Chapter 12
Circular, Smart, and Connected Cities:
A Key for Enhancing Sustainability and Resilience of the Cities

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ABSTRACT

Majority of the humanity is living in the cities. Cities have adverse environmental impact. Their environmental footprints need to be reduced. As the world's living conditions deteriorate, the survival of the humanity depends on the precautions taken. These precautions can include sustainable living styles, new technologies, and circular economy principles. Furthermore, climate change caused disasters can have adverse consequences as they can be deadly and as they can result in economic loss. The cities need to be resilient so that disasters adverse consequences can be reduced and the post-disaster phase rescue and recovery processes can be effectively carried out. Circular, smart and connected cities based on the new technologies such as big data, Information and Communication Technology (ICT), and Internet of Things (IoT) can contribute to the cities' sustainability and resilience performance. This chapter aims to investigate the roles of big data, IoT, ICT, as well as circular, connected and smart cities in enhancing sustainability and resilience of the cities. With this aim, based on the literature review, this chapter covers: need for, pillars of and aspects of smart, sustainable, circular, and resilient cities as well as ways for transforming the cities into smart, sustainable, circular, and resilient ones. This chapter can be beneficial to the researchers, academics, construction professionals, and policy makers.Keywords: Disaster; Internet of Things; Information and Communication Technology; Smart Cities; Big Data; Resilience; Building Information Modelling; Circular Cities; Circular Economy

INTRODUCTION

World has become a hub of interconnected cities. Quantities and sizes of the cities are being increased due to the humanity's trend in moving to urban land. This trend is expected to continue as more than half of the world's population is expected to be hosted in the cities (UN, 2014; Sertyesilisik & Sertyesilisik, 2015). The increasing population in the cities transforms the cities into resource exploitation hubs. Cities contribute to the causes of the climate change due their environmental footprint. Precautions have started to be taken to reduce the environmental footprint of the cities. These precautions include but they are not limited to: enhancing sustainability performance of the built environment through sustainable or green building assessment tools, sustainable or green material certificates. Most of these precautions could not be effective in preventing increase in the cities' environmental footprint. Furthermore, cities are vulnerable to climate change (e.g. risk of emergence of *biophysical hazards*) especially in case mainly only climate adaptation actions are taken (Moriarty & Honnery, 2015: 45). Circular economy principle based cities can contribute to the climate mitigation efforts and to the reduction in the cities' environmental footprint. Furthermore, circular economy based cities can contribute to the well-being of the citizens.

As cities cannot be isolated from the consequences of the climate change (e.g. disasters, extreme weather conditions), humanity has started to experience deadly disasters (e.g. tornado) and to observe how climate related disasters have caused disruption to the transportation in the cities and logistics to the cities as well as demolition of the built environment. Adverse consequences of these disasters emphasise the importance of adapting the cities to the climate change and of enhancing their resilience in addition to the climate mitigation efforts. Cities need to be smart and equipped with the infrastructure and technology needed to ensure their citizens' safety and well-being as well as to enhance the cities' resilience. Smartness and connectedness of the cities can contribute to their resilience, and to the effectiveness of the disaster management in all phases (in the pre- and post-disasters as well as during the disasters). They can reduce the adverse consequences of disasters and enable rescue and recovery processes to be effectively carried out.

Effective solutions and precautions are needed to reduce environmental footprint of the cities and to enhance resilience of the cities. Climate change avoidance actions (e.g. reducing environmental footprint), climate mitigation and adaptation actions are complementary actions for enhancing cities' circularity, sustainability, smartness, and resilience performances. Circular, smart and connected cities are based on the new technologies (e.g. big data, Internet of Things (IoT), Information and Communication Technology (ICT) which can contribute to the cities' sustainability and resilience performance. This chapter aims to investigate the role of big data, IoT, ICT, as well as circular, smart and connected cities in enhancing sustainability and resilience of the cities.

BACKGROUND

Smartness, circularity, sustainability, connectedness as well as disaster resilience of the cities are interrelated (Figure 1). Cities' performances in each of these fields influence each other's performances.

Smartness of the cities can enhance sustainability performance of the cities. Smart cities can be described as cities operating as well as solving their existing and potential problems with the help of smart technologies supported by big data, IoT, and ICT. Smart cities "…use digital data to deliver better public services and more effective uses of resources" (Alavi, Jiaob, Buttlar, & Lajnef, 2018). Ojo et al.

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