

The Challenges of Smart City Application in Oman: The Al Irfan Project Experience

RAHMA MOHAMMED BANI ORABA

MBA Student, Al-Zahra College for Women, Oman
rahma1993rr@hotmail.com

REVENIO C. JALAGAT, Jr.

Associate Professor, Al-Zahra College for Women, Oman
revjalagatjr@gmail.com

Abstract:

The main objective of this study is to investigate the challenges faced in the implementation of Smart City in Oman with an emphasis on Al Irfan City. It also highlights how the Smart City be successfully implemented. The study utilized the qualitative research design employing interviews as its primary data gathering tool. However, six experts were contacted; but only four responded and were interviewed face-to-face at different time intervals. Data were analyzed through verbatim and direct quotation using recorded interview and transcribed accordingly. Key results revealed challenges found in the aspects of economic, complexity, data privacy, governance and coordination, technology, and social elements in the application of Smart City. Recommendations were formulated based on the findings such as proper and systematic planning; sufficiency of needed resources and upgraded technologies (Smart Technologies and Digital Economy); concrete laws and regulations; readiness of each governorate for Smart City implementation; adequacy of collaborators (public-private partnerships); equal opportunity for SMEs to participate. In addition, the need for enough experts; data and information availability; ensuring the right Ministries to handle the implementation; active involvement of the stakeholders; alignment of the Smart City implementation with Vision 2040; suitable business model; and ensure sustainability after implementation. It is also recommended that rigid planning and follow-up initiatives be undertaken to ensure the realization of the Al Irfan project. The output of this study can provide a clearer understanding of the direction of the concept of Smart City and its implementation.

Keywords: Smart city, challenges, smart city application, modern technology, Oman

INTRODUCTION

The concept of a Smart City has caught the attention worldwide as it is getting recognition from both scholars and academicians. Various definitions have arisen on the term Smart City; however, the consensus from scholars define this term as a technically advanced and modernized area with a firm intelligent capability that pacts with several social, technical, economic facets of development founded on intelligent computing systems to create better organization elements and services (Bakıcı et al. 2013; Cruz-Jesus et al. 2017; Washburn et al. 2010; Zygiaris 2013; Chatterjee & Kar, 2018b). For the last two decades, international policies have been developed towards the proliferation of the smart city (Albino et al. 2015; Koo et al. 2017; Mori & Christodoulou, 2012). At the global level, countries such as Argentina, Chile, Brazil, Mexico, and China have launched initiatives relative to smart cities to supervise

urbanization (Ajaz, 2016) efficiently. On the one hand, in terms of measuring the quality of life index as opposed to urbanization, countries such as Australia, Denmark, and Switzerland have overtaken the Asian countries such as India, one of the big giants in population in the utilization of technology. Taking India as a prototype model in developing countries, the country has encountered many challenges, particularly physical problems such as waste management disposal, aging infrastructure, traffic, scarcity of resources, air pollution, deteriorating structures and buildings, and others (Chourabi et al., 2012). Nowadays, cities are competing in development and creativity. The concept of “smart city” spread worldwide, so most cities in developed and developing countries are trying to become “smart cities. The main goal of the smart city initiative is to enable cities to manage their assets efficiently. A smart city is a city that utilizes information technology to make their central infrastructure and public services more interactive and efficient. Smart city has become an emerging paradigm consisting of ubiquitous sensing, heterogeneous network infrastructure, and intelligent information processing and control systems. A smart city can monitor the physical world in real-time and provide competent services to residents and travelers regarding transportation, healthcare, environment, entertainment, and energy (Zhang et al., 2017).

In 2017, the Sultanate of Oman had launched Al-Irfan as the first smart city in Oman, not fully equipped. Still, it has residential complexes, hotels, showrooms, and exhibition & conferences halls as a start. As a promise to reflect the country’s revolution in so many aspects, it will be a portentous project to launch another smart city which will be discussed in more detail in this Research. (Information Technology Authority, 2017). Rapid urbanization and globalization make a move towards the smart city concept a must. As a result, many cities worldwide have started moving towards the smart city (Ibrahim et al., 2015). However, there are many challenges facing countries, especially Oman, in applying smart cities and demonstrating the importance of smart cities in Oman to create a smart city platform in 2017. At the end, this survey will provide necessary references to help the Government of Oman understand the challenges facing Oman and thus find it easy to find future solutions to these challenges and make appropriate decisions.

1.1. Problem Statement

There is a lack of study conducted on smart cities in Oman, and there is an in dire need to manage the resources through establishing the smart city. To guide the use of resources and capabilities in line with the requirements of modern technology, Oman has begun to adopt smart solutions such as Smart City in line with developed countries. However, Oman faced many challenges in applying smart cities including financial support, time, infrastructure, cost, and ranging from economic and technological to social and regulatory, which are typical for any other project. To classify them, the following 5 groups were created: 1. Complexity Challenges, 2. Economic Challenges, 3. Technological Challenges, 4. Social Challenges, 5. Governance and Coordination Challenges (Kogan, 2014). Cities were built to increase livelihoods, safety, recovery, and sustainability by making intelligent services such as smart education, smart government, intelligent mobility, smart homes, and e-health. The Sultanate of Oman supports the idea of smart cities, and there is a government approach to these cities. One of the national priorities of Oman 2040 vision for developing governorates and sustainable cities was to build smart and sustainable towns with high quality of living and work (Catapult Connected Places, 2021). The digital transformation of cities

towards Smart Cities proposes many opportunities, e.g., related to services, security, waste, energy management, and infrastructure management. These opportunities come with various innovation challenges from a technological perspective and for public authorities and citizens (Bork et al., 2016). Many studies had been conducted about Smart City in other countries however, most of these studies are in conceptual papers and critical reviews. To the best of knowledge of the researchers, this study is one of the very few studies conducted especially in the Sultanate of Oman.

