SMART CITY TRENDS AND INNOVATIONS SHAPING THE FUTURE OF CITIES

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Purpose: To highlight the current smart city trends and innovations that will shape the future of modern cities.

Design/methodology/approach: This article review is based on a theoretical literature review on the idea of smart city trends and innovations globally. The theoretical approach was based on published journals, government sources, and other sources.

Findings: Human needs as well as the development of electronic-based projects for urban areas have evolved over the years. Environmental pollution has caused a drastic change in climate, urbanization happening rapidly, and more pandemics are expected in the future. But with modern technology advancements, it's important for public institutions and private entities to collaborate to make cities more sustainable. Smart energy solutions, urban planning, and smart health communities are important to smart city trends that can help to significantly transform urban centers.

Originality/value: the presented review paper provides a current realistic overview of the innovations and trends implemented for smart city projects. They are implemented in some of the major cities of the world and their influence is important in shaping the lives of urban residents and the future of cities.

Keywords: smart city, urban, sustainability, trends.

Category of the paper: Literature Review.

1. Introduction

The goal of smart cities is to promote sustainability economic growth, improve the quality of people's lives, (Visvizi, Lytras, Damiani, & Mathkour, 2018) and optimize the city's infrastructures using data analyses and smart technologies. The world's population has massively increased, especially in urban areas. Rapid urbanization has caused significant stress

in the existing infrastructure and led to environmental pollution. As cities move towards digitization and focusing on sustainability, it's important to build efficient and eco-friendly solutions. The Covid-19 pandemic has also led to a shift in the way medical services are delivered- instead of them being confined in institutions, there is a need for the community to play a role in wellness.

Globally, more than 50% of the world population currently lives in urban areas. By 2045, this population will increase 1.5 times and reach 6 billion. By 2050, the urban population is expected to double its current size (Urban Development, 2022) which means that almost 7 in 10 people in the world will be living in cities. On the other hand, climate change is already causing havoc worldwide as both humans and wildlife face new survival challenges. The future of pandemics seems inevitable but it's possible to reduce the risk by implementing smart sustainable solutions. Smart city technologies are in rapid use with more countries implementing smart services for city inhabitants.

2. Literature Review

Smart cities are cities that use various types of electronic techniques and sensors to collect data and provide services that solve the cities' problems. Data in smart cities is captured by the Internet of Things (IoT) devices (Liu, Heller, & Nielsen, 2017) and then processed by artificial intelligence (AI). While the idea of smart cities goes back to 1974, it rapidly kicked in after the 9/11 tragedy. After the 9/11 attacks, New York and other major cities in the world decided to implement AI systems and 24/7 surveillance cameras to protect public spaces.

With the increased likelihood of attacks in urban areas, climate change, infectious diseases, and digitization, the development of smart cities is now more than a need. Efficiency, situation predictability, safety, improved quality of life, and sustainability have forced governments and private entities to develop more innovative solutions.

The period between 2000 and 2005 is considered as the 'IT stage only' and saw the start of the development of ubiquitous cities (U-cities) to solve urban problems but research and implementation at this stage was limited. The infrastructure development of turning U-cities to smart cities kicked in between 2006 and 2010. This was designed to solve citizen's problems based on urban problems. 2011-2015 was a critical stage for the development of smart cities with IT solutions being used to solve specific urban area problems. From 2016 up to now, extensive IT solutions have been implemented to solve entire urban area problems. Thus, smart city trends have evolved over the years, changing from just using 24/7 surveillance cameras to IoT, data analytics, and AI.

