Systemic Approach to Smart Urban Transformations of Cities Case of Muscat- Oman

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Abstracts: A smart city concept ensures sustainable development and addresses urgent urban, social, economic, and environmental concerns. Smart cities have significant potential for improving the economy and living conditions of cities and their residents; however, this potential has yet to be fully realized in many countries. Given its escalating urban challenges, the current international smart-city frameworks and models are insufficient to enable developing cities, such as Muscat city of Oman, to implement the smart-city concepts successfully. Literature review and previous studies indicate a lack of studies on systematic methodologies and standards to manage, initiate, and process the urban transformation towards smart cities in developing countries. It is due to a lack of knowledge regarding the unique characteristics of methodological frameworks for smart transformation tailored to each country's social, economic, and political circumstances. This paper aims to present an integrated methodological framework for urban transformation in the context of the social, economic, and governmental factors that affect each country's approach to smart and sustainable cities. The study depended on a qualitative and critical analysis of a selective body of literature and studies. The study presents a framework that differs from previous frameworks presented in the context of developing countries as it includes: the stages of preparation, groundwork, and setting of the basis for the city, as well as the importance of these stages in building the bridges between reality and hope; KPIs at different stages allow comparison of city performance before and after based on a smart urban transformation model, a smart city planning strategy, and an Omani case study focused on the smart cities concept. Finally, the study ends by presenting a proposed model, "CLEVER", that is assumed to be an effective approach to the smart transformation of cities in developing countries such as Muscat-Oman.

Keywords: Smart, Sustainable city, Urban transformation, Omani cities, Strategic urban planning.

1. INTRODUCTION

Smart Cities as a Solution for Urbanization Challenges

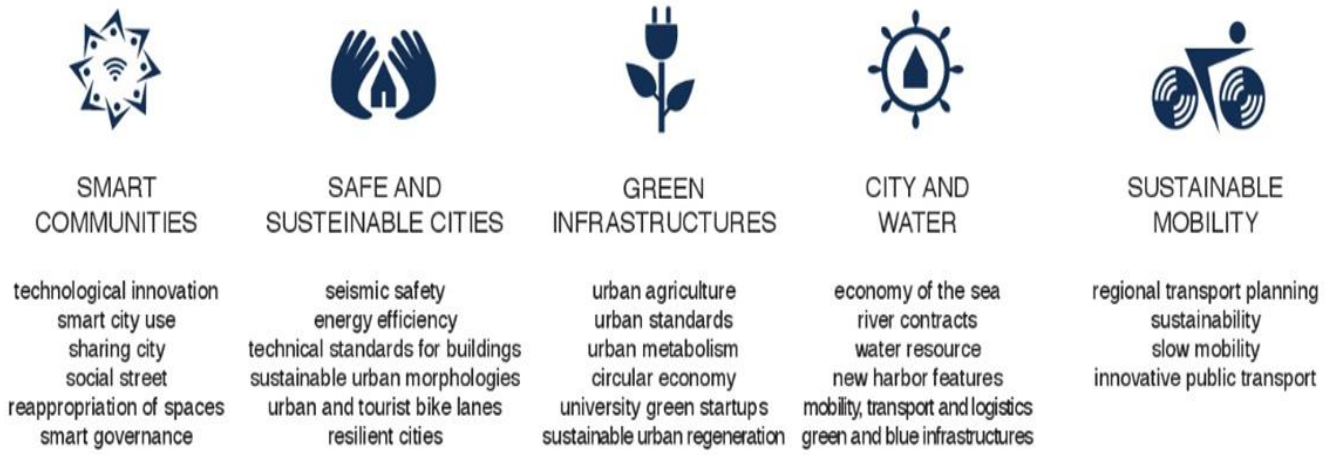

Figure 1. Smart City and Urbanization Challenges.
Source: Zigurat Global Institute of Technology- Barcelona [45].

The phenomenon of worldwide urbanization poses the question of whether urban areas can accommodate the additional 2.5 billion people predicted to live there by 2050 and the environmental and social consequences this

shift might produce. Many experts have stated that smart cities are the best strategy for meeting the challenges posed by urban growth and achieving sustainable development objectives (Figure 1). A comprehensive understanding of how smart city works is imperative. *Oman*'s cities are similar to the rest of the world regarding building a sustainable or smart city. The *Sultanate of Oman* has made several remarkable achievements during its development. A recent effort to achieve that goal is Oman Vision 2040, which outlines the country's future planning. By empowering local citizens through their involvement and participation in several aspects of city management, the vision laid the foundation for 12 national priorities [37]. Oman's development is linked to the global Sustainable Development Goals (*SDGs*). Specifically, the ninth national priority, "*Developing Governorates and Sustainable Cities*", aims to address global challenges like poverty and inequity and to give all citizens equal opportunities for prosperity by transforming Omani cities into *Smart Sustainable Cities SSCs* with advanced *Information Technology* IT infrastructure that promote social justice and equality for all members of society [37].

The idea of a sustainable smart city has become a model for city development. Cities such as *Muscat- Oman,* are interconnected and interactive at all levels, thanks to technological and information technologies; on the contrary, traditional city systems mainly operate in isolation status [39]. Information and communication technology (ICT) is the bridge that connects them [32]. In a connected city, the city systems work as a single entity, which helps in improving the city's performance in all areas and improving its quality of life. The idea of a smart city limits itself to formation and management yet also considers human and workforce development. Hence, it has been decided that the Sultanate will implement a smart city initiative to offer advanced services to its citizens (Figure 2). This solution aims to establish a three-dimensional city encompassing a city's geographical, social, and economic dimensions using modern technology. This approach will enable urban communities to create advanced and smart Omani cities that stimulate growth and are safe homes. In the next phase of the Sultanate's development, efforts will ensure that all its citizens can access successful sustainable development [40].

As a result of equitable development, the value chain will be integrated among governorates, and people's living standards will be raised. As part of the development planning for the governorates, available resources will be exploited, whether current or future, and public utilities and services will be integrated. It is imperative to acknowledge that governorates differ from one another.

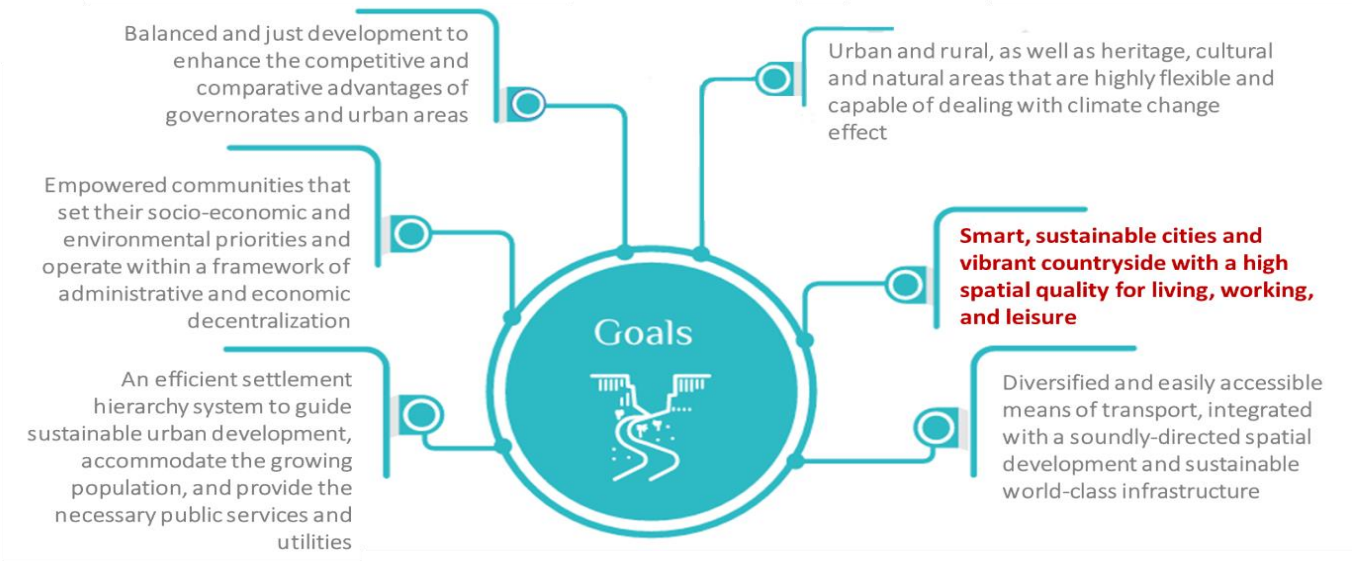

Figure 2. Comprehensive geographical development, following a decentralized approach, that develops a few urban centres and utilizes land in an ideal and sustainable way- Main goals.
Source: [Available online: OmanVision2040-Preliminary-Vision-Document.pdf]

Despite daunting infrastructure challenges worldwide, smart city technologies are transforming the economics and nature of infrastructure. By using technology, it is possible to gather information on usage patterns at a lower

physical cost and transaction cost. As a result, cities can leverage existing infrastructure systems more effectively with an unprecedented volume of data available to them.

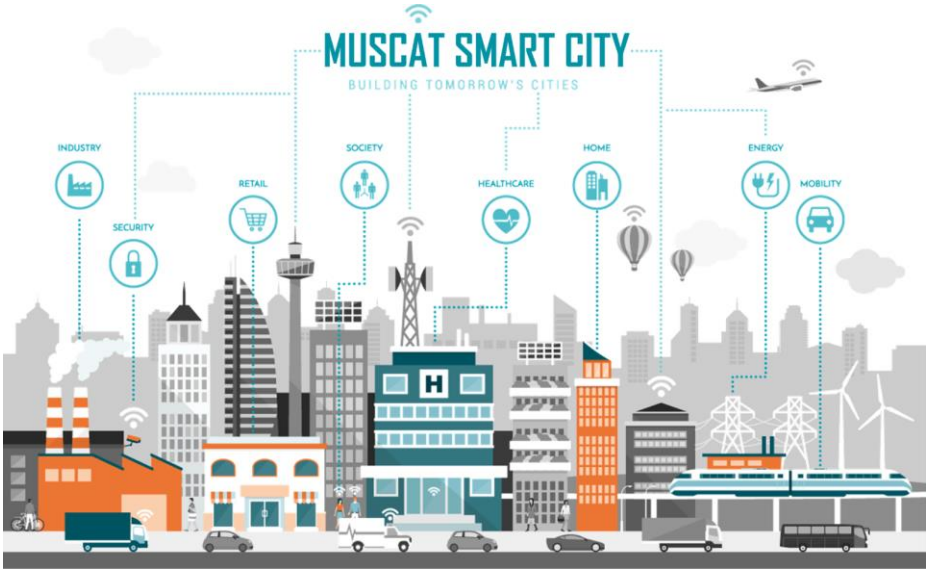

Figure 3. Muscat Smart City, the Vision of Tomorrow.

By tapping into smart systems, *Muscat city* authorities can improve efficiency by watching events unfold, analyzing demand patterns, and responding faster and often at lower costs. Figure 3 indicates some of these relevant categories. However, adding an intelligence overlay can help *Muscat* governorate make the most of its existing assets and extend its lifespans. Embedding smart technologies from the outset can ensure investments go further, even in new urban development. To meet this challenge, the application of city solutions focusing on smart urban planning and transformation processes faces challenges that differ from city to city. [18] The organizational and administrative approach problem is urgent and will be discussed in the next section.