There is scarce literature review on the subject matter. On another note, the challenges facing the transformation process in the Arab region are not well covered in the literature (Ibrahim et al., 2015). Moreover, according to Prabhu (2021, p. 120), “In Oman there are little information and published papers about smart cities and their importance in solving critical problems and the challenges facing their application”. Considering this scarcity, this study is undertaken to investigate challenges of Smart City application in Oman.

1.2. Research Objectives

In this study, the following objectives are formulated:

- 1.2.1. To gain an in-depth understanding of the concept and application of Smart City.
- 1.2.2. To determine the reasons for the need to implement Smart City in Oman.
- 1.2.3. To assess and evaluate the challenges faced in implementing Smart City in Oman.
- 1.2.4. To device ways and means on how the Smart City can successfully be implemented in Oman.

LITERATURE REVIEW

The challenges pertaining to Smart City differ from country to country. There are examples of smart cities worldwide, like Barcelona, Portages, and Masdar in Abu Dhabi. These examples proved the success smart cities especially in Singapore and Barcelona because they have accomplished and fulfilled the aims and tried to minimize the challenges. On the other hand, some examples of smart cities did not fully accomplish their desired objectives. For example, in Rotterdam, the main concern was data privacy. Still, in Masdar, the primary purpose was to make an eco-friendly city using sustainable energy.

According to some reports, Stanford University’s Research shows that around 150 smart city projects are ongoing or completed. Most of them are found in Europe (47), Asia (40), and North America (35) (Stanford University Human-Centered Artificial Intelligence, 2021). The smart city is also used as a marketing label by companies and cities that help guide their urbanization processes and increase their competitiveness. Top IT-based leading companies have targeted smart cities as their main markets and blue oceans of business development. Furthermore, academia is also increasingly embracing the topic of smart cities as one of the hottest emerging research areas launching post-graduate courses and research lines centered exclusively on the theme (CIDOB, 2014). Surprisingly, despite so much buzz around smart cities, with numerous agencies promoting, evaluating, and developing them worldwide, there is a great deal of ambiguity even on its normative definition, parameters, and international authority on its standardization (Sethi, 2015).

2.1. Definition of Smart City

Smart city has many different definitions. Mohanty et al. (2016) defined the smart city as a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants. Smart cities are greener, safer, faster, and friendlier. Also, Rocha et. al. (2018) defines a Smart City as a city which has stated its intention to use information and communication technologies to transform its modus operandi in one or more of the following areas: energy; environment; governance; mobility; buildings and services.

2.2. History of Smart City

The history of smart cities began in 1994 in Netherlands when Digital City (DDS) was launched as a virtual public domain (Van den Besselaar & Koizumi, 2005). That was the period that saw enormous growth on the Internet and increased use of public media. Research from Brookhaven National Laboratory made public the ideas of the next Big thing – Efficient Cities. By late 1999, when the commercial Internet came in its full use, such term is called “Ubiquitous Computing, Cybercity” were presented. Finally, in 2000, the idea of “Smart City” came into use. (Kogan, 2014). The challenges and Good deeds differ from country to country. There are live examples of smart cities worldwide, like Barcelona, Portages, and Masdar in Abu Dhabi.

Furthermore, academia is also increasingly embracing the topic of smart cities as one of the hottest emerging research areas launching post-graduate courses and research lines centered exclusively on the theme (CIDOB, 2014). Smart city as a platform provides transparency of the urban space processes and forms two-level management (citizen-government). When there is such projects of this level, the citizens themselves act as the center of aggregation of new meanings, values, and needs (Drozhzhin et al., 2019).

2.3. Components of Smart City

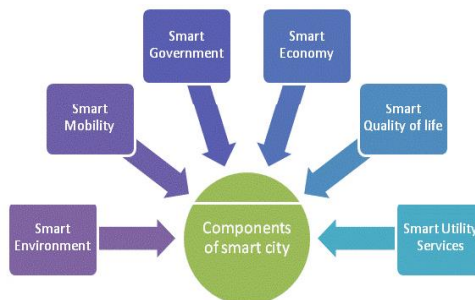


Figure 1. Components of Smart City

Source: Adapted from Samih (2019), p.3-12

Ceinsys is a world leader in serving the geospatial and information technology domain to provide professionals with customized solutions for versatile engineering domains. In 2015 it referenced the main components of smart city as seen in Table (1).

Table 1. Components of Smart City

Components	Working area	Benefits
Environment	<ul style="list-style-type: none"> Smart Buildings Resources Management Sustainable Urban Planning 	<ul style="list-style-type: none"> Certified and safe buildings Reduction in total energy consumption & waste generation Availability of per capita green space
Mobility	<ul style="list-style-type: none"> Efficient Transport Multi-modal Access Technological Infrastructure 	<ul style="list-style-type: none"> Clean energy transport Reduction in fuel consumption
Government	<ul style="list-style-type: none"> Online services Open Government 	<ul style="list-style-type: none"> Reduction in human efforts and energy consumption Quick access to Government and its policies Real-time services
Economic Development	<ul style="list-style-type: none"> Opportunity and productivity Financial Hubs 	<ul style="list-style-type: none"> Global and national investments More employment opportunities Increase in GDP and per capita income
Quality of life	<ul style="list-style-type: none"> Safety and Health Education facilities 	<ul style="list-style-type: none"> Reduction in crime Better education to all Increase in life expectancy
Reliable utility services	<ul style="list-style-type: none"> 24x7 Water & Electricity supply Solid waste management Sanitation Wi-Fi availability Wi-Fi availability City gas distribution system 	<ul style="list-style-type: none"> Availability of clean water Uninterrupted and quality power Recycling of waste Cleaner and healthier cities Quality of life Clean and hygienic toilets Online public services and information

Adapted from Samih (2019), p.3-12

2.4. Challenges of Smart City

Building a smart city is not easy without facing any challenges. According to studies conducted on cities around the world, these challenges differ from one country to another and from one region to another. For example, Kogan (2014) says that the difficulties in Korea were divided into five sections: 1. Complexity Challenges 2. Economic Challenges 3. Technological Challenges 4. Social Challenges 5. Governance and Coordination Challenges (Kogan, 2014). In 2016 “*Local attempts to develop and implement smart initiatives in particular cities they were allowed us to outline several socio-political, economic and executive challenges for Ukraine.*” (Matyushenko & Pozdniakova, 2016, p.28). The Figure below shows how Matyushenko and Pozdniakova explained the challenges in Ukraine.