## 3. Smart City Trends and Innovations Shaping the Future Cities

The journey to develop smart cities has evolved from the 1970s when Los Angeles created the 'Cluster Analysis of Los Angeles' report, the first urban big-data project to 1994's 'De Digital Stad' by Amsterdam to promote the use of the internet. The evolution has been successful due to the contributions of companies such as Cisco which put up $25m in 2005 for five-year research into smart cities (GlobalData Thematic Research, 2020). In 2011, the city of Barcelona organized the first Smart City Expo World Congress and in 2013, China announced its first batch of pilot smart cities, consisting of 90 cities, towns, and districts. Vietnam is currently working on a $4.2 billion smart city near Hanoi and its expected completion is 2028 (Cheema, 2019). With more cities and countries focusing to redefine and readapt their urban ecosystems, here are current smart city trends and innovations expected to shape the future of cities.

3.1. Smart Energy

Smart energy features intelligent optimization of energy efficiency and energy costs based on innovative technology that's implemented to operate sustainable energy management systems. In 2018, the global energy demands grew by around 2.9 per cent (Global Energy Consumption Only Going Up, n.d.) and this consumption is expected to increase by almost 30% by 2040. Energy costs have skyrocketed worldwide due to rising cost of fossil fuels and soaring costs of imports. As cities move towards digitization, there is a need to design systems that promote sustainability and efficiency.

The implementation of smart energy systems is necessary for facilitating the development of sustainable energy systems. This way, the world can achieve its greenhouse gas emissions and reduce the impact of climate change. Smart grids are important in enhancing real-time energy tracking while virtual power plants can be powerful tools in facilitating efficient energy distribution.

Agder Energi Nett has created smart energy systems using machine learning, IoT, and data analytics (Creating Smart Energy Systems with Data Analytics, IoT and ML, 2020) in a bid to transform their grids. With the use of smart meters, Agder Energi Nett customers can access their energy consumption hourly, leading to smart energy management. Besides that, this system ensures that the company can quickly discover and resolve power grid faults. With most cities in Europe moving towards digitization, the smart meter market is expected to grow at 8.5 per cent CAGR between 2022 and 2027 (Europe Smart Meter Market - Growth, Trends, Covid-19 Impact, and Forecasts (2023-2028), n.d.).
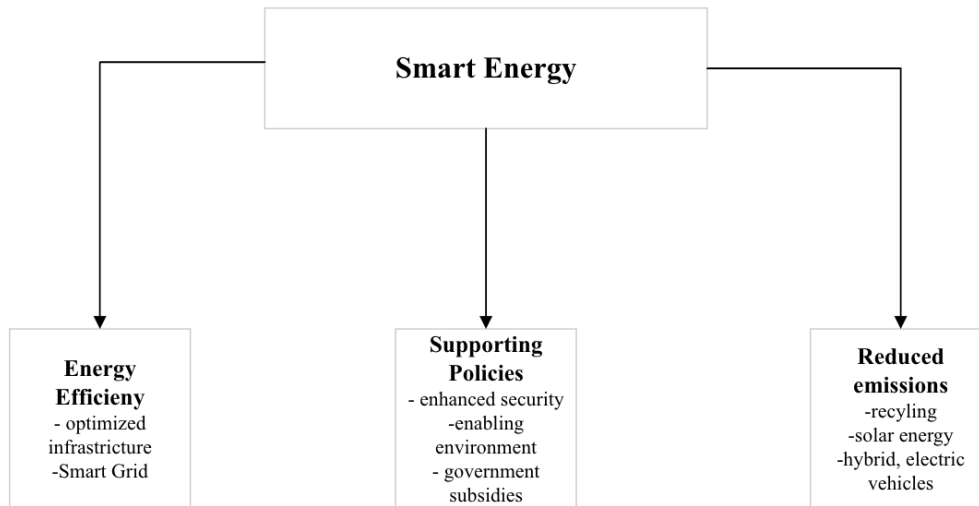
Figure 1. Smart Energy System.
Source: own image.

