The Fourth Industrial Revolution Combatting COVID-19: The Role of Smart and Sustainable Cities

Dr. Maysoun Ibrahim
Ramallah, State of Palestine
maisonib@hotmail.com

1. Introduction

Cities around the globe are facing an unprecedented urbanization growth, which is expected to reach around 65% to 75% of the total world's population by 2050 (UN, 2014). The latter sets off the wave for the revitalization and expansion of existing cities and the development and creation of new ones. To meet this, cities need a new operating paradigm that is able to provide the solutions required by urban residents. These solutions should be economically viable, environmentally sustainable, and socially inclusive. Economically viable refers to solutions that are financially self-sustaining while environmental sustainability aims at ensuring the protection of current resources for future generations. By social inclusion, the access to benefits is equitable across population segments without any discrimination (Ibrahim et al., 2017; PwC, 2010).

On one hand, the concept of Smart and Sustainable City (SSC) emerged recently as a solution for various current urban problems with the aim of improving the quality of life of citizens and enhancing the sustainability issues of cities. It is getting global attention rapidly as a desired goal for present and future urban development (PwC, 2015; ITU-T FG-SSC, 2016). As a result, many governments and city planners started to recognize the role of Information and Communication Technologies (ICTs) in meeting these objectives. In this context, the ICT components are used as an enabler in designing cities to be smarter and more sustainable, offering better quality of life through environmentally friendly and viable solutions (Ibrahim et al., 2015). On the other hand, specifically in 2015, Klaus Schwab introduced the phrase "the Fourth Industrial Revolution" in an article in the Foreign Affairs Magazine. On January 2016, the theme of the World Economic Forum Annual Meeting in Davos-Klosters, Switzerland was titled as "Mastering the Fourth Industrial Revolution" (WEF, 2016). From this date on, the world started the era of the Fourth Industrial Resolution (Industry 4.0 or 4IR).

A SSC City is defined by the International Telecommunication Union of the United Nations (ITU-T FG-SSC 2014) as "*an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects as well as cultural aspects*". It is also defined by Giffinger et al., (2007) across six dimensions, namely, Smart Economy (competitiveness), Smart Environment (natural resources), Smart Governance (participation), Smart Living (quality of life), Smart Mobility (transport and ICT), and Smart People (social and human capital). In turn, the Fourth Industrial Revolution (4IR) is a digital revolution enabled by the extraordinary technology advances of the previous industrial revolutions. This era is characterized by a fusion of technologies that is blurring the boundaries and lines between the physical, digital, and biological worlds (WEF, 2016). It is a fusion of advances in data science, Artificial Intelligence (AI), drones, robotics, quantum computing, nanotechnology, biotechnology, Internet of Things (IoT), 3D printing, and other technologies.

In December 2019, the ongoing COVID-19, also known as coronavirus, started to outbreak in Wuhan city of China. In January 2020, the World Health Organization (WHO) declared this outbreak as a Public Health Emergency of International Concern and then considered it as a global pandemic in

March 2020. This pandemic has caused confusion and disruption at the economic and social levels globally, forcing many governments to lockdown hundreds of cities around the world. Evolution of COVID-19 (coronavirus) pandemic has also resulted in strengthening the use of big technologies, especially, those related to Industry 4.0 and SSCs. This pandemic increases the trust on ICT technologies as a tool that have the needed capabilities to support the public health as well as to provide quick solutions to many governments, organizations, and people during the time of crisis.

2. Cities and COVID-19 (Coronavirus)

Cities around the globe are affected by the outbreak of COVID-19 (coronavirus), risking not only the public health, but also endangering the national and global economy and the fabric of societies. Because of COVID-19, many national and local governments around the world are currently confronting weak and strained financial resources. This is due to the decline in tourism revenues, lower exports, and economic activities' acute contraction. Unfortunately, this virus has a deep, multidimensional impact on people and cities. It forces authorities worldwide to implement a series of actions aiming at reducing its impacts, including lockdowns, travel restrictions, facility closures, distance learning, working from home, and workplace hazard controls. As a result, it is expected from COVID-19 (coronavirus) to create the worst economic contraction in decades, including hundreds of thousands of job losses.

