University of Bahrain

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A study on the challenges of implementing practical compact city strategies in the Kingdom of Bahrain

A thesis submitted in partial fulfilment of the requirements for the degree of Master in Environment and Sustainable Development

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The student is awarded a grade A in the thesis subject.

☐ Without making any changes to the thesis.

☒ After making the modifications attached with this decision.

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Abstract

The Kingdom of Bahrain has recently witnessed the phenomenon of urban sprawl, which has had a negative impact on the environment and sustainable development. Therefore, one urban planning approach that can reduce environmental problems and contribute to pollution reduction is the application of the theory of compact cities.

This study aims to explore the main challenges that may limit the application of the compact city theory in the Kingdom of Bahrain and identify the factors necessary to design and redesign cities in the Kingdom. The study also examines the requirements necessary to develop prosperous compact cities in Bahrain.

This is a cross-sectional descriptive study involving a qualitative analysis approach. The data collection process is divided into two main stages. To achieve the first objective of investigating the requirements and exploring factors for creating a compact city, a case study analysis of three cities in the world - Gothenburg, Copenhagen, and Utrecht - is conducted. To achieve the second objective of identifying challenges and gaining insight into obstacles associated with implementing compact city concepts in the Kingdom of Bahrain, interviews are conducted with academics and specialists from the public and private sectors.

The main challenges of creating a compact city in Bahrain identified in this study are culture, lack of public transportation, and the misalignment of Bahrain's policies and regulations with some compact city strategies. However, despite these challenges, there is a chance of success for this idea in the Kingdom of Bahrain through increasing public awareness and creating a well-designed public transportation network.

Dedication

To:

My Father & Mother

For their continued support and prayers

My Beloved Husband

For his support

My Son Yusuf

&

My Whole Family and Friends

Acknowledgment

I would like to thank my thesis supervisor Dr. Sh. Fay Alkhalifa of the College of Engineering at the University of Bahrain, and my co-supervisor Dr. Matthew Hardy. Their assistance was invaluable whenever I encountered a challenge or had a question about my research or writing.

In addition, I would like to thank the participants from the public and private sectors and the academics for participating in this study's interviews. Without their assistance, I would have been unable to complete the data collection.

Lastly, I would like to thank my family members for their unwavering support and continual encouragement throughout my studies, as well as during the research and writing of this thesis. Without their support, this accomplishment would not have been possible.

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List of Abbreviations

EEA - European Environment Agency

FBC - Form-Based code

INDC - Intended Nationally Determined Contributions

MMTC - Multimodal Transfer Center

OECD - Organisation for Economic Co-operation and Development

SDGs - Sustainable Development Goals

TOD - Transit-oriented development

UHI- Urban Heat Island

UPDA- Urban Planning and Development Authority

Chapter One

Introduction to the thesis

1.1 Introduction

1.2 Research Problem

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1.1 Introduction

During the past years, the world witnessed a rapid urban expansion that led to the depletion of many natural resources. Urban expansion has environmental effects that extend far beyond urban areas themselves. For example, "the urbanization of areas changes precipitation patterns at a scale of hundreds of square kilometers" (Kaufmann et al., 2007), whereby urbanization will influence the global climate as well. According to Seto et al. (2012), "direct loss in vegetation biomass from areas with a high probability of urban expansion accounts for about 5% of total emissions related to tropical deforestation and land use change". "Many studies have described how urbanization impacts CO_2 emissions and heat budgets and their effect on the circulation of water, aerosols, and nitrogen in the climate system" (Seto & Shepherd, 2009).

The Kingdom of Bahrain aims to protect its "environment and natural resources while pursuing its ambitious national development agenda". By incorporating the SDGs 2030 "set by the United Nations General Assembly into the Kingdom's Government Action Plan and Economic Vision 2030, significant progress has been made in these areas". "Bahrain's Economic Vision 2030 emphasizes sustainability as one of three guiding principles", which "cover a wide range of topics, including the environment, sustainable resource management, urban development, water and energy, transport, urban growth, waste management, marine conservation, and biodiversity" (Kingdom of Bahrain's National portal, 2022).

Therefore, one of the urban planning approaches that can reduce these environmental problems and contribute to reductions in pollution and environmental degradation is the application of the theory "of compact cities. The term compact city was first used in 1973 by George Dantzig and

Thomas L. Saaty" (Dantzig et al., 1973). It is a concept of "urban planning and urban design, that promotes a high residential density with mixed land uses. Based on an efficient public transport system, the city has an urban layout that promotes walking and cycling, low energy consumption, and reduced pollutants", according to its supporters. With an abundance of residents, there is an opportunity "for social interaction as well as a feeling of safety in numbers". It can also be argued "that this type of settlement is more sustainable than urban sprawl since it is less dependent on the car and requires less infrastructure" (Williams, 2000).

The adoption of this theory in the Kingdom of Bahrain may encounter many obstacles since the compact city theory aims to reduce the use of private vehicles and increase the use of walking and public transportation. This may be difficult to implement in hot climates like those in the Kingdom of Bahrain.

This research aims to determine the challenges and future potentials for applying 'compact city' concepts in the Kingdom of Bahrain. And to achieve an integral part of "the sustainable development goals that were outlined in Bahrain's Economic Vision 2030".

This research adopts a qualitative research methodology. The data collection and analysis are sectioned into two main stages: The first stage employed a case study approach by studying existing compact cites in the world in different regions to infer the factors needed to implement the compact city concept in the Kingdom of Bahrain. Also, by inference, the barriers to adopting the compact city concept by comparing the factors may affect applying this theory in the Kingdom of Bahrain, such as the climate, location, people's culture, etc. The second stage of data collection conducted a semi-structured interview. These will be administered to gather perspectives and opinions on the potentials and constraints of

successfully implementing the concepts of compact cities in the Kingdom of Bahrain. Using this type of interview allows a further discussion with the interviewee rather than a straightforward question.

1.2 Research Problem

The Kingdom of Bahrain "is one of the most densely-settled countries in the world", " Bahrain has a population density of 1897.2024 people per square kilometre" at present ("Population Density of Bahrain 1950-2023 & Future Projections"), yet it suffers from a number of issues that have been increasing in recent years, such as air pollution, urban sprawl, improper dealing with oil industry and using, and traffic congestion (The Supreme Council for Environment, 2022).

The implementation of compact city ideas could help ease such problems in a country that is already densely populated. However, there are challenges to the implementation that are cultural, social and economic.

Also, the Kingdom of Bahrain began systematic sea reclamation in 1990 for political and economic reasons (Environmental Justice Atlas, 2000). Thus, an increase in the construction of highways in the Kingdom of Bahrain resulted in an increase in the amount of pollutants in the air. It is therefore essential that we find a way to reduce pollutants and preserve the environment. Implementing the compact city concept in Bahrain will help reduce pollution by encouraging walking and public transportation instead of private vehicles.

In order to implement this concept in Bahrain, planners will have to overcome some challenges. This study explores some of the main challenges that may limit the application of this concept in Bahrain and set the criteria needed to re-design the neighbourhoods in the Kingdom of

Bahrain. The study also examines the requirements needed for the development of a prosperous compact city in Bahrain.

1.3 Research Questions

1. What are the factors required for the successful implementation of compact city concepts?

2. What are the challenges need to be overcome for the successful application of compact city concepts in the Kingdom of Bahrain?

1.4 Research Objectives

1. To investigate the requirements and explore factors of creating a compact city.

2. To identify the challenges and gain insight into the obstacles associated with implementing compact city concepts in the Kingdom of Bahrain.

1.5 Research Significance

The implementation of the concept of the compact city in the Kingdom of Bahrain is not widely understood because of insufficient empirical evidence, so this study assists in identifying the problems which must be addressed to enable the effective implementation of this concept in the state.

Goal 11 in the United Nations SDGs aims to make "cities and human settlements inclusive, safe, resilient and sustainable. By 2030", the target is to enhance "inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and

management" in all countries (United Nations, 2022). Thus, a compact city concept is considered to be one of the most sustainable urban planning practices. To ensure that the concept of compact cities is implemented successfully in Bahrain, it is necessary to determine what challenges may arise in its implementation.

According to Mustafa Bin Hammouche's study in 2008, the climate in Arab countries has been one of the most significant factors in shaping societies and their cities over centuries. As a result of their necessity to protect themselves from harsh environments, "old cities were characterized by their compactness". The modern American lifestyle and the Modern Movement are defining Gulf cities today, and their history is in complete opposition to their presence. Gulf countries are experiencing an unprecedented sprawl effect as a result of their "heavy reliance on private transportation, high building technology, powerful air-conditioning systems, and private housing".

Therefore, it is important to know these challenges at the present time, as the awareness of sustainability has increased recently. This study will support many future studies as the vision of Bahrain 2030 aims to create a smart and sustainable environment.

1.6 The Study's Context

This research is conducted in the Kingdom of Bahrain between 2020 and 2022. The interviewees in this research comprise experts from various fields within the built environment such as developers, planners, and architects from the public and private sectors.

To sum up, as a result of urban sprawl and the pollutants it produces in the atmosphere, the sustainability of the environment in Bahrain is

negatively affected. One of the ways to reduce urban sprawl is through the application of compact cities. The concept of urban sprawl and its underlying causal factors, benefits, elements, and supporting framework (i.e., active travel, form-based codes, and urban forms) need to be comprehended in order to elucidate the concept of a compact city.

This study explores the requirements and factors for the implementation of successful compact cities in Bahrain. Additionally, the most foremost challenges that may hinder Bahrain's embrace of compact cities will be identified.

1.7 Research Terminology

Compact city: "It is a concept of urban planning and urban design, that promotes a high residential density with mixed land uses" (Williams 2000, cited in Dempsey 2010).

Urban Sprawl: Nechyba and Walsh (2004) defined urban sprawl as an unattractive and disorganized expansion of an industrial or urban into the neighbouring countryside.

Active travel: It refers to cycling and walking as a substitute to motorised transportation or vehicles for moving from one place to another (Guidance & Travel, 2014).

Urban form: "is used to describe a city's physical characteristics. It refers to the size, shape, and configuration of an urban area or its parts. How it will be understood, structured, or analyzed depends on a scale" (Dempsey et al., 2008).

Form-based code: A development regulatory approach that is either adopted into a country or municipal law, focusing on the physical features

of development while de-emphasizing land-use regulation (Parolek et al., 2013

Compact city criteria: criteria are standards or principles used for judging, evaluating, or selecting things ("Definition of Something," n.d.). Thus, compact city criteria mean standards or principles to create a compact city.

Compact city criteria category: Category means a group of things with particular features in common (Category, n.d.). Thus, the compact city criteria category means a group of standards and principles with particular features in common.

Chapter Two

Theoretical Framework and Literature Review

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2.1 Introduction

An overview of the literature relevant to this research is presented in this chapter. Following are the main themes of the chapter, arranged thematically.

The literature review begins with a discussion of urban sprawl and compact city. It describes the definition, explains the theory, and highlights the characteristics of a compact city. Additionally, the chapter discusses the elements of sustainable planning: transport and active travel, urban form, and form-based codes. This chapter ends by focusing on studies on the challenges and strategies of a compact city.

2.2 Urban Sprawl

Earle Draper, the first City planner from the United States, was the first person to use the term 'sprawl' in 1937. Discussions about sprawl and how it was related to transport and incomes were already underway when World War II ended (Nechyba & Walsh, 2004). British city planning advocate F. J. Osborn presented a summary of the problem in the mid-1940s (1946 [1965], p. 15).

> "These new forms of transportation [...] were used [...] to facilitate the sprawling of suburbs, a type of urban growth wasteful from the economic standpoint and disadvantageous socially. Coupled with the rise of real incomes, rapid transport has enabled people to move out from the centers to find the open residential surroundings they desired. But they and the numerous immigrants from rural areas have obtained these surroundings at the expense of long and costly daily journeys to and from work. Local community life has been weakened or destroyed, and access to the country is made more difficult for the large numbers of residents still left in the city centers".

2.2.1 Urban Sprawl in the Kingdom of Bahrain

Dramatic alterations in terms of morphology and internal structures have been witnessed in cities in the Gulf region. These changes are attributed to the continuous transition from endogenous to exogenous urban growth. Historically, urban spaces were shaped by tribal structures and subsistence economies "based on fishing, pearl trade, and farming". Since oil was discovered, an exogenous form emerged. In response "to the accumulation of wealth, the kingdom adopts a comprehensive welfare policy, becoming a major player in shaping the city". The second phase, exogeneity, occurs due to globalization. "Socio-economic, cultural, and urban morphology" is directly impacted by large multinational companies, liberalization, and integration with world banking systems (Hamouche, 2004).

There is an unprecedented sprawl effect across the Gulf countries as a result of "high-building technology, powerful air-conditioning systems, and private housing" (Ben-Hamouche, 2008). Overall, Arab Gulf countries and specifically Bahrain, have undergone substantial changes in economic and social characteristics, leading to significant issues in urban growth. The expansion and creation of diverse industries at different levels have contributed to the increasing pressure experienced in the Kingdom of Bahrain (GRPAC, 2000). Apart from that, residential areas in Bahrain have expanded significantly due to the growing population and rapid urban growth. Bahrain has a high level of urbanization, with approximately "90 percent of its population living in urban cities". There are approximately 1,627 people per square kilometer, which is a high population density (El-Kholei et al., 2019). Oil is Bahrain's main economic force. Energy consumption increases in line with the urbanization process, which is comparatively higher relative the global average energy consumption.

Subsidized energy prices and excessive resource use are credited with this rise in people's daily activities. As oil dependence decreases, revenues from non-oil sectors increase gradually. In spite of this, oil revenues will remain dominant for years to come (UN, 2002).

Indicators indicate that "there are environmental problems that require urgent solutions". For example, "Manama and the Bahraini coastal cities" have been affected by urban heat islands as the impact of global warming (Elghonaimy & Javed, 2018). Uninterrupted urban growth has been observed in the city of Manama following the emergence of the oil era. However, the city is exposed to several limitations relating to land availability for urban expansion, which is mainly linked to the country's island status. This drawback has encouraged Bahrain to adopt a vertical urban expansion approach (Geospatial Technologies and Human Rights Project, 2019). Urban heat island (UHI) is a complex and vital event in the context of global climatic changes, which contributes significantly to low life expectancy, economic meltdowns and recessions, and degrading environmental quality (Elghonaimy & Mohammed, 2019). It is therefore obvious that urban sprawl is one of the greatest issues of our time. Understanding the concept, the characteristics, and "the causes of urban sprawl are needed in order to be able to solve the issues accordingly".

2.2.2 The Concept of Urban Sprawl

Urban sprawl has many definitions. Oxford Dictionary defines it "as 'the disorganized and unattractive expansion of an urban or industrial area into the surrounding countryside", while "the European Environment Agency (EEA) defines sprawl as the low-density expansion of large urban areas, under market conditions, mainly into surrounding agricultural areas". "Urban sprawl is defined by Habibi and Asadi (2011) as 'more

growth than the usual' and what differentiates it from urban growth is its excessive nature".

Habibi and Asadi (2011) research the authors who discussed the concept of urban sprawl from the point of view of several researchers. According to Brueckner, sprawl refers to excessive urban growth (Brueckner, 2000). Urban sprawl leads to job insecurity, the decline in the central city, income inequality, environmental challenges, job insecurity, and increased housing costs (Gordon & Richardson, 2000). Other problems linked to improper urban planning include long commutes, loss of farmland, species extinction, and individual anomalies such as a feeling of isolation, high blood pressure, intolerance, muscle tension, disoriented psychological status, mayhem and even murder (Gordon & Richardson, 2000).

Four factors of sprawl can be measured and analyzed by Ewing et al. (2008): "1) residential density, 2) neighborhood mix of homes, jobs, and services, 3) strength of activity centers, and downtowns, and 4) accessibility of streets". Among his other research studies, he believes that "poor accessibility and a lack of functional open space are the most important indicators of urban sprawl" (Ewing, 1997).

Gallster et al. (2001) understand that sprawl can be an ambiguous metaphor. In addition to "aesthetics, efficiency, equity, and the environment, sprawl has been defended on the grounds of choice, equality, and economics". There are "eight dimensions of sprawl: density, continuity, concentration, clustering, centrality, nuclearity, mixed-use, and proximity (Gallster et al., 2001)". "Through low-density developments on the borders of cities, Song and Zenou have introduced urban sprawl". During this process, land use is much greater than the population growth rate. In 'The Dark Side of the American Dream', the Sierra Club provided

a definition of sprawl, which was termed developments of low density outside the areas in which services and work occur. Residents are separated from places associated with shopping, employment, recreation, and education, so cars are required for inter-zone movement (Sierra Club,1999).

