



International Journal of Advanced Research & Higher Studies (IJARHS)

Smart Rajshahi City: Challenges and Opportunities

Dr. Forhad Zahid Shaikh

Chief e-Governance

a2i, ICT Division

Ministry of Post, Telecommunication and ICT

Government of Bangladesh

Phone: +8801711618368

Email: forhad.zahid@a2i.gov.bd

ABSTRACT

Silk city - Rajshahi, recognized as the cleanest city of Bangladesh, has been implementing diversified initiatives to transform the city into a smart one aligning with the government's Smart Bangladesh 2041 vision. Bangabandhu River City, Sheikh Russel City Park, Bangabandhu Sheikh Mujib Hi-Tech Park, roads, flyovers, secondary transfer stations etc. underscore the city's commitment to progress. Recently, the Rajshahi City Corporation (RCC) has formulated a comprehensive master plan to guide the implementation of the Smart Rajshahi City initiative. This research analyzes the challenges, opportunities and their impacts that will come up during Rajshahi's smart transformation journey and provide valuable insights and recommendations. Employing a mixed-methods approach, the research utilizes questionnaires and surveys for data collection. The qualitative and quantitative data undergo thorough analysis, incorporating statistical methods to derive meaningful insights.

Keywords: *Silk City, Smart Bangladesh 2041, Rajshahi City Corporation, Master plan.*

1. Introduction

In today's world, urbanization is an irreversible global phenomenon where the majority of the global population resides either in metropolitan cities or urban areas.^[11] The rapid expansion of cities and urban zones has a significant effect on both the quantity and quality of services provided by municipal administrations to inhabitants.^[12] As the twenty-first century progresses, the pace of urbanization has accelerated, bringing with it both unprecedented potential and formidable challenges. This transformational process has evolved the concept of "Smart City" as a visionary solution to meet the demands of modern urban living.

Rapid urbanization and population growth in the cities of developing nations create a number of societal, technological, and ecological challenges. These include problems like poor governance, gridlock in the streets, inadequate housing, healthcare, and educational resources, as well as difficulties with utility management and contamination of the environment.^[13] To address these challenges, the transition to a "Smart City" emerges as a strategic approach, leveraging technologies to enhance sustainability, efficiency and quality of urban living. However, launching and carrying out smart city initiatives is not without its challenges. The difficulties include problems with technology integration, governance, infrastructure, and the requirement for large investments.^[15] Despite the fact, smart cities offer enormous potential to increase urban mobility, improve public service delivery, and create more sustainable and livable environments through the use of cutting-edge technologies, connectivity, and data-driven insights.^[14] Other advantages include better overall quality of life for citizens, more opportunities for economic growth, and more effective resource management.

The Rajshahi City Corporation (RCC) has made a crucial step toward realizing the idea of a smart city by formulating a comprehensive “Smart City” masterplan. This plan outlines a roadmap for the execution of the Smart Rajshahi City initiative, acting as a guiding framework. In order to ensure a methodical and well-coordinated approach to urban development, it delineates the principal tactics, priorities, and schedules.

Against this backdrop, the study is aimed at analyzing the prospect and challenges related to transition of Rajshahi into a smart city. As the city undergoes this paradigm shift, it is critical to understand the potential impediments and favorable conditions that may arise. Analyzing and identifying the challenges and prospects of transitioning to a smart city are imperative steps in ensuring the success of such initiatives. This research not only facilitates the development of customized solutions but also influences the choices made by stakeholders, legislators, and urban planners engaged in the smart city revolution.

This paper is structured into several sections, commencing with an introduction that outlines the research problem and the study objectives. A review of contemporary literature on the transformation of conventional cities into smart cities is presented in the second section, along with an outline of the opportunities and challenges that have been encountered in this process. The methodology employed in the smart city transformation model is described in detail in the third section. The initiatives designed to facilitate the creation of Smart Rajshahi City are then described in the fourth section. In the fifth section, specific challenges and opportunities inherent in the smart transformation of Rajshahi City are discussed. Some recommendations for transforming conventional Rajshahi City into a smart city are discussed in the sixth section. Lastly, the seventh section summarizes the conclusion.

2. Literature Review

Infrastructure, governance, and service reimaginings have been spurred in cities across the globe by trends toward urbanization and technological breakthroughs. The transformation of Rajshahi City into a smart and sustainable urban center is a multifaceted endeavor that requires a comprehensive grasp of global experiences, best practices, and the lessons learned from other cities that have navigated similar paths. This study intends to contextualize the challenges and opportunities associated with the transformation of Rajshahi City, addressing important facets of the development of smart cities. Additionally, the review covers effective case studies from across worldwide, highlighting the significance of adaptability and context-specific approaches. Through an examination of the approaches taken by cities with similar problems, this study intends to extract useful knowledge that might guide and motivate Rajshahi City's future development.