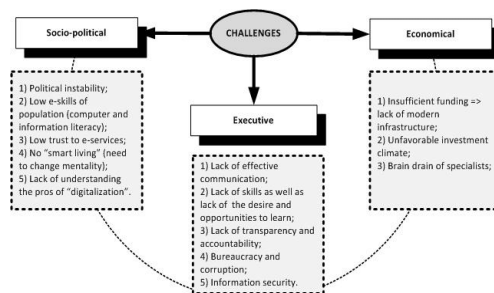


Figure 2. Challenges of Smart City in Ukraine

Source: Adapted from Matyushenko & Pozdniakova (2016), p. 25-36.

Aleksandrova expressed the challenges of smart cities as she explained that the main challenges are: Infrastructure, privacy concerns, Smart cities security issues, education for engagement, and social inclusion (Aleksandrova, 2019).

2.5. Challenges of Smart City in Arabic Countries

In the race for the development of cities, the United Arab Emirates was the first in smart cities among Arab countries. Dubai also faces some challenges, as Maroto (2015) mentioned that:

Dubai faces unique challenges in:

- Water and energy security, transportation and mobility, sustainable development, and citizen engagement.
- Create awareness among the citizens when launching smart city services to use them efficiently and effectively.
- Get public participation in designing and organizing the transport network in their area, whether public transport or roads.
- For foreign residents (property website ae recently gave a deeper insight into the things that bother them in Dubai. Its “Happiness Survey” asked almost 2,000 Dubai UK residents what annoys them most about living here. The results came back: Disruption and mess from ongoing construction work, traffic congestion, and living too far from work were the top three, followed by “feelings of isolation” and living too far from shops, restaurants, and Dubai Metro.
- Dubai could oversee resources to implement the Free City Wi-Fi project, which would feature free Wi-Fi in all public places.
- Connecting the Ultra-modern public transportation – Dubai International Airport and new Airports Al Maktoum International Airport, Metro network, Jebel Ali Port.
- Tourism targets – The main challenge is to deliver to around 60 hotels per year for at least three years. Other looming challenges are the impact of demand on construction materials, labor, and funding, which is likely to drive overall development costs higher. Additionally, increased demand for quality sites will cause an increase in land prices, thereby reducing investor returns³
- Highly scalable supply chain management – Expo’s six-month duration will place significantly increased demands on Dubai’s food and beverage and retail sectors. The city is well served with many large shopping malls, but these and other retail points will need to ensure they are always well-stocked. Dubai is fortunate to have many professional supply chain management companies. Therefore, the focus will be on integrated and highly scalable Dubai logistics suppliers who can rapidly adapt themselves to support changing market conditions. Demand planning, stock availability, and understanding of FMCG supply chains will become even more critical. Many multinationals such as McDonald's and Starwood already have scalable solutions in place. Many more will require specialist local assistance.
- Ensure that the public and private sectors are flexible, agile, innovative, and capable of engaging individuals and communities (Maroto, 2015).

Saudi Arabia was also present in the race for the development of smart cities, and the Saudi Vision Channel in 2017 reported some of their challenges in building the smart city:

1. Lack of a clear vision of the concept of smart cities and their components in the Kingdom of Saudi Arabia.
2. Poor coordination between the relevant authorities.
3. Lack of preparedness of the infrastructure supporting the implementation of smart cities.
4. Many laws and regulations are outdated and incompatible with smart city concepts and components (Counterpoint, 2017).

The previous examples from the Gulf countries may have presented some challenges that may face the establishment of smart cities in the region. Being one of the Gulf countries, the Sultanate of Oman may be subject to the same circumstances and challenges. From this standpoint, the following questions come to mind: Is smart cities technology developed in Oman? What are the most critical challenges facing Oman in applying smart cities? What is the effective future direction to solve these challenges?

METHODOLOGY

The study is aimed at evaluating the challenges faced in the implementation of the Smart City in Oman and how these challenges can be addressed. This study used the qualitative research design with face-to-face interviews through experts as the primary gathering method. Miles and Huberman (2009, p.34) defined qualitative research design as a model wherein the qualitative data “are a source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts. The reason for choosing the qualitative research design is anchored on the research objectives that investigate the challenges of Smart City implementation and expert opinions regarding how the challenges are best addressed. It also utilized the deductive approach and was associated with the qualitative research design. The focus of using this approach is to evaluate the extent of the experts’ in-depth knowledge on the Smart City concept that can be utilized to implement the Smart City in Oman. Furthermore, face-to-face interview with semi-structured and open-ended questionnaires. The interviews will rely mainly on experts, developers of cities and researchers in smart cities, and those who participated in the City of Al-Irfan project and implore their opinions on the challenges of applying smart cities in Oman. The use of interviews and questionnaires will help analyze their thoughts and suggestions and finally generalize the ideas and information on the study subject.

The sampling method used was purposive or judgmental sampling to ensure that the identified experts were appropriately chosen. Communications were disseminated to six experts initially; however, only four experts responded. They represented the different development companies that have been awarded the contract of building and operating the qualified respondent cities targeted in this study. Semi-structured and open-ended interview were conducted to the experts at different time intervals and responses were voice recorded for transcription. For easy recognition, the four expert respondents have given codes as enumerated: Expert 1 (E1), Expert 2 (E2), Expert 3 (E3), and Expert 4 (E4). Data was analyzed mainly through transcription to analyze the data with verbatim and quoted responses from the experts. Voice recorders were used during interviews with the experts, and responses were assigned codes for data analysis. Assistance from a transcriber was sought to ensure that the actual responses reflected the opinion of the researchers.

