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Housing Conditions and Needs in Urban District 5

By

Delan Almazrooei

**A Thesis Submitted in Partial Fulfilment of the Requirements for the
Degree of Master of Science in Professional Studies:
Smart Cities**

Department of Graduate Programs & Research

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Smart Cities**

Graduate Thesis Approval

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Abstract

Dubai remains one of the key tourist attraction areas in the world. However, the city has witnessed significant population growth over the past decade, which has resulted in problems associated with urbanisation, such as pollution. The formulation of the DUBAI 2020 Urban Master plan was meant to create a supple yet workable and viable formula to balance urban development and sustainability of the environment. The plan was based on population growth, utilisation of infrastructure facilities, and advancement of effectual and environmentally sustainable energy sources. The master plan will affect critical areas, including Dubai Silicon Oasis Centre (DSO). With the key challenges that future cities may face, the proposed project aims at determining the housing needs and conditions in DSO. The project aimed at consulting secondary materials in future cities and available facts on the challenges faced by residents in DSO. The study also analyzed the key factors that should determine how DSO is constructed and managed to ensure economic, social, and environmental sustainability.

Keywords: Dubai Master Plan 2040, Dubai Silicon Oasis, Urban Planning, Housing Needs

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Chapter 1: Research Introduction

1.1 Introduction

Cities in the urban areas in each country in the world need extensive and deliberate planning. The justification for this is that through planning, provision of services to the members of the public becomes a simplified process, and development is also achieved (El-Ghalayini & Al-Kandari, 2020). Through a structured plan, housing needs are also drawn eliminating the probability of confusion that results in improper drainage system, poor waste management strategies, and undeveloped infrastructure, amongst other issues that affect the quality of life that people dwell. An efficient plan results in a balanced environment and the interconnectedness between various factors flows smoothly (Kuddus et al., 2020). Residents of such areas are also able to lead their lives responsibly, while also taking measures that will reduce degradation of the environment or inequality that may then trigger other problems. Shareef and Altan (2021) noted that the growth of cities had become a vital issue globally due to carbon emissions, global warming, climate change, and natural resource depletion.

Dubai is one of the developing urban cities in the world where plans are being made and implemented to ensure the current and future housing needs are addressed (Shareef and Altan, 2021). The increase in the number of people living and residing in Dubai is visibly putting pressure on the water supply, waste management, energy supply, transport and communication infrastructure, and housing. This then necessitates the need for redesigning the cities' with sustainable principles that will create a balance as human beings interact with the services and structures in the area. El-Ghalayini & Al-Kandari (2020) stated that designing the urban cities also requires taking into consideration the economic and technological developments that are evolving

at a high rate. The housing needs and conditions in Dubai must be in a way that prevent social issues that arise when a large number of people are living within the same geographical space. For instance, traffic snarl-ups, pollution, spread of diseases and even poor economic power amongst people should be prevented and avoided.

1.2 Statement of the Problem

An urban city needs extensive planning to serve the community effectively. According to Shareef and Altan (2021), proper planning is essential to ensure residents live in a reasonably balanced environment. With the rapid urbanisation in Dubai, stakeholders must consider cultural values, the local environment, and urban requirements. According to Shareef and Altan (2021), cities are the home of complex and interlinked challenges in different areas such as climate change, pollution, water, waste, food and resources, and societal novelty. While cities are the heat of technological and economic development in many countries, they also result in inequality, environmental problems, and other challenges (El-Ghalayini & Al-kandari, 2020). El-Ghalayini and Al-kandari (2020) reported that the fast population growth in Dubai had a negative impact on the environment and climate.

Shareef and Altan (2021) noted that the growth of cities had become a vital issue globally due to carbon emissions, global warming, climate change, and natural resource depletion. According to Kuddus et al. (2020), when large groups of people flock to cities, it may result in many problems, especially for the low-economic class. There is a possibility of communicable illnesses, pollution, road traffic, and poor nutrition. According to Kuddus et al. (2020), these problems may spill over to other city dwellers. The only way to ensure a better future is by all sectors and individuals in society working together towards the transition to all-encompassing, strong, safe, and resource-efficient networks. Timely research can ensure that cities can identify any challenges that might present themselves in a city while providing the best ways to mitigate them. However, as Shareef and Altan (2021) note, there are some key variables that may affect a development's design, such as waste management, energy, water supply, and transport. It is crucial to make every city area viable for them to operate smoothly. In addition, Shareef and Altan (2021)

argue that creating a livable city is one of the sustainable urban design principles. Shareef and Altan (2021) propose several ways a city can become livable. These principles include accessibility, provision of parks and green areas, transportation, and walkability.

The problems that come with a poor urban plan can affect every city dweller. As MEED (2019) argue, while city leaders want to provide the best outcomes for citizens concerning the quality of life, the available resources to attain these goals are pretty limited. Many cities cannot meet the tripartite goal of being economically productive, socially comprehensive, and environmentally sustainable. In addition, given that Dubai is a tourism destination, it is crucial to ensure that the city meets global standards in planning and implementation. Due to the above issues, it is critical to understand urban planning to ensure a sustainable city. The project is essential because it explored how best to create the best city in District 5 in Dubai while accounting for possible pitfalls during the process. The increase in awareness of the concerns about urbanization has resulted in the need to rethink the cities. This includes how they are constructed and managed to reduce problems that come with urbanization. As Hadjri and Onyango (2013) argued, Dubai has many natural resources that can be exploited to ensure that the cities within the region meet sustainable goals.

1.3 Background Information

Dubai is the second largest city in the United Arab Emirates (UAE). The city is experiencing fast growth, prompting the need for infrastructure, housing, and public facilities. Over the past decade, Dubai has become one of the fastest-growing cities in the world. According to Shareef and Altan (2021), Dubai has grown about 100 times to reach 1.9 million residents, according to 2010 estimates. The Dubai 2040 Urban Master Plan was created by the ruler of Dubai to transform the emirate while forming an organised, people-led city that balances public needs with tourism and modernism with legacy and nature. According to Dubai Approvals (2021), the master plan also has other key priorities, including resource use efficiency and increasing green and leisure areas to offer a healthy environment for citizens, residents and visitors. The Dubai 2040 Master Plan will focus on five critical urban areas, each with its unique theme supporting economic growth and increasing job opportunities. The plan also offers lifestyle facilities that will meet the population's needs. Dubai Silicon Oasis (DSO) Centre is one of the centres in the plan. DSO is projected to be a science, technology, and knowledge hub that will encourage innovation and a digital economy while fostering talent (Dubai Approvals, 2021). DSO is one of the free zones in Dubai where people can live and work. The area offers easy transport access through various means such as air and road. Therefore, the area is relatively developed, with the government aiming to improve it further to ensure sustainability.