The term "smart city" represents an urban environment that makes use of technologies to improve sustainability, efficiency, and the general well-being of its residents.^[16] It involves the integration of digital technologies, data analytics, and connectivity to optimize the use of resources and provide intelligent services in a variety of areas, such as transportation, healthcare, energy, and government, by utilizing digital technologies, data analytics, and networking to maximize resource utilization.^[17]

Several developed countries have successfully transformed their cities into smart cities by incorporating technology to improve urban living. As a global leader in smart city initiatives, Singapore is noteworthy. In order to improve urban mobility, public safety, and sustainability, the city-state has adopted an integrated strategy that makes use of data analytics, the Internet of Things (IoT), and sensor networks.^[19] Technology has been

effectively incorporated into many facets of daily life in Singapore through the Smart Nation program.^[20] Barcelona has adopted a comprehensive strategy for intelligent urban growth.^[18] Efficiency and sustainability have increased as a result of the city's usage of Internet of Things (IoT) devices, such as waste management systems and smart streetlights. Barcelona's achievement as a smart city has also been significantly attributed to its dedication to citizen involvement through digital platforms. The adoption of IoT technology and significant investments in digital infrastructure were necessary for Seoul to become a smart city.^[21] The city prioritized raising public safety, advancing sustainable practices, and boosting citizen services. The experience of Seoul emphasizes the value of effective government leadership and public-private sector cooperation.^[22] Through initiatives like Copenhagen Connecting, Copenhagen has embraced the idea of a smart city. Among the initiatives are a citywide sensor network, waste management, and smart street lighting. The goal is to establish a livable and sustainable urban environment.^[23] Tokyo is integrating technology for disaster resilience, transportation systems, and efficient energy management as part of its smart city plans. The city optimizes urban services and raises general quality of life through the use of smart grids, IoT devices, and data analytics.^[24] Creating a global hub for smart cities is the goal of Smart Dubai initiative. Implementing blockchain technology for safe transactions, implementing IoT technologies to improve efficiency across multiple industries, and providing smart government services are just a few of the projects under progress.^[25] Using technology to address urban difficulties is the main goal of London's Smart London Plan^[26]. The city's sustainability and resilience are being improved through initiatives including open data platforms, smart transportation systems, and digital connectivity projects.

Smart city transformations, while promising, come with their own set of challenges^[27]. Various countries across the world have faced common hurdles in implementing and sustaining smart city initiatives. Large-scale data gathering and analysis are key components of many smart city applications, which raises questions around data security and individual privacy^[28]. Creating strong cyber security safeguards and guaranteeing the security of citizens' personal data have always been persistent challenges. Interoperability problems can arise when disparate technologies and systems from various manufacturers are integrated. The overall efficacy of smart city systems is hampered by the absence of established protocols, which interfere with smooth communication between diverse components^[29]. Major financial investments in digital infrastructure, sensors, and data analytics are necessary for the implementation of smart city technology. Many cities struggle to get the money required for large-scale smart city projects due to budgetary constraints^[30]. Inclusion and active community involvement are essential for the successful transformation of smart cities. There have been persistent issues in ensuring that the advantages of technological breakthroughs are felt by all sections of society, solving the digital divide, and encouraging meaningful citizen engagement^[31]. One major problem in smart city projects is ensuring their sustainability, both economically and environmentally. Logistically and technically, expanding successful pilot programs to encompass entire cities presents additional difficulties^[32]. Smart city development might be hindered by the lack of well-defined regulations and regulatory frameworks for new technology. In order to handle concerns with data governance, cyber security, and technological standards, countries must either modify their current legislation or enact new ones^[33].

Despite a number of challenges, the development of smart cities has led to a multitude of opportunities and advantages. The goal of smart city initiatives is to raise citizens' standard of living overall^[34]. Cities may create more comfortable and easily accessible environments that

promote well-being by utilizing technology to optimize public services, transportation, healthcare, and education.

Ecological efficiency and sustainability are two areas where smart cities may excel. Through more effective resource usage and decreased environmental impact, technologies like smart energy grids, waste management programs, and water conservation efforts help^[35].

The implementation of state-of-the-art technologies cultivates innovation ecosystems, drawing in enterprises and propelling economic expansion. Initiatives aimed at creating smart cities act as stimulants for the growth of new sectors, entrepreneurship, and jobs^{[36][37]}.

Technologies for smart cities offer solutions for better urban design. Data analytics can assist city planners create more resilient and flexible urban environments by providing information on traffic patterns, population trends, and infrastructure utilization^[38].

Through increased connectivity and accessibility to digital services, smart city projects support digital inclusion^[39]. By ensuring that a wider spectrum of citizens may benefit from technological improvements, this inclusivity lowers the possibility of a digital divide.

Initiatives for smart cities and digital platforms promote proactive community involvement. Residents can participate in projects that improve their communities' livability, offer input, and participate in decision-making processes^[40].

Climate change and other environmental concerns can be met more forcefully by a city through smart city technologies. Increased resilience can be attained through early warning systems, effective emergency response, and sustainable urban development^[41].