According to Glaeser et al. (2001), sprawl is the "decentralization of employment". Pendall (1999) "defined sprawl as 'uncontrolled, unplanned and uncoordinated single-use development" that lacks the provision of an appropriate and attractive mix of uses and/or linked to the ambient land use and emerges in several different forms, "comprising low density, scattered, ribbon on a strip, leapfrog, or isolated development".

2.2.3 The Theory of Sprawl

In the modern city, sprawl is an indication of problems that have existed for more than a century. It represents frustration and dissatisfaction with the seemingly chaotic condition of the late modern city and suburbs. Today, sprawl is most commonly defined as low density, amorphous, aggregate development of single-use 'pods' connected by a few, large roads. In addition to being diffuse, decentered, and without clear boundaries, it is dominated by cars. It usually consists of a patchwork of private spaces, with little figural public space, such as squares, greens, or plazas. Therefore, open space is merely a residual element. Dispersed sprawl makes it difficult for residents to reach daily activities such as shopping and working on foot because low densities do not support mass transit. As a result, sprawl features excessive roadways and parking lots, and building access is oriented toward cars rather than pedestrians. Meanwhile, sprawl suburbs are characterized by sparse street networks with cul-de-sacs and loopy roads feeding large collector streets. From local

streets to collectors to arterials, car trips feed into a decreasing number of roadways that are overcrowded and congested with new development. However, widening these streets usually results in inhospitable streets for pedestrians and does not reduce traffic (Dutton, 2000).

"Urban sprawl can take different forms", it could be as a low-density residential development (edge cities) that leads to business activity. Or as "planned communities that have their own 'downtown' or are adjusted to a lake or park". Also, it can "appear as individual houses pop up across formerly rural landscapes2. "In any case, a popular way to document the presence of urban sprawl over time is to look first at the evolution of rural and urban population levels and then to look within urban areas at the evolving relationship between suburbs and central cities" (Nechyba & Walsh, 2004).

2.2.4 Characteristics of Urban Sprawl

Sinha (2018) characterized the characteristics of urban sprawl as follows:

A. "Low-density development": Sprawl areas generally have low-density development.
B. Excessive consumption of land: a single-story building on "a large lot with a small built-up area and a larger living space" creates an excessive consumption of land.
C. Automobile dependence: in an urban sprawl area, the population heavily depends on private transportation. People are reliant on automobiles due to the difficulty they have in moving between widely separated land uses.

D. Haphazard and uncoordinated development: sprawl areas lack the control of civil or municipal authorities; therefore, development there is unregulated.
E. Aesthetics: it is considered displeasing to live in sprawl areas due to their aesthetic appearance.
F. Separation of land-use: there is complete "separation of land use in sprawl areas in developed world cities".
G. "Social segregation: people who can afford to build new houses and drive private automobiles" move to sprawl areas, while the poor are left behind.

2.2.5 Causes of Urban Sprawl

According to Karakayaci (2016), rapid urban growth may arise from alterations in the pointers of economic growth as the increase in the labour force and income per capita will ultimately culminate into a higher demand for dwelling purposes. Urban sprawl also relies on the level of industrialisation and economic growth at city boundaries. As these factors increase, the demand for housing by the labour force in such production areas increase as well (Bhatta, 2010). Moreover, urban sprawl may stem from the speculations on urban growth in response to government policies (Bhatta, 2010).

A report prepared by the "European Commission identifies seven main causes of urban sprawl in Europe" (Karakayaci, 2016) as shown in Figure 2.1:

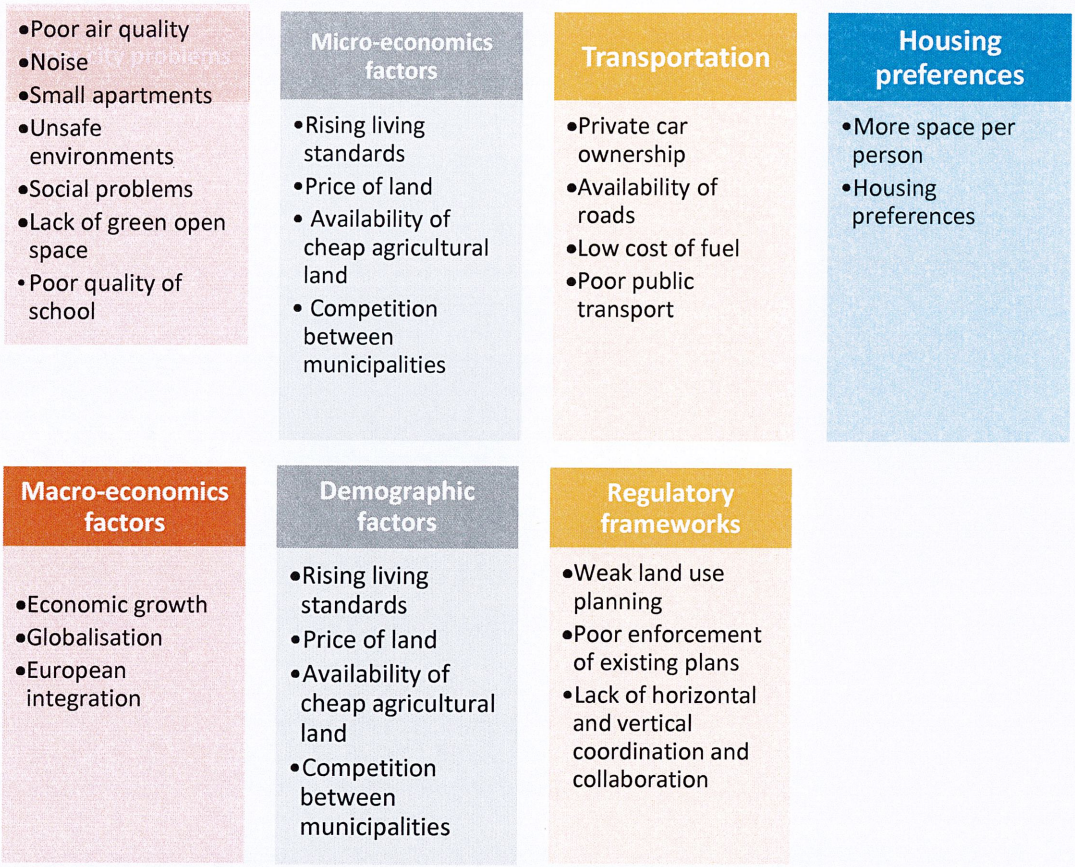


Fig.2.1: Causes of Urban Sprawl (Karakayaci, 2016)

According to the data provided in this section, urban sprawl is currently one of the main causes of environmental degradation due to its impact on the environment. Additionally, the Kingdom of Bahrain is suffering from urban sprawl, which directly impacts the marine environment through reclaimed lands. Furthermore, the expansion of highways, the reliance on private cars, and the refusal to use public transportation have all contributed to the creation of air pollution and the emission of pollutants into the atmosphere. All of these factors directly affect sustainability and the environment. There are several solutions that have been applied in many countries to reduce this urbanization effect. One of which is the adoption of compact cities in order to preserve the environment and maintain sustainability. From this point of view, the next section analyses the concept of compact cities, their characteristics and

benefits, and the factors required for the establishment of compact cities from a planning perspective such as transportation and active travel, as well as their urban form and form-based codes.

2.3 Compact City

The compact city refers to an urban form that reduces land and material consumption by increasing the density of the urban living environment. Compact cities have become a topic widely discussed by national authorities following the growth of sustainable development as an idea because of the current excessive consumption of resources and environmental damage (Faculty, 2018). Sustainability could be attained via diminished travel and commute duration as seen in compact cities, which is accompanied by a decrease in car reliance, energy consumption per capita, and lower risk of environmental pollution (Bibri et al., 2020). Compact cities also assist in preserving diverse employment options and opportunities, social contact, service facilities, and the natural ecosystem (Bibri et al., 2020).

Salingaros (2006) described suburban sprawl as a self-fulfilling 'machine' that generates extensive mechanical movement but is unable to meet human natural needs, thus making it unsustainable. The self-perpetuating characteristic of sprawl was defined by the auto-dependent landscape as the sprawling landscape. Accordingly, sprawl is enabled by cars and vice versa. The suburban 'machine' now feeds directly into globalization instead of its human creators. Individuals without cars are trapped because of the wastage of time and resources.

In the context of high energy costs, both skyscraper-based ultra-high densities and suburban sprawl-based low densities are no longer feasible.

More problems are created by ultra-high-density urbanism compared to its problem-solving capacities in terms of reliance on energy, which is associated with substantial usage of resources, surrounding regions, and depends on cheap oil supplies. Humans are used to living in dense cities, but anti-urban forces have led them to live in low-density suburban sprawl. A low-rise, intermediate-density compact city that is geometrically integrated is the best solution, not formless sprawl. An urban environment can become more flexible when similar forces are directed at building a better environment for humans, thereby creating a compact and geometrically integrated city (Salingaros, 2006).

Some scholars opined that a compact city is a vital aspect of building a sustainable environment. Travel distances can be significantly reduced by compacting cities, thus diminishing the "emission of greenhouse gases and addressing global warming" (Hillman, 1991). Despite individual lifestyles being affected by living in highly compact cities, the cost of transportation can be reduced by lower consumption of fossil fuel, "which in turn reduces the risk of environmental pollution" and heating costs for urban dwellers.

Jenks et al. (1996) describe the debate about compact cities by many authors. For instance, Breheny argued that the advantages of centralization may not meet up with expectations. The scholar raised a concern as to whether the pain experienced by urban settlers is worth the benefits associated with sustainability. Therefore, Breheny recommended a mix supporting the advantages of urban redevelopment and containment as a form of centralization, while encouraging "inevitable decentralization' in surburbs and towns in which public infrastructures are located. Scoffham, Vale, Thomas, and Cousins also hold similar positions.

Scoffham and Vale opined the need for local neighborhoods to develop and take responsibility for their local resources rather than extreme centralization. Both researchers described compact in terms of the extent of autonomy possessed by a neighbourhood relative to its physical disposition. Based on the perspectives of environmental objectives and present economic trends, life aspirations, and political realities, Thomas and Cousins concluded that compact cities are "undesirable, unsuccessful and impracticable'. A similar approach is advocated by Scoffham and Vale. The approach advocates "a decentralized urban form that is physically and virtually compact, local compactness" that "complements regional compactness, and routes" that reduce travel times and distances between settlements.

Finally, the unsustainability of compact cities for urban and suburban dwellers has been emphasised by some researchers. This is based mainly on its negative impacts on the economy, socio-cultural aspects, and the natural environment, which are considered to surpass the claimed benefits. As an example, Stretton's (1994) critique of urban compaction in Australia epitomizes this viewpoint rather than restructuring cities. The researcher disclosed the extensive losses experienced when urban areas are combined while proposing that reforming the transportation system remains the most feasible solution. According to Welbank, conviction - instead of rationality - was the main basis for the quest for sustainable reforms of town and cities in Europe and Great Britain. As a result, the reformation required to yield strategic benefits will equally enhance the quality of life among urban dwellers. Williams in a later review explored the challenges of urban intensification. To be acceptable, a compact city must be able to demonstrate benefits at the local level. The key to ensuring urban intensification is accepted among city settlers is to elucidate and address

the inherent challenges of implementing strategic goals affecting every neighborhood (Jenks et al., 1996).

Based on Chen et al. (2008), compaction has a wide range of negative impacts, including overcrowding, bad neighbor effects, noise, depletion of greenery, and town cramming. Also, Ibrahim (2011), citing Burton (2000), notes that in a compact city, the loss of open space, congestion, and environmental degradation may counteract the promotion of quality of life through a concept called 'town cramming'.

2.3.1 Compact City Principles and Strategies

The goals of sustainability can be achieved by adhering to specific strategies and principles as presented by Bibri et al. (2020). The summary is presented in Table 2.1.

Table (2.1): The goals of compact city can be achieved by the design principles and strategies as presented by Bibri et al. (2020)

Principles of Design	Sustainable, environmental, economic, and social strategies for compact cities
Compactness	• Centralize development and build. • "Concentrate on strategic points". • Mix and complement. • Strengthen the public transportation system. • Areas outside the city should be reserved for future development.
Density	• Compact urban form a with high density of built objects. • A variety of scales of built objects. • A frequent presence of larger buildings in the distribution of building footprints. • Strategic nodes are denser.

	• "Prioritization of density close to strategic nodes' central points". • Multidimensional mixed land use and high-density living go hand in hand.
Mixed land use	Physical land use mix (horizontal/vertical mix of facilities, amenities, public space, etc.). A mix of economic activities (production, consumption, etc.). The social mix (housing, demography, lifestyles, visitors, etc.). Increasing the mix of housing, business, and facilities in strategic locations Multidimensional mixed land use in conjunction with sustainable transportation.
Sustainable transportation	Walking and cycling. Public transportation (metro, buses, trams, etc.). Management of mobility. Increasing "accessibility through improvements in public transportation, infrastructure, Sustainable transportation along with mixed land use and high densities". Connect the major nodes of the transportation system with a network of link areas. Different public transportation lanes enable faster traveling time and improve the system's reliability. The main corridors should be serviced more frequently with more services. By developing a system that is secure, safe, and easy to understand in order to ensure quality and service. Availability of railway stations near strategic nodes. Multiple models "traveling in strategic nodes in order to support dense, mixed-use centers".

Green structure	Parks and green spaces. Green areas are associated with density. Intensification of natural, agricultural, and cultural areas for protection and integration.
Intensification	Population growth. Increased redevelopment of sites, conversions, subdivisions, additions, and extensions that were initially developed. Developing previously undeveloped buildings and urban land. Increased diversity and density of sub-centres. Infrastructure and services for transportation are being invested in and improved.

2.3.2 Benefits of Green Spaces in Compact City

According to Jansson (2014), a compact city encompasses four key benefits, which encompass health, economy, quality of life, and ecological sustainability.

A. Health benefits

Examples of the health benefits attributed to green spaces in cities encompass longevity, provision of brain power, ensuring mental and physical well-being, and child development. These health benefits are directly associated with "social and economic sustainability".

B. Economic benefits

The economic benefits of green urban spaces on the economy include increased values of properties, city branding and willingness to pay for goods and urban agriculture. More importantly, these benefits have a long-term effects.

C. Quality of life benefits

Residents and visitors consider the beauty of the environment as paramount to their "quality of life. Green spaces could improve the attractiveness of urban surroundings", thus providing residents the opportunity for better safety, social interaction, participation, and attractive working environments.

D. Ecological sustainability benefits

"Ecological benefits arising from urban green spaces" include reducing noise and pollution, regulating services and local climate, and diminishing global warming.

2.3.3 New Approaches to Urban Sustainability in Parallel with the Compact City Concept

The concept of a compact city and its approaches are similar to "New Urbanism, Smart Growth, and Transit Oriented Development".

A. New Urbanism

"Planning and design principles established during the first three Congress for the New Urbanism meetings became widely popular" in the 1990s. "Physical design principles articulated for development at various scales, from the region to the block and street", were developed to respond to the urban problems and related experiences of the time. As a result, "the New Urbanist movement from the norms is distinguished. Most

conventional development projects" produce "low-density, use-segregated development that intensifies automobile dependence". The New Urbanist approach focuses on "mixed-use, mixed-income, and compact development" that incorporates "a variety of housing types and supports alternative transportation methods" (Garde, 2020).

According to Laund (2008), New Urbanism presents an alternative to low-density suburban urban patterns, by imitating historic urban patterns in American cities. The New Urbanism movement is characterized by the following design principles:

A. A dense, walkable neighborhood with well-defined boundaries.
B. In a well-defined center surrounded by public buildings, public spaces, and a transit stop.
C. An interconnected network of streets should be present, creating coherent blocks with building fronts instead of parking lots.
D. The presence of various housing "activities and options".
E. "Civic spaces in prominent" locations; and
F. Open spaces are located all through the neighborhoods in accessible and convenient spots.

B. Transit Oriented Development (TOD)

"Transit-oriented development (TOD) is a mixed-use" neighbourhood within 2000 feet "of a transit stop and core commercial" district. A TOD aggregates retail, residential, open space, "office, and public uses in walkable settings", thereby "making it convenient for employees and residents to travel by various means" such as transit, car, bicycle, or by foot. As an alternative to traditional development patterns, TOD provides housing and services to a diverse population in a manner that facilitates pedestrians and transit users (Calthorpe, 1993).

