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Smart city governance and digital platforms: A framework for inclusive community engagement and real-time decision-making

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Abstract

Smart city governance represents a transformative approach to urban management, leveraging digital platforms and advanced technologies to enhance inclusivity, transparency, and efficiency. This paper explores the foundational principles of smart city governance and the critical role of digital platforms in fostering inclusive community engagement. It examines how IoT, AI, and big data enable real-time decision-making, improving resource allocation and responsiveness to urban challenges. Key findings highlight the benefits of integrating technology into governance frameworks while addressing challenges such as ethical concerns, data privacy, and digital accessibility. The paper concludes with policy recommendations for enhancing governance practices, emphasizing the importance of inclusivity, ethical standards, and public-private collaboration. These insights offer a roadmap for developing sustainable, citizen-centered smart cities capable of adapting to future demands.

Keywords: Smart city governance; Digital platforms; Community engagement; Real-time decision-making; Urban management; Data-driven insights

1. Introduction

Smart city governance is a transformative approach to urban management designed to harness the potential of advanced technologies to address the complexities of modern cities. It encompasses the integration of technology, policy frameworks, and participatory mechanisms to enhance urban living standards while fostering economic, environmental, and social sustainability (Razaghi & Finger, 2018). Central to this governance model is the adoption of digital platforms, which serve as the backbone for real-time data collection, analysis, and dissemination (Komninos, Kakderi, Panori, & Tsarchopoulos, 2019). These platforms leverage cutting-edge technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and cloud computing, to create interconnected ecosystems that facilitate efficient service delivery and informed decision-making (Komninos et al., 2019).

Digital platforms enable seamless interactions between city administrators, stakeholders, and citizens, forming the foundation for transparent and collaborative urban governance. For instance, real-time traffic management systems reduce congestion and improve mobility, while digital health monitoring systems enhance public health outcomes (Secinaro, Brescia, Iannaci, & Jonathan, 2022). Moreover, platforms that integrate open data policies allow citizens to access and contribute to urban planning processes, ensuring their voices are heard in policy formulation and implementation. These innovations make smart city governance a technological endeavor and a people-centered initiative to create inclusive, equitable, and sustainable urban environments.

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The success of smart cities hinges on their ability to engage communities in governance processes while enabling inclusive real-time decision-making. Community engagement is not merely a supplementary activity but a cornerstone of democratic and sustainable urban management (Arnstein, 2019). By incorporating diverse perspectives, city planners can ensure that policies and initiatives reflect the needs and aspirations of all citizens, particularly marginalized and vulnerable groups who are often left out of traditional governance frameworks. Digital platforms play a pivotal role in this context by providing accessible and user-friendly tools for participation, such as online forums, mobile applications, and social media channels (Dawodu, Sharifi, Cheshmehzangi, & Oladejo, 2021).

Real-time decision-making is another critical component of smart city governance. The dynamic nature of urban challenges, such as traffic congestion, air pollution, and emergency response, requires immediate and data-driven solutions (Sarker, 2022). Digital platforms with real-time analytics and predictive modeling empower city officials to respond proactively to emerging issues. For example, during a natural disaster, sensors and data feeds can provide up-to-the-minute information about affected areas, enabling swift resource deployment and minimizing harm. Similarly, real-time air quality monitoring can prompt immediate actions to mitigate pollution levels, safeguarding public health (Ma et al., 2019).

When combined, inclusive engagement and real-time decision-making create a synergistic effect that enhances trust in governance, fosters social cohesion, and improves the overall quality of urban life. Engaged citizens are more likely to participate in initiatives and adhere to policies, while real-time responsiveness ensures that governance remains agile and relevant in the face of rapid urbanization and technological change.

This paper explores the intersection of smart city governance, digital platforms, and their impact on inclusive community engagement and real-time decision-making. It seeks to provide a comprehensive framework for understanding how these elements interact to shape the future of urban management. The objectives of this study are threefold:

- To examine the foundational principles of smart city governance and the pivotal role of digital platforms in achieving these objectives.
- To evaluate the mechanisms and tools that facilitate inclusive community engagement in decision-making processes.
- To analyze the benefits and challenges of real-time decision-making in addressing urban issues effectively.