3. Methodology

The journey toward transforming Rajshahi into a Smart City necessitates a methodological approach that is both innovative and transformative. In this research endeavor, the chosen methodology is the Smart Bangladesh Design Lab (SDL), a dynamic and participatory framework. This section delves into the rationale behind employing SDL and how it serves as the linchpin for comprehensively understanding the challenges and opportunities embedded in the Smart Rajshahi City transformation.

SDL, with its foundation in inclusivity and meticulous planning, emerges as an ideal vehicle for this research due to several compelling reasons. The framework is not merely a set of procedures; rather, it embodies a philosophy that aligns seamlessly with the objectives of Smart Rajshahi City. At the heart of SDL lies an inclusive approach that actively involves a myriad of stakeholders. From service recipients sharing their firsthand experiences to service providers offering insights and recommendations, the methodology fosters a collaborative environment. This inclusivity ensures that the transformation journey is grounded in the real experiences and expectations of those who directly engage with the services in question.

One of the distinctive features of SDL is its emphasis on empathy development. Through a synergistic exchange between service providers and recipients, a profound understanding of service recipient experiences is cultivated. This empathy becomes a driving force in crafting citizen-centric solutions, ensuring that the transformation is not merely technological but deeply resonates with the needs and aspirations of the community.

SDL comes armed with some specialized tools and templates designed for various stages of the transformation process. These tools go beyond conventional methodologies, providing a multifaceted lens to analyze challenges and opportunities. Whether it's Existing Service Process Analysis, Time-Cost-Visit efficiency assessments, or crafting Digital Functional Scope Designs, the toolkit enables a nuanced understanding that is crucial in the complex landscape of Smart City transformation.

Smart Rajshahi City envisions a future where technology seamlessly integrates with urban life to enhance efficiency, sustainability, and the quality of life for its residents. SDL, as a methodology, shares this vision by promoting the development of citizen-centric, technology-driven solutions. The alignment of SDL with the broader Smart Bangladesh 2041 vision further substantiates its relevance in this context.

In the pursuit of transforming Rajshahi into a Smart City, the methodology employed embraces the Smart Bangladesh Design Lab (SDL) framework. This intricate and participatory approach unfolds within a compressed 6–7-day timeframe, characterized by inclusivity and detailed planning. As the linchpin of the research endeavor, SDL offers a unique lens through which challenges and opportunities in the Smart Rajshahi City transformation are deciphered.

3.1. Introduction to SDL

At the heart of the research methodology is the SDL, orchestrated by Envision, a2i, ICT Division, Bangladesh. This dynamic methodology aligns with the Smart Bangladesh 2041 vision, aiming to usher in a comprehensive digital transformation of government services.

3.2. Preparatory Activities

Before delving into the intensive 6–7-day SDL program, meticulous preparatory activities set the stage. Stakeholder sensitization, primary scope analysis, and program outlining form the foundational steps, ensuring a harmonious transition into the execution stage.

3.3. Execution (6-7 Days)

The crux of the methodology lies in the execution stage, a carefully orchestrated design and planning sprint. This synergistic approach involves the formation of several groups, each aligned with specific service scopes and the nature of activities within the relevant ministry or organization. These groups span critical domains, such as Smart Government, Smart Employment, Smart Infrastructure, Smart People, Smart City Living, and Smart Economy.

3.4. Participation of Stakeholders

A distinctive feature of the SDL approach is the active involvement of diverse stakeholders. Service recipients, armed with firsthand experiences, become integral contributors, sharing insights into service access points and articulating their expectations. Simultaneously, service providers, comprising domain experts, decision-makers, and policy-makers, share their wealth of insights, experiences, and recommendations.

3.5. Synergistic Exchange

This phase fosters a synergistic exchange of ideas and experiences. Service providers gain a profound understanding of service recipient experiences, fostering the development of empathy an indispensable element for crafting citizen-centric solutions. This exchange lays the groundwork for a transformational process deeply rooted in the needs and experiences of the end-users.

3.6. Input Compilation and Planning

The process is enriched by the active participation of ICT experts and sector-wise transformation specialists who provide invaluable insights and guidance throughout the sprint. The service provider synthesizes all inputs gathered, creating service/initiative-wise transformation scopes, budgets, and designing holistic solutions.

3.7. Major Steps during Execution

The execution stage encompasses a series of meticulously planned steps, each contributing to a comprehensive understanding of the landscape. Steps include service provider and service recipient's experience sharing, combining service journey maps, conducting Existing Service Process Analysis (ESPA), differentiating between Manual and Digital Features, visualizing Digital Dreams, crafting Digital Functional Scope Designs (DFSD), and designing smart initiatives – finally accumulating them into several projects.

3.8. Tools and Templates

Specialized tools and templates are deployed at various stages of the SDL process. These tools serve as instrumental guides in the design and planning phases, facilitating nuanced insights into the challenges and opportunities embedded in the Smart Rajshahi City transformation.