ANALYSIS, RESULTS, AND DISCUSSIONS

This section presents the data analysis and interpretation of the study. Data from interview questions are labeled and arranged in the following order: 4.2.1. What is Smart City? 4.2.2. Why is there a need to implement Smart City in Oman? 4.2.3. Are there any initiatives already taken to implement Smart City in Oman? 4.2.4. What ways and means by which citizens and residents in Oman are informed about Smart City's importance? 4.2.5. Are there recent literature and studies about the challenges of smart city implementation in Oman? If yes, can you give an example? 4.2.6. Who do you think should implement the Smart City?

4.1 Excerpts from the Transcribed Interview Responses of the Experts

4.1.1. What is Smart City?

The experts viewed Smart's definition differently, and details of their definitions are stated in the following sections.

“Smart City to me does not only limits to the use of technology or linking to the telecommunication sector but rather the essence of having safety first and availability of all services in one location. For example, you don't need to pay for electricity physically because you can pay online. Safety means prevention against crimes, theft, robbery, and other violent activities. (E1)

“A city where the Internet enables people and devices to be interconnected so that they can communicate data and voice. These are supported by applications and digital platforms that allow decisions to be made automatically and with human intervention and preferences”. (E2)

“When we think about Smart City, we could directly associate it with technology and connectivity, better way of living in one place although it is not about the technological application but a mixture of technology, sustainability, and people lifestyle when living together in one place.” (E3)

“Smart city can be defined subjectively as a city wherein the quality of life is improved, and the people's well-being is protected. A city wherein the technology (Information and Communication Technology) is the driving force to attain a better lifestyle, lower costs, and address the specific needs of citizens and residents. I am not saying that technology is the sole solution but an integral part in developing a better quality of living for the people”. (E4)

4.1.2. Why is there a need to implement Smart City in Oman?

To address this question, all experts expressed their agreement on the importance of implementing the Smart City in Oman. The common reasons for this are increasing population, crimes, better connectivity, better lifestyle and quality of life, improved security, and efficiency of operations for businesses. Also, Smart City can contribute significant impact socially, economically, politically, technologically, and environmentally. Excerpt from the respondents' feedback expressed that,

" Smart City enables stakeholders to create more economic and social value, building long-lasting financial and social impacts. Changes of external environment factors such as political, legal, social, economic, environmental, and most important for the people aspect are driving forces for the implementation of Smart City". (E2)

"There is in dire need to implement Smart City in Oman for citizens and residents to attain happiness, quality of life, and for businesses to achieve efficiency in operations as well as effectively maximize the use of scarce resources." (E4)

4.1.3. Are there any initiatives already taken to implement Smart City in Oman?

Three of the four experts attested that there are initiatives taken by different concerned agencies but are still in conceptual and planning stages. One of the initiatives in line with Vision 2040 is the "Smart Cities and Governorates Program" and the Ministry of Housing and Urban Planning for all governorates. Also, plans to develop the Knowledge Oasis into a Smart City in partnership with the Ministry of Housing. However, one expert expressed that the lack of tangible initiatives was evident in implementing Smart City. Their transcribed responses were narrated hereunder:

"In line with the Vision 2040, the government had launched the program called the 'Smart Cities and Governorates Program.' This program aspires to create competition and awareness for all governorates. At present, I am part of a team that works on a project that develops unified Smart city policies for implementation in Oman to determine the needs of every governorate towards transformation into Smart City and in establishing Smart City policies and standards that will become part of the Smart Cities and Governorates Program in Oman". (E1).

"As of now, Al Irfan City is the most visible initiative in implementing Smart City in Oman, although it is still a work in progress that requires lots of planning. I believe that many initiatives are on the way". (E2). In one of his speeches, his Majesty Sultan Haitham Bin Tariq mentioned a need to develop many Smart cities, so there is a core link between the Ministry of Housing and Urban Planning with other entities not only for Muscat but also extends to all other governorates.

"Yes, these include Al Irfan City, Surah, Knowledge of Oasis. However, they vary in purpose. For example, Al Irfan city is for commercial purposes. At the same time, the Surouh project is more concentrated on developing the residential areas where the direct beneficiaries are the citizens and with the initiatives and partnership with the Ministry of Housing". (E3).

4.1.4. What are the ways and means by which citizens and residents in Oman are informed about Smart City's importance?

The experts all agreed that there are many ways to promote the Smart City in the country. General consensuses suggest that it is implementable by adopting the Smart City platform, print media, workshops, and presentations to different stakeholders like investors and merchants, schools and universities, social media (e-information, e-participation, e-consultation, etc. Individual answers were transcribed as evidence of these outcomes as stated:

"One of the ways Smart City can be known is by adopting the Smart City platform. The Government in Oman through the Omanuna is the agency responsible for promoting Smart City to ensure knowledge-sharing, networking, and a collaborative environment among the stakeholders of Smart City". (E1)

“I believe that there are many ways to inform the people in Oman about the importance of having Smart City. We can make awareness through newspaper articles; awareness campaigns in schools, colleges, and universities; seminars and workshops; TV programs; workshops for government officials and business executives”. (E2)

“I am convinced that to implement the Smart City, three ways and means should be attained, namely e-information, e-participation, and e-consultation. For example, utilizing social media platforms in line with the 2040 vision helps support Smart City. E-participation allows people to participate after informing them of the goals and objectives of implementing the Smart City. Finally, e-consultation or considering public opinions from experts, businessmen, and all other stakeholders for solicited efforts and following the vision 2040”. (E4)

4.1.5. Are there recent literature and studies about the challenges of smart city implementation in Oman? If yes, can you give an example?