This paper focuses on conceptual and theoretical insights, drawing from global best practices, policy recommendations, and technological advancements. It addresses the interplay between technological innovation, policy development, and human-centric design in creating smart city ecosystems that prioritize equity, sustainability, and efficiency. Through this exploration, the paper aspires to contribute to the ongoing discourse on urban transformation by highlighting the potential of digital platforms to democratize governance and enhance the resilience of cities. It advocates for a holistic approach to smart city governance that recognizes the critical role of citizens and the importance of adaptive, real-time decision-making in navigating the challenges of the 21st century.

2. Foundations of Smart City Governance

2.1. Key Principles and Goals of Smart City Governance

Smart city governance revolves around sustainability, inclusivity, transparency, accountability, and resilience. These principles guide urban authorities in addressing complex societal, environmental, and economic challenges while ensuring equitable access to opportunities and resources. The ultimate goal of smart city governance is to improve the quality of urban life by leveraging technological advancements and fostering collaboration between stakeholders, including governments, private entities, and citizens (Agboola & Tunay, 2023).

One fundamental principle is sustainability, balancing economic growth with environmental stewardship. This is achieved through policies promoting renewable energy, efficient resource use, and green infrastructure. Inclusivity, another cornerstone, ensures that governance mechanisms address the needs of diverse communities, leaving no one behind. In addition, transparency and accountability are essential for building trust between citizens and governing bodies, ensuring that decision-making processes are open and participatory. Resilience, the capacity to adapt and thrive in the face of disruptions, is critical for smart cities in managing challenges such as climate change, economic fluctuations, and technological disruptions.

Smart city governance also seeks to integrate urban systems seamlessly. For example, transportation networks, energy grids, healthcare systems, and waste management are interconnected to operate efficiently and cohesively. The overarching aim is to create urban environments where services are optimized, economic opportunities are enhanced, and the environmental footprint is minimized.

2.2. The Role of Technology in Facilitating Transparency, Efficiency, and Inclusivity

Technology plays a pivotal role in achieving the principles and goals of smart city governance. Advanced tools such as the Internet of Things (IoT), big data analytics, artificial intelligence (AI), and blockchain foster transparency, efficiency, and inclusivity (Alahi et al., 2023). Transparency is greatly enhanced through digital platforms that enable open data sharing. Citizens can access real-time information on government initiatives, budgets, urban services, and environmental metrics, empowering them to participate meaningfully in decision-making processes. With its immutable and verifiable transaction records, blockchain technology ensures that public funds are used responsibly, thereby reducing corruption and fostering accountability (Allam & Dhunny, 2019).

Efficiency in urban management is achieved through the automation and optimization of services. IoT sensors monitor and manage resources like energy and water, ensuring minimal waste and cost. AI-driven traffic management systems analyze real-time data to alleviate congestion, while predictive analytics optimize the allocation of emergency services. Such technological interventions save time and resources while enhancing the quality of services (Rane, 2023).

Inclusivity is facilitated by digital tools that bridge gaps in communication and accessibility. Mobile apps, online forums, and social media platforms allow citizens to voice their concerns and contribute to urban planning discussions, regardless of their geographic or socio-economic status. Additionally, assistive technologies ensure that people with disabilities can access urban services without barriers. By integrating diverse voices into governance frameworks, technology ensures that the benefits of urban transformation reach all members of society (Rejeb, Rejeb, Simske, Treiblmaier, & Zailani, 2022).

2.3. Challenges in Implementing Governance Frameworks in Smart Cities

Despite its potential, the implementation of smart city governance frameworks faces several challenges, ranging from technological and economic to social and institutional barriers.

One significant challenge is the digital divide, which refers to the unequal access to technology among different demographics. Marginalized communities, particularly in low-income areas, often lack the infrastructure or digital literacy required to participate in technology-driven governance. This disparity risks exacerbating existing inequalities and undermining the inclusivity of smart city initiatives (Fang et al., 2019).

Data privacy and security also pose critical concerns. The vast amounts of data collected through IoT devices and digital platforms are susceptible to breaches, misuse, and surveillance. Balancing the need for real-time data to protect individual privacy remains a contentious issue. Governments must implement robust cybersecurity measures and establish legal frameworks to ensure ethical data usage (Reddick, Enriquez, Harris, & Sharma, 2020). Economic constraints can impede the adoption of smart city technologies. Developing and maintaining advanced infrastructure requires significant investment, which may be challenging for cities with limited budgets. Furthermore, over-reliance on private-sector partnerships can lead to conflicts of interest and compromises in public accountability (Mikhaylov, Esteve, & Campion, 2018).