3.9. Conclusion of the Sprint

The crescendo of the sprint is marked by the presentation of the consolidated plan before decision-makers and policy-makers. This critical juncture serves as the precipice for execution-related decisions and directives, charting the course for the future trajectory of Smart Rajshahi City.

3.10. Reflection on the SDL Methodology

The utilization of SDL as the primary methodology reflects a commitment to a structured, inclusive, and citizen-centric approach. By actively involving stakeholders, including both service recipients and providers, and leveraging a comprehensive toolkit of specialized tools, SDL ensures a holistic understanding of challenges and opportunities in the Smart Rajshahi City transformation.

In conclusion, the SDL methodology stands as a powerful instrument in unraveling the complexities of Smart Rajshahi City. Its amalgamation of inclusivity, participatory design, and technological acumen provides a roadmap for navigating challenges and leveraging opportunities on the journey towards a digitally transformed future.

4. Smart Rajshahi City Initiatives

In the pursuit of transforming Rajshahi into a smart and technologically advanced city, a comprehensive array of initiatives has been devised. These initiatives, spanning diverse sectors, reflect the city's commitment to harnessing innovation for sustainable development. About 132 initiatives are found by this research. The following list encapsulates the key endeavors that constitute the backbone of the Smart Rajshahi City vision:

<i>1. Smart RCC Automation</i>	<i>2. Climate Smart Rajshahi: Establishment of Green Roofs</i>
<i>3. Smart RCC Buildings Management System</i>	<i>4. Establishment of a Solar Park</i>
<i>5. Policy and Legal Framework Design for RCC Automation, D-Nothi, and other Software Solutions</i>	<i>6. Establishment of a Climate Smart Lab</i>
<i>7. Document & Filing Management</i>	<i>8. Developing a Model of Smart Apartment Complex</i>

9. Events and Projects Management	10. Smart Rajshahi Feasibility and Design Project: Smart Rajshahi Feasibility, Design and policy Development Project
11. Installment and Establishment of RCC Resources and Infrastructure	12. Business Model Development for key infrastructures of the city
13. Design, Development, and Implementation of Smart Rajshahi App Following Human-Centered Design (HCD) Approaches	14. Rajshahi Smart Transformation Vision & Heritage Experience Centre
15. Upgradation of wireless communication (radio) services for RCC	16. Project Skill Capital: Future Skills Demand Forecasting and Publication (Global & Local)
17. Assessment, Plan, and Installation for ICT Infrastructure to Establish Smart RCC	18. Occupational Competency Standardization
19. Digital archiving (Scanning) for all hardcopy records	20. Smart Skills Lab/Workshop
21. Integrated Smart RCC Architecture and M&E Design and Implementation	22. Trainers' and Mentor Pool Development
23. Develop RCC as a Model for D-Nothi Implementation, Deployment, and Sustainable Operation	24. Promotion & awareness on Smart Skills and employment
25. Citizen-Centric experience design and culture development for RCC	26. Smart Career Guidance and Counselling
27. RCC SMART Service Delivery System	28. Smart Skills Development
29. Citizen engagement Program	30. Smart Employment Locally & Globally
31. Sustainable Operational Model development for RCC Automation and Smart Solutions	32. Expatriate Skills Acceleration
33. Rajshahi OneID Solution	34. Supervision, Monitoring and Coordination
35. Smart Rajshahi 4IR Adoption Project	36. One Student, One Laptop, One Dream (Device Support for those who can't afford)
37. 4IR Lab and learning center for Smart Rajshahi City	38. Service Aggregator Training (SAT) Program (3 Month)
39. Smart Public Care Facilities: Development of Facilities for Aged Care including well-supported Old Homes	40. Smart Rajshahi Citizen: Developing an 'Inclusive City Community' - A Citizen's Physical and Virtual Network
41. Upgradation of Existing Urban Primary Health Care Center	42. Social-Good Innovation Program to Encourage Social Businesses
43. Upgradation of Walkways as Smart and Technology-Supported with Support Services	44. Community Service Engagement Program to Encourage Youth
45. Development of 10 Mother-Child Care and Breastfeeding Centers	46. Introduction of "First LEGO League"
47. Establishment of 20 Smart Restrooms in public places	48. Introduction of "World Memory Championship"
49. Smart Public Retreat Facility Development: Establishment of Leisure, Recreation and Wellbeing Complex	50. Introduction of "Youth Leadership and Entrepreneurship Program"
51. Establishment of Rajshahi City Gate	52. Introduction of "Transformational Leadership Program"
53. Designing Smart Leisure and Recreation Programs	54. Smart Talent Hunt Program
55. Upgradation of Existing Public Spaces to Make Them Smart and Technology-Enabled	56. Rajshahi Youth Governance Core
57. Developing Multipurpose Functionality of 10 Existing Parks and Playgrounds for Different Age Groups	58. Nature Stewardship Program
59. Establishment of Riverside Multipurpose Recreational Ways and Lanes Alongside Padma	60. Smart After-School Education Program
61. Construction of Bicycle Lanes Alongside the Roads of the City and Padma	62. Be Smart Festivals & Olympiads program

