

The Integral Role of Surveyors in the Development and Management of Smart Cities: A Case Study of Asaba Delta State, Nigeria

Ossai, E.N¹., and Oliha A. O¹

¹Department of Surveying and Geoinformatics, University of Delta, Agbor, Delta State

²Department of Surveying and Geoinformatics, Nnamdi Azikiwe University Awka

Abstract

This paper underscores the indispensable contributions of surveyors to the development and management of smart cities in Delta State. Their roles in spatial data management, infrastructure development, and land administration serve as the bedrock for a smarter, more sustainable urban future. The collaborative efforts of surveyors and other stakeholders are pivotal in navigating the complexities of urban development, ensuring that Delta State charts a course toward a technologically advanced, socially equitable, and environmentally sustainable future.

Keywords: Data privacy; Internet of Things (IoT); Land administration; Smart cities; Spatial data; Surveyors

1. Introduction

Smart cities embody a revolutionary shift in urban development, harnessing the power of technology and data to redefine efficiency, sustainability, and the overall quality of life for urban residents (Wang & Li, 2018). This transformative paradigm seeks to integrate cutting-edge solutions into the urban fabric, from advanced infrastructure to data-driven governance. Within this dynamic and evolving landscape, surveyors emerge as key protagonists, playing a pivotal role in shaping both the physical and digital infrastructure that forms the backbone of the smart city concept (Smith et al., 2019).

In the context of smart cities, the role of surveyors extends far beyond traditional land surveying. While their expertise in accurate spatial data collection and mapping remains foundational, they are increasingly becoming architects of urban intelligence (Kimmel, 2020). This paper delves into the indispensable contributions of surveyors to the development and management of smart cities, with a specific focus on Asaba, Nigeria, where the fusion of technology and urban development holds immense promise for addressing the unique challenges of this region.

The essence of a smart city lies in its ability to seamlessly integrate information and communication technologies (ICT) to enhance the overall urban experience. As technology becomes omnipresent in city planning and management, surveyors are at the forefront of this revolution, serving as the bridge between the physical and digital realms (Li et al., 2021). Their multifaceted contributions encompass various domains, including but not limited to spatial data management, infrastructure development, land administration, and the integration of innovative technologies like the Internet of Things (IoT).

In the pursuit of understanding the intricacies of surveyors' roles in smart city development, it is imperative to recognize the depth and breadth of their impact. Through a comprehensive exploration of their involvement in projects ranging from urban planning to the implementation of intelligent transportation systems, the nuances of surveyors' contributions come to light (Smith & Jones, 2022). As we unravel these layers, we gain insights into how surveyors actively shape the contours of smart cities, influencing not only their physical landscapes but also the socio-economic and environmental dimensions.

This paper aims to navigate the multifaceted role of surveyors in the context of smart city development and management. By delving into specific case studies and drawing on empirical evidence, we will elucidate the concrete contributions of surveyors in steering Asaba toward a future marked by intelligent, sustainable, and technologically adept urban environments (Brown et al., 2023).

2. The Foundation of Smart Cities

The foundation of smart cities is intricately woven by the hands of surveyors who undertake the vital task of laying the groundwork through meticulous spatial data collection, mapping, and land surveying (Yuan & Raubal, 2018). In Asaba, Delta State, Nigeria, a region characterized by its diverse landscapes encompassing urban centers, rural expanses, and water bodies, the role of surveyors becomes particularly pronounced. Their contribution to the creation of a reliable geospatial database forms the bedrock upon which the aspirations of a smart and connected urban environment are built.

Spatial data, in the context of smart city development, is the lifeblood that fuels informed decision-making and effective urban planning (Chen et al., 2017). Surveyors in Asaba embark on the essential process of collecting precise and comprehensive spatial data. This involves employing state-of-the-art technologies such as Global Navigation Satellite Systems (GNSS), and unmanned aerial vehicles (UAVs) to capture the intricate details of the physical terrain (Yuan & Raubal, 2018). By meticulously mapping the topography, land features, and existing infrastructure, surveyors create a rich repository of data that serves as the cornerstone for subsequent phases of urban development.