Generally, all the interviewed experts stressed limited information and published Smart City papers. One experts stated that “Smart City is one of the least talked in Oman even though many citizens and businesses are fully aware of the technology used, however; the government has considered importance by incorporating the implementation of Smart City in line with the 2040 vision” (E1). There is evidence of studies conducted in other countries such as Dubai, San Francisco, Seoul, Tokyo, etc. Another expert also stated that “I knew a person conducting a study on Smart City in Oman named Dr. Islam Bouzguenda, but this effort is still very limited in assessing the feasibility of implementing the Smart City in the country” (E3). It is also supported by another expert who said that “As far as I know, very few data can be collected on Smart City because the concept is not common in Oman in fact, I had the opportunity to examine MBA theses from graduates of different colleges and universities but less information about its publication” (E4).

4.1.6. Who do you think should implement the Smart City?

The experts agreed that implementing Smart City should be a collaborative effort by different companies and agencies. Individual responses from the experts are expressed in the following paragraphs.

“The implementation of Smart should be a collaborative effort between different government agencies such as the Ministry of Commerce, Ministry of Economy, and the Supreme Council for planning. Also, in line with Vision 2040, the Ministry of Commerce should create a partnership with the private sector for joint development. I can still recall that the Ministry of Transport, Communication, and Information Technology (MCTIT) in 2017 had launched the Smart City platform called “Towards Oman’s First National Smart City Stack” that was expected to drive economic growth, job creation, diversification from the oil-based exports, etc. One of the priority projects is developing the Al Irfan Smart City project in Madinat Al Irfan to build houses for 300,000 residents, hotels, shopping centers, parks, and others. Others are in Salalah Free Zone, Duqm planned Smart City project. And the transforming the Knowledge Oasis Muscat (KOM) which already has high-tech knowledge and innovation parks will bolster Oman Smart City Agenda”. (E1)

According to Prabhu (2021), A bolstering Oman’s Smart City plan is the presence of high-tech knowledge parks, such as Knowledge Oasis Muscat (KOM) near Rusayl. The KOM also features the Innovation Park Muscat, which facilitates Oman’s entrepreneurial, economic, and knowledge base.

“The foundation of the country’s Smart City has been laid with the joint venture between the Government and Dubai’s Majid Al Futtaim specifically for Madinat Al Irfan in 2018 and backed by the Oman Tourism Development Company (Omran). Al Futtaim had already worked on a master plan that considers the service plots available for commercial, residential, education, healthcare, entertainment, and hospitality development (Rossusseau, 2018). However, in my observation, nothing tangible development happens; hence, this requires more planning”. (E2)

“In 2017, the concept of Smart City has started with Omran managing it, and as far as I know, they have laid the vision and the general idea on how the Smart City will look like. Stage 1 was started wherein both commercial and residential places were offered to companies and investors to build in the vicinity of Smart City. One of the causes of the delays in the implementation is government approval. The infrastructure has just started recently, which means that time has passed that the Smart City remains the only concept”. (E3)

What do you think are the challenges in Smart City implementation?

In addressing this question, the question was divided into six components as stated and the experts were asked to share their thoughts. The details of the responses were presented in Tabular format as shown.

- a. Economic
- b. Complexity
- c. Data privacy
- d. Governance and coordination
- e. Technology
- f. Social

Table 2. Summary of Challenges on Smart City Implementation

Dimensions	Summary of Challenges	Experts’ Responses
Economic	Costs to build the infrastructure using the technologies like fiber lines, satellite connections, cell towers, etc.; challenges coping up for SMEs; larger budget for technologies.	The difficulty for SMEs to participate is because of a limited budget. (E1) “From a government perspective, therefore, I say that if there are laws the investors follow for establishing Smart City and make sure that they can build a city and earn returns, the government will also get returns.” (E2) “The government I think is experiencing financial struggles unlike in the past wherein national budget had surpluses; however, building a Smart City was not a priority.” (E3) “Building Smart Cities entails costs and coordination from both government and private companies. If the government does not commit funding the projects, its implementation causes delays”. (E4)
Complexity	Difficulty obtaining a building permit, changing government policies and procedures, new technologies and applications, detailed planning and	“For telecom companies to build a telecom tower, they need a permit from 10 government agencies ‘ this procedure may be linked to other government procedures, which may take up to

	implementation, financial complications, lack of accountability, complex systems.	6 months and sometimes up to a year". (E1) "It requires detailed planning and even more detailed implementation like we have not done before because a lot of the technology is new, and several applications require proper training". (E2) "Complexity in procedures to process documents and fast-changing rules and regulations are suffocating." (E3) "The most affecting complication is the administrative or the government's legislation that is overlapping." (E4)
Data Privacy	The difficulty of citizens and residents to access data or information, data privacy, data security, and government restrictions.	The four experts are in one voice in claiming that there is difficulty accessing information. The Government gives data security and privacy utmost consideration through the Royal Oman Police. One expert exclaimed that "data privacy and security is a big issue in Oman because of the hacking trend 5-10 years back" (E2).
Governance & Coordination	Transforming into a global village challenge, sustainability of Smart City, issues of coordination with different actors/implementors, changes and development of new rules and regulations related to Smart City, management challenges for Smart pilot project/s, lack of competent people to manage the project, and clarity on how Smart City should be governed.	"As for government legislation, I talked about this topic previously through my talk of obtaining a permit to build telecom towers" (E1) "I see that there is a significant role for the Ministry of Housing, and I think they are working on it precisely to find rules, so the person who wants to build a Smart City knows how. The Government can create a Smart City platform by cooperating with the Ministry of Housing, but the Ministry must find the fundamental laws to make because we have laws on our country. We must also follow them." (E2) " as we know now, governance is one of the main pillars in 2040 and a lot of new regulations relocating of creating new entities, you never know, new laws and regulations and that is the role of the Government to create the law and governance and allow the right players in the private market sector to access the lands and all these things to do the proper infrastructure and all these things. But it would help if you had adequate governance, that's true. And I believe this is a big jump for Oman for a technological breakthrough". (E3) "Most of our problems are due to legislation, governance; lack of competencies and adequate time plans are extremely neglected here and affecting the flow of any procedure. We can see in neighboring countries that the willingness and serious follow up are the main reason for the huge progress and success in achievement of projects in short time less than a year" (E4)
Technology	Delaying administrative procedures, difficulty obtaining a permit for citizen use, new technologies vs. culture and traditions, lack of competent technology providers.	All experts noted the delay of administrative procedures relative to the technological aspect. The need technology providers with the technical know-how to implement the Smart City.
Social	Public acceptance, people awareness, issues of whether it promotes safety, respect for others' rights or human rights issues, sustainability issues for people	"Citizens are either supportive or against, but the issue of thefts, accidents, and crimes in the event of surveillance cameras everywhere will make the citizen feel safe." (E1) "There is an urgent need for the society and people to have the training and a deeper