Transit-oriented development makes transit more appealing by making public transportation more accessible to more people, reducing its utility costs. Furthermore, it reduces urban sprawl by increasing the density of development around stations. Also, people are brought closer to city centers because TOD brings them closer to them. The closer the location is to the city centers, the shorter the distance to travel. A shorter distance to travel means a lower energy demand for transportation. As the increase in population has made public mass transportation essential, there is a need for an adequate transportation capacity as a result (Sutan, 2021).

c. Smart Growth

Smart growth emerged as a concept "to address the challenges posed by" conventional planning and zoning policies in the 1990s. The concept "of smart growth refers to the practical guide to implementing smart growth principles, including compact development, infill, open space conservation, and mobility" (Porter, 2002). Numerous smart growth approaches advocate developing areas with either an existing or planned structure. Additionally, smart growth strategies "encourage mixed-use, pedestrian-oriented, and transit-oriented development, providing incentives to enhance investment, reducing regulatory barriers to development, and using state and local funding to improve infrastructure within those areas" (O'Neill & David, 2000). In smart growth, advocates recognize that development will take place wherever the population grows rather than allowing growth to occur haphazardly and inefficiently. Therefore, through smart growth, growth is encouraged to occur in or adjacent to existing communities (Benfield, 2001).

2.4 Transport and Active Travel

Individual health and well-being are influenced by a physically active lifestyle. Studies link "higher levels of physical activity with lower levels of mortality and morbidity". In spite of "this, physical inactivity remains a major global risk factor for mortality". Accordingly, public health policies in many countries emphasize the importance of promoting physically active lifestyles (Norwood et al., 2014).

'Statutory Guidance for the Delivery of Active Travel' (2014) defines active travel as the means of "walking and cycling as alternative means to motorized transport to make everyday journeys. An 'active travel journey' is a journey made to or from a workplace or educational establishment to access health, leisure, or other services or facilities".

2.4.1 The Benefits of Active Travel

The health benefits of active travel include reducing the risk of complex health outcomes such as mortality from all causes, heart disease, strokes, and cardiovascular disease. Cancers can be prevented by regular physical activity, including those of the "breast, colon, bladder, endometrium, esophagus, kidney, lung, and stomach". Regular physical activity reduces the risk of developing type two diabetes, "helps maintain a healthy weight", and contributes to weight loss (Davies et al., 2011).

At the environmental level, active transport modes have zero emissions. As a result of a shift from cars to active transport, greenhouse gas emissions and energy consumption would be significantly reduced (Hunkin & Krell, 2019). Also, the reduction in transport-related carbon emissions has wider "co-benefits for health, social cohesion, and quality of life". For example, "reducing carbon-based energy in the transportation

sector often" leads to improved air quality and reduced pollution, which are co-benefits of climate-friendly policies (Davis & Whyte, 2020).

On the other hand, active travel affects air and life quality in cities. For example, a higher share of active transportation benefits urban areas in terms of reduced congestion and noise pollution while increasing road safety, helping to improve the quality of life (Hunkin & Krell, 2019). Also, based on Hunkin and Krell (2019), the benefits of active travel that are linked to improved walking and cycling conditions are:

A. Low travel time and more convenience and comfort for pedestrians and cyclists.
B. Increased accessibility to amenities.
C. Better visibility and safer infrastructure to enable improvement in traffic safety for vulnerable users.
D. Cost-effective and affordable transport systems to facilitate a higher mobility level, especially for the lower class.
E. Reduced energy consumption.
F. Diminished land consumption through sealed surface from deconstructed traffic areas.

Meanwhile, the benefits linked to reduced motorized vehicle usage are:

A. Reduced greenhouse gasses and other harmful emissions.
B. Reduced noise pollution.
C. Enhanced traffic safety by reducing motorized traffic.
D. Reduced mobility costs.
E. Reduction in travel time via decreasing congestion levels.
F. Encouraging social interaction and reducing separation effects improved quality of life.

G. Enhanced private businesses by increasing the attractiveness of public spaces.

2.4.2 Designing the Built Environment to Encourage Active Travel

To create a sustainable environment, several issues need to be addressed and redesigned, such as streets and roads for walking and cycling. It is suggested that three-quarters of all public spaces are made up of streets and roads. This "has a big impact on people's lives". People can be encouraged to walk or engage in more cycling as part of their daily schedules when the accessibility to the streets is improved. Such activities will promote a healthier lifestyle among the residents (Petrokofsky & Davis, 2016). There are some clear messages for planners from the "research on the links between walking and the physical environment". These findings reflect a higher likelihood for individuals to walk in locations with higher population densities, mixed-land use, and "highly connected street layouts" (Sinnett et al., 2012).

The combination of walking and public transportation can significantly increase physical activity levels (Besser & Dannenberg, 2006) while reducing congestion, pollution, and traffic hazards. Cities become more accessible when affordable tickets are provided and coupled with flexible bus stops to help passengers in highlighting and getting on the bus (Broome et al., 2009). Furthermore, the provision of constant and reliable services, high-quality travel information, and availability of public transport are equally vital for accessible cities (Broome et al., 2009). There is a positive relationship between cycling and dedicated cycling paths or routes, differentiating cycling from other traffics, short-trip distances, high

population density, proximity to green space or cycle path, and schemes promoting safe routes to school for children (Fraser & Lock, 2011).

Generally, Petrokofsky and Davis (2016) note that the design of a neighborhood "plays an important role in" promoting healthy travel habits, including but not limited to:

A. Short trip distances that are compatible with routine cycling and walking could be enabled by mixed-use development, comprising "local facilities such as clinics, shops, schools, and other services".
B. A road design that provides direct routes for walking and cycling while removing traffic for motor vehicles, thus encouraging active transportation.

Safe "walking and cycling to and from school are" challenging. Several approaches could be used to assist schools in promoting safe travel, which includes, providing training to promote safe cycling, developing a school travel plan, setting up walking buses, and launching other partnership programmes with parents (Public Health England, 2016). Based on the information gleaned from the Play England website, Petrokofsky and Davis (2016) highlighted that street closures or street play motivate children to play safely, actively, and self-sufficiently near their homes. This encourages physical activity and helps children build self-esteem, confidence, and resilience.

Factors such as access to amenities, pedestrian infrastructure, safety, and environmental factors affected physical activity among elderly individuals (Cairncross, 2016). The significance of good road crossings, toilets, pavements, and public seating is reflected by consulting people with disabilities (Lee, 2016). In addition, such consultations depict the vital role of attitude and organizational factors in encouraging walking

among people (R. Lee, 2016). For instance, people with dementia and their caregivers need to be engaged during the planning, development and assessment of real urban scenarios (WHO, 2014). This is because such individuals require more pedestrian crossings and spend more time in the process, as well as visual and audible cues to help them when crossing a street.

Furthermore, scholars reported a 24% higher likelihood of engaging in physical activities and lower obesity among those having access to green spaces (Stone, 2009). Also, multi-modal transport, promotion of public transport, and investment in it will likely increase the modal share of active transport. Hence, during "the development of Sustainable Urban Mobility Plans", regions and local governments should take into account this interconnectivity (Hunkin & Krell, 2019).

2.5 Urban Form

"Anderson et al. (1996) defined urban form as" "the physical characteristics of a city". The researchers also described "urban form as the spatial configuration of fixed elements on a regional scale or broad city (Anderson et al., 1996)". The urban form comprises "the physical features of built-up areas, including settlement" size, density, "shape, and configuration". The characteristics are considered "at different scales based on" whether it is regional or urban, neighborhood or street (Williams, 2014). The form of a town is determined by the relationship between its outdoor space and the built environment of a given landscape. As such, these are the elements to be examined in relation to one another and in relation to other urban elements (Valente-Pereira et al., 2015).

2.5.1 Urban Form Elements

According to Dempsey et al. (2008), the concept of urban form encompasses both "physical and non-physical characteristics, including size, shape, scale, density, land uses, building types, urban block layout, and distribution of green space". The following "are five broad and interrelated factors that make up an urban form in a city", see Figure 2.2.

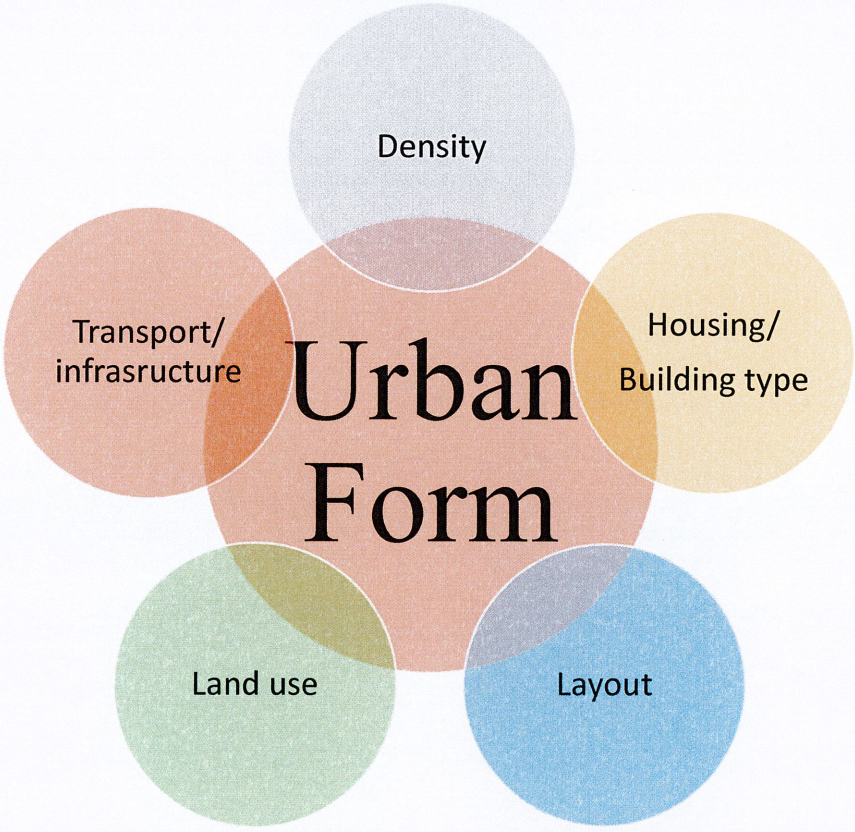


Fig.2. 2: Urban Form Elements (Dempsey et al., 2008)

A. Density

Density has a scientific, physical, and social meaning and "is a critical typology in determining sustainable urban forms (Jabareen, 2006)". The increase in density is widely advocated as a key trend in creating a more compact city, as it is a result of a re-urbanization process that encourages people to live and work in towns again (Burton, 2002). It is often termed densification because it involves subdivisions and conversions of an existing property that provides more residential units in an area already developed. Other authors describe the process of intensifying the urban environment by filling and building vacant lots, reusing underutilized sites, and renovating or expanding existing sites as infill development (Steinacker, 2003).

In general, this process involves either increasing the "population density (Gross Density)" or increasing the "density of the built form (Net Density)". As an example, new housing may be constructed on vacant lands, "underutilized sites such as parking lots and old industrial" facilities may be repurposed, and existing buildings may be renovated or expanded. In addition, Burton (2002) proposes an additional technique of intensification, namely the development of a subcentre as an intensification concept since intensification can occur within particular areas rather than across the entire city. In addition to subdivisions and conversions, density may also occur through a number of related actions such as subdivisions and conversions of existing property, greater use of existing non-residential buildings, infilling vacant and derelict areas, adding to the built environment, and redeveloping in higher density areas.

Other components of urban form are also related to density, including land usage and accessibility to services. Meanwhile, density can also arise from land use competition in a specific infrastructure of the urban

transportation system and the related accessibility pattern. On the other hand, "density has been used in urban design and construction to assess the viability of public" transport "infrastructure and other service provisions and the feasibility of certain land uses, particularly commercial and service uses". In addition to providing "an objective, a spatially based measure of the number of people living in each area may also be assessed subjectively. It is a social interpretation based on individual characteristics, therefore, may differ from resident to resident". Moreover, it is an "important policy goal as it contributes to the quality of urban life through the viability of services and the accessibility of public and private spaces (Dempsey et al., 2008)".

B. Land use

"Land use is a term used to describe the functions of an environment". A functional urban "area requires industrial, retail, offices, infrastructure, and other uses" in addition to residential land use. Spatial land use patterns and their potential to influence "urban travel patterns and quality of life are" crucial to arguments about a city's efficiency and potential sustainable urban form (Dempsey et al., 2008).

The availability of local services is "a key component of local land use". Services and facilities are provided in response to resident demands so that land use mixes may differ from one neighborhood to another (Urban Task Force, 1999).

C. Accessibility and Transport Infrastructure

Accessibility is significantly influenced by transportation infrastructure since it predicts the simplicity "with which area, buildings and places can be reached". Accessibility levels depict the locations that users and residents could access and their ability to access services, places,

and amenities outside their local areas (Talen, 2003). This form of accessibility is multifactorial as it depends on "the quality of the transport system" connecting to geographically dispersed locations, the distance from an individual's starting point to possible destinations, and the overall. characteristics (Liu & Zhu, 2004). The latter comprises the facilities and services to be used by individuals (Liu & Zhu, 2004). The concept involves access to services or amenities adjacent to people's homes and those that are further away (Barton et al., 2003). This event is closely associated with land layout and land use such as the arrangement pattern of "services, facilities, and open spaces in" a neighbourhood or city (Dempsey et al., 2008).

D. Urban Layout

"Pedestrian movement and the" manner "in which different places" are interconnected are affected by urban layout (ODPM, 2005). The layout of streets, blocks, and buildings describes their arrangement and configuration at the scale of "the street, such as grid or tree-like (cul-de-sac) street patterns". The urban layout can be feasible or permeable, while enabling pedestrian access controls and movement, which may influence other components of urban design including land density and usage (Hillier & Hanson, 1984). The character and degree "of routes between and through spaces are determined by the permeability and connectedness of urban layouts", thereby influencing how well-used and lively they are (Cowan, 1997). In contrast to deserted or quiet options, well-connected streets are likely to be more frequently used as they provide pedestrian access to services, facilities, and others (Gehl, 2001).

E. Housing and Building Characteristics

Previous studies highlighted that the experiences regarding the city among people living in low-density and detached houses with extensive gardens differed compared to those living in high-rise buildings at the centre of the cities. It is important to note that building characteristics have an impact that extends beyond urban density. The type, height, and age of a building can have an impact on several issues. The factors to be considered include the orientation of the building and its exposure to daylight and sunlight (Mardaljevic, 2005). In addition, the capacity for adjustments or "modifications, such as transforming living space to office space or modifying individual rooms" for older residents' accommodation as an aspect of the 'lifetime home' model (Holmes, 2007). The efficiency of building energy, particularly in terms of life cycle and operating energy, may also be influenced by the number and type of particular rooms, the living space in dwellings, and the lowest level of living space (Newton et al., 2000).

According to Jabreen (2006), there are four more elements for sustainable urban form:

A. Compactness

Compact urban forms are widely accepted to achieve more sustainable urban forms. However, according to Wheeler (2002), compactness also refers to "urban contiguity (and connectivity), which implies that future urban development" should be adjacent to existing urban structures.

B. Diversity

The sustainability of cities relies on the diversity of their activities. Jane (1961) "popularized the diversity dimension, which has been widely adopted by new urbanism, smart growth, and sustainable development

approaches". However, a "lack of concentrated diversity can lead people to rely almost exclusively on automobiles".

C. Passive Solar Design

Passive solar design is essential to achieve a sustainable urban form. "By implementing specific design measures, this design seeks to reduce energy consumption and use passive energy most effectively in a sustainable manner. For example, the orientation of buildings and the density of urban areas are influenced by this design" (Thomas, 2003).

D. Greening

An essential aspect of sustainable urban form is greening the city. "Among the critical agendas in urban areas, green space can contribute positively to sustainability" (Swanwick et al., 2003). "The concept of greening seeks to embrace nature as integral to the city and to bring it into the lives of city dwellers through a diversity of open landscapes" (Elkin et al., 1991).

2.5.2 Transportation and the Urban Form

Rodrigue J (2020) explains transportation and the urban form as the urban spatial structure that is influenced by transportation patterns, while urban development is shaped by transportation. Transportation infrastructure shapes urbanization, including roads, transit systems, and walkways. Due to this, "a wide variety of urban forms, spatial structures", and transportation systems are associated with urban areas. According to "transport developments, the urban spatial structure can be categorized based on its degree of centralization and clustering". The concentration and "clustering of value-added activities like retail, manufacturing, and distribution characterize urban spatial" structures. The term

'centralization' refers to the preponderance of urban activities organized in the city's central area, largely due to accessibility. While clustering refers to the degree to which urban activities maintain a sense of proximity to each other, which is primarily a result of agglomeration's benefits.

Each city's urban form and spatial structure are articulated by two structural elements, irrespective of their geographic setting, namely nodes and linkage.

Nodes: "The centrality of urban activities can be" explained by "the spatial accumulation of economic activities" or by the "accessibility of" transportation systems. For example, local and regional activities gather around terminals, such as ports, train stations, railyards, and airports. The importance and contribution of each node to urban functions are arranged hierarchically, with management and retailing at the top and production and distribution at the bottom.