3.2. Smart Mobility

This is an intelligent mobility and transport network, involving various components of mobility and technology. Smart mobility is a crucial aspect of smart cities, bringing in immeasurable efficiency. In the United States, congestion in urban areas has been cited to cost $66.1 billion annually (McCarthy, 2020)

Smart mobility umbrella features optimized public transport networks, ride-hailing, carsharing, and intelligent transport systems for logistics. In 2022, the top mobility trends included autonomous driving, smart infrastructure, mobility-as-a-service, and electrification. Advances in these areas are geared towards promoting zero-emission transportation by making urban mobility more eco-friendly and intelligent traffic management. Smart mobility's objective is to reduce noise pollution, and traffic congestion, reduce transfer costs, improve transfer speed, and increase safety.

For over a decade, European cities have been at the forefront of developing smart cities. The common aim is to increase the competitiveness of cities in this region, improve the quality of life of its citizens and help it achieve its European climate and energy targets (Smart Cities, n.d.).

3.3. E-governance

Electronic governance (e-governance) involves the use of information technology in delivering government services (Heeks, 2020). A smart city requires the dissemination of efficient and comprehensive public/government services, thus it's the foundation of a smart city. This trend is supposed to make public services and decisions more transparent, collaborative, and sustainable. This can be achieved using IoT and blockchain solutions while involving stakeholders in the decision-making process.

E-governance includes digital services such as digital passports, online voting, filing tax returns, applying for licenses, etc. The European Union has taken concrete actions in developing digital cross-border public services to help governments, businesses, and citizens.

The efficiency of e-governance involves rethinking how organizations operate, how public services are delivered, and the changing behavior of those services to citizens. The cost savings benefits of e-governance are massive and the EU's cross-border digital public services are designed to allow the free movement of people within the union. For instance, Denmark's electronic invoicing saves businesses almost 50 million euros and taxpayers 150 million euros annually. Italy's e-procurement systems have saved the country almost 3 billion euros. If such a system is introduced across various cities in the EU, then the union's annual savings can exceed 50 billion euros (eGovernment and Digital Public Services, 2022).

3.4. Green Urban Planning

In a bid to cut emissions and waste and build eco-friendly cities, green urbanism is a smart city trend that promotes sustainable urban design. Green Urban Planning is based on three main interactive pillars: materials and energy; urban planning and transportation; water and biodiversity. Sustainable cities have electrified mobility systems, energy-efficient buildings, and eco-friendly city designs. All these should be based on the principles of circular economy which is driven by design i.e., to eliminate pollution and waste, circulate materials and waste, and regenerate nature (Circular Economy Introduction, n.d.)

Copenhagen is one of the top green cities in the world that's popular with green travelers. Almost 47% of its inhabitants use bicycles every day in addition to having one of the highest numbers of electric vehicles per capita globally (What is Green Urbanism and Why is it Important?, 2021).
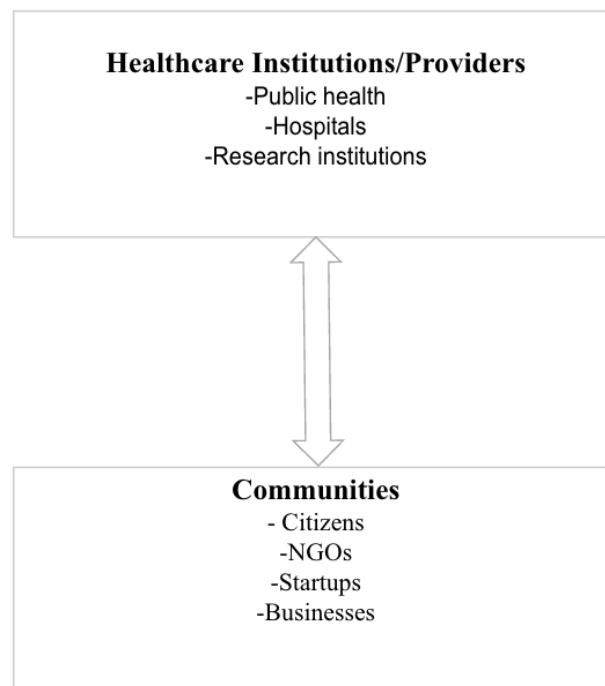
3.5. Smart health communities

The Covid-19 pandemic has shown us that the community is critical in creating better health environments. To make healthcare more intelligent and efficient, smart health consists of hospitals, regional, and families. They depend on communication and information digital-based environments to enhance existing healthcare procedures and introduce new intelligent features.

