

# *Sustainable and Inclusive Urban Development through the Implementation of Smart Cities*

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## **Abstract**

*Smart cities can promote sustainable urban development amidst urbanization and climate change. Urban planning and innovation are crucial to address global challenges. Smart urbanization emphasizes community involvement and sustainable resource use. Technology must consider its impact on daily life and the environment for climate-resilient cities.*

*Smart cities improve infrastructure and public services, requiring supportive policies for inclusivity. Citizens actively contribute to finding solutions in a smart city. Smart cities are more than just technological concepts; they foster innovation and enhance daily life. By adopting a multidisciplinary approach, they address current and future challenges for sustainable and inclusive urban development. A sustainable and participatory vision is needed for shaping the cities of the future.*

*The purpose of the article on intelligent urban areas is to clarify the notion of intelligent urban areas, to examine their benefits and challenges, to utilize specific instances to demonstrate the use of technology in the development of intelligent urban areas, and to offer a critical perspective on their impact on the lives of residents and the environment. Furthermore, it highlights the significance of scholarly research and knowledge in this field, emphasizing the role of academic inquiry in advancing our comprehension of intelligent urban area dynamics, identifying optimal methods, and addressing potential issues.*

## Introduction

A smart city uses advanced technologies and data-driven solutions to improve the efficiency, sustainability, and quality of life for residents. It integrates Information and Communication Technologies (ICT), the Internet of Things (IoT), and innovative digital infrastructure to optimize resources and address urban challenges.

A smart city gathers real-time data through interconnected devices and sensors in the urban landscape. This data includes traffic patterns, energy consumption, waste management, air quality, and citizen behavior. By using analytics and Artificial Intelligence (AI), city planners and administrators can make well-informed decisions (Alawadhi et al., 2012).

The pillars of a smart city include smart governance, mobility, energy management, infrastructure, and healthcare. Technology enhances civic engagement, public services, and communication between the government and its constituents. Intelligent transportation systems reduce congestion and environmental impact (Hollands, 2008).

The academic discourse on smart cities is also growing and becoming a dynamic field of study. It is driven by important themes like energy efficiency, economic development, and citizens' well-being. Smart cities are a focal point for addressing urban challenges caused by rapid urbanization, climate change, and resource constraints.

Smart cities are a popular topic in academia because they combine energy efficiency, economic development, and technology to solve urban problems. The focus on citizens' well-being aligns technological advancements with the goal of creating livable and sustainable urban environments. Academic projects and initiatives are increasingly focused on smart cities to prepare future experts and students to tackle urban challenges. By understanding the complexities of smart cities, academic institutions can help create a workforce capable of finding innovative solutions. By educating professionals in smart city initiatives, academia contributes to creating a talent pool that can drive positive change in urban ecosystems. This empowers individuals to actively engage with and contribute to the evolving narrative of smart cities, ensuring a sustainable and resilient urban future.

## Literature review

Smart cities represent a shift in urban development that utilizes advanced technologies to improve efficiency, sustainability, and the overall quality of life for citizens. This review of literature examines influential works that have shaped our understanding of smart cities, encompassing perspectives from technological, social, and economic dimensions.

Samith, in his comprehensive exploration of “Smart Cities and Internet of Things,” delves into the intricate relationship between smart cities and the Internet of Things (IoT). He emphasizes the pivotal role of IoT in shaping urban landscapes and highlights the integration of technology to optimize services and infrastructure.

Lee provides a nuanced perspective in “Smart City as a Social Transition towards Inclusive Development through Technology.” This article explores the transformative potential of smart cities in fostering inclusive development. Lee navigates the interplay between technology and social equity, presenting a compelling argument for smart cities as catalysts for societal progress.

Alawadhi et al.’s seminal work, “Building Understanding of Smart City Initiatives,” lays the foundation for comprehending the multifaceted nature of smart city initiatives. The authors analyze the core components of smart cities and emphasize the importance of a holistic understanding for effective implementation.

Hollands’ work, “Will the Real Smart City Please Stand Up?” critically examines the conceptual landscape of smart cities. The author explores various interpretations and urges clarity in defining the essence of smart cities, crucial for effective urban planning.

In conclusion, the literature presented offers a diverse range of perspectives on smart cities, highlighting the importance of a holistic understanding that encompasses technological innovation, social equity, and sustainable urban development. These insights contribute to the ongoing discourse on the evolution and impact of smart cities in shaping future urban landscapes.