2. RESEARCH PROBLEM (Urgent Need for Muscat's Transformation to a Smart City)

The wealth that came with the oil industry was followed by huge demographic changes and the challenges of an increasing population, both by internal and external migration (see [37,38]). Especially the Muscat Capital Area (MCA), located in the Al Batinah coastal plain, faced massive changes. As shown in Figure 4, "Oman has experienced an era of intensive and rapid modernization, and the Capital Area of Muscat is undergoing an almost unprecedented process of urbanization" [37].

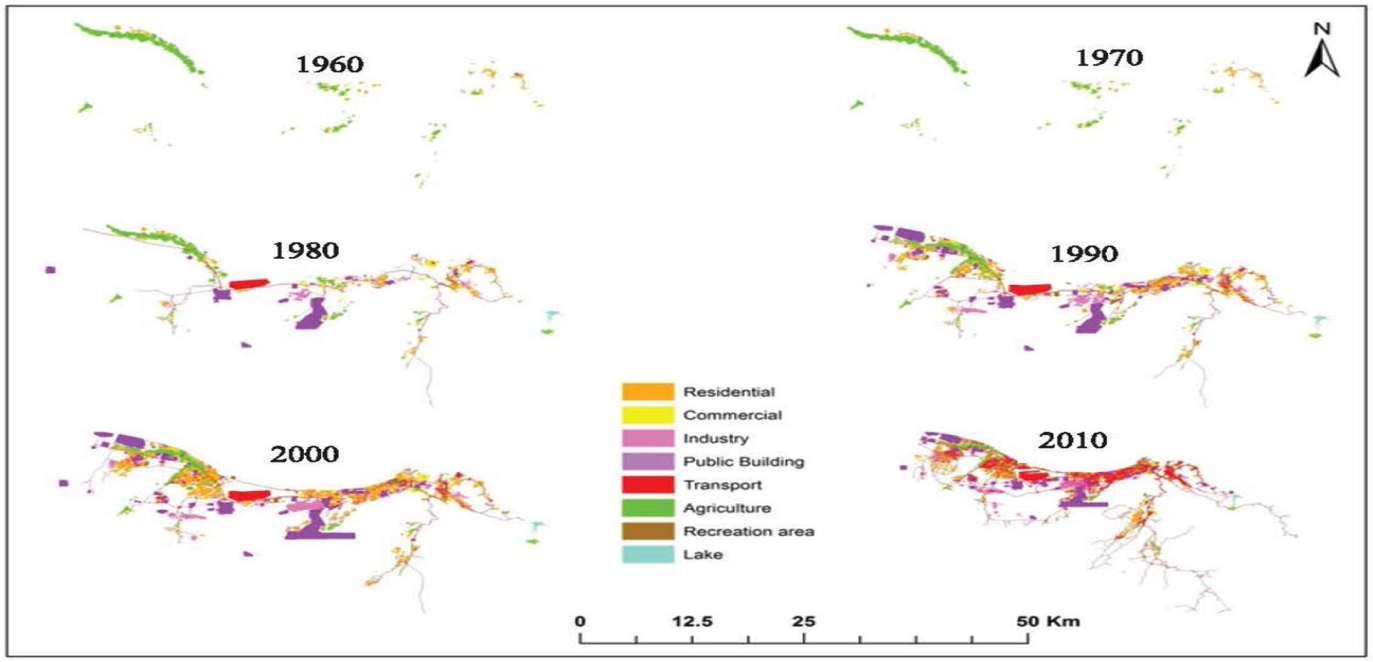

Figure 4. Urban Development and Land use of Muscat (1960-2020).

Source: Appropriate Housing Typologies, Effective Land Management and the Question of Density in Muscat, Oman- Wolfgang Scholz,2ORCID (2021).

Uncontrolled urbanization would lead to serious problems that could affect the city and its residents. Those problems could be categorized as; Housing Problems, Overcrowding, Unemployment, Development of Slums, Water and Sanitation Problems, Poor Health and Spread of Diseases, Traffic Congestion, and the increase in Urban Crime rates.

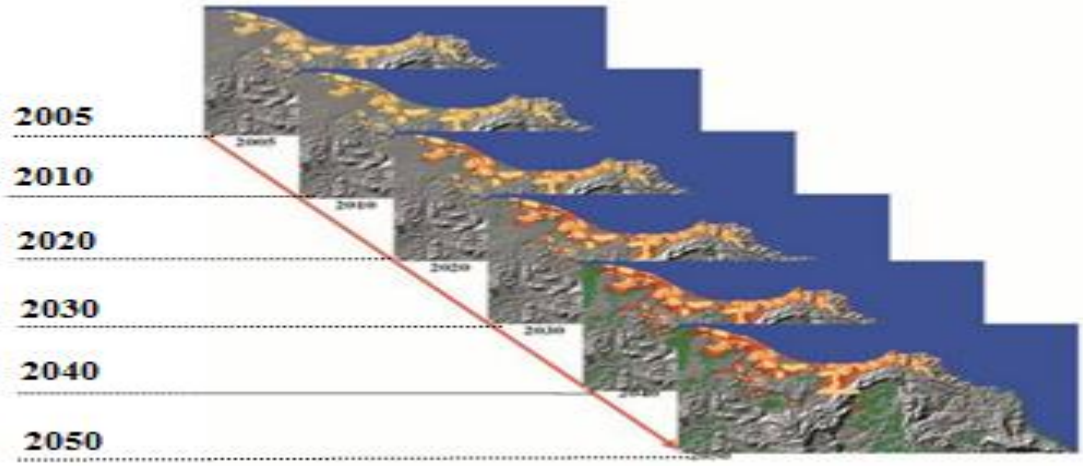

Figure 5. GIS Simulation for Urban expansion in Muscat (2005-2050).

Source: Al Awadi (2008).

Muscat will face challenges in meeting the needs of its growing urban populations, including housing, transportation, energy systems and other infrastructure. Employment and basic services such as health care and education are also affected. The importance of integrated policies to manage urban growth that guarantee all access to infrastructure and social services will grow in this context. By having access to such information, countries can improve the planning and administration of their cities (and even their entire countries) and develop a sustainable development plan that maximizes economic opportunities for their people while minimizing environmental damage. Proper administration and projection of city development require a detailed understanding of what is happening within the city and around the city. Cities and humanity are looking for a way forward. Smart

cities are easier to develop in countries with advanced technology, powerful resources, and effective city-planning strategies [37].

The main problem of this research is not to provide solutions or benefits of the concept but to provide a systematic approach and a logically applicable methodology that can be applied to Oman's case or any similar countries that need unique circumstances of management and resources. The lack of methodologies and local approaches to initiate such transformation is a phenomenon. In brief, the problem statement can be stated as:

"Developing countries lack the research capacity necessary for city initiatives to achieve sustainable smart cities; Oman's smart cities transformation processes lack methodologies and metrics for management and implementation".

3. STUDY OBJECTIVES

As a result, and based on the issues discussed above, a comprehensive, integrated methodological framework is a must. Using a detailed methodological framework for urban transformation towards a smart sustainable city in the Omani context will be a bridge between the knowledge gap in the methodological frameworks for smart transformation in the Omani context and executive and academic fields of practitioners such as planners, policymakers and other key stakeholders in an effective action plan, initiatives and programs for the implementation of sustainable smart cities with the ensures of effectiveness and efficient way.

Hence, the main aim is to:

"Create a model that links the methodology of the transformation process, the smart sustainable city and the methodology of strategic planning for urban development".

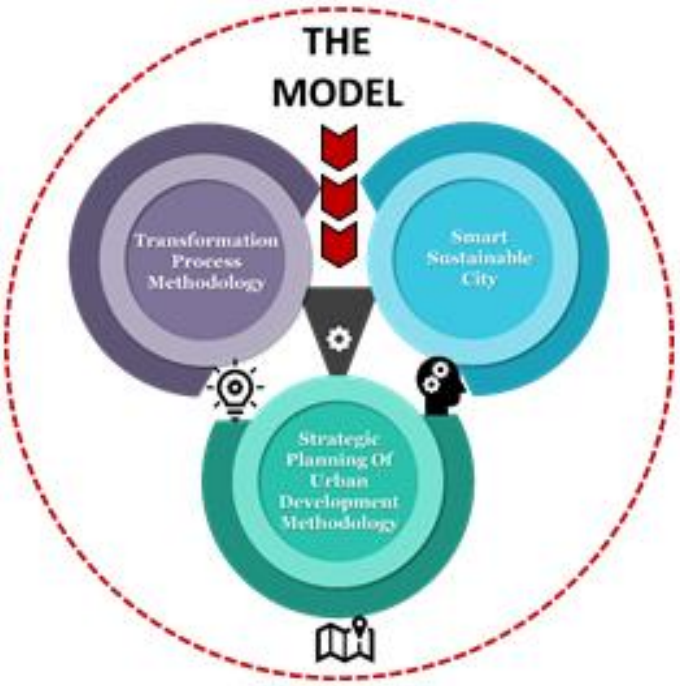

Figure 6. Linking the Three Interconnected Methodologies.

4. METHODOLOGY

This study is based on a qualitative and critical analysis of a selective group of literature and previous research, including refereed academic articles published in scientific journals, conferences, reports, documents, and articles published on the internet. This review was conducted primarily to acquire conceptual knowledge of smart transformation and its main issues. Moreover, the study focuses on examining the methodologies of the strategic planning process for urban development and the context of the Omani case with respect to smart cities. This critical

review of frameworks and roadmaps for the transformation of Omani cities towards sustainability was conducted to identify the stages for developing an integrated systemic framework for the smart transformation that can be applied to Omani cities.

The framework proposed by Ibrahim, M., El-Zaart, A., & Adams [28] was used to construct the proposed methodological framework. The proposed framework was developed based on three references: 1) A theoretical, logical model of the smart urban transformation process. 2) The methodological model of the strategic planning process for urban development; 3) The Omani case context regarding the smart city concept application.

This framework provides a basis for developing and setting realistic, effective, and applicable action plans, initiatives, and programs compatible with the Omani context rather than adopting unsuitable foreign policies and strategies. A comprehensive survey was conducted using the EBSCO, Elsevier: ScienceDirect, and SAGE Springer databases through the *Masader* – Oman Virtual Science Library "https://www.masader.om/" to access the relevant literature and references. To find the available literature on the topic of study. To identify the relevant articles for review, all refereed books and scientific papers published in refereed journals on smart cities available in the sources mentioned above from January 2010 to September 2022 were reviewed to cover all aspects that affect the construction of the methodological framework to be proposed, three sets of search terms were used: 1) "smart city", "sustainability", and "urban transformation framework" as terms for the combined research process and the result resulted in 60 scientific references in the English language; 2 "smart city" and "sustainability" and "strategic urban planning" 53 scientific references were also found; 3) "smart city" and "Oman" 3 references were obtained.