Cities and other urban settlements with a robust governance and a strong healthcare infrastructure are in a better position than others (WEF, 2020). Not surprisingly, cities that already started their transformation process to be smart and sustainable have been able to control the outbreak of COVID-19 more than others, being better prepared for the possible future crises as well. During the pandemic time, such as Coivd-19, it is critical for cities to adopt a combination of a needed measures to prevent the spread of the pandemic such as the proactive surveillance, rapid isolation, and community and personal protection (e.g. social distancing). A SSC, as known, uses ICTs to streamline urban operations on a large scale. It uses sensors to collect the data needed to monitor and control traffic, noise, air quality, health among others to improve and support future decisions of authorities, enterprises, and people. It provides a digital integrated platform to create information and knowledge network that can be used, during the pandemic time, to monitor infected people while warning others.

Cities are the result of agglomeration of hard and soft infrastructures in addition to its ICT or digital infrastructure. These infrastructures are urban features that have been installed by human activities and are essential for a city to operate. The hard infrastructure refers to the tangible (i.e. physical) structures such as buildings, roads, pipes, wires, shared spaces, bridges, and ports. The soft infrastructure, in turn, refers to the intangible structures such as laws, regulations, rules, conventions, financial systems, government systems, healthcare systems, education systems, human capital, business environments, and others (Pincetl, 2015; Anderton, 2016). These two structures are completing each other. For instance, an airport as a hard infrastructure of a city cannot function without a set of soft infrastructures that provides a list of rules about the minimum acceptable size of runways, required distance between landing and taking off planes, conventions regarding passenger loading and unloading, and so on (Pincetl, 2015). The hard and soft infrastructures are also increasingly becoming interlinked with and operated by using new technologies, such as Artificial Intelligence (AI), Internet of Things (IoT), sensor devices, online services, GPS takers, computing systems, etc. This interlink offers opportunities for improving existing city services and systems while ensuring its sustainability.

Technologies of the 4IR plays an essential role in the development of SSCs. They provide the needed technologies to allow the technological transformation of cities, providing the data needed to monitor and control the entire cities. During COVID-19 pandemic, many of these technologies were used to ensure that the COVID-19 does not spread to larger or not affected areas. Technologies such as the AI, drones, IoT, and online services and applications were used frequently by many authorities to monitor affected cities and urban settlements, offering different types of data collection tools to tracing patients, checking symptoms, and predicting outbreaks. Technologies of the 4IR offer efficient and effective ways to cope with the speed, scope, and impact of COVID-19 pandemic; however; many cities around the globe are still far from evenly using these technologies, especially for those that did not start yet

their transformation process to be smart and sustainable due to the shortages in their local supporting infrastructures and financial capabilities for example. The latter may result in increasing the risk and accelerate the transmission of COVID-19 in these cities.

3. Technology as a Response to COVID-19 (Coronavirus)

Different types of technologies have been used during the evolvement of the COVID-19 (Coronavirus) pandemic. All these technologies and initiatives have been devoted in an attempt to reduce the spread of this disease as well as to monitor public areas and patients, develop new, effective vaccines, guarantee the continuity of the educational process and medium and large--sized enterprises, and reduce the quarantine impact on citizens and pressure off overworked healthcare workers. In addition, the digital information and surveillance technologies have been unleashed in an unprecedented manner with the aim of collecting the data and reliable evidences needed to support public health decision-making (EP, 2020).

Many governments around the globe, especially those with a strong digital infrastructure and/or have already started their development process towards transforming their cities into smart and sustainable ones, have used different types of the 4IR technologies to reduce and control the outbreak of this disease. The latter include, but not limited to, Belgium, China, France, Germany, Honduras, Italy, Jordan, Kuwait, Poland, Saudi Arabia, Singapore, Spain, South Korea, United Arab Emirates (UAE), United Kingdom (UK), and United States (US) (GW, 2020).