## Analysis

The idea of the “Smart City” has become widely popular in academic literature and global policy discussions, as it harnesses a range of rapidly advancing Information Technology (IT) innovations to transform cities into more intelligent and responsive environments for their residents. It is important to note that cities and urban areas now accommodate roughly half of the world’s population (Bakıcı,

Almirall, & Wareham, 2013), and the substantial increase in urban populations in recent decades has presented challenges in terms of both quantity and quality of services provided to citizens. In response to these challenges, the emergence of smart cities has been seen as a strategic solution to effectively address them.

Both governmental and private sector entities have taken various initiatives to develop smart cities, which has led to the integration of Information and Communication Technologies (ICT). The goal of this integration is to create sustainable, efficient, and effective solutions to the numerous challenges faced by urban areas (Caragliu, Del Bo, & Nijkamp, 2011; Su, Jie, & Hongbo, 2011). These challenges encompass a wide range of areas, including education, healthcare, traffic management, energy consumption, waste disposal, unemployment, and crime (Chourabi et al., 2012). The deployment of ICT in these sectors signifies a collective effort to improve urban living conditions and meet the evolving needs of growing city populations.

The concept of the “Smart City” originated in the 1990s and can be traced back to that time, when the primary focus was on comprehending the impact of emerging Information and Communication Technologies on the urban infrastructures of modern cities. During this period, the California Institute for Smart Communities played a pioneering role in this field, dedicating its efforts to strategically planning cities in a way that incorporates information technologies and transforms communities into smart entities (Alawadhi et al., 2012). Following this, the Center of Governance at the University of Ottawa expressed concerns about the excessive emphasis on technical aspects within the notion of smart cities and advocated for a more comprehensive approach.

In more recent years, there has been a shift in focus that has led researchers to call upon actual smart cities to step forward and shed light on the multifaceted dimensions that are hidden behind the broad term “smart city” (Hollands, 2008). It is important to note that the term “smart city” is often used interchangeably with related expressions such as “intelligent city” or “digital city” (Albino, Berardi, & Dangelico, 2015). This change in terminology reflects an ongoing exploration and improvement of the conceptual understanding of cities that embrace advanced technologies to enhance urban living.

## **Components of a smart city**

In the context of densely populated urban environments such as cities and capital cities, there is an increasing recognition of the necessity for integrated subsystems that operate collectively and have intelligence embedded in each of them. Supporters of this integrated perspective emphasize the natural integration

of different subsystems within a city, including transportation, energy, education, healthcare, buildings, physical infrastructure, and public safety. The aim is to create a unified system that embodies the concept of a smart city (Gurdgiev & Keeling, 2010; Kanter & Litow, 2009). Giffinger et al. (2007) and Perera et al. (2014) have put forward six possible characteristics of a smart city: smart economy, smart people, smart governance, smart mobility, smart environment, and smart living.

Lombardi et al. (2012) have associated these characteristics with various aspects of urban life, emphasizing the interconnected nature of these elements. Nam and Pardo (2011) have presented a framework that highlights three factors - technology, people, and institutions - as integral to the concept of a smart city. According to this framework, a city can be considered smart when investments in human social capital and IT infrastructure contribute to sustainable growth and an improved quality of life through participatory governance.

The Human Category within this framework underscores elements such as creativity, social learning, and education. It includes a commitment to lifelong learning, social and ethnic diversity, flexibility, creativity, cosmopolitanism, open-mindedness, and active participation in public life (Lombardi et al., 2012; Nam & Pardo, 2011).

Governance is a fundamental element within the institutional factor of the framework. A smarter government is characterized by dynamic interactions with citizens, communities, and businesses in real-time, which fosters growth, innovation, and progress.

Taking these insights into consideration, a recommended model is the Giffinger and Rudolf model, as it effectively categorizes indicators into three components. This approach stands in contrast to the more complex measures and assessments proposed by Nam and Pardo (Nam & Pardo, 2011). The model encompasses various components and their major indicators, thereby providing a comprehensive framework for understanding and evaluating smart city initiatives (Albino et al., 2015).

**FIGURE 1-** Components of a smart city



To have a more complete understanding of the concept of a smart city, it is crucial to define and explain each of the foundational pillars that together make up a smart city. Describing these pillars is an important effort to provide insight into the many aspects that define and differentiate the complex structure of a smart city. This analytical breakdown not only helps us understand the different elements involved, but also adds to the academic discussion about the changing approach to urban development.