63. <i>Smart Mobility and Transportation: Implementation of real-time traffic Management System (Intelligent Transport System) & AI-driven traffic management system</i>	64. <i>Smart Citizens Sensitization Program</i>
65. <i>Smart parking solution</i>	66. <i>IP Club</i>
67. <i>Zero Emission Public Transport: Rajshahi Electric BUS Development Program</i>	68. <i>Smart Rajshahi Brand Development Program: Smart Service Promotion & Branding (Smart Rajshahi APP)</i>
69. <i>Smart Charging station development</i>	70. <i>Rajshahi Community Network for Smart City</i>
71. <i>Upgradation of existing EV</i>	72. <i>Rajshahi Circle Tour Service</i>
73. <i>Electric Public Transport Installation</i>	74. <i>Rajshahi City Brand Development Program Unit</i>
75. <i>Smart City Development Coordination System (SCDC): Rajshahi Central Command and Monitoring Center</i>	76. <i>Rajshahi Going Global Program</i>
77. <i>Environmental monitoring cell (Air, Water, Noise, Temperature)</i>	78. <i>Rajshahi Tourism Development Program</i>
79. <i>Establishment of a cybersecurity & Data Unit</i>	80. <i>Smart Rajshahi Art & Street Canvas</i>
81. <i>Rajshahi Digital Twin: Smart City Web-GIS</i>	82. <i>AI-enabled Rajshahi City Guide</i>
83. <i>Smart Management of Waste: Management of Liquid Waste</i>	84. <i>Rajshahi International Food Carnival</i>
85. <i>Management of Household Solid Waste</i>	86. <i>Smart City Initiatives R&D: Diversified Dwelling Management for Rajshahi</i>
87. <i>Rajshahi Waste-to-Resource Program</i>	88. <i>Smart Mobility Framework Development</i>
89. <i>Rajshahi Regional Airport and Cargo Extension</i>	90. <i>Model Smart Eating-out Culture Development</i>
91. <i>Smart Public Safety: Conceptualization of Emergency and Security for Smart-life</i>	92. <i>Smart Well-being Ecosystem Model Development</i>
93. <i>Development of a Completely Fire-Protected Area with the Engagement of Firefighters and the Community</i>	94. <i>Clean construction program</i>
95. <i>Develop a "Total-Security" Model Ward with AI & IoT-Driven Solution and Personalized Mobile App</i>	96. <i>Smart Restaurant</i>
97. <i>Develop Specialized and Approved Security Service Program for Rajshahi</i>	98. <i>Smart Livelihood for Rajshahi: Rajshahi Smart Flee Market Management</i>
99. <i>Installation and Implementation of Hi-Tech City Surveillance System</i>	100. <i>Uplifting the Informal Livelihood Dependents</i>

5. Challenges & Opportunities

Challenges:

- Implementing a smart city definitely requires a big fat funding which can be a challenge for Rajshahi City Corporation also. However sourcing international fundings from donor bodies may reduce the pressure to some extent.
- Limited available ICT infrastructures (uninterrupted high-speed internet, top notch quality devices and networks etc.) can be a hurdle because smart city projects greatly depend on that for accomodating smart technologies.
- As a Smart City will require a number of a smart devices and of course and smart infrastructure to accommodate the smart services insuring cyber security and data privacy will be a big concern. Developing policy and guidelines will also be required to address issues like cyber security and interoperability.
- Approaches like smart city has huge dependency on different government bodies and departments. But collaboration and alignment among these bodies towards a common purpose is difficult to set due to difference in policies, functions and also mindset

- Rajshahi city has the aim to transform it into a smart city which will be highly accommodate green energy and green technologies. This approach itself is difficult to achieve because transforming into a whole new energy source for the whole city will require compatible adoption of infrastructure, devices and technologies. It's a mammoth task in terms of cost and maintaining performance. On the other hand there is no example yet in Bangladesh for this type of approach on smart city. Last but not the least, staying updated with the rapidly evolving advancements in green energy technologies may also be a bit difficult.
- Smart city implementation will generate massive amount of data from various sources. Processing and analyzing such quantity of data within seconds will be required to make crucial decisions. Ensuring reliable way for efficient and timely data processing may be a big challenge otherwise the goal of smart city implementation may get hindered.
- A big concern for government project implementation in Bangladesh's perspective is the change in leadership due to transfer or political will. Such issues have halted a number of initiatives before. This can be a challenge for Smart Rajshahi also.
- Smart city project will require a huge land area to install infrastructures (i.e. power plant, airport extension, offices, EV charging stations etc.).So, a lot of citizen land acquisition will take place which may slow down the implementation process to some extent.
- After implementation, to maintain the consistency of smart city services - managing, monitoring and accommodating necessary updates and modifications to the smart technologies will be a big challenge.