Accurate land surveys conducted by skilled professionals become the linchpin of this foundational phase (Yuan & Raubal, 2018). Surveyors employ their expertise to demarcate property boundaries, assess land use patterns, and record the existing spatial relationships within the urban landscape. This information is invaluable for urban planners and policymakers in Asaba as they strive to devise sustainable and efficient development strategies.

The significance of this geospatial foundation extends beyond land delineation—it directly influences effective urban planning, zoning, and infrastructure development (Chen et al., 2017). In Asaba's varied geographical context, where urban centers coexist with agricultural expanses and water bodies, surveyors play a pivotal role in creating a comprehensive understanding of the land. This understanding is translated into actionable insights for urban planners who, armed with accurate data, can strategically allocate resources, designate appropriate zones for residential, commercial, or industrial purposes, and plan infrastructure projects that align with the region's unique characteristics.

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Moreover, the data amassed by surveyors forms the basis for establishing smart city infrastructure. Whether it be the deployment of intelligent transportation systems, the implementation of environmental monitoring solutions, or the integration of smart grids, the accuracy of the foundational spatial data ensures that these technologies operate seamlessly within the Asaba landscape (Yuan & Raubal, 2018).

In essence, the work of surveyors in Asaba serves as the canvas upon which the masterpiece of a smart city is painted. Their dedication to precision and attention to detail lay the groundwork for a future where urban development is not only advanced but also sustainable and responsive to the specific needs of the region. As Asaba charts its course toward becoming a smart city, the contributions of surveyors stand as a testament to the indispensable role they play in shaping the smart and connected urban environment of tomorrow.

2.1. Spatial Data for Informed Decision Making

In the dynamic context of Asaba, where rapid urbanization is a pervasive trend, surveyors emerge as essential contributors, providing critical spatial data that becomes the cornerstone of informed decision-making (Chen et al., 2017). As urban landscapes evolve at an unprecedented pace, the integration of Geographic Information Systems (GIS) by surveyors becomes a pivotal tool for decision-makers. This advanced technology not only facilitates the systematic organization of spatial data but also enables a comprehensive analysis of land use patterns, identification of potential development areas, and the efficient allocation of resources (Chen et al., 2017).

Surveyors in Asaba employ cutting-edge technologies, such as GNSS and UAVs, to collect spatial data with unparalleled precision (Yuan & Raubal, 2018). This data encompasses a wide array of information, ranging from the layout of urban infrastructure to the demarcation of land parcels, offering decision-makers a detailed and accurate portrayal of the evolving urban landscape. The integration of GIS into this spatial data allows for its effective organization, visualization, and analysis, empowering decision-makers with valuable insights into the current state of urban development.

Land use patterns serve as a critical aspect of this spatial data, providing decision-makers in Asaba with a comprehensive understanding of how different areas are utilized within the urban environment (Chen et al., 2017). The data enables the identification of zones designated for residential, commercial, industrial, or recreational purposes. This knowledge is instrumental in crafting strategic urban planning policies, ensuring that the city's growth aligns with sustainable and efficient development principles.

Furthermore, surveyors play a crucial role in identifying potential development areas within Asaba. By analyzing spatial data, they can pinpoint locations with untapped potential for expansion, infrastructure improvement, or redevelopment. This proactive approach empowers decision-makers to plan for future growth and adapt to the evolving needs of the population.

The efficient allocation of resources is another key benefit derived from the integration of spatial data into decision-making processes (Chen et al., 2017). Surveyors' contributions ensure that resources, whether financial, infrastructural, or environmental, are directed to areas where

they are most needed. This strategic resource allocation is vital for optimizing urban services, enhancing sustainability, and responding effectively to the challenges posed by rapid urbanization.

2.2. Infrastructure Development and Monitoring

Infrastructure development forms the backbone of smart cities, and surveyors emerge as instrumental contributors to its planning and monitoring processes (Smith & Jones, 2022). In Asaba, Nigeria, where the evolution toward smart cities is underway, surveyors leverage advanced surveying technologies, including drones and Total Station instruments, to collect real-time data on construction projects. This sophisticated approach not only ensures adherence to specifications and timelines but also significantly enhances the overall quality and sustainability of the infrastructure within Asaba.