Linkage: Nodes are linked by mobility infrastructures. Streets are the lowest level of linkages and define the urban spatial structure. The linkages are hierarchical, starting with local roads and railways and moving to air and maritime.

The development of "urban accessibility pathways based on compact and public transportation-oriented cities" may include "retrofitting and re-densifying" existing "urban cores as well as" promoting "dense, transit-oriented urban expansion, particularly" within dense, "high-growth cities (Angel, 2011)". Urban transport policy recognizes three key principles: "first, to reduce travel intensity in cities" by ensuring that different urban functions are physically located and co-located; "second, to shift from spatially inefficient and energy-intensive private" motorized "modes to the public, shared, and non-motorized modes2; "and third, to" make road-

based vehicles more efficient, "in terms of energy and space consumption" (UNEP, 2011).

2.6 Form-based Code

Form-based code is a strategy for development regulation that is integrated into a country or municipal law and focuses more on the physical characteristics of its development system ahead of land-use regulation. This form of development aligns with the community context, including the association between buildings and pedestrians, streets, vehicles, as well as private and public spaces. The approaches adopted by form-based codes to tackle the aforementioned issues entail site design regulation (Parolek et al., 2013).

Parolek K (2013) describes "the form-based code as depending on the vision" of any community that can be customized to preserve and enhance the existing character of one neighborhood or drastically change the character of another.

Overall, the function of a form-based code is as follows:

A. Boosts a "mix of land use to decrease the need to travel" extensively all through the day.
B. Provides a mix of housing types.
C. It is proactive and emphasizes the wants of the community rather than what dislikes.
D. Is "a public design process", resulting in a "consensus and a clear vision for a community".
E. Considers local architecture and overall character, that the requirements are tailored to specific places and neighborhoods.

F. Focuses on-site design and building forms, lasting for several years beyond numerical factors like use regulations and density that may alter with time.

G. Tackles the significance of streetscape design and the features of individual buildings when describing "public spaces and" creating "a sense of place".

H. Generates "information that is easier to use" compared to "conventional codes" for zoning. This is attributed to the short nature of form-based codes, as well as being more concise and focusing on illustrations over text.

2.6.1 Form-Based Codes Main Components

Identifying the main components of Form-Based Codes (FBCs) is highly dependent on the specific needs of each project. There are eight components typically found in FBCs (Sabri & Galal Ahmed, 2019). The first is the Regulating Plan, in which lots, blocks, and types of buildings specifying a specific area are illustrated along with street layouts and public open spaces (Goldstein, 2008). The Public Spaces Standards is the second component, which provides particulars on each element in the public realm (Elliott, 2012). Two main groups of standards are as follows:

A. Thoroughfares provide access to lots and open spaces (Smart Code Version, 2014).

B. Civic spaces comprise squares, parks, pocket parks, plazas, playgrounds, and playing fields (CMAP, 2014).

The third component is Block Standards, which define blocks' dimensions and streets' road patterns (Paulsen, 2012). This standard is usually applicable to projects with a two-acre or larger site. The maximum

block length usually ranging from 122 to 274 meters, with the maximum block perimeter usually ranges from 487 to 732 meters (Parolek,2008).

The fourth component describes specific building types as well as how they relate to the surrounding context (SACOG, 2013). The "fifth is the Building Form Standards", encompassing "all standards relating to the building" forms, locations, "dimensions, and" car parking regulations. The illustrations are usually three-dimensional with detailed explanations (Lawlor, 2011).

The Frontage Type Standards is considered the sixth component. This component instills the interface between buildings and streets/spaces. Thus, it defines sidewalk standards and measurements, stoops, tree lawns, porches, building height, arcades, side lot setbacks and street façades. The width, height, and depth of different types of frontages are typically regulated (Parolek, 2008).

The seventh component is the Architectural Standards. This component differs across communities according to the target area's architectural pattern. Fundamentally, architectural standards govern windows, doors, colour palettes, details, massing, and the combination of materials. Architectural standards also regulate external materials, conformation, and quality (The Codes Study, 2014). Glossary represents the eight components, containing the definition of all the terms employed in the FBC (SACOG, 2013).

2.6.2 Advantages and Disadvantages of Form-Based Codes

The Useful Community Development (2022) summarized the advantages and disadvantages of form-based codes. First, since form-based codes are newer tools, it is not necessary to equally enforce them in all facets of the city or other jurisdictions. They are also similar to zoning since

form-based codes depend on a physical strategy on the map, however, they are also applicable to a specific area or district of the city. The code also usually has the advantage of being shorter and easier to read than the zoning ordinance. Second, form-based codes are more flexible compared to zoning, with the continuous emergence of new land uses while those who have to enforce the zoning ordinance are puzzled. In a well-organized city, the approval of a zoning ordinance amendment is a prerequisite to classify the new land use. Furthermore, building placement, mass and scale are not succinctly addressed by the traditional zoning ordinance, particularly in terms of the surrounding structures. While some attempts have made residential street setbacks equal to the average setback of existing homes, this is not a widespread approach in zoning. Zoning does not usually take streetscapes, sidewalks, bicycle lanes, street furniture and other environmental amenities into account. Finally, with the growing evidence of the sole reliance of the transportation systems on sprawling roads and petroleum that have no cost and environmentally, bicycle-friendly and walkable communities (i.e., active transportation) need to be expanded. Form-based codes may promote safe and enjoyable places for bicycles and pedestrians due to their emphasis on the shape and content of the public realm.

However, there are disadvantages to FBCs. Since codes are relatively recent inventions as their first usage was three decades ago, societies are still less experienced in administering codes. Hence, there is limited comparative information on the capacity of traditional zoning and codes to adapt to changes in architectural practices and business. Likewise, the documentation of hybrid zoning ordinances applies to form-based districts within the boundaries of the zoning ordinance. In addition, locating a skilled city planning consultant to develop and execute the code is difficult

due to the novelty of this law. FBCs are also deliberated as replacing a rigid system with another form of rigidity. Moreover, it is now irrelevant to employ the land use of a building since a manufacturing building and an office building may appear identical from the outside and perform similarly relative to the surrounding environment. Thus, a prison and a school may look the same, excluding the presence of a barbed wire at the top of the fence of the former. Considering these examples, it could be argued that zoning can be too rigid and detailed for today's society. Based on the rigidity, urbanism is more likely to be favoured ahead of suburban outlook and focusing on urban design over than parcel's performance. Designers also succumb to the shifts and trends of opinion over time despite their reluctance to accept it. In the same vein, city planners are traditionally trained to brainstorm on how to develop a city or a town, but they may need to be substituted with persons experienced in physical designs. This event may be attributed to the fact that the present pertinent questions focus more on "the distance between the street and the building", the bulk of the building, the space available for parking relating to the building, and so on. Therefore, these require architects or planners with different training.

2.7 Compact City Challenges and Strategies

There are many challenges in implementing "the concept of a compact city" as an existing city is governed by strategies and regulations based on the country in which they reside.

Many differences distinguish a developed from a developing country. Urbanization in the latter exists at a comparatively lower level but at a higher rate. A city in the US or Europe tends not to experience the challenges faces by a city in a developing country, which include high-density areas, low levels of income, high income-related inequality,

budgetary limitations that restrict investments in urban infrastructures and service provision, urban environmental degradation, and problems with the provision of shelter (Jenks & Burgess, 2000). Cities in developing countries experience highly informal development components, impeding the successful implementation of policies related to compact cities. In comparison to city peripheries in developed countries, those in the developing world have low-income populations who cannot afford urban containment. Poorer people may also be affected more negatively by renewal, as occurred in early-1980s China, which undertook urban renewal projects and restructured industry on a large scale (Chen, 2008). Also, developing country cities have high urban densities and mixed-use, which may be excessive in order to reap any benefits from further growth and intensification (Jenks & Burgess, 2000).

According to Kotharkar et al. (2012), only a developing country that fulfills particular conditions can implement policies related to compact cities. These include:

High densities and compact urban forms can be maintained with less negative impacts with infrastructure improvement.

Urban areas must be managed and administered, and regulations must be stringent if the beneficial outcomes of compact lifestyles are to be sustained.

Along the axes of mass transportation, areas become densified and intensified, while growth is mixed-use. This results in growth being polycentric and development being oriented toward linear transit in urban structures, whose identified subcenters have become densified and actively intensified. Pollution, low-density sub-urbanization, and linear development are likely to affect property values adversely. In addition, in

a city core, it is impossible for areas to be infilled traditionally, densified, or intensified.

Shirazi and Falahat (2012) discussed five key issues related to compact urban forms from the perspective of cities in the Middle East. First is "the need for empirical study and scientific proof". "In the context of Middle Eastern cities", two issues arise. In this region, many standard compact forms have durable roots that extend back as far as Ur, a city that existed around 4,000 years ago (Figure 2.3). Since then, the region's typical urban layout has continued to be revealed in the patterns of urban areas (Hakim,1982). Compactness was traditionally a characteristic of cities in the Middle East, whose outer walls generally dictated that every settlement must be near the others, leading to high-density urban setups and articulation across neighborhoods. Moreover, city cores, which generally contained the main bazaar, were also examples of compact agglomeration in urban areas. They encompassed various facilities with functions such as commerce, education, religion, and culture. A city like this was normally comprised of communities of mixed use, with a functional dispersion around the city. The typical residential quarter was a community that had semi-independence and its own amenities. To determine the ways in which this compactness pattern provides its inhabitants with sustainable urban lives and to understand its morphological attributes, a scientific and multidimensional study is needed (Shirazi & Falahat, 2012)

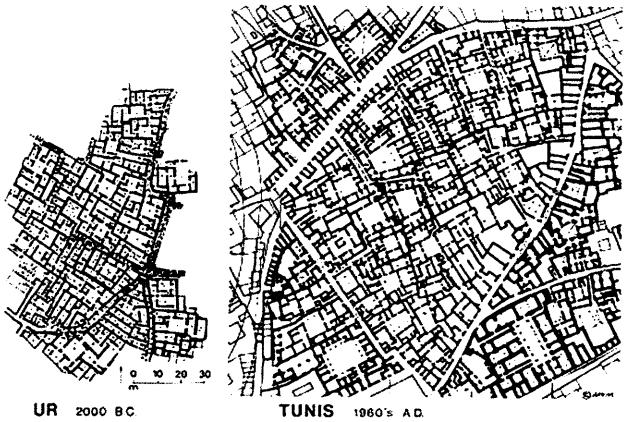


Fig.2.3:Urban fabric of Ur and Tunis Medina: similar compact urban pattern (Hakim, 1982).

The urban structure of Middle Eastern cities has changed drastically during the past two centuries due to modernization and colonization (Bianca, 2000). Additional scientific research is needed to ascertain the validity of many assertions regarding compact urban forms in cities in the Middle East today, as well as identify the principal issues facing central compact areas, the challenges linked to new development projects, and how feasible the densification of urban areas may be (Shirazi & Falahat, 2012).

Next, social acceptability and feasibility. As far as intensification is concerned, "social capacity is a major issue" in terms of how much intensification is acceptable. The social acceptability of "compact urban life" in societies "has been traditionally practiced" (Jenks, 2000). Cultural induction is responsible for increases in density, which are reflected in the social organizational patterns that are traditionally followed. A community-based lifestyle and cooperation between community members tend to result from such patterns (Richardson et al., 2000). In most Middle Eastern societies, a compact urban fabric is integral to social acceptability. A typically compact urban form could coexist with religious, ethnic, and professional solidarity in the region's cities (Lapidus, 1976).

The extent of compactness is another challenge "of the compact urban form". Jenks (2000) "contended that the" density of a city differs depending on the country in which it is located, and views on what constitutes high density may vary between different countries. Given this vital point, Dempsey (2010) stated that it would be over-simplifying to transfer the features of a compact city to every country and context. Differences exist between what it is possible to measure and between what people feel and perceive. The physical extent of compactness and its perception must be considered at different places because residents and users at different places perceive compactness differently (Dave, 2010).

The necessity of supplementary dimension is also a challenge. According to Kaido (2005), higher densities can be supported by a high level "of accessibility to public services and facilities" in general. It is extremely important that local and central governments take "efficient planning policies" to improve local facility accessibility "in order to achieve a sustainable" compact city. There are several similar cases that exist throughout Middle Eastern cities where urban management and policymaking primarily focus on "short-term improvements rather than long-term" development. "The case of Egypt is" an example. In addition, political instability, "corruption, and a lack of government solidarity threaten any such initiatives and prevent cities" from implementing them (Shirazi & Falahat, 2012).

The city size is the final aspect. The growth and size of compact cities are significant factors linked to this topic, but they have not been subject to serious investigations. Cities in medieval Europe or even Islam, whose areas were limited, tend to dictate the compact city's ideal form, in which a wall defined the city's area and separated it from the surrounding district. The traditional ideal compact city is not only defined by its shape and

compactness but also its size. Considerations of the modernization process in, and subsequent rapid urbanization of, cities in the Middle East mean that the theme of size has grown in importance. In a Middle Eastern city, a new development project generally adheres to the pre-modern and contemporary patterns of the West, in which expansion is presented in a less compact manner. This contrasts with the actual core of the city by emphasizing a low-rise and low-density approach. The indication is that city size must be incorporated into debates related to compact cities or restricted so that sustainable urban lifestyles can be achieved. By drawing a border around the city, it is impossible to stop the city's growth and development (Shirazi & Falahat, 2012).

As Kotharkar et al. (2012) argued, Indian cities also face issues because policies connected to compact "cities in developing countries can be" regarded in terms of density, "intensification", and the shaping of urban sizes, forms, structures, and patterns of settlement. The explanation for this is that increasing the density while not investing in infrastructure could have adverse effects on sustainability "due to the high cost of providing infrastructure in" the core area and informal enclaves. Also, densification may exacerbate heat islands in tropical climates and increase vulnerability to natural disasters. Finally, any manipulation of the urban form in a developing country is difficult due to the expense it entails. Furthermore, it is an unacceptable solution to build a new city with a sustainable form.

Compact development aims for "sustainable urbanism", but the quality of life "should always be the focus of any planning process". "To support cities with different needs", different "concepts, approaches, and urban design should be pursued" (Haas, 2012). As defined "by the Organization for Economic Co-operation and Development (OECD)", compactness shapes the spatial form of a compact city. A compact city is

described as a city whose dense development patterns are near each other, enabling access to local services, jobs, and public transportation systems that link to urban areas (OECD, 2012). Based on "these characteristics, the OECD maintains that a city with a high level of compactness has three" effects:

A. Intensively used urban land, contiguous urban agglomerations, and clear urban-rural boundaries at the urban fringe.
B. Public transport facilitates "mobility in urban areas, enabling them to function effectively".
C. Residents can walk or use public transport to access local services and jobs.

In Arifwidodo's (2012) study, "the author finds that some attributes, such as distance to the city, have positive effects" on compactness. However, "other attributes, such as public transportation and density, have either adverse effects or are found to be insignificant" because urban densification lowers the city's quality of life. Therefore, this policy is not desirable.

A study conducted in the US by Wang (2022) aimed to illustrate the importance of "quality of life as well as" reveal the perceptions of compactness. The result of this study shows that over-compactness significantly correlates with the low "quality of life in compact cities". There may be a universal solution to this problem "in both developed and developing countries" because it is not sustainable to promote compact development uncritically, especially in cities that are already overly compact.

Gehl (2010) reported the most practical and feasible "approach to design exceptional cities for people" is to "follow the order of life, space,

and buildings". To support city space and city life, the various "dimensions of development density", activity cantering, "street accessibility, and mix land-use must be" planned and boosted on "a human scale". In addition, livability should be the main focus in developing compact cities rather than "efficient physical urban system (Arifwidodo, 2012)". Thus, various forms of compact development need to be explored, particularly those considering social preferences and local regulations (Wang, 2022).

2.7.1 Compact City Strategies

Lee and Lim (2017) defined compact city strategies as a given set of urban plans or approaches designed to execute compact city goals, which entail reducing environmental pollution, protecting the agricultural land and local natural environment from urban encroachment, and enhancing inhabitants' quality of life. The latter is achieved by developing more compact urban forms, providing more access to local services, increasing the city's density, and encouraging green transportation (J. H. Lee & Lim, 2017). Based on a survey "conducted by the San Francisco Bay Area Metropolitan Commission in 1990", compact forms with higher density have fewer automobile trips. Moreover, this compact form promotes walking and transit use within a community. In developing countries, compact cities are expected to have the same values as they can reduce transportation problems caused by urban sprawl (Bay, 2012).