		<p>understanding of the Smart City concept and educate them in Smart usage. (E2)</p> <p>“If the country is serious in implementing Smart City, there are lots of things to be done. It requires change management; training, education, and awareness; and the readiness to implement with its resources and requirements”. (E3)</p> <p>“If we want to install a Smart City, we must first ensure sustainability, i.e., we have to find business model i.e., chances for middle to small business projects within the huge project itself to ensure sustainability to ensure that we don't run out of resources at the end. We must not rely on the Government. Yes, they will start the project, but then it is the responsibility of the people in charge of the project to ensure it is sustained, maintained properly, and well organized”. (E4)</p>
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4.1.7 How can you address these challenges, suggestions, and recommendations for a successful Smart City implementation in Oman?

Each expert has suggested and recommended how the challenges of Smart City implementation can be appropriately addressed, as presented in Table 3.

Table 3. Summary of the Experts’ Suggestion and Recommendations for a Successful Smart City Implementation

Experts Opinion	Suggestions and Recommendations
E1	<ul style="list-style-type: none"> • First, planning means putting the right people in the right place, constantly updating, and reviewing the new technology. • Revisit laws and regulations that have a relation with the Smart City implementation. • Annual review in the stages of implementation of Smart City project. • Keep updated with the changing technologies. • Collaborators should examine and evaluate their commitment to support the project and not give up in the middle of implementation. • Transform each governorate into a digital economy. • Provide all the services needed equally to each governorate to the citizens. • Strengthen security. • Consider the creation of jobs for the citizens in the proposed Smart City. • Develop national and unified policies and standards on Smart City • Provide equal opportunity for SMEs in the development of Smart City. • Identify the structure and infrastructure required for Smart City. • Joint efforts between the Government and private institutions.
E2	<ul style="list-style-type: none"> • Ensure systematic planning and stages of implementation based on timelines. • Blend with technology and people who have the technical know-how to implement Smart City. • Involve the stakeholders in the development and implementation stages. • Basic needs relative to Smart City should address by the governorate. • Scenario planning. • Ensure that assignment of the implementation of the Smart City project is given to the appropriate government agency for smooth performance and guidance. • More collaboration with private organizations, the better the outcome.
E3	<ul style="list-style-type: none"> • It requires the availability of sufficient data which the Government can collect before engaging with the Smart City project. • Gather data from different countries that have implemented the Smart City for guidance. • Assess the need for Smart City implementation in each governorate for the proper disposition of the project.

	<ul style="list-style-type: none"> • It requires careful selection and assessment of the government ministries or agencies to handle the project.
E4	<ul style="list-style-type: none"> • Ensure that you have established concrete and SMART (Specific, Measurable, Attainable, Realistic, Timebound) objectives. • Involve your stakeholders in the entire project. • Establish a public-private partnership. • Create a business best model that best suits the Smart City project. • Align priorities with your budget and in line with Vision 2040. • Strengthen the Royal Decrees towards a sustainable Smart City implementation. • Requires an intelligent vision to enable a successful Smart City. • Enable each governorate with sufficient resources to the speedy implementation of Smart Cities.

4.2 Summary

This section summarized the transcribed responses of the experts based on the interview questions formulated by the researcher. It outlined the narrated feedback and verbatim responses of the four experts analyzed and interpreted. The analyzed results will then be concluded in Chapter 5.

CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

5.1.1 Perception of Smart City

A smart city is a place where all services are available, connectivity through technology, a city that promotes safety, convenience, the driving force to attain a better lifestyle, lower costs, and sustainability of people's needs.

5.1.2 Importance of Implementing Smart City in Oman

Implementation of Smart City in Oman is essential because of the following reasons: increasing population; increasing crime and accidents; better connectivity; demand for security and privacy; better quality of life; social value; and efficiency and effectiveness for business operations. Also, it addressed changes in environmental forces such as political, economic, social, technological forces.

5.1.3 Initiatives taken to implement Smart City in Oman

Initiatives are evident, and these are more focused on the planning and conceptual formulations, although the launching of Smart City has been done since 2017. Collaborations and coordination were initiated as well as programs introduced like the Smart City and Governorates by the Ministry of Housing and Urban Planning, development plan transforming Knowledge Oasis to Smart City, and the Al-Irfan development as examples.

5.1.4 Ways and means by which citizens and residents in Oman are informed about Smart City's importance.

Smart City can promote many ways through the Smart City platform, print media, workshops, and presentations to different stakeholders like investors and merchants, schools and universities, and social media (e-information, e-participation, e-consultation), etc.

5.1.5 Recent literature and studies about the challenges of smart city implementation in Oman.

Generally, all the interviewed experts stressed limited information about published Smart City papers. There is evidence of studies conducted in other countries such as Dubai, San Francisco, Seoul, Tokyo, etc. Very little data can be collected on Smart City because the concept is not common in Oman.