According to Dubai Approvals (2021), DSOC is designed as an environment that provides wide-ranging benefits with a globally recognised free zone and an integrated technology park that offers individuals who live in the area a place to live, work, and play in a safe environment. In addition, Dubai Approvals (2021) notes that the area encourages modern-led industries, a well-designed community, and advanced infrastructure. The Dubai Master Plan 2040 notes that the

DSOC is an incubator of knowledge and innovation. The knowledge and science in technology contribute significantly to creating a knowledge-based economy while attracting creative minds to the region.

The Dubai 2040 Master Plan for the area includes a comprehensive environment that focuses on sustainability by embracing innovation through the inspiration of diverse communities. According to El-Ghalayini and Al-kandari (2020), Dubai and other nations in the UAE use revolutionary technologies such as intelligent solutions and big data analytics to counter issues that come with urbanisation. In addition, El-Ghalayini and Al-kandari (2020) note that data is an essential element in Dubai's innovative transformation. The Dubai master plan also seeks to offer sustainable and flexible means of movement while fostering economic activity and attracting foreign investors. According to United Nations Human Settlements Programme (2022), the plan aims to provide green and recreational spaces dedicated to the residents and tourists.

1.4 Project Definition and Goals

The current project explored the housing needs and conditions in Urban District 5 in Dubai Urban planning 2040, with a particular focus on the Silicon Oasis area. The project aimed to identify housing needs and conditions in the Silicon Oasis area and provide recommendations for future development. The goals of the project include the following:

- To determine the environmental requirements for urban planning in the DSO.
- To explore any urban challenges that might occur in DSO during the implementation of the Dubai 2040 Master Plan.
- To determine possible communicable diseases that may arise in DSO.
- To examine the availability of water, food, and energy resources in DSO during Dubai 2040 Master Plan implementation.

1.5 Research Methodology

The proposed project utilised pure research designed to examine and explain the basic principles behind housing needs and conditions in Urban District 5. The study used the qualitative research design. Qualitative methods allowed the project manager to collect comprehensive secondary data on urban planning and the possible housing needs and conditions in DSO in Dubai. Data was collected through secondary material. The researcher identified reliable secondary sources to obtain credible data such as the adverse per capita environmental impact in Urban District 5. As El-Ghalayini and Al-Kandari (2020) suggest, using big data in Dubai is crucial in ensuring that the city reaches the intelligent status and becomes a leading smart city globally. The data collection process involved identifying a list of reliable data sources, accessing the sources and collecting relevant information while organizing it into a single document. The researcher checked the date of publication, credibility of the sources and their relevance to the topic when selecting the research materials. The second process after identifying the sources was to filter, order and combine the information in a way that addressed the research questions. This involved looking at different sets of data and comparing them to identify the changes and trends that have happened on the DSO plan over time, and collecting the most relevant and credible information. Data collected was analysed through thematic analysis.

1.6 Project Deliverables

The following are the project deliverables:

- To provide an overall idea about the environmental requirements for urban planning in Dubai Silicon Oasis.
- To explore any urban challenges that might occur in DSO during the implementation of the Dubai 2040 Master Plan.
- To determine possible communicable diseases that may arise in DSO.
- To examine the availability of water, food, and energy resources in DSO during Dubai 2040 Master Plan implementation.
- Provide data collection results and an analysis on the awareness of environmental requirements.
- What should be included in the Dubai Silicon Oasis development plan to minimize the negative environmental effects?
- Provide advice to DSO authority based on the data analysis provided to improve resource efficiency.
- How the analysis will prove that environmental conservation strategies should be underpinned by strong political commitment and support

1.7 Research Timeline

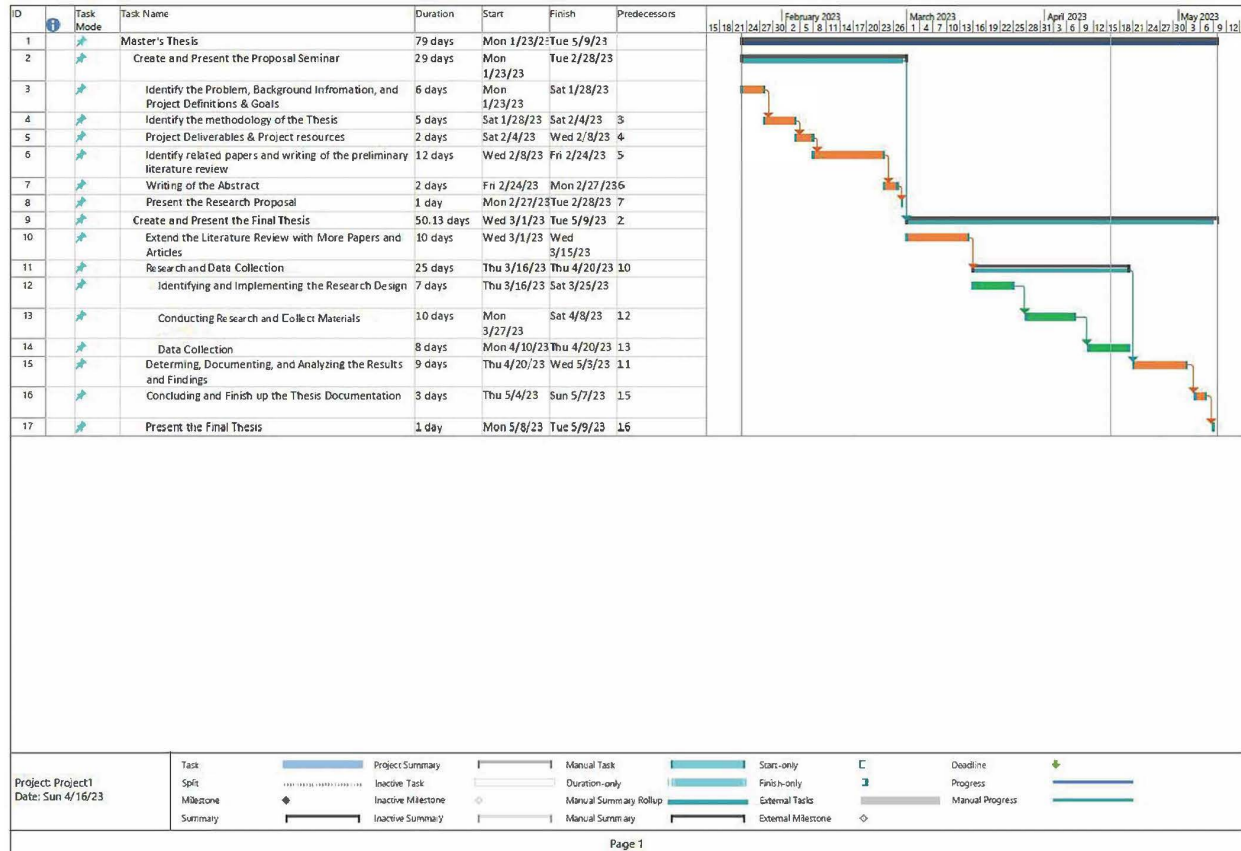


Figure 1 Research Thesis Timeline (Gantt Chart)