Opportunities:

- Vast area of land in Rajshahi city is unused. These land area can be utilized for installing smart infrastructures required for the smart city.
- Rajshahi is renowned for its high temperature during summer. Although it's tough for living but immensely beneficial for absorbing solar power by installing solar equipments on buildings or developing solar power plant or solar park etc. So, there is a huge potential to use this for not only solving Rajshahi's power demand but also for adding to the national grid.
- Bangabandhu Sheikh Mujib Hi-Tech Park (BSMHTP) in Rajshahi is playing a vital role in technology-based employment of thousands of youths. Spaces have been allocated for around 10 IT firms in BSMHTP. Around 14000 youths are targeted to be employed through this Hitech Park. These youths with their technological expertise can be an asset in implementing Smart Rajshahi City

6. Recommendations

The findings of this research illuminate critical facets of Smart Rajshahi City's transformation journey, offering insights into challenges and opportunities that are indispensable for informed decision-making. As we conclude our exploration, the following recommendations emerge as strategic guideposts to propel the city towards a seamlessly integrated and technologically advanced future:

6.1. Enhancing Citizen Engagement

To foster a truly citizen-centric Smart Rajshahi City, there is a paramount need for continuous and meaningful citizen engagement. Implementing digital platforms for community feedback, participation in decision-making processes, and transparent communication channels will empower residents and ensure their needs shape the ongoing transformation.

6.2. Continuous Iterative Planning with SDL

Building on the success of the SDL methodology, we recommend a continuous, iterative planning approach. As technologies evolve and urban dynamics shift, regular revisits to the SDL framework will ensure that Smart Rajshahi City remains adaptive, resilient, and aligned with the ever-changing needs of its populace.

6.3. Strengthening Digital Infrastructure

Investments in robust digital infrastructure are imperative for the sustained success of Smart Rajshahi City. This involves not only technological upgrades but also cyber security measures to safeguard sensitive data. Collaboration with technology partners and periodic audits of the digital ecosystem will fortify the city's technological backbone.

6.4. Multi-Stakeholder Collaboration

Smart city initiatives thrive on collaboration. Establishing partnerships with private enterprises, academia, and international organizations can infuse diverse expertise, resources, and innovation. A collaborative ecosystem will accelerate the implementation of smart projects and contribute to the overall progress of Rajshahi.

6.5. Data Governance and Privacy Measures

As Smart Rajshahi City becomes data-driven, robust data governance and privacy measures are imperative. Implementing stringent data protection policies, ensuring transparent data usage, and fostering a culture of responsible data management will mitigate risks and build public trust in the city's digital initiatives.

6.6. Eco-Friendly Urban Planning

Sustainable development must remain at the core of Smart Rajshahi City. Integrating eco-friendly urban planning practices, promoting renewable energy sources, and optimizing waste management processes will contribute not only to environmental sustainability but also to the well-being of the city's residents.

6.7. Smart Education and Skill Development

To harness the full potential of a smart city, investing in smart education and skill development initiatives is crucial. Fostering a digitally literate workforce, particularly among the youth, will create a pool of talent capable of contributing to and benefiting from the evolving landscape of Smart Rajshahi City.

6.8. Continuous Monitoring and Evaluation

A robust monitoring and evaluation framework is essential to gauge the efficacy of implemented smart initiatives. Regular assessments, performance reviews, and feedback loops will enable decision-makers to identify areas for improvement, refine strategies, and ensure the sustained success of Smart Rajshahi City.

6.9. Inclusive Accessibility Considerations

As technological advancements unfold, ensuring inclusivity in digital services is imperative. Smart Rajshahi City should prioritize accessibility considerations for differently-abled individuals, elderly residents, and those with limited digital literacy. This inclusivity will enhance the reach and impact of smart services across the entire community.

6.10. Public Awareness and Participation Campaigns

Building public awareness and garnering support for Smart Rajshahi City initiatives are critical. Implementing comprehensive communication campaigns, workshops, and educational programs will not only inform residents about ongoing developments but also encourage active participation and a sense of ownership in the city's transformation.

The culmination of research insights points towards strategic recommendations that seamlessly blend global best practices with the local context for the trajectory of Smart Rajshahi City. To enhance Citizen Engagement, the inspiration is drawn from Barcelona's citizen-centric approach, utilizing platforms like the "Citizen Card" for direct resident involvement (Reference: Caragliu et al., 2011). Emulating Singapore's success in Multi-Stakeholder Collaboration involving government, businesses, and academia is recommended to expedite project implementation (Reference: Yigitcanlar et al., 2015). Sustainable Urbanism should be modeled after Copenhagen's lead, emphasizing green technologies and prioritizing cycling infrastructure for a sustainable future (Reference: Girardet, 2010). For robust Data Governance, adopting Toronto's principles ensures responsible and transparent data usage, safeguarding sensitive information (Reference: Crawford & Schultz, 2014). Learning from Seoul's commitment to Inclusive Accessibility is crucial, urging Smart Rajshahi City to ensure that smart initiatives prioritize accessibility for all residents (Reference: Nam & Pardo, 2011). Finally, to achieve success in Public Awareness Campaigns, mirroring New York City's comprehensive communication strategies is recommended to inform residents and encourage active participation (Reference: Glaeser & Berry, 2006).