5.1.6 Agencies or companies that can implement the Smart City in Oman.

The experts agreed that implementing Smart City should be a collaborative effort by different companies and agencies. These may include the Ministry of Commerce, Ministry of Economy: Supreme Council for Planning; Ministry of Transport, Communication, and Information Technology; Oman Tourism Development Company; Ministry of Interior and backed by private companies and corporations.

5.1.7. Challenges in Smart City implementation.

Main challenges faced of Smart City implementation are:

- a. Economic-Costs to build the infrastructure using the technologies like fiber lines, satellite connections, cell towers, etc.; challenges coping up for SMEs; larger budget for technologies.
- b. Complexity-Difficulty is obtaining a building permit, changing government policies and procedures, new technologies and applications, detailed planning and implementation, financial complications, lack of accountability, complex systems.
- c. Data privacy- The difficulty of citizens and residents to access data or information, data privacy, data security, and government restrictions.
- d. Governance and coordination- Transforming into a global village challenge, sustainability of Smart City, issues of coordination with different actors/implementors, changes and development of new rules and regulations related to Smart City, management challenges for Smart pilot project/s, lack of competent people to manage the project, and clarity on how Smart City should be governed.
- e. Technology- Delaying administrative procedures, difficulty obtaining a permit for citizen use, new technologies vs. culture and traditions, lack of competent technology providers.
- f. Social- Public acceptance, people awareness, issues of whether it promotes safety, respect for others' rights or human rights issues, sustainability issues for people

5.1.8 Recommendations for a successful Smart City implementation in Oman

A couple of suggestions and recommendations can be summarized as follows: proper and systematic planning; sufficiency of needed resources and upgraded technologies (Smart Technologies and Digital Economy); concrete laws and regulations; readiness of each governorate for Smart City implementation; adequacy of collaborators (public-private partnerships); equal opportunity for SMEs to participate. In addition, the need for enough experts; data and information availability; ensuring the right Ministries to handle the implementation; active involvement of the stakeholders; alignment of the Smart City implementation with Vision 2040; suitable business model; and ensure sustainability after implementation.

5.2. Conclusion

Smart City is a relatively new concept in Oman compared to the other countries, and its first launching can be recalled in 2017 with the Al Irfan Smart City. The main objective of this study is to investigate the challenges facing Oman in the implementation of Smart City. The Smart City implementation has experienced difficulty for many reasons based on the study findings. The challenges were found in the economic aspect with costly to build the infrastructure using the technologies like fiber lines, satellite connections, cell towers, etc.; challenges coping up for SMEs; larger budget for technologies. Complexity in terms of the difficulty in obtaining a building permit, changing government policies and procedures, new technologies and applications, detailed planning and implementation, financial complications, lack of accountability, complex systems. Data privacy with citizens and residents' difficulty accessing data or information, data privacy, data security, and government restrictions.

Technology through the delays in administrative procedures, difficulty obtaining a permit for citizen use, new technologies vs. culture and traditions, lack of competent technology providers. In addition, the challenge of governance and coordination with difficulty in transforming into a global village challenge, sustainability of Smart City, issues of coordination with different actors/implementors, changes and development of new rules and regulations related to Smart City, management challenges for Smart pilot project/s, lack of competent people to manage the project, and clarity on how Smart City handling. And, the social aspect with the problem of public acceptance, people awareness, issues of whether it promotes safety, respect for others' rights or human rights issues, sustainability issues for people.

It can also be concluded that Smart City is essential and should be sustained in Oman and promoted in different platforms for nationwide information and application. More research and literature reviews are required to have excellent and sufficient ideas on how Smart City should be best implemented. Initiatives already started can be enhanced and strengthen the collaboration among participants of the Smart City.

5.3. Future Researches

The state of implementation of Smart City since its launching in 2017 is still to be experienced by the people in Oman. Initiatives are laid and linked with the Vision 2040, and for Al Irfan Smart City, it remains a concept rather than implementation. It is recommended that rigid planning and follow-up initiatives be undertaken to ensure the realization of the Al Irfan project. It is also suggested that the output of this study can provide a clearer understanding on the direction of the concept of Smart City and its implementation. The lack of experts to address the questions laid in this study is its primary limitation. This study can therefore be expanded with more experts including international experts who can participate and freely give their valuation opinions. Finally, future studies may include the related governmental ministries and agencies that can contribute to the decisions directly and indirectly to the development and sustainability of Smart City in Oman.