1.8 Project Resources and Budget Estimate

Some resources required for the proposed project were secondary sources of data, including government databases, journals on DSO and publications on the DSO project. The researcher compiled the data collected from different databases into a single document for ease of reference and analysis. In addition, the project manager needed a laptop for data analysis. A research assistant was hired to assist in the project to ensure that milestones were met by the set date. Table 2 below represents the research budget:

Table 2

Proposed Budget

Item	Amount
Equipment	\$250
Materials	\$250
Laptop	\$1000
Searching and compiling data	\$100

Chapter 2: Literature Review

2.1 Environmental Requirements for Urban Planning

The 2040 Urban Master Plan is a simplified sustainable development plan whose main focus is the improvement and enhancement of the quality of lives that people lead while increasing their happiness (Kourtit et al., 2021). It also reinforces Dubai as an international destination for locals and visitors. The integrated and structured plan and layout has been aligned with the economic objectives Dubai intends to achieve both in the short-term and in the long-term. Despite this clearly laid out plan, there are different environmental requirements that Dubai should meet so that it could be properly implement its plan as an urban city (Alawadi, 2017). The justification for this is that a plan involves diverse changes that necessitate standards to be built, and dynamic investments to be made. The overall objective focuses on the physical changes that will take place in a specified space (Kourtit et al., 2021). Hence, reforms must be introduced to smoothen the process and achieve the objectives within the stipulated deadline.

Awad & Jung (2022) stated that each city in the world is a sophisticated and interconnected network that allows the interaction of economic, physical and social factors. Urbanization is a continuous process of modernizing a region which means that investments must be made to restructure and transform an area. Employment opportunities must be created which give people an opportunity to engage in income-generating activities (Mushtaha et al., 2020). The quality of life changes as people earn more, while the demographics are diverse in that socio-economic factors are supportive of both male and female employees. Infrastructure and buildings, during urban planning, are redesigned to eliminate problems that may affect the interactions of social, environmental and economic factors within a geographical region (Al Marashi, 2010). Dubai

government is at the forefront to support the urban planning process, with policies being developed to recreate the physical, cultural, economic, and regional sectors which will then help achieve sustainability in the long-term (Alawadi, 2017).

Urban planning requires the planners to evaluate the potential risks and challenges that are likely to arise in the future, and then formulate a mitigation plan. Policies, processes and actions should be geared towards urban regeneration. There should be a connection and network between the spatial, economic, technical, and social issues, which will then reduce any environmental burden on the developed urban systems. Awad & Jung (2022) stated that the main pillars that urban planning should reconsider before, during and after restructuring and reorganizing an urban area are the environmental, economic, institutional and social systems.



Figure 2 Main pillars in urban development

2.2 Potential Urban Challenges during implementation of Urban Planning Processes

Adams (2012) stated that the implementation of an urban planning process is characterized with challenges and problems. Some of the issues are expected while others are unforeseen, which makes it hard to preempt what and how the challenges or risks could be mitigated or avoided. As with any urban area undergoing developmental changes especially in the infrastructure, congestion in traffic is inevitable as roads are expanded while others are diversified (Esposito De Vita et al., 2016; Yigitcanlar, 2015). Movement of people and commodities become slower which means economic activities are also reduced by a large margin. Scholl & Kemp (2016) claimed that a change in the public transport system to improve urban movement and developments includes other means of transport like through bicycles and walking.

Greenhouse emission rates are a concern for urban dwellers, with the quality of air affecting the quality of life that people lead. Yigitcanlar (2015) stated that greenhouse gases are a global concern since the harmful gases in the atmosphere have an adverse effect on the respiratory health of members of the public. Each government in a country has a responsibility of formulating policies that will safeguard and protect the emissions of harmful gases and ensure that they are at lower and insignificant levels (Bush & Doyon, 2019). Vehicles operating in the city should have minimal rates of emission, while the waste management processes should be channeled to eliminate the spread of diseases. Budgets should be allocated by the government to have proper structures that increase greening levels in the city, as a countermeasure to the emission of harmful gases in the atmosphere. Scholl & Kemp (2016) claimed that in the modern and sophisticated world, smart cars that have limited emissions become an option for the developed urban centers. The justification for this is that such vehicles do not increase the risk of health issues amongst human beings.

Billger et al. (2017) claimed that another significant challenge facing urban planning processes is the supply chain model for food. Human beings survive and depend on food, and with more people moving in urban areas, the demand for food commodities is expected to be high. Food security reduces social issues like theft and wastage, affirming that the demand and supply of commodities is balanced. Urbanized cities have segregated areas where foods are supplied, which ensures the sellers and buyers interact (Adams, 2012; Boyko et al., 2006). This increases the circulation of money in the economy while also ensuring rural food suppliers earn an income which they can use to develop the rural areas. Crops that could survive for a relatively long period are preferred in urban areas to reduce food wastage and reduce storage expenses.

2.3 Communicable Diseases in Urban Areas

Mishra et al. (2015) claimed that urban areas, especially those that are densely populated, are at risk of being a hub for the spread of communicable diseases. The movement of people from rural areas to the urban centers increases the risk of communicable diseases as human beings are carriers. Health-seeking behavior which is relatively lower in rural areas, characterized by the low-resource demands in such regions become one of the driving forces of spreading communicable infections (Kuddus et al., 2020). Biswas et al. (2016) claimed that there are differences between urban and rural areas in matters traditional and biomedical treatment, secular and spiritual health practitioners, with the formal and informal structures to seek treatment being dissimilar. Communicable diseases are amongst the leading causes of death around the world, with the burden of treatment being mostly on people living in rural areas (Goryakin et al., 2017). Lifestyle changes due to the urbanized movement may result in some people leading sedentary lifestyles which increases the risk of diseases.

