Designing a conceptual framework of a smart city for sustainable development in Bangladesh

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Abstract. A smart city is a future solution to better management of the city and people. Recent researches have highlighted the necessity of smart city projects to improve urban lifestyle for the growing population. Bangladesh is one of the most densely populated countries in the world. Despite being a developing country, Bangladesh still lacks a smart city. A smart city framework is required to ameliorate urban lifestyle. The purpose of this study is to address a conceptual framework for a smart city project focusing on sustainable development in Bangladesh. The research approach follows an exhaustive literature review to collect suitable information to design the new smart city framework. Necessary information to design a smart city framework such as the core smart city dimensions and the sustainability indicators are identified through the thorough literature review. From the extracted information a new smart city framework is developed focusing on sustainable development. The findings of this study offer a clear overview of the smart city core dimensions and factors that influence sustainability in a smart city. The research presents a smart city framework that can be followed in a developing country like Bangladesh.

Keywords: smart city, framework, sustainable development.

1. Introduction
Bangladesh is a developing country. According to the Bangladesh Bureau of Statistics, there are 532 urban centers in Bangladesh. The rapid growth of the population in Bangladesh makes the city life more challenging. Every day more and more people are migrating to the cities from rural areas for better livelihood. The management and governance of the cities are becoming harder than before due to the increasing population. In these circumstances, sustainable smart city projects can be a solution for a better urban lifestyle in Bangladesh.

The concept of a smart city is fuzzy and inconsistent. The label “smart city” is sometimes replaced with other adjectives like the digital city, eco-city, knowledge city, or intelligent city. Despite its popularity, it is difficult to find a prevalent or universally acknowledged definition of a smart city. Stated by Meijer and Bolivar [1], there are three different kinds of ideal-typical definitions of the smart city. They are – technology-focused, human-resource focused (smart people) and governance focused such as smart collaboration among the government and the citizens. V. Fernandez-Anez [2] defined a smart city as a system that interacts with natural and economic resources via technology-based solutions and intensify human and social capital properly. Regarding public engagement, smart cities are divisible into three groups: bottom-up, beneficial, and techno smart cities [3]. Lara et al. [4] defined the smart city as an umbrella concept holding several sub-concepts such as smart technology, smart governance, smart
transport system, smart health management, smart economy, smart economy, and so on. The expected outcomes of smart city projects are sustainability, the livability of the citizen, improved quality of life, equity, and resilience [5].

A smart city has some unique characteristics than traditional cities. According to M. Angelidou [6], a smart city can hold a variety of characteristics based on distinct domains like technology-centric, development of human resource and social status, promoting the entrepreneurs, information security and privacy, adapted strategies, top-down management, networking, an explicit strategic framework, exchange of information, interdisciplinary planning, and general collaboration. The fundamental characteristics of a smart city are high-speed broadband connection plus quick data management. The strategy that lies beneath a highly effective and demand-responsive smart city project is to create a clever combination and connection between these characteristics and overcome the challenges deliberately.

A smart city project requires having a clear concept of sustainable urban development. According to the United Nations [7], “sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” A recent review study by Yigitcanlar and Kamruzzaman [8] found out that cities need to be sustainable before they become smart. Despite incorporating several dimensions, smart cities cannot successfully achieve sustainable goals in practice rather than using technology [9], [10]. A smart city faces difficulties to meet the sustainable goals because of its high-tech requirements, the complexity of practices, and conceptualizing the smart city idea in an ad-hoc manner [8]. T. Yigitcanlar et al [8] found that smart cities practice a genuine and progressive approach that easily reaches a sustainability goal. The study approach dealt with quick practice and policymaking to achieve the set goal of a smart and sustainable city.

This study aims to present a conceptual framework for smart cities which is expected to be a major turning point for sustainable development in Bangladesh. The study searches for other successful sustainable smart city models and case studies to create a new framework. The research also recommends the elements which must be met for the smart city initiative in the Bangladeshi context. The outcome of this study provides a conceptual model of a modern smart city for Bangladesh. The model includes the core smart city dimensions and sustainability indicators with the technological backbone. The whole smart city architecture stands on four generic smart city pillars. The new smart city framework shows a proper relationship between the smart city components.

2. Proposed Method
This study follows a qualitative research method based on a thorough literature review. Figure 1 is showing the proposed research methodology for designing a sustainable smart city framework.

![Figure 1: Research methodology for sustainable smart city framework design](image)

The literature review process takes two approaches. The initial literature study focuses on finding papers related to this study and screening them according to quality and relevant information. The initial approach also focuses on identifying the major smart city dimensions. Initially, relevant studies published in reputed journals and conferences for the last five years are collected. Assuring the quality of the literature to SCImago Journal Rank (SJR indicator) is followed. The journals bearing highest rank Q1 to least Q4 has been considered as a good source of information. The core smart city dimensions are identified from the selected papers. The rigorous literature study reviews the current smart city
frameworks in practice according to various dimensions which helps to extract the factors for a sustainable smart city. The extracted factors are used to design our smart city framework for sustainable development. This study however is different from other existing studies in this sector. The focus on sustainable development, extracting the factors for smart city core dimensions and smart city sustainability dimensions combined with smart city pillars, makes this framework unique than other existing frameworks.

