of people. It is technically possible to ensure that the owner of the gathered information remain anonymous. The problem here is not technical, it is legitimate. India made the usage of such mobile application obligatory (O'Neill, 2020). It is possible to control the pandemic by the use of the sufficient majority of the community following the granting of the adequate assurance by the public authorities. In addition to mobile phones, there are many pandemic-related data gathering methods. Through the observation of the collective transportation systems, urban centres, streets by using thermal cameras, it is possible to detect the identities, fever and health statuses of the persons. It is another method to look at the usage statistics of some keywords in the search engines and social networks for the early detection of the regions with a spread risk of pandemic. In some cases, the artificial intelligence can be used to proactively determine the persons under risk. For example, a health insurance company in Israel ranked its 2.4 million subscribers according to COVID-19 risk by using artificial intelligence techniques, and called its 40.000 subscribers for urgent testing (Heaven, 2020).

The above examples show that the informatics and communication technologies offer very effective methods for struggling with COVID-19 and the possible future pandemics. Without any doubt, the public health authorities will get more prepared for struggling with the pandemic with their COVID-19 experience. By taking the support of the public, the methods basing on data will come to the fore in struggling with the pandemic. It is hoped that with the opportunities offered by the informatics and communication technologies, the future pandemics will be avoided before they damage as much as COVID-19.

New Normal

It is in question that a shock like COVID-19 can deeply effect the social life. COVID-19 pandemic showed that the Asian countries, such as S. Korea, Japan, Hong Kong, Singapore, Taiwan and China that are experienced and prepared against pandemics managed to control this pandemic relatively with a less damage, to keep the economic destruction in the minimum, and achieved both psychological and economical superiority on the remaining part of the world. By moving from these achievements of the Asian countries, it has been expressed that the following normal will be the normal of the Asia (Tonby & Woetzel, 2020). What is more possible is that each country will develop measures specific to them concerning the preparation for pandemic. The

individuals will continue to live with the reoccurrence of the pandemic and will act cautiously on travelling, eating outside, and being in crowded places. Even in the societies that are sensitive on the privacy of the personal data, it is assumed that the location and health statuses of the citizens will be followed for the purpose of monitoring the pandemics. In this section, the subjects related to the effects of the pandemic and the permanent changes to result are addressed.

In the report prepared in cooperation with Faethm company and MIT Technology Review, the effect of COVID-19 on the business and employment has been reviewed (FAETHM, 2020). The business has been ranked in terms of *being remotely done, the requirement of interaction with people and inclination to automation*. Since some professions (cashier, caregiver, waiter, etc.) require face-to-face contact with the people, and some other (factory worker, cleaner, etc.) workers need to be in a certain location, they are not suitable for being performed remotely. On the other side, some professions requiring intensive communication with the people (call centre operator, customer and sales representative, etc.) may be performed remotely since they do not require face-to-face contact. Some professions that do not require intensive communication and face-to-face contact (accounting, consultancy, etc.) may be performed remotely in the easiest manner.

The persons who are employed in the professions that cannot be performed remotely and do require close contact with the people are under the risk of infection. The ones who are listed in this category and perform crucial works for struggling with the pandemic, for example; the health personnel, the cashiers working in food stores, were able to continue working by wearing occupational protective equipment. The workers who are working under risky category but not crucial, for example; tourism industry personnel, restaurant personnel and store sales officers, became unemployed due to the closing of their companies. On the other side, the designers, software developers, administrators doing office work carried their works to home and were able to continue working without any serious loss of productivity. And also passed to remote education in the education industry by sending the students to their homes.

According to a study carried out by McKinsey, 57 million professions in USA and 59 million professions in Europe (EU, United Kingdom and Switzerland) are under risk (Lund et al., 2020). In the same study, it is stated that 26 million American citizen applied for unemployment pay as of April 18th, 2020.

The industries that experienced the highest loss of employment are the tourism and travel, retail, non-crucial health and personal care services. Even after the finalization of the pandemic, it is assumed that these industries will not be able to recover for a period of time due to the changing consumer habits.

How to invigorate the tourism and travel industries that are particularly matter to Turkey and how to benefit from the technology for this are the subjects that

should be addressed. Many of the companies sent their personnel to home and cancelled their business trips due to pandemic. However, it is recognized that the works did not hinder in some industries. By means of broadband internet, the companies were able to carry out their meetings via video conference. Virtual offices have been established by means of cloud supported information services. Trade continued to be performed in virtual platforms instead of physical venues. The banking transactions continued to be carried out remotely. The citizens were able to follow up their proceedings via E-government. If there was such a pandemic in the pre-internet era, most of these mentioned items would not be possible even in the most advanced countries of the world. These examples show that communication and information technologies are a strategic infrastructure that supports the economies of modern societies.

Today, a new 5G based internet is being established in many countries of the world. This new internet will form the infrastructure of informatics and artificial intelligence processes that cannot be imagined today. By means of the communication technologies, there will be no need to travel and face-to-face meetings; with three-dimensional teleconference units, all kinds of business meetings will be able to be organized efficiently and cost-effectively. The teleconferences that are started to be performed compulsorily by many companies due to COVID-19 will become a part of *new normal*.