The total number of references obtained was 116, which met the essential search criteria; 54 articles were deleted due to the distance of their field from the field of study or repetition. Following the preliminary analysis by reading the summaries, 23 scientific papers were excluded, and the latest references were taken. The references were selected and identified to contribute to the following:

- **Identifying** the frameworks proposed in the literature and previous studies (focusing on the context of developing countries, especially the Omani case), to identify the knowledge gap and shortcomings in those frameworks.
- **Forming** a clear, comprehensive, and integrated picture of the process of smart urban transformation (the phenomenon of urban transformation and its relationship to the smart, sustainable city, the importance and advantages of smart transformation as a strategic option, the driving forces, components and pillars of the process of smart urban transformation), with
- **Building** a logical and modern realism theoretical model for intelligent urban transformation.
- **Identifying** the strategic planning model for sustainable urban development and its importance in the transformation process towards a smart, sustainable city.
- **Reviewing** Omani experience with smart cities and strategic urban planning. In addition, it identifies the opportunities and challenges facing smart city applications in Omani cities.

As a result, the list of references was limited to 39 articles. All articles were independently reviewed, each used according to the topics presented in this paper. This is in addition to 6 references in Arabic obtained by researching the same method as before but using the Arabic language. Figure No. (1) presents the general structure of this paper (objectives, methodologies, structure of the study)

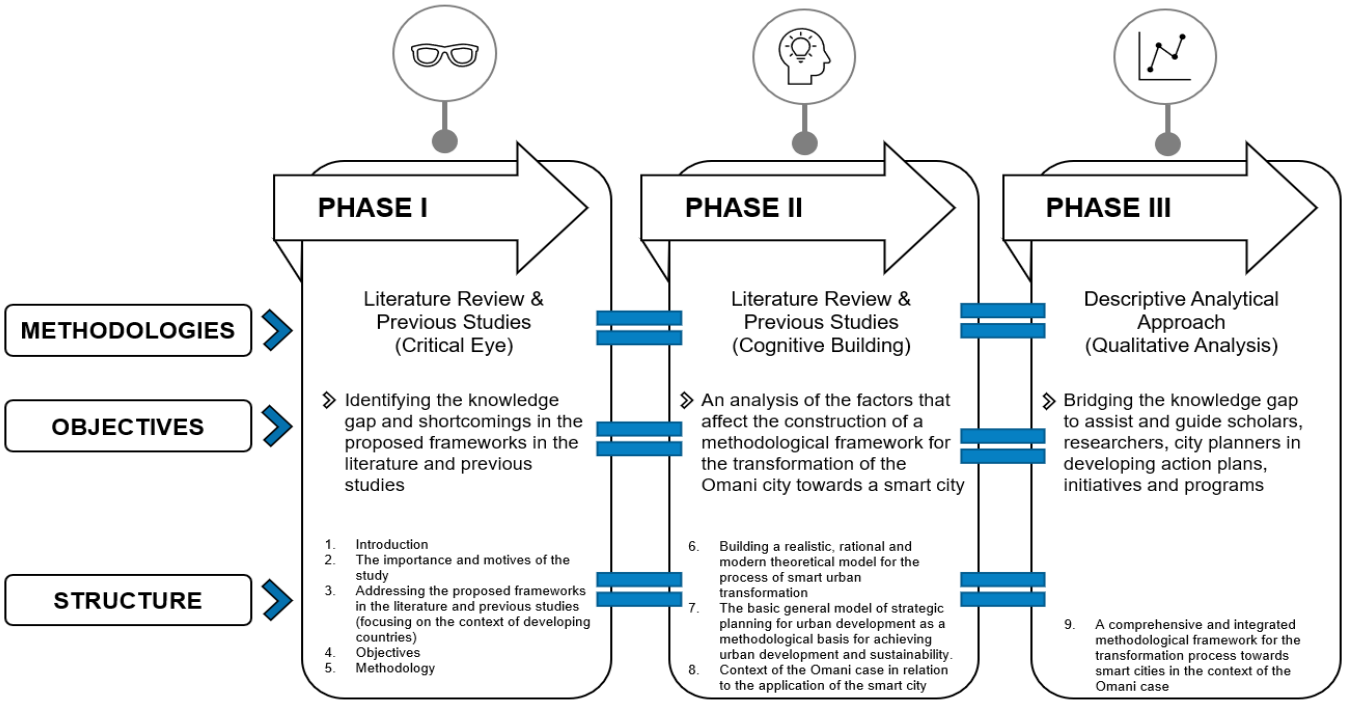

Figure 7. General Structure of the Research Paper: Objectives - Methodologies and Structure of the Study.

5. LITERATURE REVIEW

5.1. Conceptual Theoretical Framework for the Smart Urban Transformation

This part aims to build a realistic, logical, modern theoretical model for smart urban transformation. This model is the cornerstone of the methodological framework for the transformation of Omani cities, which is built toward smart, sustainable cities. The model is built through 1) Tracking the phenomenon of urban transformation and its relationship to the smart sustainable city; 2) Recognizing the importance and advantages of smart transformation as a strategic option; 3) Driving forces, components, and pillars of the intelligent urban transformation process.

5.2. The Phenomenon of Urban Transformation and Its Relationship to the Smart Sustainable City

Change is an essential component of the human condition, as it is a continuous phenomenon with the continuous development of thoughts, practices, and experiences. The processes of change did not stop over time but differed in speed and complexity. In the eighteenth century, radical urban transformations occurred in cities, from industrial towns to global cities, then globalization. The twenty-first century has also witnessed a development in the concept of urban transformation of international towns (after industry) into sustainable cities, competitive areas, and knowledge cities [20]. They are reframing cities and defining the concept of urban transformation. Thus, urban transformation approaches focus on comprehensive urban renewal at the institutional, organizational, and physical-spatial levels. Urban transformation processes are currently taking place through multi-model frameworks. The main challenge in urban transformation has become integrating different models of transformation processes, for example: linking heritage preservation and curricula to green, sustainable, smart, and knowledgeable cities [38].

The concept of sustainable development has been applied in urban planning since the early nineties. Sustainable urban development is a strategy used as a pathway to create a healthy, livable, and prosperous environment with minimal demand for resources and energy. Also, it has a minimal negative environmental impact [8]. Sustainability in urban development is defined as “a process of change in the built environment that promotes economic development by conserving resources, improving the quality of life for the individual and society, and enhancing the ecosystem.” Sustainable urban development is achieving a balance between economic and urban development and justice, Social and Environmental Protection in Urban Areas [35].

Conflicts between sustainable urban development goals have become one of the most difficult challenges facing the urban planner in relation to planning the transition toward sustainable cities. Planners must simultaneously use the three values while balancing economic, social, and environmental factors [5]. This requires cooperation between all parties (development partners) to form a comprehensive idea of the complex challenges and issues facing contemporary cities and identify the actions to be taken to balance the aspects of sustainability: promoting economic development, conserving resources, and ensuring the safety of the ecosystem and the improvement of social aspects [27].

According to *Angelidou et al*. [6], environmental problems have become global, and sustainable technology development requires innovative solutions and advanced methods resulting from opening potential horizons for technology Information and communications. This will increase the efficiency of city systems, services, and infrastructure. This is achieved during a comprehensive transformation process to enhance the sustainability of cities [25]; in this spirit, the integration of the agenda began with Research on innovation in urban computing and ICT development with Sustainable Development and Urban Planning Agenda [6]. Thus, encouraging investment in technology information and communication and directing them to address environmental issues and social and economic needs in contemporary cities [8; 11]. An urban technology vision for smart, sustainable cities that reflects scientific, technological, social, and institutional developments provides an understanding of cities' problems. It also provides options for ICT solutions to help meet the challenges of urban sustainability and urbanization [10]. In today's environment-managing computational resources using information and communication technology is critical to achieving sustainable smart cities in environmentally and technologically advanced countries. Urban planning is not only a topic of academic discourse but also a way of life. This is done through diverse urban development strategies and projects that exploit the potential of Innovative ICT to stimulate and enhance sustainable urban development processes. Thus, the advancement and development of cities in terms of urban sustainability and quality of life [7]

As a result, the concept of smart urban transformation in urban studies refers to the use of innovative technology to address the increasingly complex challenges cities face when trying to achieve sustainability. An urban transformation process that is smart and sustainable is viewed as a comprehensive approach. This approach attempts to combine sustainable and smart cities and remedy their main shortcomings. The goal is to improve their contribution to achieving sustainable development goals. This is accomplished by integrating what each category offers to maximize its use with regard to pervasive computing and advanced information and communication technology (from smart cities), design concepts and planning principles (from sustainable urban forms) to accomplish the goal of promoting sustainability in the era of hyper urbanization [8, 9]

5.3. Smart Urban Transformation as a Strategic Option

To keep pace with the modern global urban trend, there have been many initiatives worldwide to implement the smart city concept sustainably. To do this, countries have adopted three strategic paths: (1) the Greenfield Stream, which is the creation of a completely new city; (2) the Brownfield Stream, which is the transformation of traditional cities into sustainable smart cities; (3) Merging the two previous tracks by creating neighbourhoods within the extensions of existing urban areas [25].

Angelidou [4] has made it clear that most urban planners in the Western world see cities as old enough to accommodate current residents and their activities. We should focus on developing it rather than creating new cities. This requires a budget of up to ten times greater than a city development list [2]. In addition, the establishment of new cities near existing cities is dangerous. This is because adopting a new city over an existing one encourages the use of cars and increases fossil fuel consumption, which increases environmental pollution [3]. However, the first path was adopted in developing countries, and many initiatives were launched to develop entirely new smart cities, such as Cyberjaya (Malaysia) and Masdar City (Abu Dhabi - United Arab Emirates). These cities were designed and built from scratch and require huge investment. Even with the application of standards and modern methods in infrastructure and construction, most of these cities remain ghost towns because they failed to

attract a population. This is according to a study conducted by McKinsey Global Institute (MGI) on 50 smart cities around the world [29].

On the other hand, in the second track, the existing cities are developed into sustainable smart cities according to the characteristics and priorities and needs of existing cities, in addition to global market forces and available technology. In order to reach socially sustainable and livable cities. This indicates the importance of involving city residents as well as cooperation between public and private actors. Among the most critical features of this strategy are the following:

- Capitalizing on the collective momentum and participation of the population when employing new technologies and open data allows for a combination of top-down (government-led) and bottom-up (government-led) work society). The success of smart cities does not depend on the implementation of smart city solutions but rather on learning innovation with smart environments and capabilities distributed between organizations and people, which contributes to 1) creating A collaborative, inclusive and cohesive environment. 2) Create partnerships to implement IT-related initiatives and communications jointly; 3) Coordinating the efforts of this collaborative environment in order to achieve a common group of goals that reflect the vision and priorities of the city [42]
- The existence of an urban system and infrastructure already in place reduces the volume of investments and the budget required for the development of a sustainable smart city [2,5]. Likewise, the real challenges that cities face It is a catalyst for innovation in the field of digital technologies and smart applications [34]
- Benefitting from the unique local and cultural aspects of cities (personality, character, and identity) help cities compete and face globalization and the loss of identity. It is a digital technology and the promotion of distinctive cultures in cities that will allow them to become more sustainable and endurance. By providing this level of urban innovation, society will have the ability to progress from being a widespread phenomenon of digital globalization to a modern mode of achieving society's Meaning and Values. So future smart cities should depend on their own ecosystems and distinct informatics to meet local economic, social, and environmental needs [23] and [16]

5.4. Driving Forces, Components, and Pillars of the Smart Urban Transformation Process

Although there is no single solution, there are recurring elements in the literature that support intelligent transformation for cities, whether in the strategic planning or implementation phase. These elements constitute the driving and supporting forces for the success of the transformation process. These elements can be categorized as follows:

- **Digital technologies (software, hardware, platforms, and networks)**

It is the technological component that adds digital intelligence to existing urban systems. It is effective and economical in improving some quality-of-life indicators by 10-30 % [29]. In order for the city to become smart, it should have three layers that work together simultaneously (see Figure 8) 1) the technology base that consists of smartphones and sensors connected to high-speed networks (wired such as fibres), optical fibres, and wireless such as Wi-Fi; 2) a set of specific applications that translate Raw data into appropriate warnings and actions which improves decision-making through the use of Data provided by all relevant authorities, governments, business owners, and residents; 3) class Users, residents, visitors, or those in charge of the city administration, companies, and institutions [43].

