Chapter 1
An Overview of Smart Cities Covering Applications, Challenges, and Emerging Trends

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ABSTRACT

As city populations grow at a pace unprecedented in history, cities across the world are facing mounting challenges in the areas of sustainability, provision of services, mobility, and governance. The present chapter offers an in-depth overview of the Smart City theme, discussing how it has evolved as an integrated solution to urban complexity through the adoption of advanced digital technologies. The chapter discusses the key drivers of smart urbanization. It identifies the key building blocks of Smart Cities like the Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), and cloud computing, edge computing, illustrating how these technologies facilitate data-driven governance. Furthermore, it discusses ongoing

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challenges like data confidentiality issues, high costs of implementation, etc. Based on global case studies of Barcelona, Songdo, and Amsterdam, the chapter presents actionable insights into the socio-technical nature of Smart Cities and discusses emerging trends like digital twins, blockchain technology, robotics, and human-centered design.

1. INTRODUCTION

The phenomenon of rapid urbanization is the 21st century world's hallmark, affecting deeply the character of the way we live, work, and use resources. Cities are growing at record rates, putting pressure and complexity on their infrastructure, services, and institutions. Over 55% of the global population now live-in urban areas, a proportion that will reach approximately 68% by 2050, according to the United Nations' World Urbanization Prospects (Buettner, 2015). Such raw growth comes with unparalleled opportunities for creativity and innovation, as well as a vast range of challenges around congestion, equity, sustainability, health, and delivering services.

Population increases at high rates as shown in Figure 1.1 and increasing density worsen most of the challenges already inherent in contemporary cities. Congestion of traffic on the roads has become an enormous challenge, adding hours of delay to daily trips and propelling high levels of greenhouse gas emissions. Pollution of air, water, or land spoils the health of city residents and the environment. Increasing social inequalities also emerge in unequal access to education, healthcare, food, clean water, and employment opportunities (Kjellstrom et al., 2007). Inadequate and poorly facilitated public amenities from parks and recreation halls to hospitals and schools also reduce the well-being of an increasing population. All these issues in aggregate erode the level of living, reduce civic participation, and erode social stability.

This sobering reality portends a greater need for imaginative, responsive, and visionary solutions that can facilitate policy makers and city officials to grapple with their expanding mandates and enhance the lives of their residents. It is here that the idea of Smart Cities is born a new paradigm to think and govern the expanding complexity of the urban environment. Smart Cities harness advanced digital technologies and data-driven innovations to facilitate the more sustainable, resilient, responsive, and people-centric management of services.

By definition, a Smart City is not necessarily a city full of technology but a city that employs technology to optimise its human and environmental capital (Albino et al., 2015). Smart Cities are configured to provide a high quality of life and be resource-efficient and service-intensive in a manner that is environmentally sustainable, socially just, and economically viable.