A study conducted by Mahriyar and Rho (2014) explored strategies to increase the effects of the compact city in Surabaya. The following strategies and improvement points can be implemented. First, building vertically and improving mixed-use points. Further, "compact cities can be synergized with transit-oriented development and public transportation priority strategies to reduce trips". "Through comfortable intermodal

transit mechanisms, these strategies can increase the preference of communities for public transit". Second, improving low-density areas where there are fewer people. It is recommended that "areas with medium and low urban compactness" levels be designated "as sub-city centers of areas with high urban compactness" levels, which are "the main activity centers". This direction can also be strengthened by transit-oriented development as a means of increasing accessibility in the area.

A study conducted by Lee and Lim (2017) identified the factors that influence local governments' choices of policy instruments for achieving the compact city concept. The study revealed that "there is no compact city" strategy in Korea. In addition, the compact city concept is compatible with several urban policy instruments to prevent urban sprawl. These policies are designed to generate more energy-efficient, compact, and environmentally sustainable urban environments (J. H. Lee & Lim, 2017). Others are as follows:

A. retrofit "built-up areas",
B. action plans for green growth,
C. a "multimodal transfer" center (MMTC),
D. greenbelt strategies,
E. "intended nationally determined contributions (INDCs), and"
F. local green growth committees.

Lee and Lim (2018) concluded that compact city policy decisions are influenced by the location and "socio-economic capacities of a local government. Hence, there are higher odds of implementing compact city-related policy instruments in Korean cities" characterized by low-income and higher automobile ownership rates.

Chapter Three

Research Methodology

3.1 Research Methodology
3.2 Research Tools
3.3 Data Collection and Procedures
- **3.3.1 To investigate the requirements and explore factors of creating a compact city.**
- **3.3.2 To identify the challenges and gain insight into the obstacles associated with implementing compact city concepts in the Kingdom of Bahrain**

3.4 Interview Questions Validity
3.5 Research Limitations

The purpose of this chapter is to describe and explain the methods used in this research. The methodology developed in this research aims to determine the challenges and future potentials with regard to implementing the compact city concept in the Kingdom of Bahrain. This chapter describes the procedures, analytical tools, and data collection strategies used in this research, as well as the research's data analysis. This chapter is organized in accordance with the order of the objectives outlined in Chapter 1, section 1.4.

3.1. Research Methodology

This study employed a cross-sectional descriptive study involving a qualitative analysis approach. The data collection process is described in two main stages. Each stage describes the methods used to achieve each of the objectives stated in Section 1.4 of Chapter 1, refer to Figure 3.1.

The first stage utilized a case study approach. The research aim influenced the selection of the study design, with the objective being to examine the issues of introducing of the concept of compact cities in the Kingdom of Bahrain. The case studies selected are used to infer the requirements and factors needed to implement the compact city concept in the Kingdom of Bahrain. To determine the challenges, the factors and requirements relating to compact cities must be analyzed. The selection of case studies is based on two criteria that could provide sufficient information for this research:

A. The first criterion is that the country should have a ranking of environmental performance.
B. The second criterion is that the country should have existing environmental policies and strategies.

According to the rankings provided by EPI (2022), the UK, Denmark, Finland, Malta, and Sweden make up the top five countries with the highest level of sustainable development practices. Meanwhile, Austria, Luxembourg, Slovenia, Switzerland, the Netherlands, and Iceland, belong to the top 15 spot (EPI, 2022). In this study, case studies are collected from three cities: Gothenburg in Sweden, Copenhagen in Denmark, and Utrecht in the Netherlands.

In the second stage of data collection, in depth semi-structured interviews are conducted. The use of semi-structured interviews allows for an in-depth discussion with experts in the field of urban planning regarding the challenges of implementing the compact city concept. The purpose of the interviews, which consisted of questions derived from the results of the case study analysis as shown in Figure 3.2, is to gather the perspectives and opinions of experts on the potential and constraints of successfully implementing the concept of compact cities in the Kingdom of Bahrain. The interviews involved experts from both the public and private sectors, including specialists in various fields related to the built environment such as developers, planners, and architects.

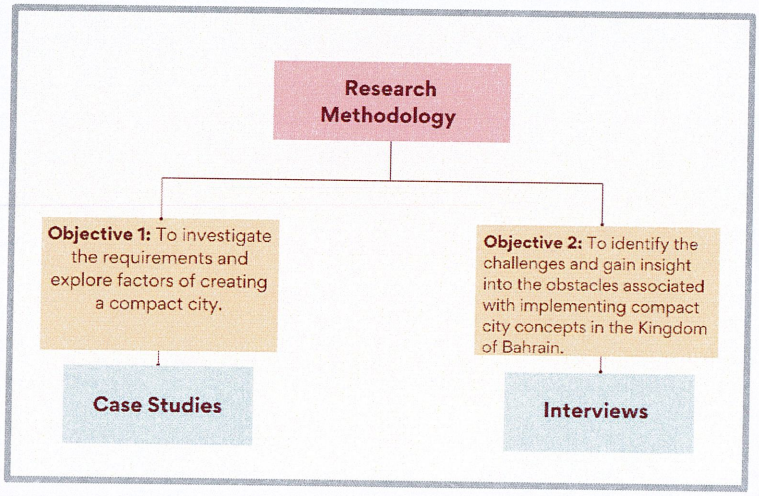


Fig.3.1: The methodology approach

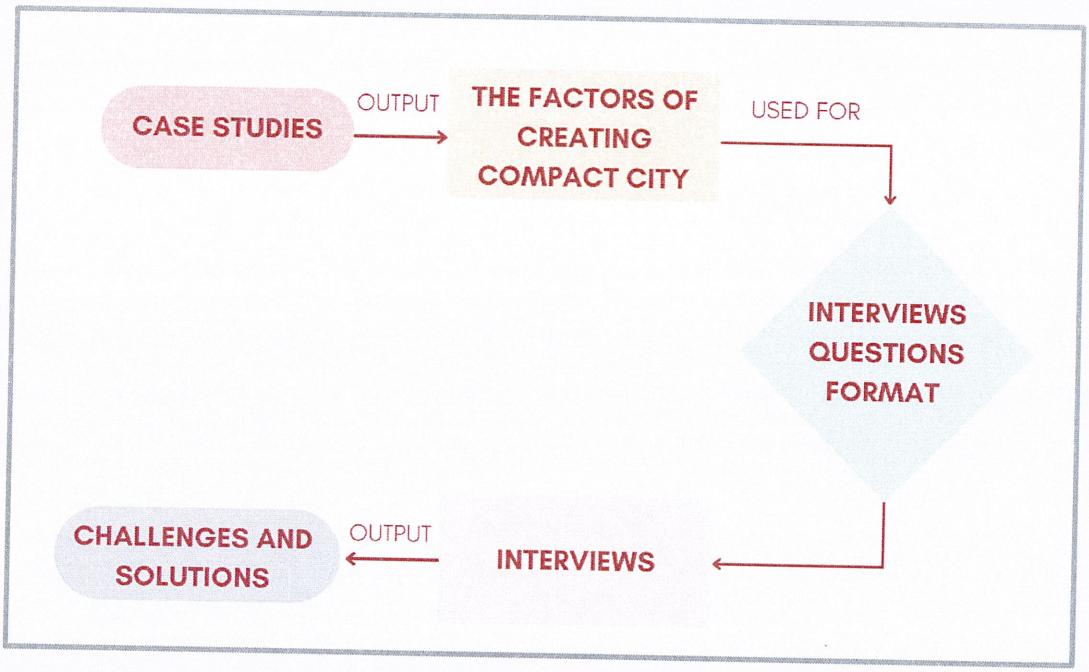


Fig.3.2: The methodology process

3.2. Research Tools

This research aims to elucidate and explore the conditions required for a successful implementation of the compact city concept in the Kingdom of Bahrain. To understand these factors and requirements, exploratory case studies are conducted. An exploratory case study is employed because it provides researchers with the opportunity to gain a comprehensive understanding of a subject matter (Yin, 2003) or a particular situation or setting (Sulaiman, 2017) by utilizing several ways to collect data and conduct investigations.

For example, to extract qualitative data, a series of searches can be conducted on various online databases to identify multiple sources of evidence. This is to gain access to primary sources that constitute archival records and documents, including plans, policies, visions, strategies, and

principles, produced by both public and private organizations. Furthermore, this approach to searching helped to locate documentary secondary sources, including reports, articles in periodicals, and research project deliverables that had been published by groups and academics with no direct involvement in compact city schemes. This Study utilized this strategy to gather the data to study the compact city concept of the three selected cities: Gothenburg in Sweden, Copenhagen in Denmark, and Utrecht in the Netherlands. The data is then analyzed using NVivo software 20.6.1.1137, which is one of the preferred software resources for analyzing qualitative data.

This research also utilized interviews. This approach is selected as the study relies on the findings of qualitative social research. The use of semi-structured interviews is common in social research and is advantageous in this study. This is because "open-ended questions in semi-structured interviews offer a formal structure and set a specific direction", but also allow both interviewees and interviewers to elaborate on issues by allowing for the incorporation of follow-up discussions (Gill, 2008). As a result, semi-structured interviews allow interviewers and researchers "to gain an in-depth understanding of the 'how', 'what', and 'why' regarding a particular issue" (Adams, 2015).

In this study, an in-depth semi-structured interview approach employed to comprehend the issues involved in the implementation of the concept of compact cities in the Kingdom of Bahrain. A face-to-face interview method was utilized in this study in order to facilitate direct physical communication between the interviewer and the interviewee. The interviews are recorded using a digital audio recorder. Handwritten notes are also taken to prevent the loss of critical data in the event of potential technical failures on the part of the digital audio recorder. The transcripts

are then transcribed to text using Microsoft Word. Finally, the data are analyzed using NVivo 20.6.1.1137. The results of the analysis are used to define the challenges associated with implementing the compact city concept in the Kingdom of Bahrain.

3.3. Data Collection/Procedures

The two stages of data collection are aligned with the two main objectives of this study as follows:

3.3.1 To Investigate the Requirements and Explore Factors of Creating a Compact City:

Three European cities are studied. The first is the city of Gothenburg in Sweden. The Swedish government occupies a top spot on the list of the most progressive economies globally in terms of "eco-cities" and sustainable compact cities. Sweden's city was considered an ideal case study, given the nation's position internationally in terms of urban sustainability. This was coupled with Gothenburg's ambitions and successes in compact urbanism, particularly its planning and development strategies. In addition, Gothenburg passed several recent initiatives related to smart sustainability programs for the city (Bibri et al., 2020b).

The second is Copenhagen in Denmark. This decision is prompted by the recent announcement from ECA International (ECA), a global mobility expert, that Copenhagen has won the joint top spot "as the most liveable city in the world" (ECA, 2022). Copenhagen has been leading sustainable development through its efforts to provide a model for mitigating human impact on the environment through innovative technologies and policies (Samuels & Karasapan, 2014). In addition, Copenhagen's goal is to

demonstrate to the world that progress can be achieved by reducing carbon dioxide emissions while at the same time improving living standards (Karimi & Zandieh, 2016).

The third is the city of Utrecht in the Netherlands. Utrecht is the most sustainable city in the Netherlands and in the world (Solanki, 2018). The city is currently ranked second in the world for its bike-friendliness, and it continues to invest in its extensive cycling infrastructure in order to maintain a healthy and sustainable form of mobility (Colofon, 2014).

The data gathered from the three case studies are analyzed in three stages:

A. The first stage involved extracting the compact city factors based on the policies and strategies of the countries.

B. In the second stage, the principles according to the study conducted by Bibri et al. (2020). These principles comprise density, compactness, transportation, mixed-land use, green structures, and intensification. The objective of this analysis is to define the requirements necessary to implement a successful compact city.

C. The third stage is devoted to finding the factors affecting the creation of a compact city. This is necessary because there are several factors that affect the formation of compact cities, such as climate (Pattacini, 2012), culture (Raiygani & Islami, 2018), and safety (Helbich et al., 2019). As the Kingdom of Bahrain has an arid climate, the urban heat island "is one of the most important factors" to consider in the country's city planning due to climate change and the potential increases in temperatures globally (Pattacini, 2012). The culture, in terms of the local mindset, also affects the use of public transportation. In Bahrain, residents use their private cars for many reasons, with tradition and culture being one

of them. Furthermore, safety is one of the factors affecting the shaping of a city. For example, providing safe walking lanes can encourage residents to walk. Thus, it is necessary to determine the challenges faced by the three cities. The findings from this stage are used to formulate the interview questions for the next stage, see Figure 3.3.

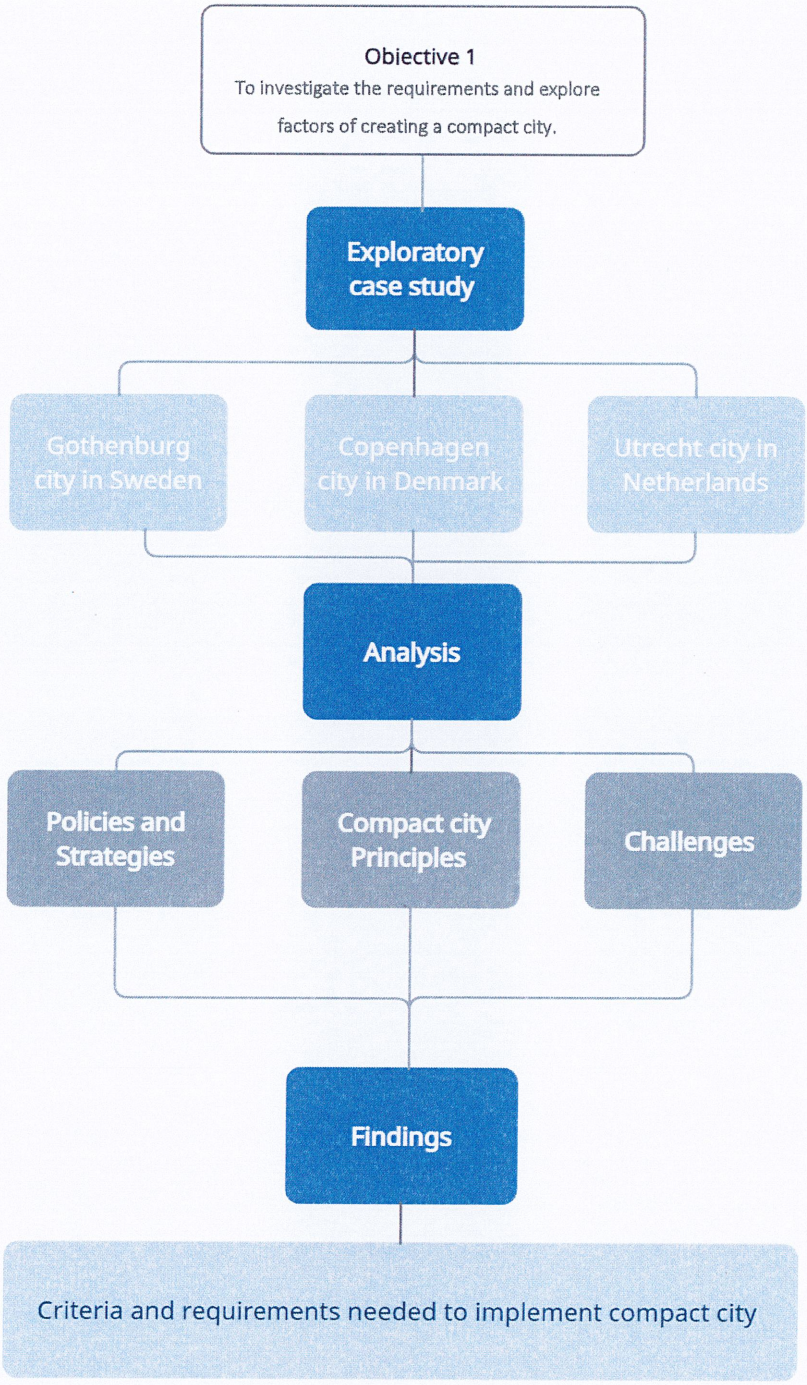


Fig.3. 4: Data collection of objective 1

3.3.2 To Identify the Challenges and Gain Insight into the Obstacles Associated with Implementing Compact City Concepts in the Kingdom of Bahrain:

In the second stage of data analysis, in-depth interviews with a sample of twenty interviewees to gather and understand the largest number of challenges and obstacles around the implementation of compact city concept in the Kingdom of Bahrain. These interviews serve as an additional form of primary data. The sample comprised two groups: academics and professionals, with the professionals representing the private and government sectors. The selection of interviewees is based on three criteria that could provide sufficient information for this research:

A. Academics should specialize in sustainable urban planning and built environments.
B. Government sector professionals should work in departments that specialize in urban planning, sustainable development, transportation, and land classification.
C. Private sector professionals who have worked on urban planning projects and have a background in sustainable urban planning.