REFERENCES

1. Aijaz, R. (2016). *Challenge of making smart cities in India*. IFRI Center of Asian Studies. *Asie Visions*. 1–34. Retrieved August 12, 2022, from: https://www.ifri.org/sites/default/files/atoms/files/av87_smart_cities_india_aijaz_0.pdf
2. Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. *Journal of Urban Technology*, 22(1), 3–21.
3. Aleksandrova, M. (2019). Principles and considerations for mainstreaming climate change risk into national social protection frameworks in developing countries. *Climate and Development*, 12(6), 1-10. doi: 10.1080/17565529.2019.1642180
4. Bakıcı, T., Almirall, E., & Wareham, J. (2013). A smart city initiative: The case of Barcelona. *Journal of the Knowledge Economy*, 4(2), 135–148.
5. Bork, D., Buchmann, R., Hawryskiewicz, I., Karagiannis, D., Tantouris, N., & Walch, M. (2016). *Using Conceptual Modeling to Support Innovation Challenges in Smart Cities*. 2016 IEEE 18th International Conference on High Performance Computing and Communications; IEEE 14th International Conference on Smart City; IEEE 2nd International Conference on Data Science and Systems (HPCC/SmartCity/DSS), pp. 1317-1324. doi: 10.1109/HPCC-SmartCity-DSS.2016.0187.
6. Catapult Connected Places. (2021). *Towards Oman's First National Smart Cities Stack*. Retrieved July 15, 2022, from: <https://www.ita.gov.om/itaportal/Data/English/DocLibrary/202172911511454/Oman%E2%80%99s%20First%20National%20Smart%20Cities%20Stack.pdf>
7. Chatterjee, S., & Kar, A. K. (2018a). Readiness of Smart City: Emerging economy perspective. *Advances in Theory and Practice of Emerging Markets*, 2, 221–232.
8. 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*. 45th Hawaii international conference on system science, 2289–2297
9. CIDOB. (2014). *Beyond Smart Cities: It's time for urban sustainable development*. Retrieved July 1, 2022, from: https://www.files.ethz.ch/isn/182614/NOTES%2092_COLL_ANG.pdf
10. Counterpoint. (2017). *GITEX 2017 – A stepping stone for the Smart City Vision*. Retrieved July 17, 2022, from: <https://www.counterpointresearch.com/gitex-2017-a-stepping-stone-for-the-smart-city-vision/>
11. Cruz-Jesus, F., Oliveira, T., Bacao, F., & Irani, Z. (2017). Assessing the pattern between economic and digital development of countries. *Information Systems Frontiers*, 19(4), 835–854.
12. Drozhzhin, S., Shiyani, A.V., Mityagin, S.A. (2019). *Agent Based Modeling of Smart Grids in Smart Cities*. Chams, Switzerland: Springer International Publishing
13. Ibrahim, M., Adams, C., & El-Zaart, A. (2015). Paving the Way to Smart Sustainable Cities: Transformation Models and Challenges. *Journal of Information Systems and Technology Management*, 12(3), 559-576.
14. Information Technology Authority. (2017). *Smart Cities: Today's New Lifestyle*. Retrieved September 2, 2022, from: https://www.trc.gov.om/trcweb/sites/default/files/2018-07/ITS%202018%20%2019_compressed.pdf
15. Kogan, N. (2014). *Exploratory Research on Success Factors and Challenges of Smart City Projects*. (Published Master Thesis). Kyung Hee University, South Korea.
16. Koo, C., Ricci, F., Cobanoglu, C., & Okumus, F. (2017). Special issue on smart, connected hospitality and tourism. *Information Systems Frontiers*, 19(4), 699–703.
17. Maroto, P. (2015). *Dubai, Middle Eastern Smart City Reality or Promise*. Retrieved July 15, 2022, from: <https://pacomaroto.wordpress.com/smart-cities-series/dubai-middle-eastern-smart-city-reality-or-promise/>
18. Matyushenko, I.Y., & Pozdniakova, A.M. (2016). Smart Cities in Ukraine – The evolution, state and challenges of Smart solutions in the area of governance. *Acta Innovations*, 19(3), 25-36.
19. Miles, B., & Huberman, A.M. (2009). *Qualitative data analysis*. Thousand Oaks, CA: Sage Publications Ltd.
20. Mohanty, S.P., Choppali, U., & Kougianos, E. (2016). *Everything you wanted to know about Smart Cities*. Retrieved August 24, 2022, from: http://www.smohanty.org/Publications_Journals/2016/Mohanty_IEEE-CEM_2016-July_Smart-Cities.pdf
21. Mori, K., & Christodoulou, A. (2012). Review of sustainability indices and indicators: Towards a new City sustainability index (CSI). *Environmental Impact Assessment Review*, 32(1), 94–106.
22. Prabhu, C. (2021). *Industrial zones, knowledge hubs to buoy Oman's Smart City project*. Retrieved December 15, 2021, from: <https://www.omanoobserver.com/article/1105068/business/industrial-zones-knowledge-hubs-to-buoy-omans-smart-city-project>
23. Rocha, A., Adeli, H., Reis, L.P., & Contanzo, S. (2018). *Trends and Advances in Information Systems and Technologies*. Chams, Switzerland: Springer International Publishing AG.
24. Rossusseau, O. (2018). *Oman starts development of Madinat Al-Irfan Smart City*. Retrieved September 13, 2022, from: <https://www.constructionweekonline.com/projects-tenders/article-50702-oman-starts-development-of-madinat-al-irfan-smart-city>
25. Samih, H. (2019). Smart cities and internet of things. *Journal of Information Technology Case and Application Research*, 21(1), 3-12, doi: 10.1080/15228053.2019.1587572
26. Saunders, M., Lewis, P. & Thornhill, A. (2012). *Research Methods for Business Students*. (6th ed.). London, UK: Pearson Education Limited

27. Sethi, M. (2015). Smart Cities in India: Challenges and Possibilities to attain Sustainable Urbanisation. *Nagarloka*, 47(3), 20-38.
28. Stanford University Human-Centered Artificial Intelligence. (2021). *Artificial Intelligence Index Report 2021*. Retrieved June 21, 2022, from: https://aiindex.stanford.edu/wp-content/uploads/2021/11/2021-AI-Index-Report_Master.pdf
29. Van den Besselaar, P., & Koizumi, S. (Eds.) 2005. *Digital Cities III: Information Technologies for Social Capital*. Berlin: Springer
30. Washburn, D., Sindhu, U., Balaouras, S., Dines, R. A., Hayes, N. M., & Nelson, L. E. (2010). *Helping CIOs understand BSmart City initiatives: Defining the smart city, its drivers, and the role of the CIO*. Cambridge: Forrester Research.
31. Zhang, K., Ni, J., Yang, K., Liang, X., Ren, J., Shen, X. (2017). *Security and Privacy in Smart City Applications: Challenges and Solutions*. Retrieved July 15, 2022, from: <https://fardapaper.ir/mohavaha/uploads/2018/10/Fardapaper-Security-and-Privacy-in-Smart-City-Applications-Challenges-and-Solutions.pdf>
32. Zygiaris, S. (2013). Smart city reference model: Assisting planners to conceptualize the building of smart city innovation ecosystems. *Journal of the Knowledge Economy*, 4(2), 217–231