### *Information and Communication Infrastructure in the Context of Smart Cities*

The Information and Communication Infrastructure (ICI) is vital for smart cities, as it enables the use of data from devices and resources in these urban environments. Advanced networks and information technologies connect and harmonize data, leading to practical applications. The Internet of Things (IoT) connects everyday objects to create a network that collects real-time data. High-level telecommunications technologies ensure fast and reliable connections for all users. New technologies like 5G networks and Cloud Computing enhance data utilization. The application of ICI technologies improves urban life and transforms cities towards intelligence and sustainability.

### *Intelligent Transportation in Smart Cities*

Intelligent transportation is essential for smart cities, using technology to enhance public transportation efficiency and reduce traffic congestion. Technologies like artificial intelligence and sensors help monitor and manage transportation. Real-time information and traffic predictions empower users to plan their trips better. Connected technologies and applications share traffic information, suggest alternate routes, and improve mobility. Ride-sharing apps, electric bikes, and smart buses contribute to user-friendly transportation. Intelligent transportation integrates diverse transportation data for analysis and predictions, preventing congestion and improving resource distribution. It also fosters innovative solutions for urban transportation. In conclusion, studying intelligent transportation in smart cities improves the quality and efficiency of urban mobility.

### *Resource Management in Smart Cities*

Efficient management of natural resources like water and energy is crucial for smart cities. Technology helps preserve these resources and protect the environment.

Advanced technologies monitor and manage natural resources in smart cities. Smart sensors and monitoring systems observe water levels and ensure its quality. This prevents losses and minimizes the impact of urban activities on water resources. Smart grids and automated systems optimize energy usage and reduce wastage. Sustainable sources like solar panels and wind turbines are utilized efficiently.

Monitoring systems and information technologies provide detailed analyses and predictions of resource performance. This helps cities address present and future resource management challenges. Resource management in smart cities goes beyond technical and economic efficiency. It also aligns with sustainable development goals and environmental conservation.

**FIGURE 2-** Resource Management in smart cities



Technology establishes an integrated infrastructure for a better urban life and a cleaner environment for future generations.

### *Citizen Services in Smart Cities*

Smart cities use technology and innovation to improve urban services and make them more efficient and transparent. This includes healthcare, education, public transportation, and other public services. In healthcare, technology is used to monitor and improve services, with personalized care and prevention being emphasized. The integration of 5G technology ensures fast and reliable healthcare information distribution. Education in smart cities is enhanced through digital platforms and technology, benefiting both students and teachers. Other services like online payments reduce bureaucracy and improve the relationship between citizens and the government. Overall, technology greatly improves urban daily life in smart cities, creating a more advanced and inclusive community.

## *Security and Economic Development in Smart Cities*

Smart cities use technology to improve the safety of their citizens, including monitoring crime and reducing risks. Intelligent initiatives promote economic development by fostering innovation and creating business opportunities.

Smart cities employ monitoring technology to identify and respond to dangerous situations. Security camera systems linked with artificial intelligence monitor suspicious activities, aiding in the prevention and resolution of crime. Analyzing big data helps identify patterns and trends in criminal incidents, enabling proactive responses.

Smart cities prioritize economic development by creating an environment that encourages innovation and supports new businesses. Internet of Things (IoT) platforms offer opportunities for innovative projects and services. Local governments intervene using artificial intelligence data and supporting initiatives to foster growth and create jobs.

Economic development in smart cities includes sustainable energy and responsible resource management. Green energy infrastructure, low-carbon transportation, and businesses that prioritize sustainability are promoted.

The relationship between security and economic development in smart cities shows the impact of technology in creating safer and more economically developed urban environments. Advanced technology and innovative strategies drive positive societal and economic changes.

### **Example of smart cities**

Let us now turn our attention to a few compelling instances of smart cities that have gained widespread recognition for their exceptional advancements in technology, which in turn have provided effective solutions to the prevailing and forthcoming challenges faced by their inhabitants. These cities have managed to distinguish themselves by adopting an inventive approach that skillfully integrates state-of-the-art technology, thereby effectively tackling urgent issues and providing a tantalizing glimpse into the future of urban living.