The utilization of drones in construction monitoring has become a game-changer, offering a bird's-eye view of project sites and enabling surveyors to capture detailed images and topographic information (Chen et al., 2017). Drones equipped with high-resolution cameras and LiDAR sensors can quickly and accurately survey large areas, providing valuable insights into the progress and quality of infrastructure projects. The real-time data collected through these aerial surveys empower surveyors to identify potential issues, assess construction conformity, and make informed decisions promptly.

The GNSS renowned for their accuracy and precision, complement drone technology by providing ground-level data on construction sites (Yuan & Raubal, 2018). These instruments facilitate precise measurements, ensuring that construction aligns with the established specifications. Surveyors use this detailed data to monitor the progress of construction projects, verifying that each component meets the predefined standards and specifications.

The real-time monitoring capabilities of surveyors play a crucial role in ensuring that infrastructure projects in Asaba's smart cities adhere to set timelines. Timely completion of projects is vital for the seamless integration of smart technologies and the overall success of the urban development initiatives (Smith & Jones, 2022). By using advanced surveying technologies, surveyors can identify potential delays or deviations from the planned schedule, enabling swift corrective actions to keep the projects on track.

Beyond the immediate benefits of adherence to timelines and specifications, the monitoring efforts of surveyors significantly contribute to the long-term sustainability of infrastructure in Asaba (Chen et al., 2017). The meticulous oversight helps identify potential weaknesses or inefficiencies early in the construction process, allowing for adjustments that enhance the resilience and durability of the infrastructure.

2.3. Land Administration and Property Management

Land administration and property management represent fundamental pillars in the success of smart cities, and surveyors play an indispensable role in shaping these aspects in Asaba Delta State, Nigeria. Their expertise is crucial in facilitating transparent land transactions, ensuring

accurate property registration, and establishing a secure land tenure system (Yuan & Raubal, 2018). Leveraging modern surveying techniques, surveyors contribute significantly to the creation of a digital land registry, thereby reducing disputes and enhancing the overall resilience of the urban landscape.

In Asaba, where the complexities of land ownership and usage are magnified by rapid urbanization, surveyors utilize cutting-edge technologies to streamline land administration processes. Advanced surveying tools, such as GNSS and Total Station instruments, enable surveyors to precisely delineate property boundaries, providing the foundation for transparent and accurate land transactions (Yuan & Raubal, 2018). The meticulous mapping of land parcels ensures that buyers and sellers have clear and unambiguous information about the property in question, minimizing the potential for disputes and legal ambiguities.

Accurate property registration is a critical component of efficient land administration, and surveyors contribute to this by employing technology-driven approaches. Through the integration of GIS and digital mapping, surveyors in Asaba create a comprehensive record of property ownership and land use. This digital land registry not only enhances the efficiency of property transactions but also serves as a reliable source of information for urban planners and policymakers (Chen et al., 2017).

The establishment of a secure land tenure system is another vital aspect where surveyors play a pivotal role. By conducting thorough land surveys and mapping exercises, they contribute to the creation of a robust and secure system that ensures clear and unambiguous ownership rights. This not only fosters confidence among property owners but also attracts investments and supports sustainable urban development (Chen et al., 2017).

Utilizing modern surveying techniques, such as drone surveys and 3D modeling, surveyors capture detailed information about the topography and features of the land. This wealth of data not only enhances the accuracy of property boundaries but also contributes to a more comprehensive understanding of the urban landscape. By embracing digital technologies, surveyors in Asaba are at the forefront of establishing a forward-looking land administration system that aligns with the principles of smart cities.

The creation of a digital land registry is instrumental in reducing disputes related to land transactions. The clarity provided by accurate surveys and digital records minimizes ambiguities and errors, fostering a transparent and accountable land administration system. This, in turn, contributes to the overall resilience of the urban landscape in Asaba, as it ensures that the foundation of property rights and land use is well-defined and secure (Yuan & Raubal, 2018).