However, Oommen et al. (2016) claimed that with the higher rates of communicable diseases in urban areas, there are sophisticated and better treatment methods that exist. The management of health conditions is relatively improved and enhanced compared to that in the rural areas. Additionally, professional advice and knowledge amongst health practitioners enable people to live longer lives despite being sick (Biswas et al., 2016). Governments are forced to invest more money in the health sector as a means to assist and help reduce the spread of communicable diseases. Social and healthcare services become strategies to help manage the spread (Kuddus et al., 2020). However, if issues like sanitation and water supplies are low, poor waste management, and poor housing which forces a large number of people to live within a single space, are not addressed, then elimination of this social and health issue cannot be resolved. Goryakin et al.

(2017) stated that proper housing plans in urban areas have an impact on the overall health outcomes for the populations. This is evident in slum areas, which are common in most urbanized cities in the world.

2.4 Availability of Resources during the Urban Planning Implementation

Governments across the world allocate budgets to sponsor capital projects in their respective cities (Santagata et al., 2020). Plans have to be formulated and implemented with the input of relevant stakeholders being incorporated to ensure success both in the short-term and in the long-term. Some cities experience more development and changes compared to others in the world. This is dependent on the available resources as well as the implementation of the sustainable plans. Drawing plans is a single step, but implementing and actualization of the same requires resources and more time could be taken before that could be achieved. Addanki & Venkataraman (2017) stated that innovative approaches have to be redefined and followed and short-cuts should be avoided since they would lead to substandard processes and structures being erected in the area. The availability of resources during the urban planning implementation is also dependent on the interconnectedness between macroeconomic actors, microeconomic factors, demographic and social factors as well as schemes meant to enhance urbanization (Chofreh & Goni, 2017).

The human resource is also an important feature and asset in implementation of urban planning process. Roelich et al. (2015) claimed that once a plan has been drawn, it can only be implemented by experts, whose experience and knowledge will contribute to the success of the plan as a whole, both in the short-term and in the long-term. The human resource makes sure that all information captured in the plan has been implemented. The experts use their critical and rational thinking skills to determine that which is and which not important (Chofreh & Goni, 2017). Adjustments are made based on the challenges that are faced, while patterns are defined in a manner that allows the movement and interactions between human beings and the resources or amenities (Spiliotopoulou & Roseland, 2022).

Literature Review Summary

The literature review discusses the concept of smart cities and the need for innovation in building cities to address the challenges posed by urbanization. It begins by noting that cities are complex networks where infrastructure, economic, and social factors are interconnected. The report highlights that the global urban population has been steadily increasing, with over 6.1 billion people living in urban areas in 2015, almost double that of 1975's population. Factors such as changes in demographics, immigration, economic growth, employment, and socio-economic factors like high quality of life are identified as key drivers of urbanization.

The review specifically focuses on the urbanization trend in the United Arab Emirates (UAE) where the percentage of people living in urban areas has increased from 54.5% in 1950 to 86.5% in recent times, with a forecasted increase to 90% by 2050. This rapid urbanization has led to the need for innovation in building cities, and the concept of smart cities is highlighted as the future of urban development.

The vision of smart cities is described as encompassing ultra-modern amenities, automated systems, and green means of transport. The integration of building, electrical, and lighting firms is seen as essential in creating an effective ecosystem to enable sustainable cities. The review mentions various technological advancements, such as hi-tech security structures, lighting control systems, smart cable administration, and cable fittings, as well as the development of electric vehicles (EVs), connected electric car charging systems, solar power networks, and clean energy sources to promote sustainability.

The role of technology as a crucial enabler in building smart cities is emphasized, with big data, the Internet of Things (IoT), and artificial intelligence (AI) identified as drivers of futuristic cities. The potential for using technology to improve quality of life while maintaining the human

element is highlighted, and the use of big data to enable more efficient use of city services, roads, and public transport is mentioned.

The review also discusses the challenges posed by traffic congestion in urban areas, particularly in the case of Dubai Silicon Oasis (DSO), and the need for improvements in mobility. The future is predicted to have fewer cars and more autonomous, self-driving vehicles, as well as increased reliance on vehicle and bicycle sharing and public transport pods. Walkability and bikeability are emphasized as important elements of smart cities, with solutions ranging from shifting walkways to underground and above-ground bike tracks. The potential for flying vehicles, specifically electric vertical ascent and landing automobiles (eVTOLs), is also mentioned as a potential mode of transportation in the future.

Finally, the review discusses the lessons learned from the COVID-19 pandemic, highlighting the need for cities to be prepared for volatile situations in the future. It notes that many cities worldwide were not adequately prepared for the economic and social impacts of the pandemic, underscoring the importance of resilience and preparedness in urban planning and development.

Chapter 3: Extended Research Methodology

3.1 Research Design

A research design is a simplistic, yet detailed outline of the action plan of what a researcher intends to do as they conduct the study (Tetnowski, 2015). It captures the collection of data methods and processes, the analysis and presentation of data. This is done to increase the validity and reliability of the findings presented at the end of the study. A secondary research design was followed for this study as there was vast information that exists on the public networks on the implementation of the 2040 Grand Plan that involves urban development in the DSO area in Dubai. The data collected in the research was expected to add to the quality of information about the development of urban planning in Dubai. It is important to note that the researcher used their critical and rational thinking skills to pick relevant and viable information from the secondary sources (Hammarberg et al., 2016).

3.2 Data Collection

A secondary research method enables a researcher to access extensive knowledge and information from diverse sources, including websites, journals, books, and articles (Lewis, 2015). Of interest to the researcher were publications and verifiable websites that address how the urban plan is currently being implemented. Information generated from the urbanization plan was captured with the intention of answering the identified objectives of the study (Adhabi & Anozie, 2017). Secondary information was easily and readily available, and the researcher used the recently updated records related to the urbanization planning.

3.3 Qualitative Methodology and Data Analysis

The researcher, through the qualitative methodological approach, collected and analyzed information from secondary material. As El-Ghalayini and Al-Kandari (2020) suggest, using big data in Dubai is crucial in ensuring that the city reaches the intelligent status and becomes a leading smart city globally. The use of reliable secondary sources and qualitative research design enabled the researcher to explore the topic comprehensively and explore the adverse per capita environmental impact in Urban District 5 (Galanis, 2018). Data collected will be analysed through thematic content analysis. The justification for using content analysis in this particular study is to reduce the probability of the researcher having any personal biases from the collected data, while also presenting and drawing realistic conclusions that are valid and reliable (Galanis, 2018).