3. Result and Discussion:

According to the literature review findings, the smart city’s core dimensions are smart governance, smart people, smart economy, smart mobility, smart living as well as smart environment [11]–[13]. We identified the sustainability dimensions that influence the sustainability of a smart city. Table 1 is showing the sustainability dimensions derived from recent existing literature.

| Sustainability Dimensions                              | References |
|--------------------------------------------------------|------------|
| Transport/Mobility                                     | [14], [15] |
| Power system / Energy                                  | [16]       |
| Environment                                            | [17]       |
| Resource (Natural and Human Resource)                  | [18]–[20]  |
| Education                                              | [21]       |
| Public safety                                          | [22], [23] |
| Healthcare                                             | [15]       |
| Data security and privacy                              | [24]       |
| Land use                                               | [25]       |
| Waste management                                       | [26]       |

Table 2: Smart City Projects Focuses on Sustainability Dimensions and their Contributions

| Ref. | Year | Focus                  | Purpose                                                                                       | Merits                                                                 |
|------|------|------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| [14] | 2018 | Transportation         | Optimizing transport system and reduce carbon footprints                                     | Optimized transportation routes and less CO₂ emissions                 |
| [16] | 2016 | Power system / Energy  | Efficient resource utilization using smart technology in the photovoltaic connected grid system | Efficient power utilization, forecast, and smart suggestion             |
| [17] | 2018 | Environment            | Environmental sustainability solution for smart cities                                       | A framework for future use in smart cities to achieve environmental sustainability |
| [18] | 2019 | Resource management    | Developing a sustainable algorithm to minimize electric drains thus prolonging a smart city’s battery lifetime | Optimized power and energy                                             |
| [19] | 2018 | Human resource management | Knowing the HRM role towards exploiting and exploring the smart city projects’ alliances | Guidelines to multinational enterprises to adapt HR practices in a smart city context |
Table 2 is showing a summary of the recent researches focuses on the smart city sustainability dimensions, tools, or methods used and their contributions. From Table 1 and Table 2, we can say that the major sustainability dimensions of a smart city are transport, education, public safety, land use, data privacy and security, energy, environment, resource, healthcare, and waste management. B. Silva et al. mentioned four pillars on which a smart city can be based – institutional, physical, social, and economic ‘infrastructures’ [27]. We designed our new smart city framework based on the smart city core dimensions, the sustainability indicators, and the generic smart city pillars.

Figure 2 is showing our new smart city conceptual framework for sustainable development. In our conceptual framework IoT, Big Data, and cloud technology are working as a backbone. The smart city core dimension surrounded the backbone creates an interconnected combination and network of the dimensions. These core dimensions communicate between the sustainability factors by exchanging data and information. The technological backbone, the core dimensions, and the sustainability dimensions based on the institutional infrastructure, physical infrastructure, social infrastructure, and economic infrastructure. In the whole process, citizens engage actively to improve the quality of life. The success of the smart city project following this framework depends on the proper alignments of these factors with each other.

A smart sustainable city requires fast public transport as mobility is a prominent requirement in this development. The citizens need to move quickly to increase overall productivity. People need quality education to be smart. From primary to higher education, the quality of all educational sectors must be monitored updated with new concepts, methods, and techniques. Ultimately, smart educated people will serve for a long time with a significant contribution. The government must ensure public safety, data
privacy, and security for better management. Lands and living zones must be utilized smartly to support the increasing number of inhabitants. One essential building block of a sustainable smart city is the smart economy. Investment in the urban sectors can act as ‘engines of a smart economy’ in a smart city. The healthcare system must be smart to ensure the quality of medical treatment of the citizens. Smart resource management will ensure the maximum utilization of the limited assets for a longer time.

For the successful implementation of this framework, we recommend a four-step strategy for Bangladesh. Figure 3 is showing the recommended strategy steps. Initially, Bangladesh needs to develop its technological background and fulfill the requirements of fundamental requirements for a smart city such as high-speed internet. Secondly, the existing megacities like Dhaka and Chattagram should be developed into the first smart cities. Thirdly, new small smart city projects should be started along with turning the existing medium and small cities into a smart city. Finally, smart cities must integrate by exchanging data and information.

![Figure 3: Strategy recommendation for smart city projects in Bangladesh](image)

4. Conclusion
A smart city’s success heavily depends on project sustainability. In this paper, a conceptual framework in the context of sustainable development is proposed. From a rigorous literature review, the smart city core dimensions and sustainability factors are identified. The new framework is designed based on the smart city core dimensions and sustainability factors and technological background. The total structure stands on four generic pillars. The citizens actively engage in the whole process to make better livability. The research recommends a strategy process to begin a smart city initiative in Bangladesh. This work preliminarily contributes to the development of a smart city in Bangladesh for a sustainable future. However, further researches must be done if the new framework is appropriate for building a sustainable smart city.

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