Institutional challenges include the lack of coordination and standardization across different government departments and agencies. Smart city initiatives often require cross-sector collaboration, but siloed operations and bureaucratic inefficiencies can hinder progress. Additionally, the rapid pace of technological advancement may outstrip the capacity of governance institutions to adapt and regulate effectively. Social resistance is another barrier, as citizens may be wary of changes that disrupt traditional systems or perceive smart city projects as catering primarily to elites. Building trust and ensuring that benefits are equitably distributed is crucial to overcoming such resistance (Broccardo, Culasso, & Mauro, 2019).

3. Digital Platforms for Community Engagement

3.1. Tools and Technologies Enabling Public Participation in Decision-Making

Digital platforms are at the forefront of fostering community engagement in smart city governance. These platforms empower citizens to participate in decision-making by providing accessible, interactive, and transparent

communication channels. Tools such as mobile applications, web portals, and social media networks have revolutionized how citizens interact with urban authorities.

Mobile applications are widely adopted to streamline public participation. Apps designed to report issues, such as potholes, broken streetlights, or waste management problems, provide citizens with a direct line to municipal services. Platforms like SeeClickFix and CitySourced have been implemented globally to enhance civic engagement by enabling individuals to voice concerns and monitor progress (Tang, Hou, Fay, & Annis, 2021).

Web portals provide a centralized hub for urban data and public feedback. Open data platforms, such as the ones used in cities like Helsinki and Barcelona, allow residents to access information on city operations, budgets, and environmental metrics. This transparency fosters informed participation, enabling citizens to participate in policy and initiative discussions (Chamoso, González-Briones, Rodríguez, & Corchado, 2018). Social media networks are pivotal in mobilizing communities and facilitating two-way communication between citizens and local governments. Urban authorities often use platforms such as Twitter and Facebook to disseminate information, gather feedback, and engage with residents in real time. Additionally, online surveys, digital town halls, and participatory budgeting platforms enable large-scale citizen involvement in shaping urban policies and allocating resources.

Advanced technologies such as virtual reality (VR) and augmented reality (AR) are emerging as innovative tools for community engagement. These technologies allow citizens to visualize urban projects, such as new infrastructure or public spaces, enabling them to provide meaningful input before construction begins. By making abstract plans tangible, VR and AR facilitate more informed and constructive discussions (Saßmannshausen et al., 2021).

3.2. Strategies for Ensuring Inclusivity Across Diverse Communities

While digital platforms offer immense potential for community engagement, ensuring inclusivity remains a critical challenge. Effective strategies must address disparities in access, digital literacy, and representation to ensure that all citizens can participate meaningfully, regardless of socio-economic or demographic background. One key strategy is bridging the digital divide. Governments and organizations must invest in infrastructure to ensure reliable internet access and affordable digital devices for underserved communities. Public Wi-Fi zones, subsidized smartphones, and community technology hubs are practical measures to reduce inequalities in access.

Promoting digital literacy is another essential strategy. Educational programs and workshops can equip citizens with the skills to navigate digital platforms effectively. Tailoring these initiatives to different age groups, languages, and educational levels ensures that they meet the diverse needs of urban populations (Abiddin, Ibrahim, & Aziz, 2022). Multilingual and culturally sensitive platforms are crucial for engaging diverse communities. Offering content in multiple languages and designing interfaces that respect cultural nuances enhance accessibility and inclusivity. For instance, cities with multicultural populations, such as Toronto and Singapore, implement multilingual digital services to engage all residents (Cardinal, Gonzales, & J. Rose, 2020).

Addressing the needs of marginalized groups, such as individuals with disabilities or those living in remote areas, requires specific interventions. Accessible design features, such as screen readers, voice recognition, and simplified navigation, ensure that people with disabilities can interact with digital tools. Similarly, offline engagement mechanisms, such as SMS-based services, can supplement online platforms to reach communities with limited internet access.

Collaborative partnerships between governments, non-profits, and private sector entities drive inclusivity. These partnerships can pool resources and expertise to develop platforms that are both user-friendly and widely accessible. For example, partnerships with tech companies can enable the integration of advanced features, such as voice-to-text functionality for low-literacy users (Burch & Di Bella, 2021).