Chapter 4: Results and Findings

4.1 Objective 1: To determine the environmental requirements for urban planning in the DSO.

Singh (2015) claimed that the urban planning process is a complicated and sophisticated process that will require the planners to merge the environmental, physical and eco-system needs. It aims to consider the coordination between the quality of the ecosystem and human development and the quality of the ecosystem to promote sustainable development. City Development Strategies in today's world are designed to incorporate the environment in urban planning, to promote climate-sensitive urbanism. A study by Galanis (2018) indicated that Dubai has adopted fascinating development in construction and city styles, while striving to balance between environmental protection and socio-economic development. This will initiate the region's quick renovation and revolution towards sustainability.

According to the United Nations, countries should embrace sustainable development to meet the current needs while considering the needs of future generations. Sustainable development entails social, economic, and environmental sustainability. Environmental sustainability experiences the challenge of shortage of resources and degradation of the environment due to urbanization and population growth worldwide. Bibri et al. (2020) note that effective urban planning and development are necessary to prevent environmental concerns such as a high number of energy-inefficient buildings, excessive noise, solid waste hazards, water and air pollution, traffic congestion, and lack of green spaces. Urban areas account for a significant share of energy consumption and pollution. The futuristic city should be developed in a manner that allows all economic activities and decisions to take care of the environment, ensuring that the protection of natural resources should be capitalized, even as developments are being initiated (Kocjan, 2017).

4.1.1 Principles of Urban Planning

United Nations Environment Programme (UNEP) provides guidelines for the creation of equitable, innovative, and sustainable cities. According to Bush and Doyon (2019), some of the measures that should be included in the DSO development plan to minimize negative environmental effects and improve resource efficiency include prioritizing environment conservation measures in the development plan through strategies that reconcile resource efficiency with urban economic growth, creating green jobs and implementing strategies to reduce greenhouse gas emissions in urban planning and management to improve the quality of life and reduce the impact of the city on the global environment. The DSO area should also embrace the use of green energy to prevent pollutions that result from unsustainable energy sources and undertake projects to improve the quality of the environment. The environmental conservation strategies should be underpinned by strong political commitment and support.

4.1.2 Respect for nature

Yu et al. (2021) explain that there should be harmony between the attraction of the city and the natural environment in urban planning and development. A respondent noted that DSO developers and planners should avoid damaging the relationships between living things in the natural environment. According to Ratcliffe et al. (2021), the connections between living things are universal, from the smallest to the ecosystems, to specific locations on the entire planet. There is an increased need to balance the natural and artificial environment in an attempt to protect the environment. Urban planners have a responsibility to respect nature and maintain the connections to ensure sustainable development. Eco-city development will enable the government to address the environmental and climate challenges in developing the city.

4.1.3 Use of renewable energy and reduction in energy consumption

Renewable energy, such as water conservation energy, wind energy, photostatic energy, solar energy, and reduction in energy consumption, are significant in urban planning and development (Medeiros & van der Zwet, 2020). Renewable energy enables developers to save non-renewable energy and reduce its environmental impacts. DSO focuses on the conservation of energy to contribute towards achieving Dubai Integrated Energy Strategy 2030 (Hannawi et al., 2019). Bonakdar and Audirac (2020) note that urban developers can save energy by adopting building designs that reduce heat loss since building architecture is among the prevalent energy-consuming entities in urban areas. Loss of heat depends on the density of the buildings, thermal insulation on the exterior walls, the volume and structure of buildings, and the orientation of buildings. Hannawi et al. (2019) recommend that DSO should address these aspects to create a sustainable city that will promote energy conservation.

4.1.4 Observing the environmental characteristics of the region.

Bonakdar and Audirac (2020) note that cities closely relate to the environmental characteristics of their locations. Different cities have different ecological conditions and combinations of ecological factors due to geographical variations. Bonakdar and Audirac (2020) suggests that DSO should utilize and emphasize the environmental aspects of the area and maintain the uniqueness of Dubai's environment. DSO articulates Dubai's Plan 2021 to promote a smart and sustainable city. The aim of Dubai Plan 2021 is to make Dubai a sustainable and smart city through the transformation of key government sectors, including communications, infrastructure, transportation, electricity, urban planning, and economic services. The plan aims to establish smart transport, smart beaches, and parks and optimize sustainable energy sources (Kent et al., 2018).

The city will reserve space for recreational and greening spaces, with beautification programs being incorporated to enhance the visual appearance of the city. The DSO Urban plan intends to maximize the clean strategy ideology in energy production and consumption, where solar panels and natural lighting systems will be incorporated when constructing the buildings (Ramachandran et al., 2022; Walters et al., 2006). Renewable energy will be used as a means to preserve natural resources. According to Al-Azzawi (2019), Dubai has achieved interesting development in city styles and construction, making it an advanced modern city with some of the tallest buildings in the world. The city has embraced a balance between environmental protection and socio-economic targets (Al-Azzawi, 2019). For instance, Dubai Integrated Energy Strategy 2030 has set a target to reduce cumulative energy consumption by 30% by 2030. DSO is designed to enable the city to achieve the target, among other sustainability goals, by reducing water and energy use and minimizing waste production. Al-Azzawi (2019) notes that by January 2016, DSO had reduced cumulative energy consumption by 31% exceeding the 2030 target of 30% reduction, as set by Dubai Integrated Energy Strategy 2030.

Dubai prioritizes the environment in its overall strategic plan through initiatives, sub plans, and projects to reduce energy use and improve the environmental conditions of the citizens. The green plan entails the use of green construction materials and the construction of green buildings. DSO follows Dubai's Green Building Regulations and Specifications that encourage contractors to undertake sustainable construction toward an eco-friendly future. It entails various aspects of green building design, including building vitality, ecology planning, resource efficiency in materials, water, energy, and waste management (Al-Azzawi, 2019). The regulations aim to create a balance between the natural environment and the artificial environment by having a reasonable assessment of the impact of urban development on the natural environment.

The DSO area will be a secure environment that is integrated and sustainable, which will be made possible through innovative approaches and collaborative decisions among the diverse sectors of the economy (Singh, 2015). The environmental changes and dynamics have been designed to allow and increase the values of lifestyle while appreciating the different commercial factors and sectors that will come into play seamlessly. Residential complexes are built towards environmental protection and a balanced ecosystem with commercial spaces allowing the free flow of air (Kocjan, 2017).