The overview of the findings of the first stage of this research (refer to Appendix A) was presented to the interviewees. This included the factors and requirements needed to implement a compact city. The interview questions were divided into three main sections.

The first section contained questions related to the challenges and obstacles associated with implementing the concept of a compact city in the Kingdom of Bahrain. The questions were as follows:

1- How would you rank the following factors from the most important to the least important?

2- Are any of these factors are applicable to Bahrain?

3- In your perspective, what are the challenges associated with applying the compact city concept in the Kingdom of Bahrain?

4- How will these challenges affect the implementation of the compact city concept in the Kingdom of Bahrain?

5- In your opinion, what are the causes of these challenges?

The second interview section presents the strategies and methods employed to successfully implement the compact cities concept in the Kingdom of Bahrain. The following questions were asked:

6- Despite the challenges discussed in the first part of the interview, do you believe compact city concepts can be implemented in Bahrain? If so, how?

7- To what extent are the urban policies and strategies in Bahrain aligned with those of compact cities?

8- Is it possible to redesign existing cities in Bahrain to become more compact? or do you think only new cities can truly implement compact city strategies?

The proposed solutions and recommendations regarding implementing the concept of a compact city in Bahrain are outlined in the third section of the interview. This question was as follows:

9- In your opinion, what are the solutions for implementing the compact city concept in the Kingdom of Bahrain?

3.4 Interview Questions Validity

A pilot study was conducted with four participants. A sequence error was discovered in the interview questions as stated in 3.3.2 section; when the interviewees answered the fifth question about the causes of the compact city challenges, they pointed out the third question, which refers to the challenges of the compact city in the Kingdom of Bahrain. Therefore, question five is combined with the third question in the final version of the interview. Moreover, question four, which is about the effect of the challenges on the implementation of the compact city concept in the Kingdom of Bahrain, is removed from the final version of the interview due to the difficulty of understanding this question and the redundancy of the answer. The final version of the interview questions is given in Appendix B.

3.5 Limitations of the Research

A number of challenges have been encountered:

A. Many countries in the Middle East have compact cities, but there are obstacles to adopting these as successful models (refer to section 2.7). Therefore, this study only focuses on cities at the global level.
B. There are some differences between the selected cities and those in Bahrain regarding climate and urban design principles.
C. Finding English versions of the reports and legislation for the studied cities is difficult. Thus, many non-English documents have been excluded to avoid mistranslation by the researcher.
D. 4. Due to time constraints. It was not possible to interview as many of the target academics as was originally hoped.

Chapter Four

Results

4.1 An Exploratory Case Studies Methodology to Explore Compact City Factors
- 4.1.1 Thematic Analysis
- 4.1.2 Gothenburg City Case Study
- 4.1.3 Copenhagen City Case Study
- 4.1.4 Utrecht City Case Study
- 4.1.5 Findings Summary

4.2 In-Depth Interviews Methodology to Identify Compact City Challenges
- 4.2.1 Thematic Analysis
- 4.2.2 The Challenges and Obstacles Associated with Implementing the Concept of a Compact City in the Kingdom of Bahrain
- 4.2.3 Implementation of Compact City in the Kingdom of Bahrain
- 4.2.4 The Proposed Solutions and Recommendations with Regard to Applying the Concept of the Compact City in the Kingdom of Bahrain.
- 4.2.5 Findings Summary

In this chapter, the researcher presents the outcomes after implementing the methodology outlined in chapter 3. The chapter comprises two broad sections. The chapter is divided into two main sections. The first presents the results of the two stages of the research as shown in Figure 4.1, while the second presents a discussion of the results.

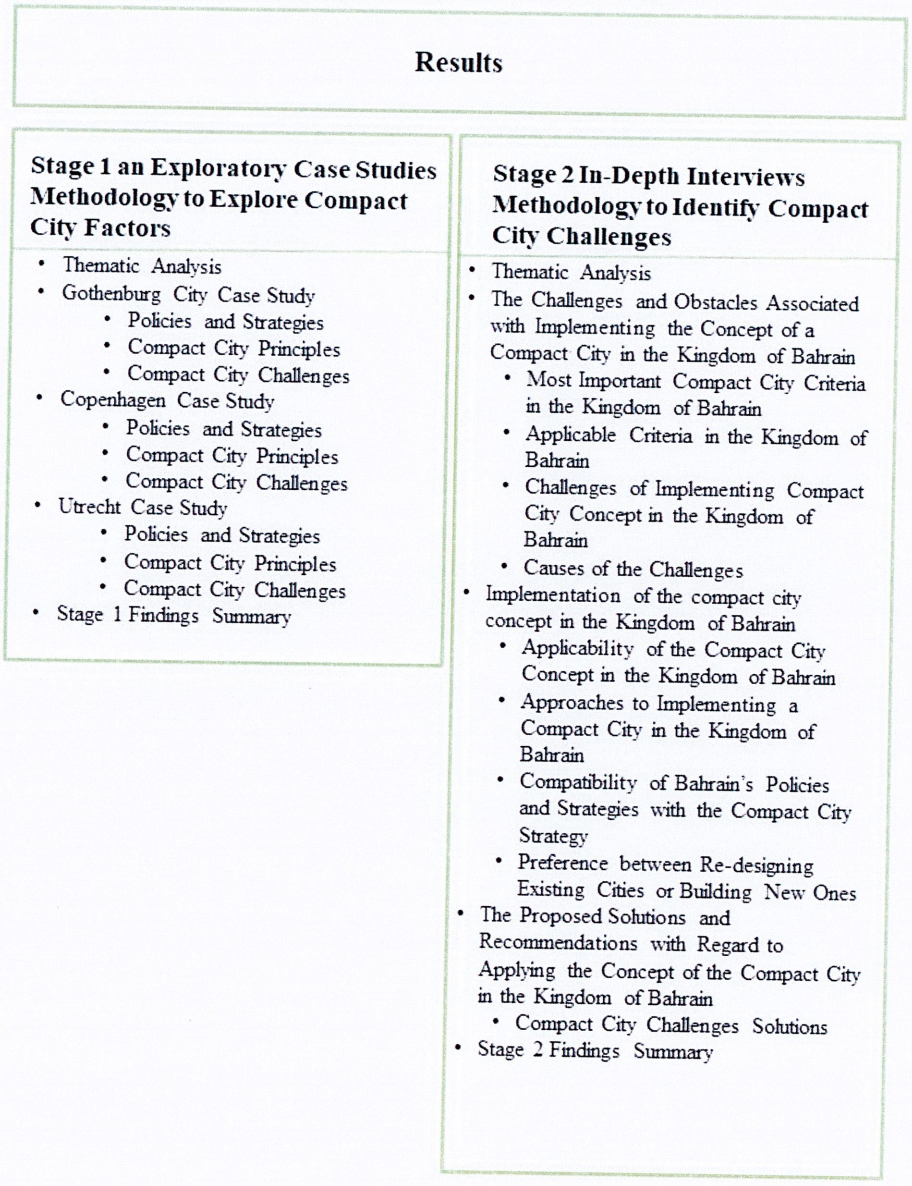


Fig.4.1: Chapter 4 Framework

4.1 Stage 1 an Exploratory Case Studies Methodology to Explore Compact City Factors

Data in this stage are collected based on the following selection criteria:

A. The availability of data (open access online).
B. Published by an official source, such as reports issued by accredited institutions and official authorities' websites.
C. Published within the last ten years.
D. Relevant to objective 1 of the study.
E. Availability of an English-language version to prevent incorrect translations.

The collected data are then filtered. To achieve the first objective, it is necessary to analyze the policies and strategies of compact cities, compact city principles, and the challenges faced by the selected cities.

4.1.1 Thematic Analysis

After data collection, the data are analyzed using Nvivo. Based on the data analysis, ten categories were identified as the most relevant to the establishment of compact cities worldwide:

A. Mixed Land Use,
B. Transportation,
C. Density,
D. Green Spaces and Structures (refer to Chapter 2, section 2.3.1),
E. Social Cooperation (Alkhani, 2020),
F. Social Integration,
G. Social Vulnerability (Cereda, 2009),

H. Infrastructure (Cullbreg Et Al., 2014),

I. Climate Change (Samuels & Karasapan, 2014), And

J. Budgets (Cereda, 2009).

The data analysis is based on the number of repetitions of the coding references to determine the most weighted category for each selected city.

Table 4.1 shows the document references, data classification, publishers, and publication dates.

The data for Gothenburg were obtained from four key documentary sources: "Urban Challenges: Policy and Action in Gothenburg" (Cullbreg et al., 2014), "Transport strategy for a close-knit city"(Boberg et al., 2014), "Innovation and development for the smart traffic of the future in Gothenburg," and "Compact city planning and development: Emerging practices and strategies for achieving the goals of sustainability" (Bibri et al., 2020c).

For Copenhagen, the collected data come from seven main documents: "Compact City Policies in England, Denmark, the Netherlands and Norway"(Hanssen & Hofstad, 2013), "A Strategy for the Development of the Greater Copenhagen Area: The Finger Plan", "Urbanisation, urban growth and planning in the Copenhagen Metropolitan Region with reference studies from Europe and the USA"(Fertner, 2012), "Copenhagen European green capital 2014"(Bach, 2014), "The Danish environmental protection agency", "World city with responsibility", and "Copenhagen: a Case Study of one of the Most Sustainable Cities in the World"(Samuels & Karasapan, 2014).

For Utrecht, the data come from five main sources: "City of Utrecht: growing with green ambitions" (Schenkels & Hendriks, n.d), "The Happy City. For a state of happiness" (Bergink, 2014), "Our vision for Utrecht in

2040", "The Compact City: Planning Strategies, Recent Developments and Future Prospects in the Netherlands" (Nabielek, 2012), and "Compact City Policies in England, Denmark, the Netherlands and Norway" (Hanssen & Hofstad, 2013).

Table (4.1): Data Collection Documents

	Document	Data Classification	Publisher	Date
	Gothenburg City			
1	(Cullbreg et al., 2014)	Policies	MISTRA Urban Features	2014
2	(Boberg et al., 2014)	Strategies	Urban Transport Committee	2014
3	("Innovation and development for the smart traffic of the future in Gothenburg", 2021	Strategies	Gothenburg stud	2021
4	(Bibri et al., 2020c)	Principles	Developments in the Built Environment	2020
	Copenhagen City			
1	(Hanssen & Hofstad, 2013)	Policies	Norwegian Institute for Urban and Regional Research	2013
2	("A Strategy for the Development of the Greater Copenhagen Area: The Finger Plan", 2015)	Strategies	The Danish Nature Agency	2015

3	(Fertner, 2012)	Challenges	Forest and landscape	2012
4	(Bach, 2014)	Challenges/Policies	European green capital: an initiative of the European Commission	2014
5	(The Danish environmental protection agency, 2020)	Policies	The Danish Ministry of the Environment	2020
6	(World city with responsibility, 2019)	Policies	Copenhagen's Municipal Plan 2019	2019
7	(Samuels & Karasapan, 2014)	Strategies	Colby College	2014
	Utrecht City			
1	(Schenkels & Hendriks, 2018)	Principles/ Challenges	EU Repository of Nature-Based Solutions	2018
2	(Bergink, 2014)	Principles/ Challenges	For a State of Happiness	2014
3	(Our vision for Utrecht in 2040, 2021)	Strategies	Gemeente Utrecht	2021
4	(Nabielek, 2012)	Policies/ Challenges	Netherlands Environmental Assessment Agency	2012
5	(Hanssen & Hofstad, 2013)	Policies	(NIBRA) Norwegian Institute for Urban and Regional Research	2013

Table 4.2 shows the number of repetitions of the coding references for each category in each document.

Table (4.2): Number of coding reference repetitions in each document is used to extract the compact city factors.

Gothenburg City									
Mixed land use	Transportation	Density	Green spaces and structures	Infrastructure	Social cooperation	Social vulnerability	Climate change	Social integration	Budget
Document 1									
3	4	2	1	3		2	2		
Document 2									
5	6	3			1	1		1	1
Document 3									
5	5	4			1			2	1
Document 4									
7	13	8	3						
Copenhagen City									
Mixed land use	Transportation	Density	Green spaces and structures	Infrastructure	Social cooperation	Social vulnerability	Climate change	Social integration	Budget
Document 1									
4	2	1	1						
Document 2									
5	9	1	9						
Document 3									
1	3	1	2		1				
Document 4									
		1	2						
Document 5									
	6								
Document 6									
	3								
Document 7									

	4		6				7		
Utrecht city									
Mixed land use	Transportation	Density	Green spaces and structures	Infrastructure	Social cooperation	Social vulnerability	Climate change	Social integration	Budget
Document 1									
	1	3	7				2		
Document 2									
1	1	1						2	
Document 3									
4	2		4				1	1	
Document 4									
		1	1	1					
Document 5									
1	2	1	1						
36	61	27	37	4	3	3	12	6	1

4.1.2 Gothenburg City Case Study

A. Policies and Strategies

Based on the data collected, the number of repetitions emerged in the documents in relation to compact city factors categories are mixed land use, density, transportation, green spaces and structures, infrastructure, social cooperation, climate change, and social integration.

Table (4.3): Gothenburg City - Policies and Strategies

Gothenburg City			
Policies and Strategies			
Transportation	**Density**	**Green Spaces and Structures**	**Mixed Land Use**
12	**6**	**1**	**12**
Infrastructue	**Climate Change**	**Social Cooperation**	**Social Integration**
2	**1**	**2**	**3**

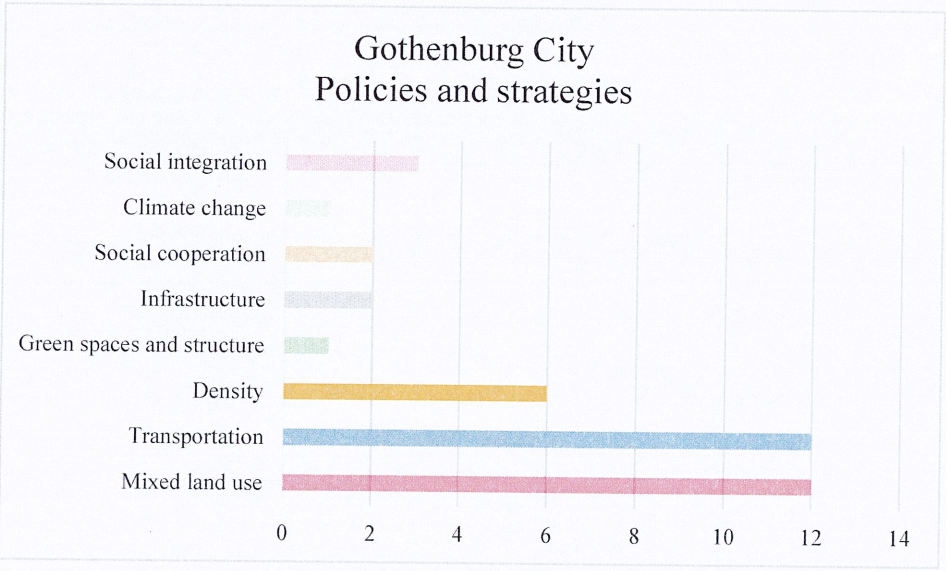


Fig.4.2: Gothenburg City Policies and Strategies

As shown in Table 4.3, the mixed land use factor and transportation factor are the most prominent in Gothenburg City's policies and strategies, despite its statement referring to the importance of social integration and avoiding social segregation, as shown in graph below Figure 4.2.

B. **Compact City Principles**

A lot of the interventions in the city of Gothenburg of the factors are related to transportation. This indicates the extent to which transportation considerations are applied, as shown below in Table 4.4 and Figure 4.3.