3.3. Benefits of Real-Time Engagement in Urban Policy and Service Delivery

Real-time engagement facilitated by digital platforms offers numerous benefits in urban policy-making and service delivery, transforming the relationship between citizens and governing bodies. First, real-time feedback mechanisms allow for dynamic policy adjustments. When citizens provide immediate input on proposed initiatives or ongoing projects, urban authorities can make data-driven modifications to better align with public preferences and needs. This iterative approach enhances policy relevance and effectiveness.

Second, real-time engagement improves the efficiency of service delivery. For instance, digital platforms with geotagging features enable rapid identification and resolution of local issues. Waste management systems allow citizens

to report uncollected garbage or traffic apps highlighting congested areas, facilitating timely interventions, reducing delays, and improving urban functionality. Third, real-time communication fosters trust and transparency between citizens and authorities. When residents see that their concerns are acknowledged and acted upon promptly, it builds confidence in governance systems. Platforms that update reported issues or project timelines ensure accountability, reinforcing public trust (Leclercq & Rijshouwer, 2022).

Moreover, real-time engagement enhances disaster preparedness and response. Digital platforms can disseminate critical information, collect citizen reports, and coordinate rescue efforts in real time during emergencies, such as natural disasters or public health crises. For example, apps like Nextdoor have been instrumental in mobilizing community responses during emergencies by connecting neighbors and sharing resources. Finally, real-time engagement encourages active citizenship. By enabling citizens to contribute to urban governance through quick and easy tools, digital platforms foster a sense of ownership and responsibility. This participatory culture strengthens social cohesion and aligns individual actions with collective urban goals (de Hoop, Moss, Smith, & Löffler, 2021).

4. Real-Time Decision-Making and Data-Driven Insights

4.1. Integration of IoT, AI, and Big Data in Urban Management

Integrating the Internet of Things, artificial intelligence, and big data analytics has revolutionized urban management by enabling real-time decision-making. These technologies create a connected ecosystem where vast amounts of data are collected, analyzed, and utilized to optimize urban systems and services. IoT forms the backbone of real-time urban management by connecting the city's devices, sensors, and systems. These devices monitor various aspects of urban life, such as traffic flow, air quality, energy consumption, and waste management. For instance, smart sensors embedded in traffic lights can adjust signal timings based on congestion levels, while air quality monitors provide data to inform public health advisories (Alahi et al., 2023).

AI plays a critical role in analyzing the vast datasets IoT devices generate. Machine learning algorithms identify patterns, predict trends, and suggest solutions to urban challenges. For example, AI-powered predictive models can forecast electricity demand, enabling utility providers to adjust supply and reduce outages. Similarly, AI-driven crime analytics can help law enforcement predict hotspots and allocate resources effectively (Rane, 2023).

Big data analytics further enhances decision-making by transforming raw data into actionable insights. To comprehensively understand city dynamics, urban management systems can process data from diverse sources, including IoT sensors, social media, and historical records. For instance, transportation agencies use big data to analyze commuter behavior, optimize public transit routes, and reduce travel times (Saggi & Jain, 2018).

The synergy between IoT, AI, and big data enables cities to operate as intelligent entities capable of adapting to real-time conditions. This integration improves efficiency and enhances sustainability and citizen satisfaction by ensuring resources are allocated where they are needed most.

4.2. Case for Real-Time Analytics in Enhancing Responsiveness and Resource Allocation

Real-time analytics has become a cornerstone of smart city governance, offering unparalleled responsiveness and resource allocation advantages. By analyzing data as it is generated, urban authorities can address challenges promptly and make proactive decisions. One of the primary benefits of real-time analytics is the ability to enhance responsiveness. For instance, real-time data from IoT sensors and social media platforms allows authorities to monitor the situation, coordinate rescue efforts, and communicate with affected populations during emergencies such as natural disasters. Early warning systems powered by real-time analytics can detect anomalies such as rising floodwaters or seismic activity, enabling swift evacuations and minimizing casualties (Shah, Seker, Hameed, & Draheim, 2019).

In public safety, real-time crime analytics have proven invaluable. Surveillance cameras equipped with AI can detect suspicious behavior and alert law enforcement in seconds. Similarly, predictive policing tools analyze historical and real-time data to forecast potential criminal activities, allowing for targeted interventions. Real-time analytics also optimizes resource allocation, ensuring that urban services are deployed efficiently. For example, smart energy grids dynamically analyze consumption patterns to balance supply and demand, reducing waste and lowering costs. In waste management, IoT-enabled bins equipped with fill-level sensors notify collection services when they are near capacity, optimizing collection schedules and reducing fuel consumption (Ardabili et al., 2023).