In synthesizing these recommendations, Smart Rajshahi City has the potential to evolve into a model of sustainable urban living, where technology seamlessly integrates with the daily lives of its residents. By adopting these strategic recommendations, decision-makers can navigate the complexities of smart city transformation, ensuring a future that is both innovative and inclusive.

7. Conclusion

The Smart Rajshahi City integrated design and plan has opened the door for a transformative growth and sustainable development. Although there are lots of challenges, there are also opportunities. The plan is ambitious but not impossible. If implemented, smart Rajshahi can be the first smart city of Bangladesh and be an example for other cities. Limited ICT infrastructure, difficult fund sourcing, threat of cyber attack and breach in data privacy, possibility of ending up the project in graveyard due to leadership change and political unrest - keeping all this challenges and others in mind, strategic planning, significant investment from Government and also from donor bodies, and a collaborative approach involving both public and private sectors may pave the way faster. However, within challenges lie the opportunities. Adopting solar may change the whole scenario because enough power supply will ease the chance of accommodating smart technologies and thus enhance urban efficiency, sustainability, and quality of life. On the other hand renewable energy source will limit carbon emission which will save the city from being polluted like other cities for example Dhaka. Implementing smart waste management systems and electronic vehicles can position Rajshahi as a model city for the future. Smart City also requires involvement of their citizens who will use the smart services. That's why Smart Bangladesh Design Lab (SDL) engaged citizens like businessman, students, Street vendors etc. in the planning and design process. The journey towards a Smart Rajshahi City is both challenging and promising. Feasible strategy that addresses limitations while leveraging technological advancements and innovative solutions may help to transform into a resilient and efficient urban landscape. So, we can say, Rajshahi has the potential to emerge not just as a smart city but as a lighthouse of inspiration for other cities of Bangladesh.

References

1. Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, 18(2), 65-82.
2. Yigitcanlar, T., Lee, S. A., & Kamruzzaman, M. (2015). Does the built environment matter? Assessing the impact of decentralized renewable energy installations on community building energy efficiency. *Renewable Energy*, 75, 730-738.
3. Girardet, H. (2010). *Cities, people, planet: Liveable cities for a sustainable world*. Wiley.
4. Crawford, K., & Schultz, J. (2014). Big data and due process: Toward a framework to redress predictive privacy harms. *Boston College Law Review*, 55(1), 93-128.
5. Nam, T., & Pardo, T. A. (2011). Conceptualizing smart city with dimensions of technology, people, and institutions. In *Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times* (pp. 282-291).
6. Glaeser, E. L., & Berry, C. R. (2006). *Why are smart places getting smarter?* Taubman Center for State and Local Government.
7. Bangabandhu hi-tech park becomes blessings for youths in Rajshahi. Retrieved from <https://businesspostbd.com/national/bangabandhu-hi-tech-park-becomes-blessings-for-youths-in-rajshahi>
8. SMART CITY CHALLENGES. Retrieved from <https://www.skills4cities.eu/blog--news/smart-city-challenges>
9. 4 challenges faced by smart cities. Retrieved from <https://www.allerin.com/blog/4-challenges-faced-by-smart-cities>
10. The Challenges and Opportunities of Smart Cities. Retrieved from <https://www.smartcity.co.nz/blog/challenges-of-smart-cities/>
11. Sharifi, Ayyoob, and Hadi Alizadeh. "Societal smart city: Definition and principles for post-pandemic urban policy and practice." *Cities* 134 (2023): 104207.
12. T. Singh, A. Solanki, S. K. Sharma, A. Nayyar and A. Paul, "A Decade Review on Smart Cities: Paradigms, Challenges and Opportunities," in *IEEE Access*, vol. 10, pp. 68319-68364, 2022, doi: 10.1109/ACCESS.2022.3184710.
13. Karmaker, Ashish Kumar, S M Rezwanul Islam, Md Kamruzzaman, Md Mamun Ur Rashid, Md Omer Faruque, and Md Alamgir Hossain. 2023. "Smart City Transformation: An Analysis of Dhaka and Its Challenges and Opportunities" *Smart Cities* 6, no. 2: 1087-1108. <https://doi.org/10.3390/smartcities6020052>
14. A. Caragliu, C. D. Bo and P. Nijkamp, "Smart cities in Europe", *J. Urban Technol.*, vol. 18, no. 2, pp. 65-82, 2011. 15.
15. Liang, Longwu, Zhenbo Wang, and Jiabin Li. "The effect of urbanization on environmental pollution in rapidly developing urban agglomerations." *Journal of cleaner production* 237 (2019): 117649.
16. Al Sharif, Reem, and Shaligram Pokharel. "Smart city dimensions and associated risks: Review of literature." *Sustainable Cities and Society* 77 (2022): 103542.
17. Singh, Jagendra, et al. "Artificial Intelligence and Blockchain Technologies for Smart City." *Intelligent Green Technologies for Sustainable Smart Cities* (2022): 317-330.
18. Bakıcı, Tuba, Esteve Almirall, and Jonathan Wareham. "A smart city initiative: the case of Barcelona." *Journal of the knowledge economy* 4 (2013): 135-148.
19. Cavada, Marianna, Miles R. Tight, and Christopher DF Rogers. "A smart city case study of Singapore Is Singapore truly smart?." *Smart city emergence*. Elsevier, 2019. 295-314.
20. Shamsuzzoha, Ahm, et al. "Smart city for sustainable environment: A comparison of participatory strategies from Helsinki, Singapore and London." *Cities* 114 (2021): 103194.
21. Joo, Yu-Min. "Developmentalist smart cities? The cases of Singapore and Seoul." *International Journal of Urban Sciences* 27.sup1 (2023): 164-182.