Smart healthcare communities introduce a new multi-level change (Tian, et al., 2019) including informatization construction changes, disease-centered to patient-centered medical model, personalized medical management, and focus on preventive healthcare.

This trend will allow smart cities to develop medical ecosystems that support intervention and prevention, away from the traditional model of diagnosing and treating medical issues. once social or communal determinants are effectively determined, it will be easier for both the private sector and governments to efficiently collaborate and address healthcare issues.

It's important for cities to create healthy living communities and a smart health system facilitates the engagement between patients, public entities, and companies in delivering high-quality digital health services, improving the quality of life, and supporting economic growth due to better public productivity.

A smart health community ensures that healthcare moves outside medical institution by creating new, disruptive community players in the city's ecosystem. Consequentially, this facilitates more scientific advances in the medical field and guarantees affordability in personalized healthcare services. A citizen's wellness will be based on data analytics and processes interoperability, leading to positive decision making (Smart Health Communities, n.d.).

Healthcare Institutions/Providers
-Public health
-Hospitals
-Research institutions

Communities
- Citizens
-NGOs
-Startups
-Businesses

Figure 2. A Smart Health System.
Source: own image.

4. Limitations

Implementation of smart city projects faces poor coordination between private and public sectors (Smart City Planning Must Work for Both Private Business and Public Citizens, 2022). It's very difficult for government agencies and private organizations to share sensitive data. It's also difficult for them to standardize common infrastructure, networks, and tools, limiting the effectiveness of cross-collaboration (Kim, 2022). The life cycle of politics is dynamic and one of the biggest challenges in the development of smart city initiatives. Thus, political capital can easily expire before the completion of a project, leaving the incoming administration in

jeopardy. This often leads to increased complexities and delays. Smart city projects are generally implemented on a large scale and therefore not easy to fund since they need buy-ins from several stakeholders, based on a public-private funding system that naturally blends with local, state, and national interests. These projects need administrations with long-term commitments. Smart cities guarantee people efficiency, convenience, and healthy environments. However, nobody wants to be constantly monitored. While sensors and cameras being installed everywhere may help deter crime, for law-abiding citizens, this may only make them paranoid (Klimovsky, Pinteric, & Saparniene, 2016). However, such can be avoided if citizens are educated about these projects. Developing transparency and community minds might help improve the level of trust for people whose these solutions are designed for.

5. Conclusion

This article's goal was to highlight some of the current smart city trends that will shape the future. Energy prices have skyrocketed globally and as countries and urban centers seek to implement mechanisms that can help cut down energy costs, smart energy solutions can come in handy in limiting energy waster and enhancing promote the utilization of smart energy systems.An intelligent transport system can help reduce traffic congestion, air pollution, and promote mobility efficiency. Green urban planning is critical since climate change is real and cities must find a way of making their spaces safe, eliminate waste, circulate materials and waste, and regenerate nature. After the covid-19 pandemic, the future of other pandemics is inevitable hence cities must create systems that minimize overreliance solely on medical institutions and move healthcare systems to communities. This integration will ensure citizen's wellness will be based on data analytics and processes interoperability, leading to positive decision making. However, the implementation of smart cities comes with challenges such as privacy concerns from city inhabitants, political commitment, and lack of cooperation between public institutions and private entities. There is a need for the masses to be educated on the benefits of smart city projects, especially with regards to data transparency. Administrations should also make long-term commitment to smart city projects since the completion of most of these projects take time and require long-term financial investments.

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