The success of the Smart Transformation depends on the widespread dissemination of applications in various spheres (urban services, environment, buildings, transportation and mobility, security, networks, energy, water, etc.), resulting in a behavior change wherein agencies and residents alike perform their functions remotely using the digital media available by default [29]. Modern applications provide instant information to users 24/7/365 to help them make better decisions. This reduces the need for mobility, uses less energy and water, and reduces the stress on urban systems. Lives, crime prevention. It also saves time and reduces the waste of effort, money and resources. It enhances social bonding. As a result, energy consumption and harmful emissions are reduced,

improving cities' performance and increasing their efficiency. In this way, they become more productive and sustainable [44] [10].

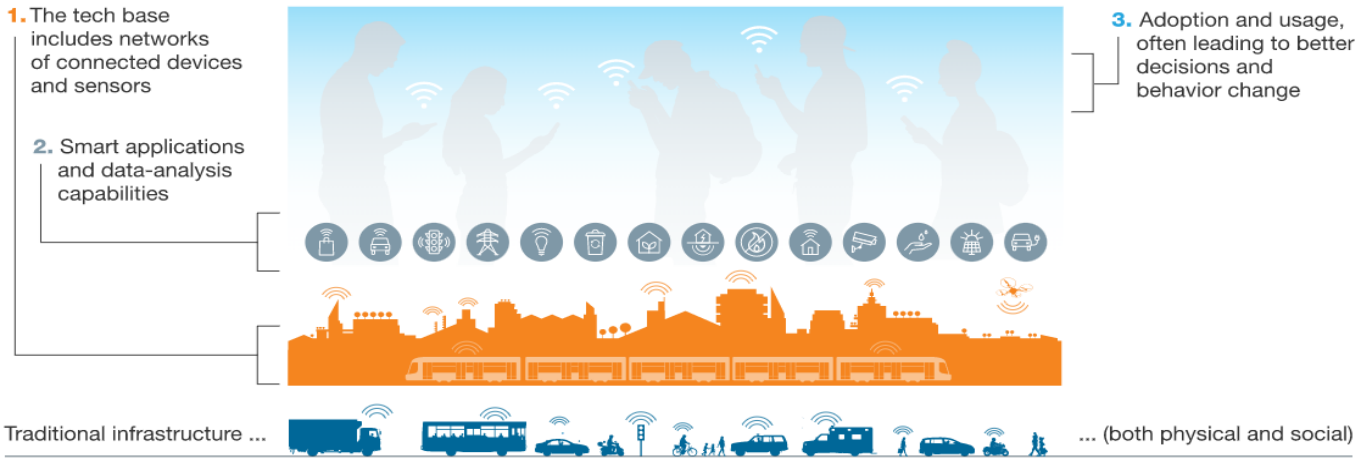

Figure 8. Layers of "Smartness" Will Elevate Life in Cities of the Future.
Source: McKinsey Global Institute analysis.

As the use of different information models and applications leads to interoperability, smart cities and how they are implemented require a compatible and integrated platform of modern technology applications. These include Net Objects, cloud computing, signal preprocessing, and geographic data networks. Through the combination of these advanced technologies and the underlying information system, a smart city can be developed that is efficient, sustainable, and able to meet the future's needs. In addition to ensuring data privacy, big data storage and management must be secure. Before sensors are widely deployed, cybersecurity precautions must be taken to protect data from hacking, viruses, and corruption [15].

- **People (Education, Innovation and Creativity)**

People are key to the success of the transformation process, but they are often neglected at the expense of technology. ICTs and technological advances do not automatically transform and improve cities but are contingent on human effort [43]. Citizens represent the driving force for the smart city, and their participation is its starting point. Citizens of smart cities are not only measured on their level of educational qualification but also by the level of social interaction that extends beyond the concept of "life personality" to include a concern for general issues. Smart solutions can solve some urban problems from citizens through citizen awareness, community participation, learning, training and skills development, creativity, flexibility, openness, cultural and social pluralism and cooperation between the various parties [21].

The population has an imperative role in the process of smart transformation, which is through 1) participation This is in all phases of the transformation process, starting with putting forward and formulating a vision, strategy and goals transformation process; Then participating in the implementation process and managing that process; 2) Innovation and dissemination of technology solutions information and communications to help solve urban problems; This is done through an intense focus on education that enhances knowledge and innovation. Hence, the formation of a group of citizens that is the nucleus of the smart society; 3) Through some applications on their smartphones, residents can act as mobile smart sensors, reducing the costs of implanting sensors across the city [30].

- **Institutions (city government, universities, institutes, and organizations)**

Developing a comprehensive vision for the transformation process requires the involvement of organizations to provide governance, guidance, and leadership. Preparing governance is a major challenge for smart city development. Some traditional challenges include limited transparency and accountability, isolated city services, and a lack of human resources [24]. The smart city needs a smart governance model to address these limitations and integrate collaboration, communication, partnership, and leadership solutions and implementation of the

structure Infrastructure and ICT support smart governance that facilitates service integration and collaboration communication and data exchange work to strengthen the dynamics of the relationship between institutions [30].

Paving the way for the smart transformation process is the responsibility of the city government. This is because the city government must develop a model of smart governance to manage and operate the city [36]. To ensure the transition to sustainable urban systems, the government should commit to The package includes the following guiding principles: 1) Manage resources more effectively and understand urban systems, so Develops integrated urban models and tools to provide a comprehensive view of energy consumption Resources [21] 2) Upgrading the infrastructure, with the aim of providing smart systems and networks for water, energy and mobility Waste disposal...etc. 3) Development of urban services 4) Shift towards smart governance and access to government information, data, and citizen participation in decision-making [1,17,4]; eliminating Legal and regulatory barriers as well as contradictions between international, national, and regional regulations that impede cooperation or impede the transformation process [21].

A smart governance model must produce results and changes at three levels: at the first level (government institutions) and at the second level (relationships between government and external actors). The most significant one is to think beyond the impact of developing the governance model to produce results at the third level (improvements in all elements of the city) [12]. The flow of information helps to understand how the city works and how residents use its elements, which helps in identifying realistic and viable solutions to urban problems [40]

Kumar, H. et al. [41] stated that the shift toward smart cities depends on many Enabling factors and key constituents. Information and advanced technology are not an end in themselves. Rather, it is a means to achieve urban sustainability and a better quality of life for citizens. This is achieved through enabling factors to monitor urban systems and provide strong safety and security systems, research and development systems and parking systems. Smart cars, and intelligent transportation, reduce the need for mobility and improve services, networks, and city performance. The transformation process also depends on non-technical components, such as providing affordable and appropriate housing and developing pedestrian and bicycle paths [33]; This is in addition to a diverse list of enabling factors circulated in the specialized scientific literature. Figure (9) shows a list of factors that contribute to smart cities and their components, categorized into six aspects: enabling factors and environmental elements, infrastructure, logistical strategy, social and technology, then transport and mobility factors.

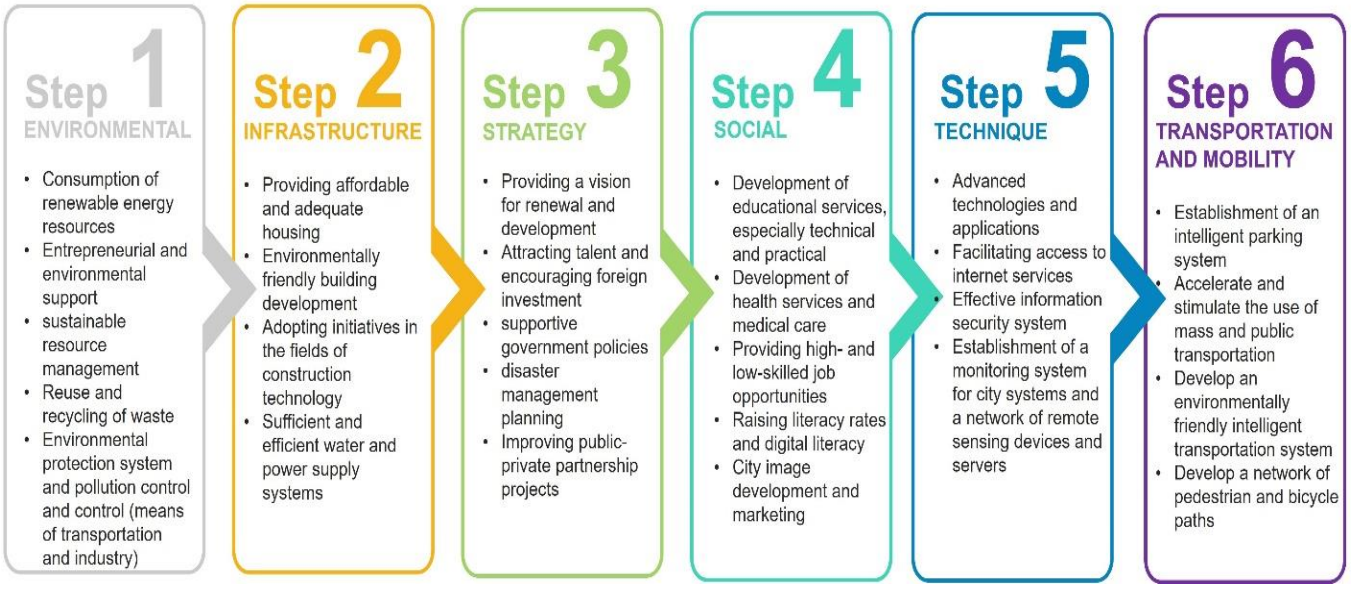

Figure 9. Enabling Factors and Components of Smart Cities.

Source: Yadav, G., Mangla, S. K., Luthra, S., & Rai, D. P. (2019).

5.5. Theoretical Logic Model for Smart City Transformation

After reviewing the previous topics and delving into the smart transformation process; Since there is no specific definition of a smart city, each city has its own challenges and priorities; It is imperative to establish a framework for a specific and theoretical model for the process of smart transformation of cities to facilitate understanding of its steps, divisions, and success factors.