Table (4.4): Gothenburg City - Compact City Principles

Compact City Principles			
Transportation	**Density**	**Green Spaces and Structures**	**Mixed Land Use**
22	**9**	**3**	**7**

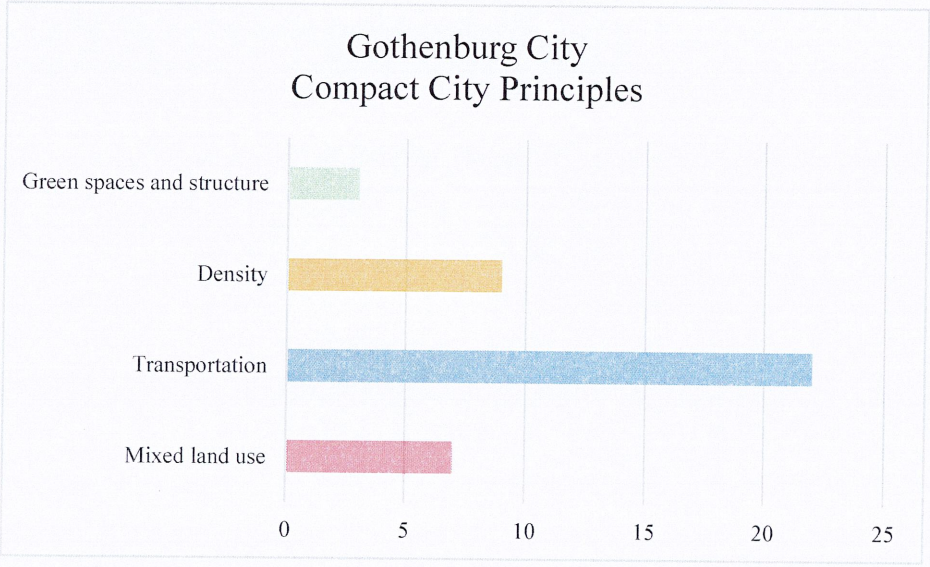


Fig.4.3: Gothenburg Compact City Principles

C. Compact City Challenges

The factors related to the compact city challenges in Gothenburg are under mixed land use, transportation, density, infrastructure, social vulnerability, climate change, and budgets categories, as shown in Table 4.5.

Table (4.5): Gothenburg City - Compact City Challenges

Gothenburg City			
Compact City Challenges			
Transportation	Density	Social Vulnerability	Mixed Land Use
2	1	3	1
Infrastructue	Climate Change	Budget	
1	1	1	

The major compact city challenges in Gothenburg are under the social vulnerability category, refer to Figure 4.4, which shows the significance of social integration, as mentioned in the policies and strategies of the city of Gothenburg.

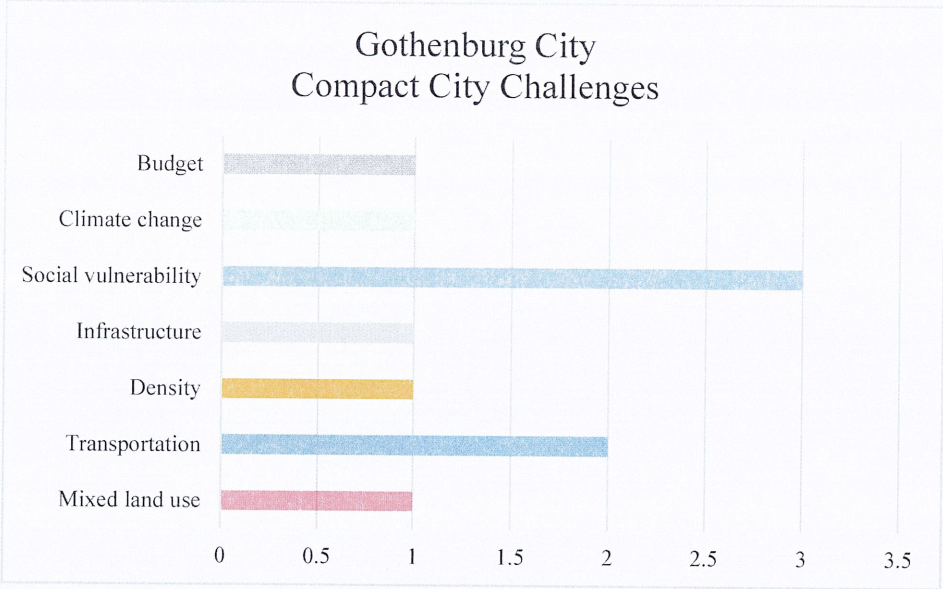


Fig.4.4: Gothenburg Compact City Challenges

4.1.3 Copenhagen City Case Study

A. Policies and Strategies

For Copenhagen, Table 4.6 shows the policies and strategies are dominated by keywords relating to transportation, followed by green spaces and structures. This explains the high frequency of climate change keywords in the policies and strategies documents, compared with the other case studies, see Figure 4.5.

Table (4.6): Copenhagen City - Policies and strategies

Copenhagen City			
Policies and Strategies			
Transportation	**Density**	**Green spaces and structures**	**Mixed Land Use**
21	**3**	**18**	**10**
Social Cooperation	**Climate Change**		
1	**6**		

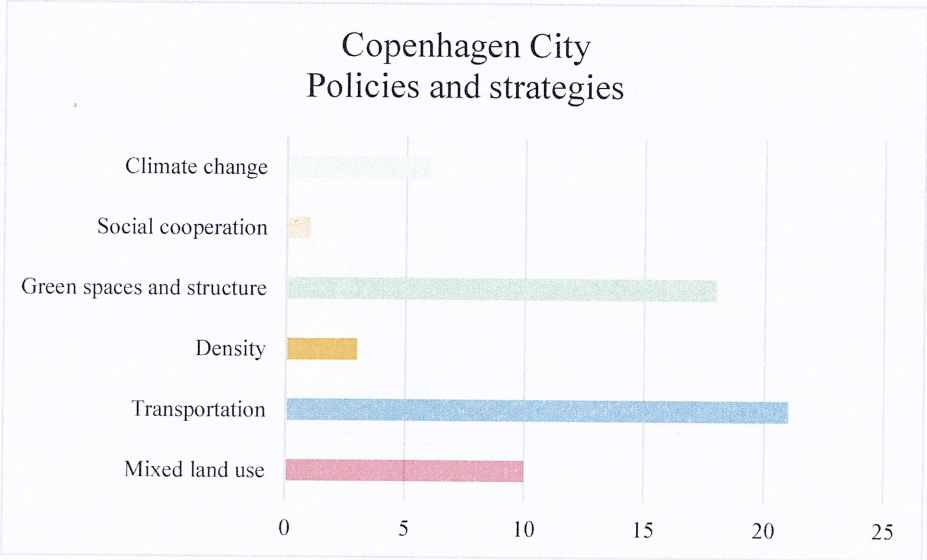


Fig.4.5: Copenhagen Policies and Strategies

B. Compact City Principles

Many of the factors are related to transportation. However, those related to mixed land use and green spaces and structures are in a similar range, see Table 4.7 and Figure 4.6.

Table (4.7): Copenhagen City - Compact City Principles

Copenhagen City			
Compact City Challenges			
Transportation	Density	Green spaces and structures	Mixed Land Use
7	2	5	5

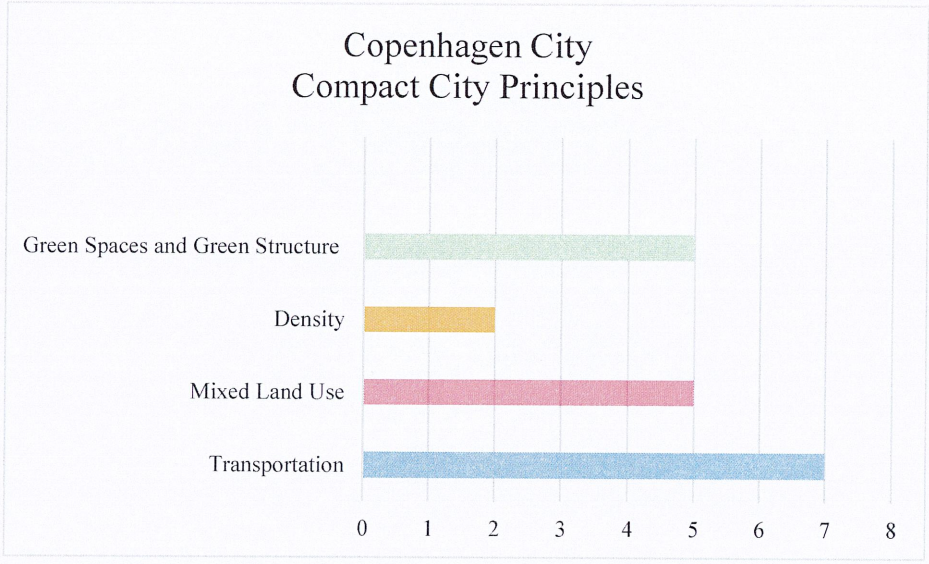


Fig.4.6: Copenhagen Compact City Principles

C. Compact City Challenges

The most significant challenges in Copenhagen that relate to compact cities are transportation, climate change, and density (see Table 4.8). The

transportation system in Copenhagen is one of the city's most critical challenges, as shown in Figure 4.7.

Table (4.8): Copenhagen City - Compact City Challenges

Copenhagen City		
Compact City Principles		
Transportation	**Density**	**Climate Change**
2	**1**	**1**

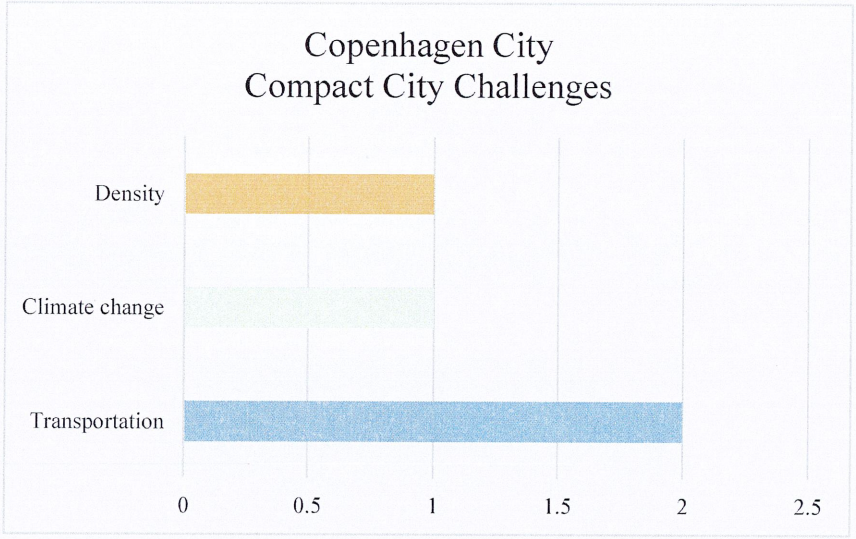


Fig.4.7: Copenhagen Compact City Challenges

4.1.4 Utrecht City Case Study

A. Policies and Strategies

The following keywords consistently appear in Utrecht's policies and strategies: mixed land use, transportation, density, green spaces and

structures, infrastructure, social cooperation, climate change, and social integration, see Table 4.9.

Table (4.9): Utrecht City - Policies and strategies

Utrecht City			
Policies and Strategies			
Transportation	**Density**	**Green spaces and structures**	**Mixed Land Use**
6	**1**	**10**	**4**
Infrastructure	**Social Cooperation**	**Climate Change**	**Social Integration**
1	**1**	**2**	**2**

The majority of the factors are related to green spaces and structures because Utrecht designs spaces for human interaction in a way that focuses on both social integration and social collaboration within the city, see Figure 4.8.

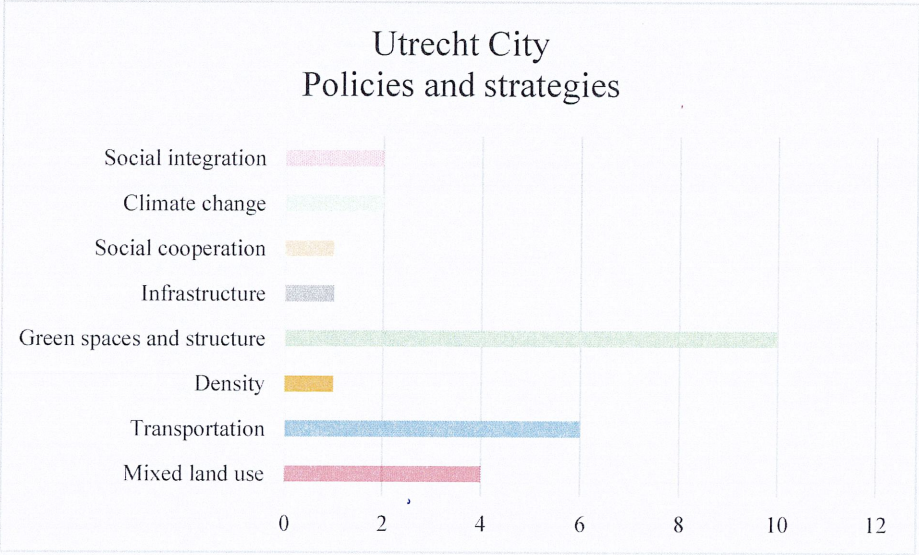


Fig.4.8: Utrecht Policies and Strategies

B. Compact City Principles

A number of compact city factors appear in the compact city principles documents: mixed land use, transportation, density, and green spaces and structures, see Table 4.10.

Table (4.10): Utrecht City - Compact City Principles

Utrecht City			
Compact City Principles			
Transportation	Density	Green spaces and structures	Mixed Land Use
2	3	1	2

On the basis of the data collected, the results indicate that the majority of Utrecht's compact city factors fall under the density category, while the fewest fall under the green space and structures category as shown in Figure 4.9.

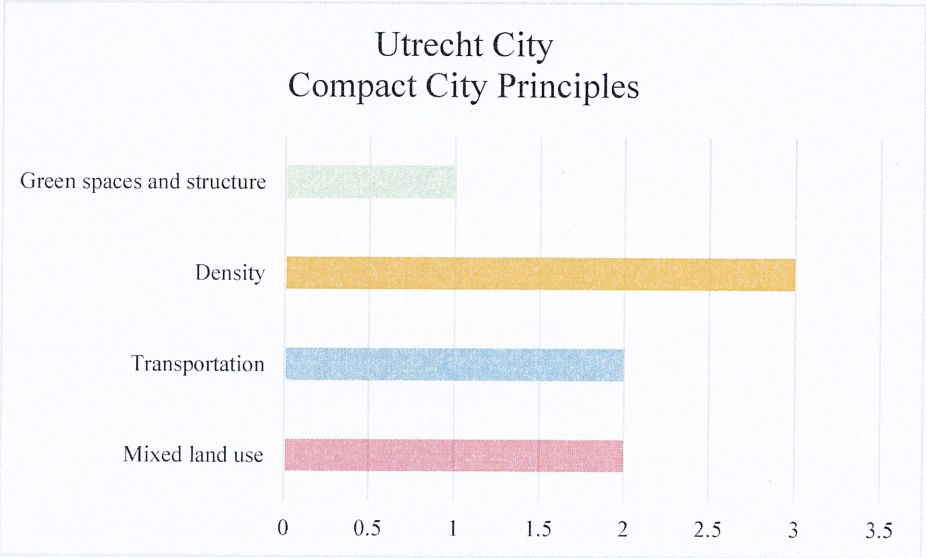


Fig.4.9: Utrecht Compact City Principles

C. Compact City Challenges

Among the challenges associated with compact cities in Utrecht are the following: transportation, density, green spaces and structures, as well as climate change, see Table 4.11.

Table (4.11): Utrecht City - Compact City Challenges

Utrecht City			
Compact City Challenges			
Transportation	Density	Green spaces and structures	Climate Change
2	1	2	1

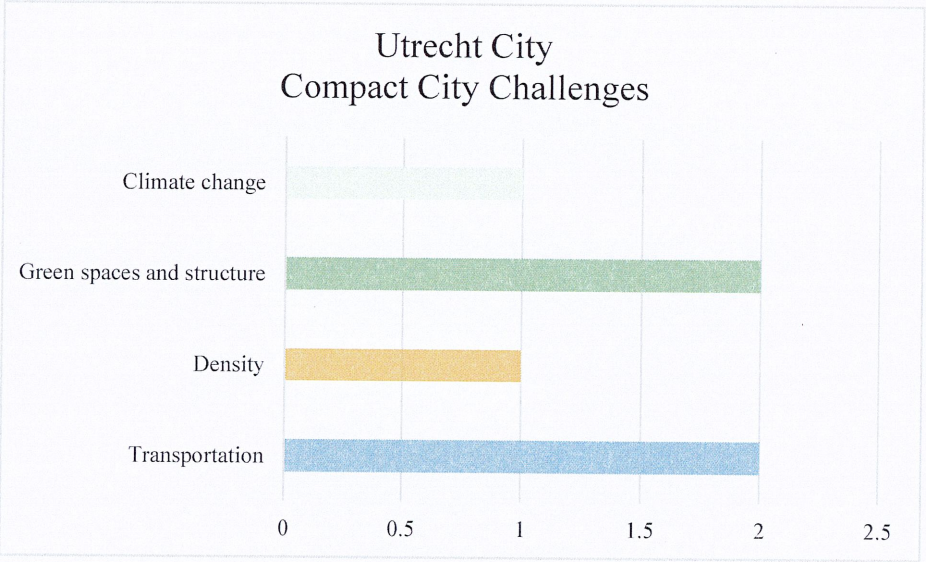


Fig.4.10: Utrecht Compact City Challenges

Most of the challenges are related to green spaces and transportation, whereas climate change and density are in the same range, refer to Figure 4.10.