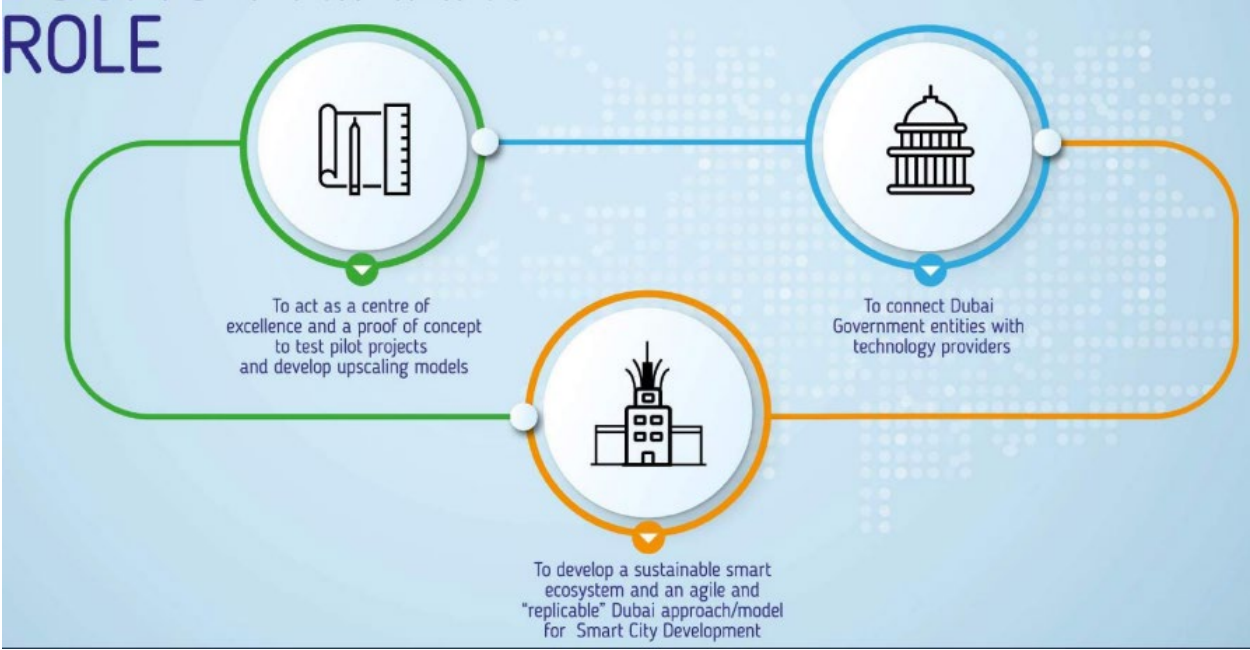


Figure 3 Smart City DSO Dubai

4.2 Objective 2: To determine Possible Communicable Diseases that may arise in DSO.

Shawkat et al. (2021) highlight the communicable diseases that are risky to the DSO area. The diseases include Corona Virus, measles, SARS, influenza, whooping cough, Hepatitis C and Hepatitis C. Mahanta et al. (2021) indicate that Corona Virus and SARS were the most risky due to the ease of spread. This could be attributed to the fact that the world has been recovering from the after effects of the Corona Virus pandemic. DSO, like any other region in the world, is a potential risk to communicable diseases due to the large number of people that will be continually interacting and liaising with each other within the same geographical space (Karmakar & Sahib, 2017). The area will house companies operating in the hospitality industry, education and academic centers, recreational areas, religious centers, and commercial based areas. Key pillars that determine the success of a smart city include transportation networks, tourism industry, education, buildings, utilities, processes and people (Kocjan, 2017).

The emergence of the global pandemic, Corona Virus, a communicable diseases has necessitated the DSO planners to carefully integrate strict health measures that will protect the residents and occupants of the region (Shawkat et al., 2021). With many economic activities taking place in the geographical location at any time of the day, the likelihood of the spread of infectious diseases is high. Vaccinations certificates will be a major requirement

for all visitors in the region, while regular medical checkups will be recommended for all business operators (Karmakar & Sahib, 2017).

The DSO urban plan will be designed to allow its sanitation, drainage system, and housing to be conducive for human beings so that the quality of life they lead is not compromised. Proper sanitation and drainage will prevent water-related vector-borne infections, fecal-transmitted infections, and chronic conditions due to exposure to agrochemical residues (Kent et al., 2018). Malaria and schistosomiasis are common in areas with poor drainage since the vectors live in aquatic environments. A respondent noted that although the DSO plan provides proper drainage and sanitation systems, proper maintenance of drainage structures will ensure that people are not exposed to environmental health problems. Smart waste management system aims to promote proper sanitation and prevent health hazards associated with poor sanitation. The management system includes sensors that are installed in garbage bins and are operated through IOT technology.



Figure 4 key pillars of a smart city

The management system aims to reduce carbon dioxide emissions, lower the cost of operating the sanitation system and reduce trips to pick up waste (Pineda, 2020). Proper waste disposal mechanisms will protect the environment in addition to promoting good health.

The health sector will also be allocated enough space for development. This means that every building in the DSO region will have a health center which will increase access to medical services (Hadjri & Onyango, 2013; Shawkat et al., 2021). Extensive research from the government's health department will be financed to facilitate new ideas that will reduce the possibility of diseases being spread from one person to another regular fumigation of all public areas will be encouraged, while quarantine measures will be done to anyone suspected to have an infection that may affect members of the public (Mahanta et al., 2021).

4.3 Objective 3: To examine the challenges and availability of resources in DSO during Dubai 2040 Master Plan implementation.

One of the main challenges that urban cities face is poverty and inequality in the economic opportunities for all people. According to Kent et al. (2018), inadequate access to clean water, poor sanitation, and poor health are also major challenges in urban areas. Inequalities in urban areas include access to education, employment opportunities, health services, housing, and open land. This then has a negative effect on the provision of basic services like health, housing, and transportation. The growth of cities leads to inadequate supply of public services and inability to guarantee the minimum quality of life for the people residing in the urban areas (Wilson et al., 2019). Adequate planning is essential to enable DSO to overcome the challenges that come from increased urbanization and an increase in the city population. A respondent noted the need to design the housing needs and conditions in a way that prevents social issues that arise due to the co-existence of a large population in one geographic location. The Dubai 2040 Master Plan provides an urban plan that will prevent pollution, the spread of diseases, and traffic congestion while ensuring environmental sustainability (Mahmoud et al., 2022). The plan will reduce inequalities by improving access to affordable housing, services, and infrastructure since good transport connectivity, including between the commercial and residential areas, is significant to economic inclusion and growth. The urban development plan will provide job opportunities and boost the region's economic activities through increased facilities such as schools, hospitals, and restaurants, increasing employment opportunities. Access to decent employment will also empower the residents financially and reduce inequalities. The Dubai 2040 Master Plan provides innovative and sustainable measures to deal with the challenges associated with urban development to make DSO a sustainable, attractive, and world-class city.