This perception is based on two basic models:

- The input/process/output model of the urban transformation process.
- The smart city development model proposed by the Smart Cities Council https://smartcitiescouncil.com

The logical model is the cornerstone of the proposed methodological framework. The model was developed according to the transformation process model, where the model was divided into the three stages of the transformation process (inputs - processes - outputs). The strategy should also consider the basic elements of a measurable success metric in order to achieve a smart city transformation. The proposed smart city development model From the Smart Cities Council illustrates these basic elements. These elements can be summarized as follows: [14]

- Understanding the starting point: understanding the city's performance in the areas of leadership and governance, the level of participation of different stakeholders and citizens; the efficiency of the data and information infrastructure; and the efficiency of the information and communication technology infrastructure.
- Setting smart goals: The success of the transformation process depends on basing the strategy on specific, measurable, applicable, realistic, and time-dependent smart goals that are compatible with city development plans and national and global goals. A sound business plan and clear governance arrangements must be in place, with performance measurement and evaluation tools identified.
- Not inventing the wheel: This is achieved by participating in sustainable smart city platforms to exchange knowledge to promote efficient practices related to governance, transportation, water and sanitation, electricity, mobility, environment, urban planning, social cohesion, quality of life, citizen participation and digital infrastructure. With awareness of the local context and political and technical alternatives, with the need to conduct research to assess alternatives related to policies, strategies, and tools, and choose the option that corresponds to local conditions.

Considering the above, a logical and theoretical model of the intelligent transformation process can be conceived. As explained in Figure (10); the theoretical model consists of the following sections:

- **Input**: City context: The context refers to specific issues and characteristics of the local environment (the city) that should be taken into account in the development of a smart city. It includes various elements that will influence choices for planning and implementation of Smart city initiatives, such as opportunities and challenges, goals of the transformation process and driving forces, friends Governance, administration, funding mechanisms and opportunities, legal and legislative framework, and technical capabilities.
- **Operations**: Action Plan: It refers to the necessary policies, strategies, initiatives, and practices. In addition, the plan should take into account achieving gradual advancement towards the smart city commensurate with administrative, technological, and financial capability. In its three sequential stages, the transformation process should include: 1) construction of adequate housing and basic services; 2) establishing an information and technical infrastructure of equipment, networks, software, applications, sensors, cyber security, data centres, and the necessary analysis tools, then 3) deploying smart solutions in the fields of education, economy, warning, disaster response, health, tourism, transportation, waste collection, services, and public security and crime.
- **Outputs**: Smart Sustainable City: This is the desired goal of the transformation process. Renewal and innovation are at the heart of this city. It has a strong focus on sustainability, improving the quality of life, being a competitive economy, and raising living standards for its residents. According to the Smart City Group of the Fiber to the home (FTTH) Council, it must have essentially achieved at least all of the following three initiatives in order to be classified as a “smart city” [31:] a strong, secure, fibre-optic communications network;

Government participation in providing added value to citizens; Initiatives to encourage the use of renewable energy.

Figure 10. The Proposed Theoretical Model for the Smart Transformation of Cities.

6. A STRATEGIC PLANNING METHODOLOGY FOR URBAN DEVELOPMENT

By identifying the methodology of strategic planning for urban development, we will be able to determine the elements necessary to complete the methodology of the transformation process toward a smart city, which has been presented in previous documents and studies. The smart city is a future vision that can be transformed through strategic planning. It considers the characteristics and components of the existing urban context in addition to all the characteristics and components of the smart city.

6.1. The Importance of Strategic Planning for the Transformation Process toward a Smart Sustainable City

The strategic planning approach has gained momentum in planning practices since the beginning of the current millennium as a reaction to the emergence of urgent urban issues such as unequal development, social inequality, environmental pollution, Global warming and climate change, the emergence of advancing technology, the globalization of culture and economy, the rise of Energy costs, economic crises, etc. As a result, many countries, including Oman, moved from the general planning of cities to the strategic planning of urban development. This is in a way that contributes to achieving goals that are compatible with it with the goals of smart sustainable cities: [39]

- Benefiting from the distinctive characteristics and components of each city to resist the trend of globalization; where should every city has a vision and plan to take advantage of city characteristics to improve urban productivity and develop services; In order to ensure the city does not only prosperity at the local level but may extend beyond that to achieve a position in the global/international context.
- Alleviating social inequalities and spatial isolation by taking care of marginalized and vulnerable groups Focusing on raising efficiency, productivity and access to services for these groups in urban areas.
- Integrating the three dimensions of sustainable development, environmental, social and economic, into the field of urban planning and development.
- Promoting participatory and decentralization in proposing and implementing policies in order to integrate and satisfy the interests of societies and stakeholders in the planning process.

6.2. Strategic Planning Methodology

There are a variety of models for urban development strategic planning methodology. These may differ in terms of style and some details, but there is consensus on a number of basic steps. All models share the following four steps: the preparatory phase, case analysis, development and design, The strategic plan and the preparation of an implementation plan with a timetable, and finally, monitoring, follow-up and review: [5] As a result, figure (11) reviews and summarizes each of these steps as they contribute to our planning process.

7. A SMART CITY APPLICATION IN THE OMANI CASE

In the case of Oman, the government has been actively pursuing the development of smart city initiatives in order to address the challenges facing the country's urban areas, such as traffic congestion, energy consumption, and waste management. One example of a smart city application in Oman is the implementation of a smart transportation system through *Mwasalat* transportation company, which uses real-time data and analytics to optimize traffic flow, reduce congestion, and improve the overall efficiency of the transportation network. [38] This system can include smart traffic lights, intelligent transportation management systems, and connected vehicles, all of which work together to provide real-time information to drivers and help them make informed decisions about their routes.

Another example of a smart city application in Oman is the development of smart energy systems, which aim to improve energy efficiency, reduce greenhouse gas emissions, and promote the use of renewable energy sources. [16] This can involve the deployment of smart meters, which allow for real-time monitoring of energy consumption, and the integration of renewable energy sources, such as solar and wind power, into the energy mix.Overall, the adoption of smart city technologies and practices in Oman is part of a wider effort to create more sustainable, efficient, and livable urban environments. By leveraging the latest advancements in technology and data analytics, the government of Oman is working to improve the quality of life for its citizens and enhance the competitiveness of its cities on a global scale.

7.1. The Omani Experience in the Field of Applying the Concept of the Smart City

According to Oman Vision 2040, Sustainable urban development has become an imperative priority to make sustainable cities a key driver for achieving national and global goals. The Ministry of Housing and Urban Planning has launched an ambitious initiative to support the development of “Smart Cities” in three key locations in the Sultanate of Oman: *Suhar*, *Nizwa* and *Salalah*. [39] The Omani government needs to pay special attention to work on developing smarter cities to ensure sustainable development. The focus should be on the technology that helps support the economy, people and the environment to achieve sustainable urban development as an imperative priority and that to ensure: 1) Providing job opportunities and raising the efficiency and capabilities of individuals; 2) Achieving equality of access for basic services, health care and equal opportunities in education.

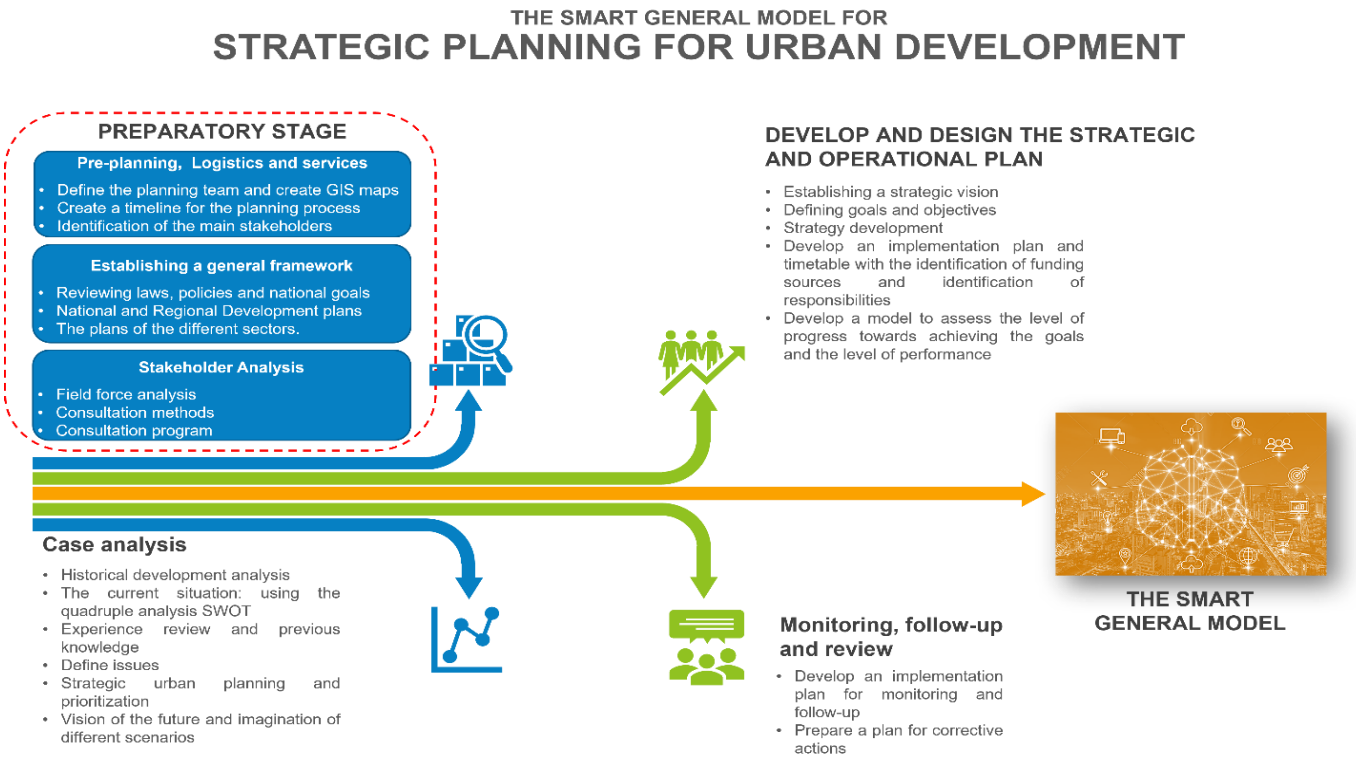

Figure 11. The model of the strategic planning process for urban development in light of the transformation processes towards the concept of smart cities adopted vaguely by the Omani government.
Source: By author with modification, as the preparatory stage was added to the form submitted by Angelidou, M. (2015). [4,5, 37].

In Oman, the smart city concept is not clearly and specifically defined. Most of the Omani experiences were in the form of creating new cities with world-class technological standards, Where Oman adopted the green path [39] to ensure sustainable development and the preservation of its natural resources. In order to strengthen and diversify Oman's economy, the government has invested in sustainable development through the design and construction of new cities, such as *Madinat Al Irfan*, using cutting-edge technologies and sustainable practices to minimize their environmental impact. The city features energy-efficient buildings, renewable energy sources, and sustainable transportation systems.