In a report prepared by McKinsey, e-commerce and contactless economy are listed among the topics discussed about the normal of the future (Sneader & Singhal, 2020b). Due to COVID-19 pandemic, a significant part of the population also met with virtual shopping for the first time in their lives. It is very likely that this new experience will become a permanent habit. Even there was no COVID-19, there was a trend where virtual stores were replacing the physical stores, but COVID-19 will accelerate this trend. Retail trade shifts from chic Shopping Malls to where high rents are paid, from the warehouses established outside the city to virtual commerce for doing business. This rapid transformation occurring in retailing is an example of the constructive, organizer, efficiency improver power of the communication and information technologies on one hand, and on the other hand, its destructive, disruptive and transforming power. The businesses and enterprises that cannot keep up with the new technologies are obliged to extinct.

During the COVID-19 pandemic, the ordinary health services fail at the health institutions. On one hand, the patients were afraid to go to the hospital, on the other hand, the hospitals could not accept patients. This has increased the demand for telemedicine services. For example, Teladoc, the largest telemedicine company of the USA, reported a 50% increase in its services with the start of the pandemic and included thousands of new physicians in its service network; in Sweden, there has been an increase of 200% in the member registrations of KRY International company (Sneader & Singhal, 2020a). The efficiency increases that telemedicine application will bring are obvious. Telemedicine field is a candidate to become one of the rising industries of the new normal after COVID-19.

In an article published by the World Economic Forum, the attention is taken to ten technology trends related to the COVID-19 pandemic (Xiao & Fan, 2020):

- Online shopping and delivery with robots
- Digital cash and contactless payment instruments replace cash
- Teleworking
- Distance learning
- Telehealth
- Online entertainment, games, virtual tours
- Supply chain 4.0
- Three-dimensional printing (3D printing)
- Robotic and unmanned aerial vehicles (drones)
- 5G informatics and communication technologies

Some of the above topics have been previously addressed in this section. It is only useful to mention the supply chain 4.0, 3D printing and 5G separately. In the rest of this section, these issues will be addressed by benefiting from (Xiao & Fan, 2020).

What is meant by supply chain 4.0 is the reconstruction of the supply chain with technologies such as big data, cloud-based computing, Internet of Things (IoT), block chain, etc. that form the basis of Industry 4.0. COVID-19 pandemic caused breaks in the global supply chain. Some factories were closed due to quarantine practices, transportation was disrupted, restrictions and prohibitions were imposed on the movement of many goods (particularly those that became critical during the pandemic such as food, personal protective equipment, masks).

Countries are willing to re-establish their supply chain in a more transparent, flexible and resource diversified manner. And as a part of this, it is expected from the supply chains to focus more on local resources. It is expected that *just-in-time* and *just-in-case* style supply chains will replace the supply chains that have been optimized with the logic of “*just-in-time*” due to the doubt on the possibility of a break in the supply chain (Sneader&Singhal,2020b). Particularly the tendency of European countries towards Turkey to diversify their supply chains will bring major opportunities along with.

The supply chain of 3D printing comes to the fore in relation with the supply chain issue here. 3D printing is a technology that provides flexibility in production as a measure against breaks in the supply chain or the restrictions imposed on the trade of various materials that become critical during the pandemic such as personal protective equipment. By means of 3D printing, the parts that cannot be supplied can be produced flexibly and quickly by a 3D printing machine; the only thing needed for 3D printing is the digital design files of the material that will be produced and the raw materials such as plastic and metal to be used in the production. Although this kind of production with

3D printing is technologically possible, the occurrence of many commercial or legal obstacles is inevitable. It may not be always possible to urgently access the design files of products that are the subject of 3D printing. The original designs may be protected by patents. For these reasons, the emergency plans for 3D printing that is considered against the breaks in the supply chain should be established before occurrence of the problem.

Including supply chain 4.0, all applications such as online shopping, digital money, contactless economy, teleworking/distance learning, telehealth, etc. require a high-speed and affordable informatics and communication infrastructure. At this point, the critical role of 5G comes to the fore. It is estimated that the contribution of 5G as a catalyst to the world's economy will reach \$13.2 trillion annually by 2035 (Arias et al., 2020). A subject required to be mentioned in this context is the recent conspiracy theories about 5G. One of these theories establishes a link between 5G base stations and the spread of corona virus (Temperton, 2020). The ones believing in this conspiracy theory attacked base stations in the United Kingdom and set them on fire. Conspiracy theories that do not base on any evidence are still on the agenda and possibly the establishment of 5G will be delayed in some countries for this reason. It is a subject that by whom and for what these conspiracy theories that has the potential to directly affect the competitiveness and well-being of countries are generated and kept on the agenda should be taken into consideration.

Conclusion and Evaluation

Informatics and communication technologies, particularly the internet and increasing artificial intelligence technologies, as independent of the COVID-19 pandemic, are transforming every area of economic and social life and defining their own new normals. COVID-19 had accelerating effects on this transformation. The new normal will be built on the broadband internet and cloud-supported information infrastructure. The communities that keep up with this technological transformation will continue to improve their welfare, and those who cannot keep up will be challenged to even protect their current economic gains.

The merging of the communication and artificial intelligence initiated a process that brings a series of innovations from sensor networks to smart cities, from remote surgery to Industry 4.0 applications. This process comes across with resistance at levels varying from country to country due to some real or perceptual threats it accommodates. In general, the concern that artificial intelligence and robotic technologies will cause widespread unemployment in almost every country. Indeed, the history of technology and industry is full of countless examples of lost and newly created occupations. This process will continue in the future, too. It is not possible to stand in front of this historical development. The only rational way is to adopt and manage the technological change. The countries left behind in this race will be exposed to the risk of losing their current economic reservoir.

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