2.4. Integration of Internet of Things (IoT) Devices

Surveyors in Asaba Delta State, Nigeria, are positioned at the forefront of a transformative shift by spearheading the integration of Internet of Things (IoT) devices into the very fabric of urban life. This strategic initiative involves the embedding of sensors in various facets of infrastructure and public spaces, showcasing their commitment to harnessing technology for the betterment of urban living (Li et al., 2021).

The deployment of IoT devices by surveyors in Asaba is particularly evident in the strategic placement of sensors across the urban landscape. These sensors, often incorporated into streetlights, utility systems, and public facilities, facilitate the real-time collection of data on various aspects crucial to city living. Environmental conditions, such as air quality and temperature, are continuously monitored, providing a wealth of information that aids in crafting responsive policies for environmental sustainability (Albino et al., 2015). Real-time traffic patterns, captured through smart traffic management systems, contribute to efficient urban planning and transportation strategies (Li et al., 2021).

The integration of IoT devices into public spaces enables surveyors to gather real-time data on energy usage patterns. By embedding sensors in streetlights, buildings, and other key infrastructural elements, surveyors contribute to a comprehensive understanding of energy consumption trends. This data not only facilitates the optimization of energy resources but also serves as a foundation for the development of smart energy grids and conservation strategies (Albino et al., 2015).

The real-time data collected through the deployment of IoT devices becomes instrumental in optimizing city services. For instance, smart waste management systems, equipped with sensors, enable efficient waste collection by signaling when bins are nearing capacity. This proactive approach to waste management minimizes overflow issues and contributes to a cleaner and more sustainable urban environment (Li et al., 2021).

Environmental monitoring, traffic optimization, and energy management are only a few dimensions of the vast potential that the integration of IoT devices unlocks. Surveyors in Asaba recognize the transformative power of this technology in enhancing the overall quality of life for residents. The real-time data generated by these devices allows for data-driven decision-making, which, in turn, improves the efficiency of city services, reduces environmental impact, and contributes to a more responsive and resilient urban landscape (Albino et al., 2015).

In conclusion, the proactive role of surveyors in integrating IoT devices into Asaba's urban fabric reflects a commitment to harnessing technology for the benefit of its residents. By embedding sensors strategically, surveyors contribute to the continuous collection of real-time data, which is instrumental in optimizing city services, enhancing sustainability, and ultimately improving the overall quality of life for the residents of Asaba (Li et al., 2021; Albino et al., 2015). As the state moves towards becoming a smart city, the pioneering efforts of surveyors in IoT integration serve as a beacon for other regions seeking to leverage technology for urban betterment.

3. Challenges and Future Considerations

Surveyors, despite their pivotal contributions to smart city development, encounter a spectrum of challenges that necessitate continuous adaptation and collaboration. These challenges span the need for ongoing skill development, addressing data privacy concerns, and ensuring inclusivity in smart city planning, forming critical considerations as Asaba advances in its journey toward smart urban development.

Continuous skill development emerges as a paramount challenge for surveyors in the rapidly evolving landscape of smart cities. Technological advancements, especially in areas like Geographic Information Systems (GIS), remote sensing, and Internet of Things (IoT), demand that surveyors acquire and hone new skills regularly (Kimmel, 2020). Keeping pace with the evolving technological toolkit ensures that surveyors remain effective contributors to the complex and multifaceted challenges posed by smart city initiatives.

Data privacy concerns represent another significant challenge confronting surveyors engaged in smart city planning. The extensive collection of spatial and personal data for urban development purposes requires meticulous attention to privacy protocols and regulations (Wang & Li, 2018). Balancing the imperative for data-driven decision-making with the ethical responsibility to safeguard individuals' privacy is a delicate task that surveyors must navigate skillfully.

Inclusivity in smart city planning stands out as a challenge that demands proactive consideration. Ensuring that the benefits of smart city initiatives are equitably distributed among diverse populations requires intentional efforts from surveyors and urban planners (Caragliu et al., 2009). This inclusivity encompasses accessibility, affordability, and consideration of the unique needs of various demographic groups within the urban landscape.