Additionally, it includes green spaces and parks that encourage outdoor recreation and connect residents with nature. These experiences in Oman show the country's commitment to sustainable development and willingness to embrace the latest technologies to create a better future for its citizens. However, there is a general consensus that the smart city concept in Oman involves using technology and data analysis to improve the quality of life for citizens, enhance sustainability, and streamline urban services. This can include everything from smart transportation systems and energy-efficient buildings to digital government services and improved public safety.

7.2. The Omani Experience in the Field of Strategic Planning for Urban Development (Negative Aspect)

The last few decades have been characterized by focusing on creating well-planned and sustainable cities. The Omani government has invested in comprehensive planning processes that take into account the needs and aspirations of its citizens, as well as the country's unique cultural and environmental context. The result has been the creation of new cities and urban developments that balance economic growth, social well-being, and environmental protection.

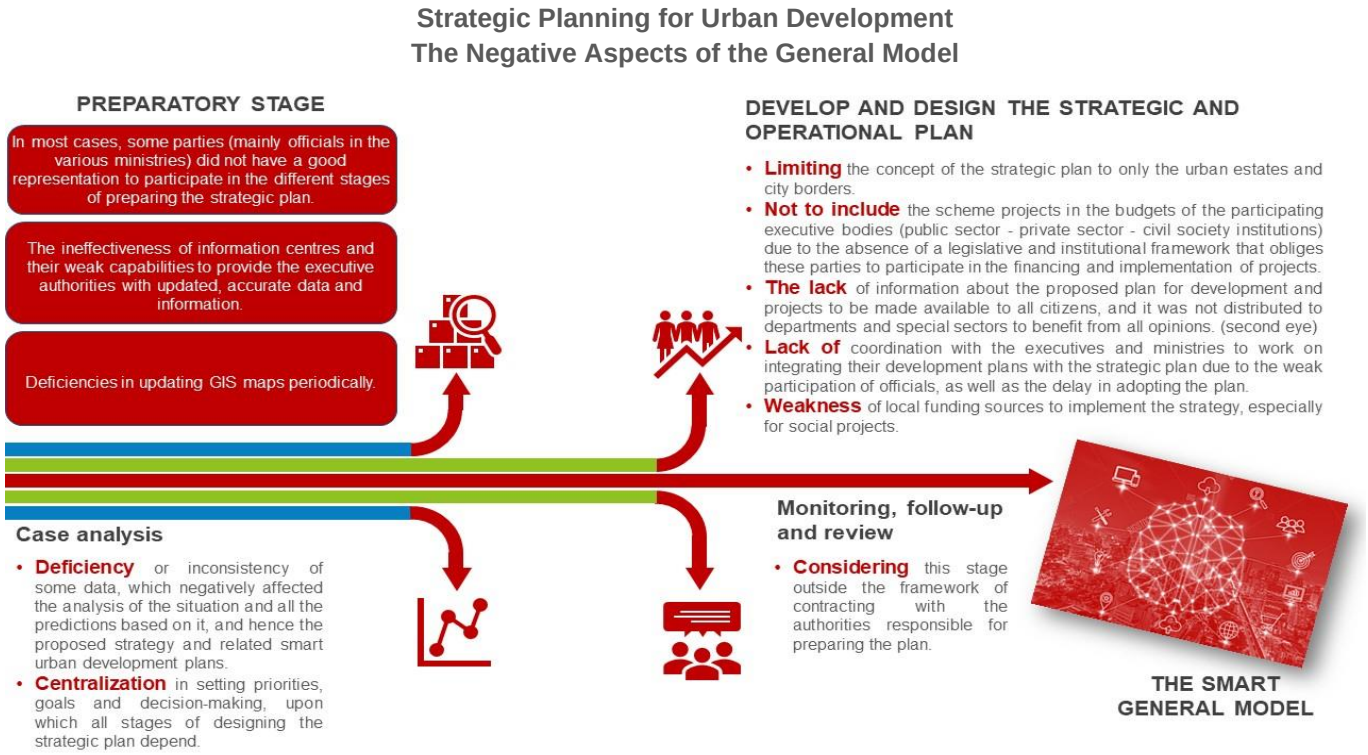

Figure 12. The negative aspects of the process of preparing strategic plans for Omani cities in its various stages that could lead to the failure of the proposed model.
Source: [32] and author with modifications.

One notable example is the "Muscat Master Plan," which guides the development of the capital city of Muscat and its surrounding areas. The plan prioritizes the preservation of the city's cultural heritage while also addressing its growing population and economic needs. It includes strategies for improving transportation, housing, and public services and preserving the city's natural environment. A focus on public engagement and collaboration between different government agencies, private sector organizations, and citizens has also characterized the Omani experience in urban planning and development. This approach ensures that all stakeholders' needs and perspectives are considered when making decisions about the future of the country's cities.

Overall, the Omani experience in strategic planning for urban development is positive, characterized by a commitment to sustainability, public participation, and the use of technology and data analysis to inform decision-making. Although the strategic planning process model shown in figure (11) was implemented vaguely, the application process faced many negatives. [39] The negative aspects that affected the process of preparing strategic plans for Omani cities were presented by extracting the opinions of 100 academics and executives with experience in that field generally. Figure No. (12) illustrates the most important negative aspects of implementing the strategic planning methodology for urban development in Omani cities.

7.3. Challenges Facing the Application of the Smart City in Omani Cities

There are two categories of challenges: the first represents the obstacle and the stumbling block in the process of achieving a smart, sustainable city; the second represents governance and economics; it is the cause of the transformation process in an entwined manner [13], and it must be addressed in order to pave the way for the process and determine what is required to embark on it. However, the second group benefits from the transformation process as its presence does not pose an obstacle. Rather, reaching a smart and sustainable city means solving these challenges. There are several challenges facing the implementation of smart city initiatives in Omani cities, some of which include:

1. Lack of technology infrastructure: To be considered a smart city, a city must have a robust technology infrastructure. This includes a high-speed internet network, a modern transportation system, and smart energy management systems. In some cases, these technology infrastructures are lacking in Omani cities, making it difficult to implement smart city initiatives.
2. Funding: Implementing smart city initiatives can be expensive, and many cities in Oman may not have the financial resources to fund these projects. This can make it difficult for the government to implement smart city initiatives at the p needed to meet their citizens' growing demands.
3. Data privacy and security: One of the hallmarks of smart cities is the collection and analysis of data to make informed decisions. However, this data collection also raises concerns about privacy and security. To protect citizens' personal information, cities must have robust data privacy and security policies in place.
4. Skill shortage: Implementing smart city initiatives requires a high level of technical expertise in areas such as data analysis, information technology, and smart city planning. In some cases, there may be a shortage of skilled professionals in these areas in Oman, making it difficult to implement these initiatives.
5. Resistance to change: There may be resistance to change from citizens and local businesses who are used to the current way of doing things. Engaging with these stakeholders and working to overcome any resistance to change is important to implement smart city initiatives successfully.

Despite these challenges, the Omani government is still moving forward with smart city initiatives, as it believes it can improve its citizens' quality of life and create a more sustainable future for their cities.

8. A METHODOLOGICAL FRAMEWORK FOR TRANSFORMING CITIES TOWARD SMART CITIES: THE OMANI CASE

With the aim of bridging the knowledge gap in the field of methodological frameworks for smart transformation in the Omani context, a comprehensive theoretical rationale for the process of smart transformation is proposed by providing a link between the methodology of the transformation process, the smart sustainable city and the methodology of strategic planning for urban development. Figure No. 13 provides a detailed summary of the main stages and components involved in the proposed methodological framework for applying the strategic planning methodology for urban development. Within the context of the Omani case, this framework aims to achieve the smart transformation of cities into smart sustainable cities.

8.1. Preparation Stage

- Identification of stakeholders to be involved in the smart city project as part of the operating environment (e.g. government agencies and the local community)
- Gathering information about the city: cities must study the current system and the surrounding environment to obtain a comprehensive overview of the current state of the city and a framework for study and work.
- Preparing a list of smart city directions. Learning from technologies and trends that have an impact on smart cities: open data, e-participation, smart technologies (such as IoT, data analytics, cloud computing, artificial intelligence, digital city platforms, constant and immediate interaction with the citizen, linking vehicles with sensors/government networks, and increasing focus on technologies that focus on improving the lives of citizens.
- Study and analyze the experiences of smart city projects in other countries to learn from their successes and failures, with a focus on cases whose circumstances are similar to the Omani case.

8.2. Analyzing the Situation and Assessing the City's Readiness for Transformation

A multidisciplinary team of qualified professionals supports a readiness assessment, including representatives from government, academia, industry, and civil society; representation should occur in the largest number of different sectors.

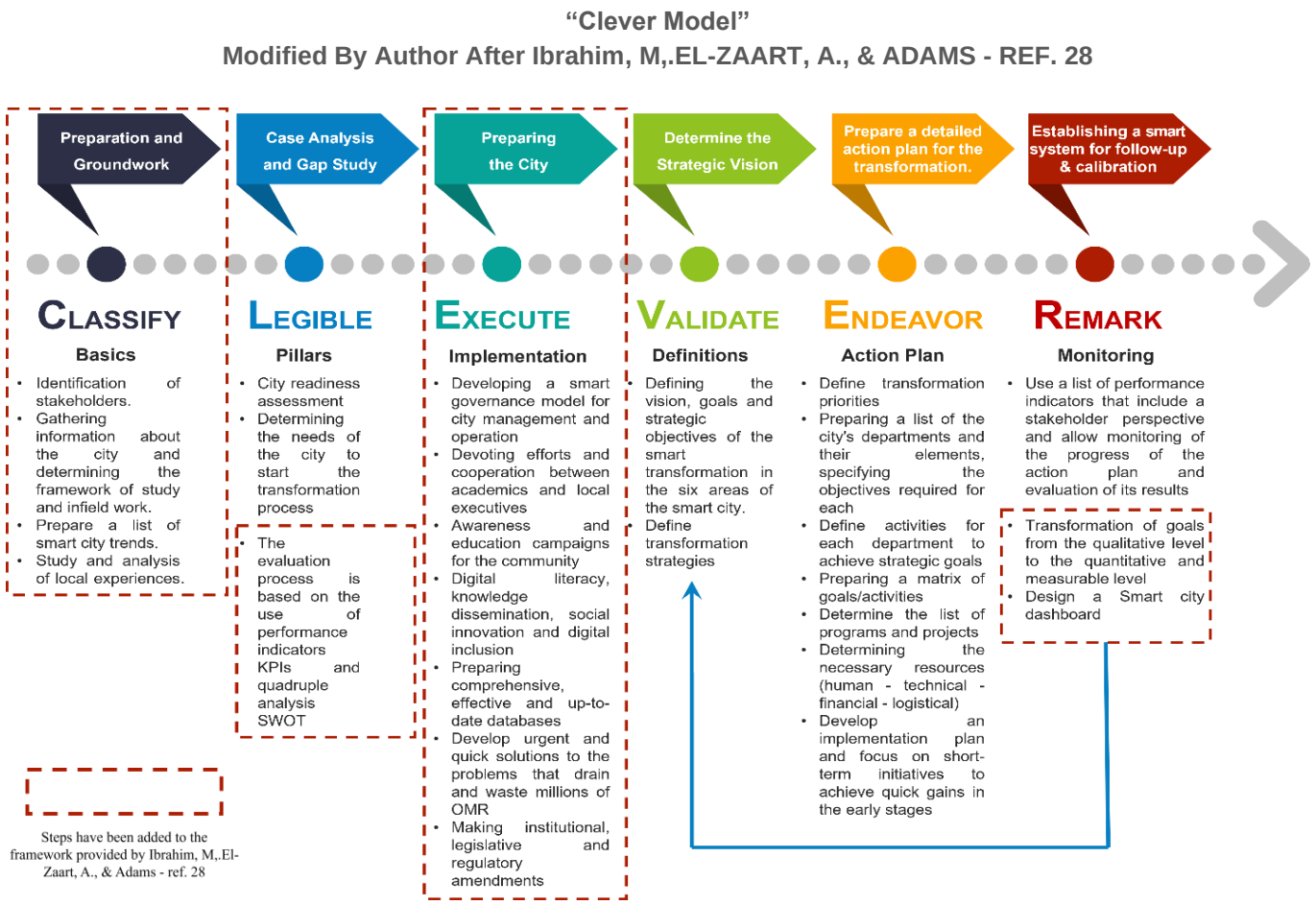

Figure 13. The proposed methodological framework for the smart transformation of cities towards a smart sustainable city in the context of the Omani case – Clever Model.
Source: Ref. 28 with author modification and additions