The development of DSO poses challenges related to energy consumption. As Wilson et al. (2019) note, urban areas present a challenge to urban consumption. The development of DSO follows a sustainable approach and aims to ensure that buildings are sustainable and their contribution to energy consumption is reduced. Points that buildings are an essential aspect of urban development. Interventions to enhance the sustainability of the building and construction sector offer opportunities to reduce the environmental effects of the sector and facilitate the achievement of sustainable development goals. The built environment accounts for 40% of energy use globally, 30% of the greenhouse emissions, significant use of natural resources, and waste generation (Wilson et al., 2019). DSO has focused on addressing environmental issues.

With the increase in the number of people in DSO due to its upgrade that will lead to increased economic activity and tourism, the challenge of congestion is likely to arise. According to Aldogom et al. (2019), the land area for tourist activities, hotels, and commercial activities will increase, increasing the area's population. The Dubai 2040 Master Plan will implement strategies to promote ease of movement and prevent congestion, such as creating green corridors to link residential areas, service areas, and workplaces, enhancing sustainable means of transport across the region, and facilitating the movement of bicycles and pedestrians. The transport system will also be characterized by mega bridges, underground spaces, and super-linked street encounters. Dubai's Roads and Transport Authority (RTA) recently made a contract to extend the Dubai Metro network by 20 km, which will open a train line to DSO. The Dubai Integrated Economic Zone Authority (DIEZ) has also developed internal road connections in DSO to link the region to the surrounding main roads. The developments aim to open up the region toward achieving the Dubai's 2040 Master Plan goals and meet the needs of the residents (Wilson et al., 2019). Expansion of service roads and pedestrian corridors is also ongoing to enhance transport in the region, prevent

congestion and enhance the sustainability of the city. The expansion of the transport system will also enhance access to DSO and neighboring commercial and residential areas. DIEZ develops the infrastructure in the region to increase green spaces in coordination with smart, sustainable technologies, expanding and improving the internal roads, shortening distances between different areas, establishing new lanes, and reducing the time commuters use to get to the city.

The spread of communicable diseases due to an increase in the city population is another challenge in DSO. The government postulates that Dubai's population will increase from 3.5 million to 5.8 million by 2040. Measures to prevent the spread of diseases, such as COVID-19, will be implemented. Dubai's 2040 Master Plan aims to increase the land area allocated to health facilities and education by 25% by 2040 (Aldogom et al., 2019). The close distribution of hospitals in the region will ensure promote good health for the residents.

Technology will be a driving force to provide smart solutions in various sectors, including security, transport, and lighting (Al Sakka, 2014). For instance, in security management, biometric measures will be needed to access some offices, while the smart cable system will allow access to the internet at all times. The transport system will also be characterized by mega bridges, underground spaces, and super-linked street encounters where big data, the Internet of Things, and Artificial Intelligence will be the main drivers to manage and support all sectors of the economy (Siano et al., 2019).

The rise in nature and natural resource reserves will create an effective microclimate in DSO, supporting agriculture. The goal is for agriculture to operate in harmony with the ecosystems, promote responsible consumption behaviors to lower food waste, and alter how good food is produced and consumed. This will enhance food security in an arid climate by varying crops, observing water-saving practices, and spending on sustainable farm techniques (Khan et al.,

2022). DSO plan incorporates smart irrigation, which will promote water conservation by reducing irrigation water consumption levels (Shareef, 2021; Noori et al., 2020). The city aims to implement smart irrigation in all green areas. The future will see DSOA empower smallholder farmers by highlighting the significance of offering them financial and technical assistance, capacity building, and financial learning to enhance their operations and adapt to the shifting climate. Residents of DSO undertake community farming on pieces of land given by the Dubai Silicon Oasis Authority (DSOA). About 400 pieces of land of 8,000m² are allocated to inhabitants to try sustainable organic farming from September to May. By growing their food on a community farm, inhabitants support their food system and help create healthy locally-produced food and vegetables. Dubai's food safety and security pointers have revealed positive results in 2022.

DSO will provide opportunities for different leisure activities to cater to the needs of the residents and tourists. Besides being a hub for innovation, the region has several leisure activities. A respondent noted that many families reside in the region to the convenient lifestyle it provides. The central location of DSO also makes it favorable and convenient for different groups of people, including young families, students, and tourists. The upgrade of DSO aims to increase the number of recreational facilities, including beaches, eco-friendly parks, dining places, and shopping centers throughout the region (Shareef, 2021). DSO is a busy community and is well-connected and accessible, offering different residential solutions. The area has luxurious amenities such as restaurants, supermarkets, residential towers, recreation facilities, and an innovative technology park. The Dubai 2040 Master Plan aims to upgrade the region even further to enhance its sustainability and attractiveness. Green beaches and parks will enable people to have the desired recreation experience while promoting environmental sustainability.

DSO attracts many education seekers due to the availability of education facilities and proximity to Academic City, which is the hub for work and education. With the planned 25% expansion of education facilities under the Dubai 2040 Master Plan, the region will cater to the education needs of the increasing population and attract learners from the region and across the globe (Awad & Jung, 2022). Kirk (2018) notes that inadequate access to quality education is the root cause of various challenges, including economic inequality, poverty, and crime. Enhancing access to education facilities will enable the region to overcome these challenges and promote the well-being and literacy of the residents. The high number of amenities and education facilities makes the region a desirable location for different cultures and nationalities seeking a comfortable and balanced life in Dubai.

Chapter 5: Conclusions and Recommendations

5.1 Conclusions

Dubai hosts a large number of people, and there are projections that the number will continue to increase in the future. Major drivers of urbanization in Dubai include economic growth, socio-economic factors, vast employment opportunities, and tourist destination. The availability of social amenities coupled with automated systems are some of the incentives that attract and retain the attention of visitors and residential dwellers in Dubai. Urban planning in Dubai is critical to its achievement of being a global tourist destination with internationally recognized facilities and services. With technology being at the core of the urban planning and housing reforms that are being implemented in Dubai and that has to be achieved by 2040, there will be well-orchestrated developments and structures that will be connected through sophisticated road and communication networks.