The Artificial Intelligence (e.g. AI-based computer vision cameras) and drones have been used to monitor public areas to assess whether social distancing was being represented or not. Globally, the cloud-based platform, such as Zoom, Google Hangouts, and Webex, have been used to make it easier for workers to work from home and students to complete their studies online. Robots, drones, and self-driving cars have also been used to deliver meals and medicine to infected patients as well as medical supplies to health facilities. Mobile money and visa cards allowed people and vendors to go cashless. In turn, scientists are using the nanotechnologies and advanced materials to preparing and testing possible future vaccine as well as preparing new forms of personal protective equipment. These technologies are playing currently a critical role in rapid diagnostic, therapeutics.

For example, the AI-based thermal imaging cameras have been used in China to scan public spaces with the aim of identifying any potentially sick people; while robots have been deployed to deliver medical supplies and meals within hospitals and to patient rooms, guaranteeing a contactless delivery process. Drones have been used in China, Honduras, Spain, and UAE to spray disinfectant on public areas. Drones have been also used to deliver groceries in some parts of Australia, China, and the United States. Other governments have deployed drones to restrict citizen's movements. The latter includes, for example, Belgium, China, France, Italy, Jordan, Kuwait, Saudi Arabia, Spain, UAE, and UK (GW, 2020). In Saudi Arabia, drones have been used as well to measure people's body temperatures. Additionally, some governments developed special application to provide awareness data on the disease and to highlight affected areas to citizens using the GPS technology. These includes, for instance, China, Germany, India, Palestine, Poland, Singapore, UAE, and UK. Last but not least, people-tracking wristbands have been used to monitor COVID-19 patients' movements in Bahrain, Belgium, Bulgaria, India, Hong Kong, and South Korea. This wristband is designed to alert the authorities once the wearer leaves her/his home and/or tries to remove it.

As COVID-19 (Coronavirus) pandemic evolves, schools and universities have totally shutdown across the globe. Based on the World Economic Forum (2020), over than 1.2 billion children in around 186 countries have been out of classrooms because of this disease. This resulted in changing the educational systems in many countries, with the distinctive rise of the remote e-learning (i.e. distance learning) using digital platforms, even in countries that do not accredit this type of learning. As a result, many online learning platforms have been offering free access to their services. The digital platforms have been used as well by many organizations to organize online meetings, conferences, and workshops due to the coronavirus-related travel restrictions between countries.

On a final note, although many countries have used different types of technologies to deal with COVID-19 pandemic, not all countries have the same capabilities to use and employ these technologies to fight this disease. In fact, the hard, soft, and digital infrastructures along with the capacity of the human capital for utilizing these technologies vary from one country to another, even between cities within the same country. Countries also vary in how effectively and widely these technologies are deployed.

4. Recommendations

Many things had been taken as "normal" pre-COVID-19 (pre-Coronavirus) such as traveling, going to work, school and universities every day, hanging out with friends, doing different types of activities, among many other things. COVID-19 changed our ways of living. It forced governments globally to take unprecedented quick actions, aiming to decrease the spread of this disease. People around the world are waiting to returning back to their normal lives but this needs a period of time with a hope not to be a long one.

Cities globally, as a result, must take different actions during and after COVID-19 (Coronavirus) pandemic. From this article point of view, these actions (i.e. recommendations) could be divided into three main phases named as: outbreak phase, early recovery phase, and normal phase. It is worth noting that these recommendations are not dedicated to a specific field, such as the healthcare system that COVID-19 showed the need to enhance and improve globally, but are general as described below:

1. **The outbreak phase**: during this phase nothing could be done as pre-COVID-19 preparations. Each country should deal with the virus using its available capabilities and resources, focusing on preventing the outbreak of the disease while caring for the affected. Most governments, as a response, applied a partial or full lockdown, or citizens' quarantine, with the aim of preventing the spread of the virus. Although the preparedness level differs from one country to another, even between cities within the same country, cities must provide all possible support to the healthcare services using available infrastructures. Each city should find the appropriate ways to harness its available technologies to raise citizen's awareness, support patients and doctors, monitor social distancing in public spaces, and guarantee the continuity of needed and critical sectors within the city. This also includes harnessing the appropriate technologies to develop an effective vaccine to the disease. Online learning, or e-learning, can be used as a mean to ensure the continuity of the educational process, especially for university students. Although these techniques did not fully perform its intended purpose as the traditional education, they have helped a lot in preventing a complete cessation of the educational process in most countries globally. As for workers at different types of organizations, online platforms (i.e. either the free or the enterprise-owned ones) can help them to accomplish their tasks and duties and attending different meetings without any need to be physically at the workplace, noting that this technique may not be helpful for works that depend on the human physical efforts.

2. **The early recovery phase**: there is no guarantee yet that the COVID-19 will totally vanish. Therefore, cities could start returning back to their normal lives based on a careful, well though-out plans. This does not mean opening everything at once. This should be gradual, while maintaining all existing precautions until the disease threat is ceased or the vaccine is developed. The latter includes keeping schools and universities closed while ensuring the continuation of the educational process using the e-learning techniques, maintaining social distancing (e.g. in public areas, markets, restaurants, banks, workplaces etc.), isolating affected people and areas, providing the needed support to healthcare systems, preventing returning back to work with a full capacity, among others. The use of adequate technologies of the 4IR should continue to ensure the application of the above-mentioned precautions. During this phase, governments should also focus on jumpstarting their local economy, mitigate the impact on affected groups, and plan carefully for the new normal, under the fiscally stressed and strained conditions. For example, the tourism sector could be gradually reopened, taking the necessary precautions to prevent the re-outbreak of the disease. Governments should also develop adequate plans to support and assist their local Small

and Medium-sized Enterprises (SMEs) ecosystem using the appropriate trade policies as these enterprises are the backbone of all economies globally.

3. **The normal phase**: after vanishing of COVID-19 or after finding the needed vaccine, governments should start thinking on how to prevent this crisis from happening again, taking the whole mess caused by this tiny virus as a lesson to learn from in the future. Cities should strengthen their hard, soft, and digital infrastructures. Those cities that did not yet start their transformation process into being smart and sustainable should create well-studied plans for this purpose. SSCs are designed to enhance existing systems and services of the city over its six smart dimensions, at the economy, social, environmental, governmental, and cultural levels including the healthcare. It also based on using all possible technologies of the 4IR, enhancing the digital capabilities and infrastructure of cities. This does not mean implementing this transformation at ones. Each city should identify its readiness level, existing gap, and local priorities before planning their transformation process. For the smart education, governments should issue new educational policies to accept online learning certificates under special conditions and agreements with existing international traditional universities. Researchers and vaccine developers should use the 4IR technologies, such as the nanotechnologies, AI, big data, cloud computing, robots, etc., to support the empowerment and enhancement of the healthcare systems. Different sized enterprises, in turn, should reconsider their working modality as this pandemic showed that many workers around the globe could work from home, including the ability to arrange big meetings online without the need for traveling. This opens the door for organizations to adopt this modality for their workers. The latter will result in reducing the operational costs of many organizations globally. Last but not least, governments should issue new policies and laws to allow the use and adoption of the 4IR technologies with the aim of improving their local services, safety, security, competitiveness, and quality of life.

Dealing with COVID-19 pandemic needs joint efforts by all countries around the globe. Although many countries in the mid of this pandemic were not able to provide a hand to others because of their internal pressure, they must harness their potentials in the future together. This includes at least finding a vaccine for this unprecedented disease and learning from the experiences of each other, with the aim to not repeating the same mistakes again during the same or similar future crisis. Finally, this virus will be a remarkable point in the humankind history. Accordingly, this article expecting that the world will start using the terms pre-COVID-19 and post-COVID-19 for an indefinite period of time when pointing to future developments and changes within cities and around the globe.