One example that stands out prominently is Singapore, a sovereign city-state that has unquestionably emerged as a global frontrunner in the realm of smart urban solutions. Singapore has astutely harnessed the power of extensive data analytics, the Internet of Things (IoT), and Information and Communication Technologies (ICT) to optimize various aspects of city management, including traffic flow management, waste reduction, and public safety (Thales 2023).



Barcelona, located in Spain, is another exemplary city that has successfully transformed itself into a smart city, showcasing a comprehensive strategy that encompasses multiple areas such as intelligent parking systems, efficient waste management, and meticulous environmental monitoring. Moreover, Barcelona's unwavering focus on fostering citizen engagement through digital platforms has further bolstered its reputation as an innovative and forward-thinking urban center (Reimer, 2020).

Moving on to Dubai, located in the United Arab Emirates, we find yet another prime example of a city that has strategically positioned itself as a leading smart city through groundbreaking initiatives such as the Smart Dubai project. By adroitly integrating transformative technologies like blockchain, artificial intelligence (AI), and the Internet of Things (IoT), Dubai has successfully enhanced various aspects of governance, sustainability, and innovation within the city (Riadh AL-Dabbagh, REES, 2022).

Individuals have the capacity to play a pivotal role in precipitating transformative change towards the development of smart cities, even amidst the grandeur of large-scale projects showcasing state-of-the-art technology, advanced methods of communication, and transportation. The realization of this potential became apparent during my visit to Oslo, Norway, within the framework of the SmartWB project.

The primary aim of the SmartWB project is to deepen and enhance the standard of higher education in the field of intelligent urban development, with a focus on climate considerations. The overarching objective is to reinforce the importance of this domain in the job market and wider society. Additionally, the project aims to strengthen connections and relationships between higher education institutions in partner countries, which include Albania, Bosnia and Herzegovina, and Montenegro. This endeavor is intricately woven into the economic and social fabric.

This strategic vision will be brought to fruition through the establishment of a technological platform designed to facilitate collaboration and the exchange of knowledge, experiences, and best practices. Furthermore, the project envisions the modernization of university curricula, aligning them with the standards and trends endorsed by the European Union. Simultaneously, there is a deliberate emphasis on enhancing the competence and skills of the teaching staff.

These orchestrated efforts are poised to have a positive impact on the advancement of knowledge and the intelligent development of urban landscapes with a climate-conscious perspective. The result will be the creation of a sophisticated and conducive environment, benefiting both students and society.

FIGURE 3- SmartWB Project



### Partners



Curricula innovation in climate-smart urban development based on green and energy efficiency with the non-academic sector

[www.smartwb.ucg.ac.me](http://www.smartwb.ucg.ac.me)

During our trip to Oslo, we had the opportunity to inspect the recently renovated Voldsløkka Secondary School, which had undertaken a highly innovative rainwater management project throughout its premises. This initiative was particularly important due to the difficulties caused by high water levels in the surrounding area during rainfall and storms. The execution of this project was inherently intricate, as it required adhering to specific criteria:

**Permeable Coverage:** Thirty percent of the outdoor spaces need to be covered with surfaces that allow to penetrate water or natural elements. **Development of a Schoolyard Resembling a Park:** The schoolyard was designed to resemble a park, with a wide variety of plants at different heights. **Open and Local Treatment of Stormwater:** Stormwater had to be treated in an open and local manner, with secure pathways established in anticipation of flooding (Landezine, 2023)

The stormwater management plan consisted of three main stages:

**Handling Light Rainfall:** Involving the capture and penetration of light showers. **Managing Heavy Rainfall:** Including the collection and storage of water during heavy rain. **Addressing Intense Rain Events or Bursts:** Establishing reliable flood paths for significant rain events.