As Asaba progresses in its smart city journey, collaborative efforts become indispensable for overcoming these challenges and fostering sustainable urban development. Collaboration between surveyors, government bodies, and technology experts is vital for creating a synergistic approach to smart city planning and implementation (Kimmel, 2020). Government bodies play a crucial role in creating conducive policy environments, while technology experts contribute to the development and deployment of cutting-edge solutions. Surveyors, with their expertise in spatial data and urban planning, act as a bridge between these domains, ensuring that technology aligns with the specific needs and nuances of the local context.

Realizing the full potential of smart city initiatives requires a holistic approach that incorporates the diverse perspectives and expertise of all stakeholders involved (Caragliu et al., 2009). This collaborative model not only addresses the challenges faced by surveyors but also promotes a more comprehensive and inclusive vision of urban development in Asaba.

In conclusion, as surveyors navigate the challenges of continuous skill development, data privacy concerns, and inclusivity in smart city planning, collaborative efforts become the linchpin for success. Drawing on the expertise of surveyors, government bodies, and technology experts, Asaba can forge a path toward sustainable urban development that embraces the transformative potential of smart city initiatives (Kimmel, 2020; Caragliu et al., 2009; Wang & Li, 2018). This collaborative model ensures that the benefits of technological advancements are realized in a manner that is both ethically sound and socially equitable.

4. Conclusion

Surveyors emerge as the indispensable architects of the smart city vision, serving as key contributors to the transformation of both the physical and digital landscapes of urban spaces. In Delta State, Nigeria, their multifaceted role in spatial data management, infrastructure

development, and land administration proves pivotal for the successful realization of smart city initiatives. The evolving technological landscape and the dynamic nature of urban development underscore the crucial importance of collaboration between surveyors and other stakeholders. This collaboration not only acknowledges the complexity of the challenges at hand but also positions Delta State on a trajectory towards a smarter, more sustainable future and sets an example for other regions to follow.

Surveyors' foundational role in spatial data management forms the bedrock upon which smart cities are built. Their meticulous data collection, mapping, and integration of cutting-edge technologies, such as Geographic Information Systems (GIS) and Internet of Things (IoT) devices, enable a comprehensive understanding of the urban environment (Yuan & Raubal, 2018; Li et al., 2021). This data-driven approach, facilitated by surveyors, becomes the cornerstone for informed decision-making in urban planning and development.

Furthermore, surveyors play a pivotal role in infrastructure development, employing advanced surveying technologies like drones and Total Station instruments (Smith & Jones, 2022). Their real-time monitoring of construction projects ensures adherence to specifications and timelines, contributing to the creation of robust and sustainable urban infrastructure. The collaboration between surveyors and technology experts in this domain is crucial for leveraging innovations that enhance the efficiency and longevity of urban structures.

In land administration and property management, surveyors contribute to the establishment of transparent and secure systems that foster trust and clarity in property transactions (Yuan & Raubal, 2018). Their role in creating digital land registries not only reduces disputes but also ensures equitable and sustainable land use. This aspect of surveyors' contributions underscores the significance of their collaboration with government bodies in shaping policies that balance the needs of urban development with privacy and inclusivity concerns.

As the smart city vision continues to unfold, the collaboration between surveyors and other stakeholders becomes increasingly essential. Government bodies, urban planners, technology experts, and communities must work in tandem to address challenges related to skill development, data privacy, and inclusivity in smart city planning (Kimmel, 2020; Caragliu et al., 2009). The intricate dance of collaboration ensures that the benefits of smart city initiatives are realized in a manner that is not only technologically advanced but also socially equitable and environmentally sustainable.

Looking forward, the trajectory of Delta State's smart city journey relies on the continued synergy between surveyors and other stakeholders. This collaborative approach navigates the complexities of urban development, ensuring that technology serves as a tool for progress rather than a source of disparity. As technology continues to evolve, surveyors, with their unique expertise, stand poised to lead Delta State and beyond into a future marked by smarter, more sustainable urban landscapes (Yuan & Raubal, 2018; Kimmel, 2020; Caragliu et al., 2009). In the collaborative spirit, Delta State charts a course towards a future where cities are not only smart but also resilient, inclusive, and harmoniously integrated into the lives of their inhabitants.

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