5. Conclusion

The COVID-19 (coronavirus) pandemic has significantly changed people lives all around the globe. Governments have taken many quick actions as a response to fight this virus. Cities with robust governments, healthcare system, and digital infrastructure are in a better position than others. During this pandemic, Information and Communication Technologies are having a remarkable role in fighting this disease. This article sheds light on the impact of future technologies in reducing the outbreak of COVID-19. It shows how the Fourth Industrial Revolution technologies have been significantly used to reduce the spread of this disease to larger areas, guarantee the continuity of work and educational systems, provide a hand in supporting the healthcare system, develop a vaccine, and reduce the quarantine impact on citizens. It also highlights that cities that already started their transformation process to be smart and sustainable are able to control the outbreak of COVID-19 more than others, being better prepared for the possible future crises as well. This article ends by suggesting a list of recommendation that could be considered by the governments and the local, regional, and international organizations during the outbreak phase, early recovery phase, and normal phase of COVID-19.

References

Anderton, D. (2016). Science in the City Region: Establishing Liverpool's Life Science Ecology. *Regional Studies, Regional Science, Taylor & Francis Online*, Vol. (3), Issue (1), pp. 434-444.

EP (2020). *Ten Technologies to Fight Coronavirus*. European Parliament (EP), European Parliamentary Research Services (EPRS). Brussels: Belgium.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic´, N. & Meijers, E. (2007). *Smart Cities: Ranking of European Medium-sized Cities*. Center of Regional Science (SRF), Vienna University of Technology. Graz, AG: Austria.

GW (2020). How drones are being used to combat COVID-19. Geospatial World (GW), Web. Access, Retrieved from: https://www.geospatialworld.net/blogs/how-drones-are-being-used-to-combat-COVID-19/.

Ibrahim, M., Al-Nasrawi, S., El-Zaart, A. & Adams, C. (2015). Challenges facing E-Government and Smart Sustainable City: An Arab Region Perspective. *15th European Conference on e-Government, ECEG*, pp. 396-402.

Ibrahim, M., El-Zaart, A. & Adams, C. (2017). Smart Sustainable Cities Roadmap: Readiness for Transformation towards Urban Sustainability. *Sustainable Cities and Society*, doi: 10.1016/j.scs.2017.10.008.

ITU-T FG-SSC (2014b). *Technical Report on Smart Sustainable Cities: An analysis of Definitions*. United Nations, International Telecommunication Union (ITU-T), Focus Group on Smart Sustainable Cities (FG-SSC).

ITU-T (2016). *Shaping Smarter and more Sustainable Cities: Striving for Sustainable Development Goals*. International Telecommunication Union Telecommunication Standardization Sector (ITU-T). Geneva: Switzerland.

Pincetl, S. (2015). Cities as Novel Biomes: Recognizing Urban Ecosystem Services as Anthropogenic. *Frontiers in Ecology and Evolution*, Vol. (3), Article (140).

PwC (2010). *Sustainable Urbanization and the Role of ICT in City Development*. PricewaterhouseCoopers (PwC), The Global Strategy Consulting team at PwC (Strategy&). Delhi: India.

PwC (2015). *Connecting the Dots: Smart and Sustainable Cities*. PricewaterhouseCoopers (PwC) Private Limited, PD 426. Delhi: India.

UN (2014). *Report of the World Urbanization Prospects: the 2014 Revision, Highlights*. United Nations, Department of Economic and Social Affairs, Publication Division (ST/ESA/SER.A/352).

WEF (2016). *Mastering the Fourth Industrial Revolution*. World Economic Forum Annual Meeting 2016, Global Agenda, 23-23 January. Davos-Klosters: Switzerland.

WEF (2020). How Cities around the World are Handling COVID-19 – and why we need to measure their preparedness. World Economic Forum (WEF), Web. Access, Retrieved from: https://www.weforum.org/agenda/2020/03/how-should-cities-prepare-for-coronavirus-pandemics/?utm_campaign=clipping_institucional_dia_a_dia&utm_medium=email&utm_source=RD+Station.