The evaluation is carried out using a quadruple analysis (SWOT) for all dimensions and the following is a detailed explanation explaining the steps of the proposed framework and the most important considerations and tools used in components of smart cities. This is done using measurement indicators that are designed based on smart city assessment systems. Provided that all parties participate in determining the indicators and their qualitative weight, the analysis is done to extract the strengths, weaknesses, opportunities, and challenges. The Readiness Assessment aims to identify issues and challenges that limit the sustainable growth of cities as well as technological progress. Possible areas of assessment include the following:

- Priorities, values, driving forces, enablers, challenges, and risks.
- City stakeholders and their level of readiness for smart city initiatives, including their ICT capabilities.
- The current legal and regulatory framework for smart city initiatives.
- Financing mechanisms and opportunities, as well as local investment portfolios.
- Existing ICT infrastructure deployed in the city and in the regions and their capabilities, including the support they provide to provide other public services such as energy, water, transportation, etc.
- Identify current public services in identified priority areas and potential areas for improvement.
-

The approach, objectives, and policies necessary for achieving a smart sustainable city are determined based on the analysis. The situation requires a reform process and preparation for transformation if weaknesses and challenges outweigh strengths and opportunities. The larger the gap, the more time and cost are needed for the preparation and repair process. The reform plan is developed according to the priorities identified by agreement between all parties and stakeholders. Worked to meet the challenges described in the first group in Table No.1

8.3. Preparing the City for the Transformation Process

The onboarding process aims to inculcate the values and elements that drive the intelligent transformation process. By implementing a reform plan to work on:

- Devoting efforts and cooperation between academics and executives. This is to identify a set of smart good practices for use by the city for the purposes of reciprocal and collaborative learning. Ideally, effective practices should include examples of two types of cities: 1) cities with conditions similar to the local context and 2) cities that excel in a specific area of interest to the local context. Through this, the city can enhance cooperation in smart city development.
- Initiating awareness campaigns and educating the community on issues related to smart sustainable cities, such as energy consumption, use of renewable energy sources, carbon footprint, green areas, water consumption, and waste management. Devoting special efforts to raising awareness and educating children in schools.
- Digital literacy, knowledge dissemination, innovation, and digital integration elevates the population, which is the primary guarantor of the continuity of development.
- Preparing comprehensive, effective and up-to-date databases on all city systems (transport, traffic, water and electricity networks and stations, waste disposal, services, etc.) in order to improve the city's management and quality of life.
- Encouraging local technological and research institutions to produce technologies and applications as an urgent and quick solution to problems that drain and waste billions, such as smart programming for street lighting, as well as for heaters, air conditioners and elevators in various types of buildings; As well as technologies and software that help in rationalizing water consumption and detecting network defects.
- Legal, legislative and regulatory reform to ensure the success of the transformation process and remove any obstacles and ensure the commitment of the various authorities and sectors to implement the transformation process plan, ensuring decentralization as well as coordination and non-conflict between the plans of the different entities, which ensures the commitment of the different entities to implement the scheme; It also ensures the provision of technical and financial support necessary for implementation.

8.4. Define the Strategic Vision

The first challenge of smart transformation is to develop the strategic vision: determining why the smart transformation is needed, the targeted changes and outcomes of this transformation, and what procedures and resources are needed to carry out this smart transformation. The process of developing a strategic vision requires the following:

- Understand why the city needs smart transformation. Justify the contribution of information and communication technology to transforming the city into a smart city and setting strategic goals for smart transformation.
- Describe the objectives of the smart city strategy and the strategic challenges that may face the city’s smart transformation. Example challenges: cost, diversity of technologies, interoperability, mega data analysis, and information security. It should be based on SMART Objectives.
- Drawing an initial vision. The initial vision includes elements to focus on in building a successful smart transformation strategy. In order to formulate the vision, it is necessary to identify: (i) the strengths and weaknesses of the city, (ii) identify the main components to be strengthened through the transformation strategy, such as leadership, governance, investment, services, interoperability, architecture infrastructure, legislation, and workforce); (iii) determine the results, changes, and the desired smart transformation effect; (iv) determine the necessary components, procedures, tasks, budget, programs, etc.) to achieve the desired results.
- Improving the vision by searching for opportunities and removing obstacles to success on an ongoing basis.

8.5. Develop a Plan of Action

The Smart Cities Action Plan is a set of projects, programs, and activities at the city-wide level to achieve the strategic vision. The action plan identifies the possibilities for success and establishes the elements for its preservation; The processes to be followed to build an action plan to transform the city into a smart city are:

- Involve stakeholders in planning and implementation; To ensure effectiveness and efficiency and contribute to the sustainability of the smart city.
- Policy development, strategic planning, and good practices, keeping in mind the differences between local conditions and the urban context regarding financing, environmental, economic, and social aspects. A successful strategy must be: 1) comprehensive and in-depth in all the details of the city while ensuring progress in all dimensions so that progress is not made in one dimension at the expense of the deterioration of another; 2) capable of aligning the capabilities and objectives of all stakeholders, according to the areas of the priority that has been agreed upon between them; 3) takes into account the local characteristics, the identity of the place, and the local challenges/needs/opportunities.
- Preparing a list of the city's administrations, specifying the objectives of each. (education, health, transportation, infrastructure, and environment).
- Defining the activities for each department to achieve the strategic objectives, with preparing the objectives/activities matrix to ensure that the activities are linked to the objectives and that the activities cover all the objectives. Then the inputs and outputs of each activity are determined. The PERT method is applied to manage time, organize the activities, and arrange them in terms of importance or priority, identify the activities that are related or consequent to each other, and determine the least cost, critical time and the best means to achieve the goal.
- Define the list of programs. A program is a set of activities linked to each business process or strategic objective. Then select Project List. The project is a set of programs.
- Determining the necessary resources (human, technical, financial, logistic) to achieve activities, programs, and projects.
- Develop an executive plan and a timetable for implementation that includes planning for projects, programs, and activities - in stages (short-term, medium-term and long-term). Clarifying the responsibility for implementation and scheduling funding according to the time stages.

8.6. Establishing an Intelligent System for Follow-Up and Evaluation

The planning process does not end with the development and implementation of a plan, but rather it is an ongoing process that needs management, monitoring and evaluation. Therefore, cities need to have a management system for monitoring and evaluation to guide urban development and ensure the sustainability of development and improvement. And the establishment of a smart system for monitoring and evaluation that depends on the following:

- List of Key Performance Indicators (KPI) as an effective tool for monitoring the sustainable development of cities. It is necessary to define a list of indicators that include the stakeholder's perspective and allow monitoring of the progress of the action plan and evaluation of its results.
- Measurable goals: In this stage, the goals are transferred from the conceptual to the quantitative and measurable levels. One of the best tools for identifying relevant KPIs is the GQM model (Goals-Questions-Metrics).
- The Smart City Dashboard is a massive and diversified city data platform that is dynamically updated in real-time by a network of sensors to capture KPI values in the city. Sensors are placed at appropriate locations in the city to capture real-time data and then send it to online dashboard servers. The city's performance map is displayed on dashboards in the form of charts, graphs or maps to help decision-makers.

9. CONCLUSION

The research concluded that smart transformation planning is a bridge between ideas and actions. In fact, it is not a separate document or plan but is directly related to the city's plan for urban development and to its vision for that field. It is necessary to study it systematically and strategically. Smart transformation strategies should include all stages of strategic planning methodology (preparation, situation analysis, development, implementation, and control) and utilize a city's public and private resources. Obstacles to transforming into a smart sustainable city; 2) identifying transformation activities and the best starting point, enabling the city to build, maximizing synergies, reducing costs, increasing public support, and developing and attracting talent and investments.

Oman needs to adopt the second path (development of existing cities into sustainable smart cities) to take advantage of cities' local and cultural characteristics to resist globalization and the loss of identity against the background of digital globalization. This vision describes the elements of the road map that lead to more sustainable and resilient cities. This road map is well described in the methodological framework presented in this paper. The proposed methodological framework ensures verification of the city context at an early stage. This allows this to be used for defining the elements of subsequent phases according to the city context, local needs and interests, and sustainability goals. Learning from previous experiences, the presented framework ensures continuity of the transformation process and continuous improvements. In addition, it produces additional changes at all levels of the city. A smart city concept needs to be crystallized by studying the context of the city. In order to accomplish this, one must understand the reasons for the transformation as well as their willingness to change. Any change programs or initiatives are only likely to fail if they begin before a city is ready for change. Therefore, any transformation process must consider the city's needs and capabilities and adapt the transformation framework accordingly. Preparation, settings, and configuration of the city for transformation have been added to the methodological framework proposed in this paper; they have not been present in any methodological framework that has been proposed for developing countries, and they are two important stages in the context of developing countries because there is a major gap between reality and expectations.

Key performance indicators (KPIs) are an important tool of the framework and are used in two phases: the first is when assessing the city's readiness for the transformation process, and the second is after the start of implementation of monitoring and evaluation. This allows a comparison of the performance of the city before and after implementation that reflects the level of progress towards achieving the goals. To ensure a balance between the elements of the city and not to improve in one area at the expense of another, the key performance indicators must cover all dimensions of the smart city (economy, government, environment, people, mobility, living) as well. The necessity of developing the legal and institutional framework to ensure the implementation of the steps of the proposed framework, with the necessity of evading the negatives that affected the implementation of the preparation of strategic plans for Omani cities, such as A representative voice for stakeholders- Availability of cadres' coordination between different sectors and agencies - Defining roles - Consolidating decentralization - Providing the necessary funding...etc.

The methodological framework proposed in this research serves as guide-to-guide city planners and relevant stakeholders throughout the transformation process by providing more critical details that support the success of the transformation process.

REFERENCES

[1] Aelenei, L., Ferreira, A., Monteiro, C. S., Gomes, R., Gonçalves, H., Camelo, S., & Silva, C. (2016). Smart city: A systematic approach towards a sustainable urban transformation. Energy Procedia, 91, 970-979.