Transportation systems are another domain where real-time analytics excels. Traffic management systems use IoT sensors and GPS data to optimize traffic flow, reduce congestion, and improve public transit efficiency. Apps like Waze and Google Maps leverage real-time data to provide drivers with alternative routes, saving time and fuel (Wan, Ghazzai, & Massoud, 2019).

The benefits of real-time analytics extend to healthcare as well. During the COVID-19 pandemic, real-time data from contact tracing apps and hospital dashboards enabled governments to monitor infection rates, allocate medical resources, and implement timely lockdown measures. Real-time analytics improves operational efficiency and enhances residents' quality of life by enabling cities to act on data at the moment. However, its implementation requires careful planning to address data integration, interoperability, and ethical considerations (Wang, Su, Zhang, & Li, 2021).

4.3. Addressing Potential Ethical and Data Privacy Concerns

While integrating real-time decision-making technologies offers significant advantages, it raises critical ethical and data privacy concerns. These challenges must be addressed to ensure that technological advancements do not compromise individual rights or public trust. One major concern is data privacy. The vast amounts of personal and sensitive information collected by IoT devices, cameras, and digital platforms can be misused if not adequately protected. Unauthorized access to data, whether through cyberattacks or lax governance, risks individuals' privacy and security. Governments must implement stringent data protection laws and robust cybersecurity measures to safeguard citizen data.

Surveillance and ethical considerations also come into play. The use of AI-powered surveillance tools, while effective for crime prevention, can lead to over-policing or the targeting of specific communities, exacerbating social inequalities. Striking a balance between public safety and individual freedoms requires transparent governance and accountability mechanisms.

Additionally, there is a risk of algorithmic bias in AI systems used for decision-making. If the datasets used to train AI models are biased, the resulting decisions may perpetuate or amplify existing inequalities. For example, biased predictive policing algorithms could disproportionately target certain demographic groups, leading to unfair outcomes. Ensuring the ethical use of AI involves regular audits, diverse training datasets, and ongoing oversight.

Another challenge is the ownership and control of data. Private companies play a significant role in developing and operating technological systems in many smart city initiatives. This raises questions about who owns the data, how it is used, and whether it aligns with public interests. Clear regulations and public-private agreements are essential to ensure that data governance prioritizes transparency and accountability. Finally, there is a need to address public awareness and consent. Citizens must be informed about how their data is collected, stored, and used. Providing options for individuals to opt in or out of data-sharing arrangements can foster trust and mitigate resistance to smart city technologies.

5. Conclusion

Smart city governance, with its integration of digital platforms and advanced technologies, marks a significant shift in how urban centers are managed. This transformative approach combines the principles of inclusivity, transparency, and efficiency to address the multifaceted challenges of modern urbanization. Throughout this discussion, we have examined the foundational principles of smart city governance, highlighted the pivotal role of digital platforms in community engagement, and underscored the benefits of real-time decision-making. Together, these elements present a comprehensive framework for creating resilient and citizen-centric cities capable of adapting to the evolving demands of urban living.

One of the most critical insights from this exploration is the indispensable nature of inclusive community engagement. Digital platforms provide an accessible and scalable means for fostering public participation, ensuring that the voices of diverse communities are heard in policy formulation and urban planning. Furthermore, integrating real-time technologies like IoT, AI, and big data empowers city administrators to make informed decisions swiftly, optimizing resource allocation and enhancing service delivery. However, the potential of these innovations can only be fully realized by addressing underlying challenges such as digital accessibility, ethical concerns, and data privacy. These challenges underscore the need for robust governance frameworks to mitigate risks and build public trust.

To enhance the effectiveness of smart city governance, a series of targeted policies and practical recommendations must be implemented. These include establishing comprehensive data governance frameworks that prioritize transparency

and ethical data use, fostering digital inclusion by bridging the digital divide and promoting public-private collaborations to leverage the strengths of diverse stakeholders. Ethical AI practices and participatory mechanisms should also be employed to ensure fairness and accountability in decision-making. By integrating sustainability goals and prioritizing resilience, cities can align their initiatives with broader environmental and social objectives. Ultimately, the success of smart cities will depend on their ability to foster collaboration, maintain transparency, and engage citizens in meaningful ways, ensuring equitable and sustainable urban development for generations to come.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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