DSO is among the five areas in Dubai that will be upgraded and developed through sustainability and innovation under the Dubai 2040 Master Plan. DSO development aims to embrace innovative technology to create a conducive and attractive environment to enhance the well-being and lifestyle of the diverse population. The establishment of DSO is inclined to the goal of facilitating and promoting industries that are led by modern technology to support tech-venture in the country. Dubai's 2040 Master Plan aims to develop the city alongside four others, to enhance its sustainability and innovation in urban planning.

The study outlines the principles of urban planning and the urban planning and development guidelines developed by UNEP to promote the sustainability of the built environment. Dubai's 2040 Master Plan is designed in adherence to these principles and guidelines to produce innovative and sustainable cities. One of the key principles is respect for nature. Urban

development should be implemented with minimal damage to the environment and should promote a balanced ecosystem. Another principle is the use of renewable energy and reduction in energy consumption. DSO has adhered to this principle by developing sustainable buildings and embracing the use of renewable sources of energy such as solar, wind, and hydraulic energy. The third principle of urban development is observing the environmental characteristics of the region. DSO balances socio-economic and environmental targets in its goal to achieve substantial development in city styles and constructions and enhance the attractiveness of Dubai city.

The 2040 Urban Master Plan is a sustainable plan to improve the quality of life of people in Dubai and reinforces the city as an international destination for tourists. The plan provides an integrated and structured layout in line with Dubai's economic objectives and environmental sustainability requirements of the built environment. The implementation of the plan in DSO is characterized by various challenges, including traffic congestion, high energy consumption, the spread of communicable diseases, economic inequality. In terms of infrastructure, congestion is a major challenge. The improvement of the city's transport will expand pathways for sustainable modes of transport such as cycling and walking. The plan also aims to reduce greenhouse emissions by embracing renewable energy sources and mass transit transport methods. There is a call for governments and countries to reduce greenhouse gas emissions to combat climate change. To that effect, DSO will use smart technology to manage its waste and protect the environment properly. The study noted that diseases such as COVID-19 pose a significant threat to urban residents due to their ease of spreading in densely populated areas. The city will implement measures such as vaccination and enhance access to healthcare facilities to control the spread of diseases. Security is another challenge likely to occur in DSO. The implementation plan makes

significant use of technology to curb the challenge, such as using biometric measures to access some offices and using a smart cable system to allow access to the internet at all times.

The transport system will also be characterized by mega bridges, underground spaces, and super-linked street encounters and entail technology such as big data, the Internet of Things, and Artificial Intelligence. Smart vehicles in both the private and public transport system will connect the economic hub, while the housing units will be sustainable for the large number of people living and working in the region at any single time. DSO will be a 24-hour economy that allows its residents to engage in income-generating activities. This will be made possible by structured lighting and power systems on all roads, streets, and cities. Additionally, policies to protect the economy and encourage energy preservation will be implemented as a strategic approach. Taking into consideration that the DSO economy will be operating all the time, then methods of reducing energy consumption will be done through recycling, while the use of solar energy will be highly maximized. Greening levels will also be high to increase and enhance the beauty of the cities, where buildings will incorporate smart greening technologies. This will improve the circulation of fresh air in the atmosphere.

The development of DSO exposes the region to various challenges, including transportation challenges, the spread of communicable diseases, and security concerns. Dubai 2040 Master Plan takes the possible challenges into consideration and implements strategies to deal with them. The DSO region is being built as a smart city that will comprise ultra-modern amenities and automated systems. Dubai 2040 Master Plan will implement a sustainable mobility system to facilitate bicycle and pedestrian movement. The master plan will encourage the use of flexible methods of transport, use of mass transit, cycling, and walking to prevent congestion in the city. There will also be an expansion of roads and green pedestrian corridors to facilitate

transportation. New lanes will be opened to enhance access to the region and reduce commuter distance. Technology will play a significant role in promoting efficient transport and communication, and security within the region.

DSO will also ensure the sustainability of buildings to reduce energy consumption. Some of the measures adopted to enhance energy efficiency include renovations to enhance thermal insulation and optimize heating, ventilation, and air conditioning. Good insulation will reduce the loss and overuse of energy. Using renewable energy, such as hydraulic, wind, geothermal, and solar energy is also significant progress in promoting energy efficiency. The use of renewable energy coupled with thermal insulation techniques will reduce energy consumption and prevent adverse environmental effects associated with the use of non-renewable sources of energy. The urban development plan incorporates other measures to enhance the energy efficiency of buildings, including reducing lighting, heating, and cooling demands of buildings through conservation practices and climate-responsive building designs, use of efficient lighting systems, optimizing building performance through the use of energy modeling programs and integrate water saving techniques to minimize the use of energy in supplying water.

5.2 Recommendations

The study recommends the following ideas to facilitate and enhance the DSO urban housing plan and development:

1. The government should consider injecting more resources into Urban District 5 in Dubai Urban planning 2040, with money being allocated every financial year until the main objectives have been achieved. This will help address the arising issues like environmental requirements, mitigation of urban challenges, and investments in the healthcare sector. This vast project will need amendments before the timeline has elapsed due to the technological developments taking place in the world, and they will affect Dubai as a region.
2. Complex networks should be incorporated in Urban District 5 in Dubai Urban planning 2040 that will support the 24-hour economy as a whole. Technology should be used as a strategic approach to access housing units. For instance, residents should be able to locate and get housing arrangements through mobile technology after the Dubai Urban planning 2040 has been actualized in Urban District 5.
3. Although DSO has strived to develop sustainable buildings and reduce the energy consumption of these buildings, the sustainability of the built environment is hindered by limited cooperation between different stakeholders throughout the lifespan of the buildings. It is necessary for the government to establish incentives and conditions to ensure that all stakeholders promote sustainable building practices collaboratively. The Dubai 2020 Master Plan adheres to the tools and strategies set out by UNEP to evaluate, implement and maintain sustainable practices in construction. It is essential to monitor the performance of buildings in terms of conserving energy through measures such as annual reporting, metering, and a commissioning policy, to determine whether they meet the set

target of reducing energy consumption by 30% by 2030. Additional measures should be implemented in instances where the energy conservation measures that are put in place prove to be insufficient.

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