22. Lim, Yirang, Jurian Edelenbos, and Alberto Gianoli. "Dynamics in the governance of smart cities: Insights from South Korean smart cities." *International Journal of Urban Sciences* 27.sup1 (2023): 183-205.
23. Ateş, Mücella, and Deniz Erinsel Önder. "A local smart city approach in the context of smart environment and urban resilience." *International Journal of Disaster Resilience in the Built Environment* 14.3 (2023): 266-284.
24. Yamashita, Jun. "Impacts of the First to the Second Generation of Smart City Initiatives in Japan." *SMART CITY 2.0: Strategies and Innovations for City Development*. 2023. 195-212.
25. El Khatib, Mounir, et al. "Interdependencies and Integration of Smart Buildings and Smart Cities: A Case of Dubai." *The Effect of Information Technology on Business and Marketing Intelligence Systems*. Cham: Springer International Publishing, 2023. 1637-1656.
26. Brown, Will, Melanie King, and Yee Mey Goh. "UK smart cities present and future: An analysis of British smart cities through current and emerging technologies and practices." *Emerald Open Research* 1.5 (2023).
27. Mora, Luca, et al. "Smart city governance from an innovation management perspective: Theoretical framing, review of current practices, and future research agenda." *Technovation* 123 (2023): 102717.
28. Telo, Joan. "Smart City Security Threats and Countermeasures in the Context of Emerging Technologies." *International Journal of Intelligent Automation and Computing* 6.1 (2023): 31-45.
29. Karduri, Rajini Kanth Reddy, and Christo Ananth. "Sustainable Urban Energy: Integrating Smart Grids into Smart Cities." This paper has been published in *International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)* DOI 10 (2023).
30. Khang, Alex, et al., eds. *Smart Cities: IoT Technologies, big data solutions, cloud platforms, and cybersecurity techniques*. CRC Press, 2023.
31. Anthony Jr, Bokolo. "The Role of Community Engagement in Urban Innovation towards the Co-Creation of Smart Sustainable Cities." *Journal of the Knowledge Economy* (2023): 1-33.
32. Mora, Luca, et al. "Smart city governance from an innovation management perspective: Theoretical framing, review of current practices, and future research agenda." *Technovation* 123 (2023): 102717.
33. Noori, Negar, et al. "Transplanting good practices in Smart City development: A step-wise approach." *Government Information Quarterly* 40.2 (2023): 101802.
34. Chen, Zhaoyu, and Irene Cheng Chu Chan. "Smart cities and quality of life: a quantitative analysis of citizens' support for smart city development." *Information Technology & People* 36.1 (2023): 263-285.
35. Su, Yiyi, and Di Fan. "Smart cities and sustainable development." *Regional Studies* 57.4 (2023): 722-738.
36. El Khatib, Mounir M., et al. "Dubai Smart City as a Knowledge Based Economy." *The Effect of Information Technology on Business and Marketing Intelligence Systems*. Cham: Springer International Publishing, 2023. 1657-1672.
37. Mitra, Somnath, et al. "Entrepreneurship in smart cities: Elements of Start-up Ecosystem." *Journal of Science and Technology Policy Management* 14.3 (2023): 592-611.
38. Bibri, Simon Elias. "Data-driven smart eco-cities of the future: an empirically informed integrated model for strategic sustainable urban development." *World Futures* 79.7-8 (2023): 703-746.
39. Lee, Juhyun, et al. "Smart city as a social transition towards inclusive development through technology: a tale of four smart cities." *International Journal of Urban Sciences* 27.sup1 (2023): 75-100.

40. Pansera, Mario, et al. "Exploring citizen participation in smart city development in Mexico City: An institutional logics approach." *Organization Studies* 44.10 (2023): 1679-1701.
41. Bianchi, Isabella, and Lucas Schmidt. "The Smart City Revolution: Design Principles and Best Practices for Urban Transformation." *Eigen Pub Review of Science and Technology* 7.1 (2023): 55-70.