[2] Alawadhi, S., Aldama-Nalda, A., Chourabi, H ,.Gil-Garcia, J. R., Leung, S., Mellouli, S., Nam, T., Pardo, T. A., Scholl, H. J., & Walker, S. (2012). Building understanding of smart city initiatives. Paper presented at the international conference on electronic government

[3] Allam, Z.andNewman, P. (2018 .) Redefining the smart city: Culture, metabolism and governance. Smart Cities, 1(1), 4-25.

[4] Angelidou, M. (2014). Smart city policies: A spatial approach. Cities, 41, S3-S11.

[5] Angelidou, M. (2015). Strategic planning for the development of smart cities. doctoral dissertation, University of Thessaloniki. P.386-29

[6] Angelidou, M., Psaltoglou, A., Komninos, N., Kakderi, C., Tsarchopoulos, P., & Panori, A. (2018). Enhancing sustainable urban development through smart city applications. Journal of Science and Technology Policy Management, 9(2), 146-169 .

[7] Bibri, S. E. (2018). Approaches to Futures Studies: A Scholarly and Planning Approach to Strategic Smart Sustainable City Development. In S. E. Bibri (Ed.), Smart Sustainable Cities of the Future :The Untapped Potential of Big Data Analytics and Context–Aware Computing for Advancing Sustainability (pp. 601-660). Cham: Springer International Publishing .

[8] Bibri, S. E. (2018). Conceptual, Theoretical, Disciplinary, and Discursive Foundations: A Multidimensional Framework. In S. E. Bibri (Ed.), Smart Sustainable Cities of the Future: The Untapped Potential of Big Data Analytics and Context–Aware Computing for Advancing Sustainability (pp. 39-131). Cham: Springer International Publishing .

[9] Bibri, S. E. (2801 .) A foundational framework for smart sustainable city development: Theoretical, disciplinary, and discursive dimensions and their synergies. Sustainable Cities and Society, 38, 758-794. doi: https://doi.org/10.1016/j.scs.2017.12.032

[10] Bibri, S. E.andKrogstie, J. (2017). On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society. Sustainable Cities and Society, 29, 219-246. doi: https://doi.org/10.1016/j.scs.2016.11.004

[11] Bibri, S. E.andKrogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. Sustainable Cities and Society, 31, 183-212. doi: https://doi.org/10.1016/j.scs.2017.02.016

[12] Bolívar, M. P. R.andMeijer, A. J. (2015). Smart Governance: Using a Literature Review and Empirical Analysis to Build a Research Model. Social Science Computer Review, 34(6), 673-692. doi: 10.1177/0894439315611088

[13] Camboim, G. F., Zawislak, P. A., & Pufal, N. A. (2018). Driving elements to make cities smarter: Evidences from European projects. Technological Forecasting and Social Change. doi: 10.1016/j.techfore.2018.09.014

[14] Carl Piva, T. F. (2016). 3 steps to a measurable smart city strategy. https://smartcitiescouncil.com/article/3-steps-measurable-smart-city-strategy

[15] Chourabi, H ,.Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Pardo, T. A., & Scholl, H. J. (2012). Understanding smart cities: An integrative framework. Paper presented at the 2012 45th Hawaii international conference on system sciences .

[16] Conrad Prabhu. (2017). Smart grids key to oman's power sustainability goals. Available [Online]. https://www.omanobserver.om/article/73739/Business/smart-grids-key-to-omans-power-sustainability-goals

[17] Dameri, R .P., Benevolo, C., Veglianti, E., & Li, Y. (2018). Understanding smart cities as a glocal strategy: A comparison between Italy and China. Technological Forecasting and Social Change. doi: 10.1016/j.techfore.2018.07.025

[18] Estevez, E. (2016). Smart Sustainable Cities - Reconnaissance Study .

[19] Geray, O. (2019). An Impact-Driven Smart Sustainable City Framework to Address Urban Challenges: Smart Dubai Experience. In W. A. Samad & E. Azar (Eds.), Smart Cities in the Gulf: Current State, Opportunities, and Challenges (pp. 13-39). Singapore: Springer Singapore.

[20] Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Milanović, N., & Meijers, E. (2007). Smart cities-ranking of european medium-sized cities. Rapport technique, Vienna Centre of Regional Science .

[21] Gülersoy ,N. Z.andGürler, E. (2011). Conceptual challenges on urban transformation. ITU A| Z, 8(1), 10-24 .

[22] Halepoto, I. A., Sahito, A. A., Uqaili, M. A., Chowdhry, B. S., & Riaz, T. (2015). Multi-criteria assessment of smart city transformation based on SWOT analysis. Paper presented at the 2015 5th National Symposium on Information Technology: Towards New Smart World (NSITNSW) .

[23] Hamza, K. (2016). Smart City Implementation Framework for Developing Countries: The Case of Egypt. In J. R. Gil-Garcia, T. A. Pardo & T .Nam (Eds.), Smarter as the New Urban Agenda: A Comprehensive View of the 21st Century City (pp. 171-187). Cham: Springer International Publishing.

[24] Han, H.andHawken, S. (2018). Introduction: Innovation and identity in next-generation smart cities. City, Culture and Society, 12, 1-4. doi: 10.1016/j.ccs.2017.12.003

[25] Heaton, J.andParlikad, A. K. (2019). A conceptual framework for the alignment of infrastructure assets to citizen requirements within a Smart Cities framework. Cities, 90, 32-41. doi: https://doi.org/10.1016/j.cities.2019.01.041

[26] Ibrahim, M., Adams, C., & El-Zaart, A. (2015). PAVING THE WAY TO SMART SUSTAINABLE CITIES: TRANSFORMATION MODELS AND CHALLENGES. JISTEM - Journal of Information Systems and Technology Management, 12, 559-576 .

[27] Ibrahim, M ,.Al-Nasrawi, S., El-Zaart, A., & Adams, C. (2015). Challenges facing e-government and smart sustainable city: An Arab region perspective. Paper presented at the 15th European Conference on e-Government, ECEG .

[28] Ibrahim, M., El-Zaart, A., & Adams, C (. 2016 .) Smart Sustainable Cities: A New Perspective on Transformation Roadmap and Framework Concepts. Paper presented at the The Fifth International Conference on Smart Cities, Systems, Devices and Technologies (includes URBAN COMPUTING 2016), IARIA .

[29] Ibrahim, M ,.El-Zaart, A., & Adams, C. (2018). Smart sustainable cities roadmap: Readiness for transformation towards urban sustainability. Sustainable Cities and Society, 37, 530-540. doi: https://doi.org/10.1016/j.scs.2017.10.008

[30] Jonathan Woetzel, J. R., Brodie Boland, Katrina Lv, Suveer Sinha, Gernot Strube, John Means, Jonathan Law, Andres Cadena, and Valerie von der Tann (2018). SMART CITIES DIGITAL SOLUTIONS FOR A MORE LIVABLE FUTURE. Retrieved 02 12 2018, 2018, from https://www.mckinsey.com

[31] Joshi Sujata; Saxena Saksham Godbole, T. S. (2016). Developing Smart Cities: An Integrated Framework. Procedia Computer Science, 93, 902-909. doi: 10.1016/j.procs.2016.07.258

[32] Kang Yanrong, Z. L., Chen Cai, Ge Yuming, Li Hao, Cui Ying, Jeanette WhyteandHart, T. (2014). Comparative Study of Smart Cities in Europe and China Current Chinese Economic Report Series: Springer.

[33] Korachi, Z.andBounabat, B. (2019). Integrated Methodological Framework For Smart City Development.

[34] Kumar, H., Singh, M. K., Gupta, M. P., & Madaan, J (. 2018 .) Moving towards smart cities: Solutions that lead to the Smart City Transformation Framework. Technological Forecasting and Social Change. doi: 10.1016/j.techfore.2018.04.024

[35] Martin, C. J., Evans, J., & Karvonen, A. (2018). Smart and sustainable? Five tensions in the visions and practices of the smart-sustainable city in Europe and North America. Technological Forecasting and Social Change, 133, 269-278. doi: 10.1016/j.techfore.2018.01.005

[36] McCormick, K. A., Stefan; Coenen, Lars and Neij, Lena. (2013 .) Advancing sustainable urban transformation. Journal of Cleaner Production, 50, 1-11. doi: https://doi.org/10.1016/j.jclepro.2013.01.003
[37] Meijer, A.andBolívar, M. P. R. (2015). Governing the smart city: a review of the literature on smart urban governance. International Review of Administrative Sciences, 82(2), 392-408. doi: 10.1177/0020852314564308
[38] Oman vision 2040- Preliminary Vision Document, Muscat- Oman, 22 December 2013.
[39] Oman Daily Observer, December 15, 2021. [Online]. Available:https://www.zawya.com/en/business/mwasalat-launches-smart-transportation-system-in-oman-m93e7sdw
[40] Thorns, D. C. (2017). The transformation of cities: urban theory and urban life : Macmillan International Higher Education .
[41] S. Suresh, “oerlive”, 15 June 2022. [Online]. Available: https://www.oerlive.com/oman/smart-city-planning-underway-in-suhar-nizwa-and-salalah/
[42] T. O. O. e. S. P. Omanuna, "Sustainable Development," Feb 2023. [Online]. Available: https://omanportal.gov.om/wps/portal/index/aboutportal/!ut/p/a1/hc5NC4JAEAbg39LBqzO55kc3QZQs6WCY7SU0ttXQXVkt6d9n0UXoY27v8LzMAIUMqMhvFc_7Soq8fmZqHQmGiFt3FZtJOkcjCvyFk9hGiPYIDiPAL-Phv_4e6JSsd7GHBkmDyN1YxPfNN_hxImECIqC8lsXr5YMnCuJwoIqdmWJKv6pxXfZ92y011HAYBp1.
[43] Togliatti, I. (2013). Urban strategic planning. Local decision making II, p.42.
[44] Veselitskaya, N., Karasev, O., & Beloshitskiy, A. (2019). Drivers and Barriers for Smart Cities Development (Vol. 14) .
[45] Yadav, G., Mangla, S. K., Luthra, S., & Rai, D. P. (2019). Developing a sustainable smart city framework for developing economies: An Indian context. Sustainable Cities and Society, 47, 101462. doi: https://doi.org/10.1016/j.scs.2019.101462
[46] Yigitcanlar, T., Kamruzzaman, M., Buys, L., Ioppolo, G., Sabatini-Marques, J., da Costa, E. M., & Yun, J. J. (2018). Understanding ‘smart cities’: Intertwining development drivers with desired outcomes in a multidimensional framework. Cities, 81, 145-160. doi: 10.1016/j.cities.2018 . 04.003
[47] Z. G. I. o. Technology, "Smart City and Urbanization Challenges," 8 May 2019. [Online]. Available: file:///C:/Users/Admin/Desktop/A%20SYSTEMIC%20APPROACH%20TO%20SUSTAINABLE%20SMART%20URBAN%20TRANSFORMATION%20THE%20EGYPTIAN%20CASE/Links%20and%20pages/Smart%20Cities_%20The%20strategy%20to%20face%20the%20urbanization%20challenges.html. [Accessed 25 DEC 2022].

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