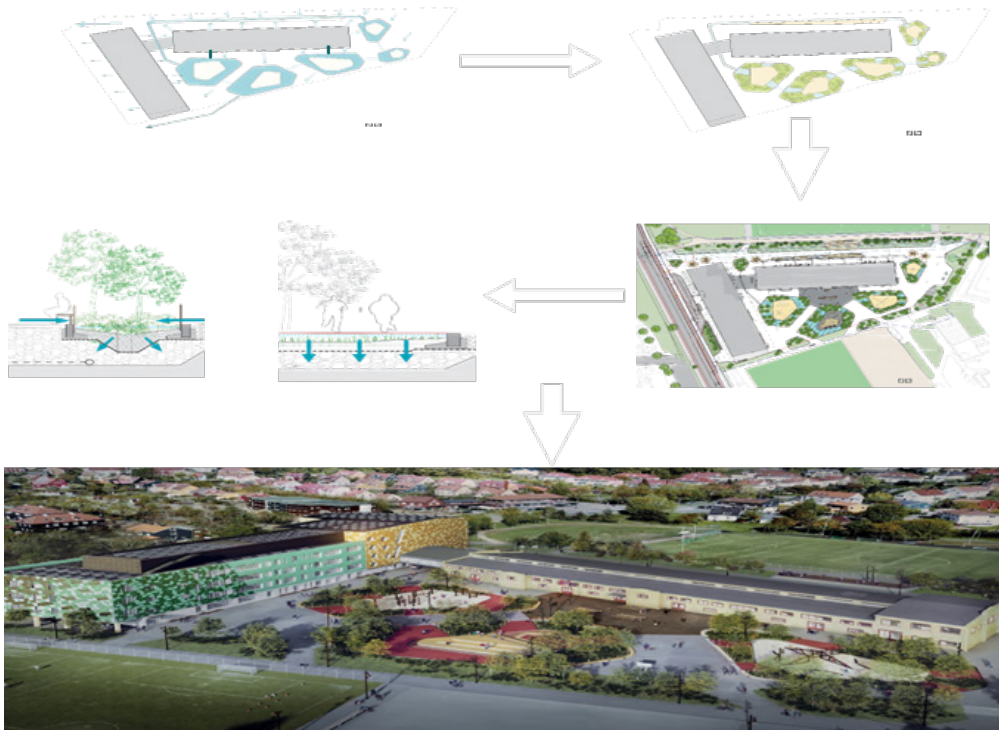
The project also had to find a balance between durable and sustainable surfaces for recreational activities and permeable and green surfaces for effective stormwater management. The commitment to addressing these challenges highlighted the school's dedication to implementing environmentally conscious and resilient urban development solutions (Landezine, 2023)

The impediments were resolved, and the project was executed by carefully selecting materials and implementing a multi-layered strategy. This effort involved skilled engineers, architects, academics, and students from NMBU University, adding an academic aspect to the project.

The solution involved creating islands that were centrally constructed with materials allowing water to pass through to the lower layers. These islands combined with rainfall collected from the surrounding green areas. To optimize the water flow from the courtyard to the central islands, small bridges were built over the green zones using water-permeable materials. This intricate engineering not only addressed the main challenge but also ensured efficient water movement.

However, the resolution did not stop with these structural interventions. There was still a challenge with precipitation in the courtyard that could inconvenience students and academic staff. The solution involved the strategic implementation of guiding channels to direct the water around the green spaces surrounding the islands. This innovative approach effectively tackled technical and environmental challenges and showcased pioneering research and advanced methodologies in urban development and water resource management.

**FIGURE 4-** Voldsløkka Secondary School



## Conclusions

The rise of smart cities signifies a transformative shift in urban development, utilizing advanced technologies like Information and Communication Technologies (ICT) and the Internet of Things (IoT) to improve efficiency, sustainability, and overall quality of life for urban residents.

Smart cities aim to address urban challenges such as traffic congestion, energy inefficiency, waste management, and healthcare provision using real-time data and cutting-edge technologies.

Smart governance promotes civic engagement, transparent communication, and operational efficiency in delivering public services by integrating technology. Smart cities focus on environmental sustainability by integrating renewable energy sources, intelligent transportation systems, and resilient infrastructure. The rise of smart cities raises ethical concerns and privacy issues due to the extensive collection and processing of data.

Smart city projects need to foster inclusivity across diverse socioeconomic backgrounds to ensure accessibility and equity. The educational aspect of smart cities is crucial for driving innovation and managing the transition to intelligent urban environments.

Collaborative efforts between government, academia, and industry stakeholders are pivotal in implementing smart city paradigms.

The Voldsløkka school project demonstrates the strategic utilization of public spaces to improve citizens' well-being and mitigate flood-related vulnerabilities.

The symbiotic partnership between academic and non-academic institutions plays an important role in addressing urban challenges and improving the quality of life for citizens.

Collaboration between academic and non-academic institutions is crucial for sustainable development and societal progress. The trajectory of smart cities has great potential to improve urban challenges and enhance the human experience. However, careful consideration of ethical, social, and economic factors is necessary to ensure that technological advancements contribute responsibly to a sustainable and inclusive urban future.

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