4.1.5 Stage 1 Findings Summary

To sum up, based on previously examined data, the most frequently used factors are related to transportation, followed by green spaces and structures, mixed land use, density, climate change, social integration, infrastructure, social cooperation, social vulnerability, and budgets, as shown in Figure 4.11 below.

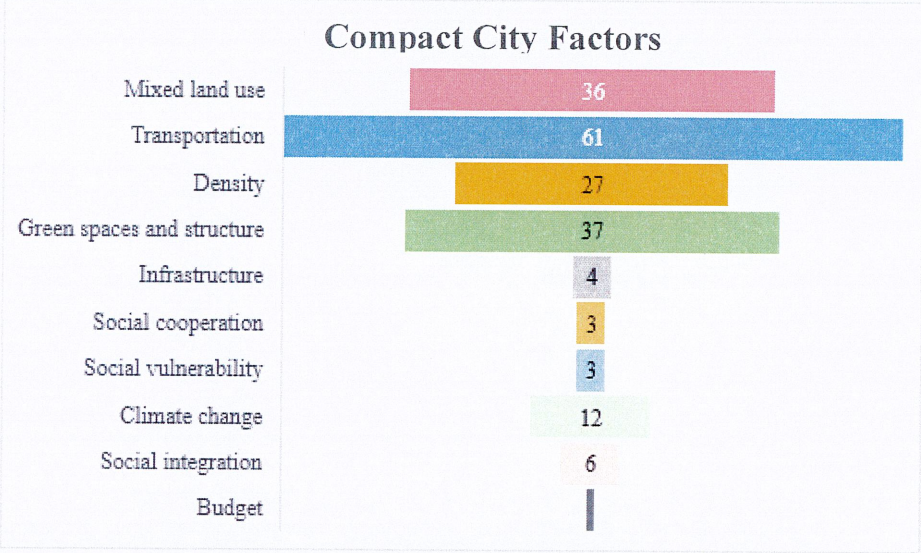


Fig.4.11: Compact City Categories

Based on the analysis of all the collected data using NVivo, the compact city factors of the three studied cities are divided based on the most repeated category in these cities, The categories are, Figure 4.12:

A. Transportation
B. Mixed land use
C. Density
D. Green spaces and structure
E. Climate change
F. Social cooperation.

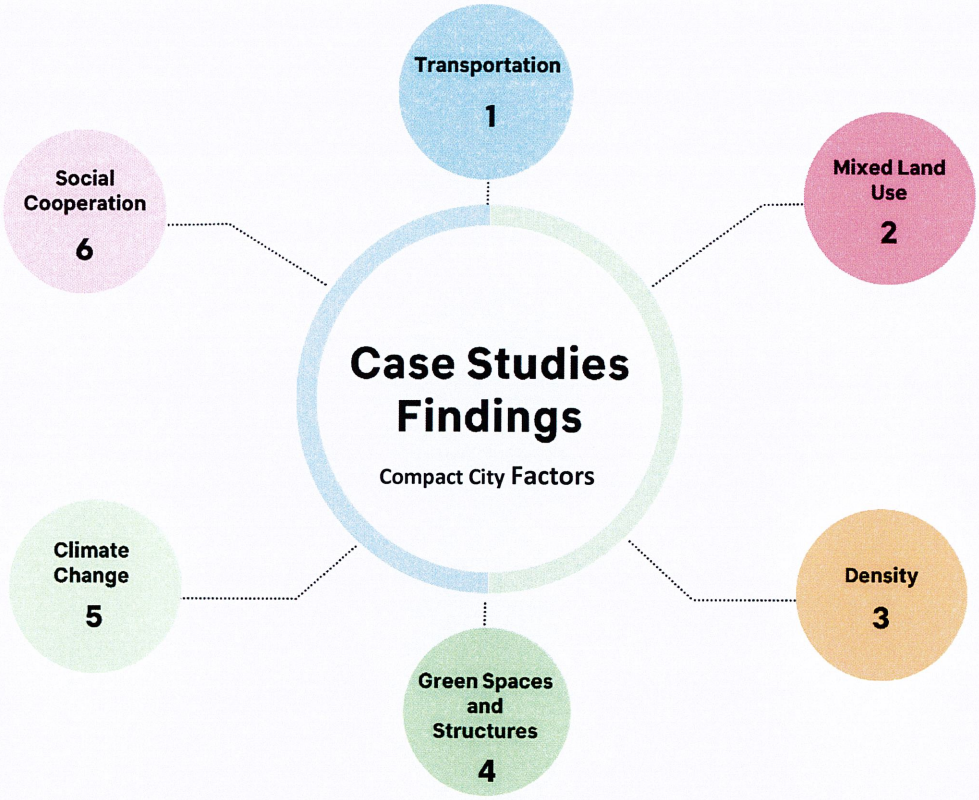


Fig.4.12: Most Repeated Compact City Categories

The factors under these categories are used in the second stage of the methodology (the interview phase) to determine the most important factor in the Kingdom of Bahrain. Then, all similar factors are removed to facilitate the interviewee's ability to read the compact city factors and rank the main categories. The final list of the compact city factors extracted from the relevant case studies is presented in Appendix A.

4.2 Stage 2 In-Depth Interviews Methodology to Identify Compact City Challenges

The data are collected through in-depth interviews with nine participants from the public sector in different fields of work, three participants from the private sector, and three from the academic sector in different universities. The target was to conduct interviews with seven more academics and two more from the private sector, but due to time constraints and reaching the saturation point (reaching similar answers), the interview stopped with fifteen participants. The 15 interviews are conducted between December 11th, 2022, and January 4th, 2023, 60% of which were face-to-face interviews, while the other 40% were done via online conference calls due to the interviewees' time and their preference.

All participants have received an invitation email with attachments of the interview questions and compact city factors (the result of stage 1 in this study), as shown in Table 4.12. Furthermore, all participants gave their consent to participate in the research and were informed that their data would be anonymized and stored for three years before being destroyed and that no personally identifiable information was collected.

All interviews are recorded by video (for the conference calls) or audio (for the face-to-face interviews). For ease of expression and discussion, the interviews are conducted in a mix of English and local Arabic dialogues for Arab participants. All conducted interviews are transcribed and documented with translations when necessary. For Participant 11 (Private 2), the main interviewee had asked two of his team members to join the interview as a form of validation.

Table (4. 12): Details of the Conducted in Depth Interview

	Interview category	Participant Fields	Interview Time	Interview Date	Interview duration
P1	Public sector 1	Strategic Urban planning	09:00 AM	12/12/2022	20 min
P2	Public sector 2	Strategic Urban Development	09:30 AM	12/12/2022	55min
P3	Public sector 3	Urban policies	10:00 AM	15/12/2022	48 min
P4	Public sector 4	Road Transportation Policies	01:00 AM	21/12/2022	1 hr 15 min
P5	Public sector 5	Policy and strategic planning	12:00 PM	02/01/2023	25min
P6	Public sector 6	Urban Planner	12:30 PM	02/01/2023	25min
P7	Public sector 7	National plans	11:00 AM	03/01/2023	30min
P8	Public sector 8	Land classification	11:35 AM	03/01/2023	15min
P9	Public sector 9	Strategic Urban projects Management	08:00 AM	03/01/2023	30min
P10	Private sector 1	Public Limited Liability Company	12:00 PM	11/12/2022	25min
P11	Private sector 2	Consultant Company	03:00 PM	21/12/2022	33min
P12	Private sector 3	Consultant Company	03:30 PM	02/01/2023	30min
P13	Academic 1	Urban Planning	10:00 AM	11/12/2022	35min
P 14	Academic 2	Urban Planning	04:00 PM	14/12/2022	50min
P15	Academic 3	Built Environment	07:00 PM	04/01/2023	25min

4.2.1 Thematic Analysis

The data collected from the 15 interviews answer a group of questions that tackle the three aspects of compact city challenges outlined in Chapter 3, section 3.3.2: the challenges and obstacles associated with implementing the concept of a compact city in the Kingdom of Bahrain; exploring how to successfully implement the compact city concept in the Kingdom of Bahrain; and the proposed solutions and recommendations with regard to applying the concept of the compact city in the Kingdom of Bahrain. The transcripts of those in-depth interviews are analysed and coded through Nvivo, based on the participants' responses. Those codes are then grouped into categories, generating the general themes of compact city factors, challenges, implementation, and solutions, refer to Table 4.13. To facilitate a better understanding of the interview data and for ease of presentation, the data are grouped and presented according to the themes. Each theme is categorized and coded based on the responses of the participants.

Table (4. 13): In-depth Interviews Coding

Themes	Categories	Codes
Compact City Factors	Compact city Factors in Bahrain	Mixed land use / Transportation / Density/ Green spaces and structures/ Social cooperation / Climate change
	Applicable Factors in Bahrain	Mixed land use / Transportation / Density/ Green spaces and structures/ Social cooperation / Climate change
Compact City Challenges	Challenges in Bahrain	Bahrain zones/ Budget/ Building regulations/ climate/ culture/ lower percentage live in apartments/ People reluctance to use public buses/ high price of land in city centre/ Infrastructure/ investments/ Lack of available vacant lands./ lack of mixed land use/ lack of open spaces/ lack of public transportation/ lack of transportation connection/ road design/ Weak roads guidelines/ wide roads/ lack of services in new city/ lack of walking and cycling/ Private cars/ Reclamation and urban sprawl/ Social integration/ social needs

	Causes	availability of car parks/ Climate/ Culture/ Faster change in urbanization/High cars ownership/high cost of infrastructure/ high cost of the development of transportation/ high density effect on green spaces/ high density reduces social vulnerability/Inconsistency of the bus's arrival time/ Lack of available lands/ Lack of foot paths/ lack of public awareness/ Lack of utility connectivity/ land classification/ social issues/ Time consuming in public buses/ urban design
Implementation	Possibility of the implementation	Yes/ No
	How to Implement	availability of city parameters/ open spaces/ planning guidelines
		services/ balance development/ combined different concepts/ encourage investment/ increase open spaces/ integrated as new standalone city/ legislation of policies and regulations/ Limiting car parks/ network connections/ provide services/ provide smart solutions/ public participation/ renewable energy/ respect traditions and culture/ social integration/ stakeholders cooperation/ study the concept/ administrative study/ Applied on the right basis/ economic study/ investment study/ safety and security study/ use urban renewal strategy
	Policies and Strategies	Aligned/ Moderate/ Not aligned
	Built or Re-design	Re-design/ New city/ Both
Solutions	Challenges solutions	accessibility to public transport/ affordable housing units/ balance density/ control land value and regulations/density connected to transportation/develop green spaces/develop public transport/ Autonmus shuttles/hi-tech public transportation/metro/scoters/shuttle taxi/developing building regulations /development of pedestrian lanes/ environmental design and construction/ focus on infrastructure/investment/invitation/ land classification/ Legislated the strategies/ limiting car parking/ more public transportation companies/ Policies and regulations in line with energy consuming/ proper design of public transportation network/ air conditioned terminals/connected pedestrians lanes/ customize buses path/ pedestrian bridge/ provide comfort/seating area/ services in terminals/ shaded paths/ Proper scale planning/ provide financial resources/ provide more mixed land use/public awareness/ encourage

		usage of public transportation/ encourage walking and cycling/ Public participation/ public realm/ Rezoning/ separate lanes/ services facilities/ shaded open spaces/ sources renewable energy/ stockholders Partnership/ study the concept/ Sustainable developments

4.2.2 The Challenges and Obstacles Associated with Implementing the Concept of a Compact City in the Kingdom of Bahrain

4.2.2.1 Most Important Compact City Factors in the Kingdom of Bahrain

Based on the perspective of the 15 interviewees, the most important factors in the Kingdom of Bahrain are: density, mixed land use and transportation in the same numbers of respondents. While the least important factors are climate change and social cooperation, Figure 4.13.



Fig.4.13: Professionals Perspectives of the Most Important Compact City Factors in the Kingdom of Bahrain

4.2.2.2 Applicable Factors in the Kingdom of Bahrain

From the perspective of the interviewees, most participants believe that the green spaces and structures factor and mixed land use factor are the most applicable in the Kingdom of Bahrain. These are followed by the transportation factor, density, and climate change. In contrast, some participants believe all the compact city factors are applicable in the Kingdom of Bahrain.

4.2.2.3 Challenges of Implementing Compact City Concept in the Kingdom of Bahrain

A. Culture

Among the challenges of implementing compact cities in Bahrain, most of the respondents are related to the culture of Bahraini society, as the participants (P2, P5, P9, and P15) believe that residents in Bahrain prefer to live in villas rather than apartments, meaning that urban expansion is horizontal rather than vertical. According to the participants point of view, since vertical growth is one of the pillars of compact cities, people's tendency to expand horizontally and live in villas would be considered one of the most significant challenges.

In Bahrain, according to Participant P11, people prefer to live near their families rather than work.

Participants P1, P2, P6, P12, P13, P14 and P15 also explained the reluctance of people to use public transportation based on the culture of Bahraini society and since Bahrain has only one means of public transport, which is public buses. Bahraini citizens prefer to avoid taking these buses because of several factors, including the hot weather, bus time schedules, and the length of time it takes to reach the needed area. The congestion and the time wasted moving between buses are additional reasons. Participants P7, P12 and P13 also stated that public buses in Bahrain are used only by expat workers and only a few residents.

B. Lack of Public Transportation

Participants believe that more public transportation in Bahrain needs to be introduced. Therefore, this is one of the challenges that limit the implementation of the compact city concept in Bahrain. In addition,

Participants P2, P3, P6, P7, and P11 showed that a poorly connected public transportation network affects public transportation.

Participant 4 (P4) also explained that the design of some streets in Bahrain is not suitable for public transport stations. Therefore, it is difficult for people to access these stations. Also, these stations need to be connected to the pedestrian path, which impedes pedestrian movement and makes people reluctant to use public transportation. Moreover, wide roads and highways lead to the use of more cars due to the weak road guidelines in Bahrain. Additionally, the most used mode of transportation in Bahrain is cars, as P9 explained.

C. Building Regulations and Policies in the Kingdom of Bahrain

Participants also highlighted Bahrain's governmental policies and regulations pose one of the biggest challenges to implementing compact city concepts in Bahrain. According to P14, compact cities tend to expand vertically, while building heights within residential areas are limited.

Participants P1 and P11 suggest that policies and building regulations in Bahrain should be applied more effectively and developed further following the compact city concept. Furthermore, P4 believes that Bahrain's planning guidelines and urban planning policies could be more robust. Moreover, P10 believes mixed land use is limited in some areas due to the land classification regulations.

D. Infrastructure

Participants believe that infrastructure is one of the challenges of implementing the compact city concept in Bahrain. P11 and P8 believe that Bahrain needs more infrastructure and utilities since the compact city tends to increase in density in certain areas. Additionally, as P3 and P14 believe, infrastructure should be more sustainable.

E. Lack of Available Vacant Land in the Kingdom of Bahrain

Participants believe there is a lack of vacant land in Bahrain. P2 explained that there is a shortage of governmental lands in Bahrain and P5 said that due to horizontal expansion, many lands in Bahrain are owned privately.

F. Budget

Most of the Participants cited the budget as a challenge. P14 and P15 explained that financial inputs are required for the criteria for climate change, social cooperation, and green spaces and structures. P1 explained that the compact city project is innovative and requires large funds, so we need to attract investors to invest in the project. As for P11 thinks that the city development projects in Bahrain are mainly by private developers, and these types of projects should be in cooperation with governments. Also, P8, believes that the budget is essential for construction and maintenance.

G. Lack of Walking and Cycling

Furthermore, participants indicated that more walking and cycling in Bahrain needs to be encouraged. P10 explained that cycling is not a means of transportation in Bahrain but is more for entertainment and practice. At the same time, P12 said that the ability to efficiently move between a city and a central location without a car is crucial. Currently, this is accommodated through cars, as pedestrian and cycling routes are not developed sufficiently, and most transport is through highways. Public travel routes, such as metros and cycling lanes in smaller residential areas, should be encouraged. P4 thought there needed to be more cycling and walking due to unconnected routes and different widths of footpaths.

H. Bahrain's Climate

Participants P10, P13, and P14 believe the hot weather in Bahrain affects the implementation of compact cities due to their effect on walking and cycling in Bahrain, which is one of the elements of a compact city.

I. Reclamation and Urban Sprawl

As P5 and P14 explained, urban sprawl in Bahrain, which is largely caused by horizontal expansion due to a lack of available land, is one of the country's challenges.

J. Bahrain's Zones

P7 and P11 believe there is a concentration of workplaces, schools, universities, and zones in a specific area; for example, Salmaniya is the location of hospitals, Isa Town is the location of universities and schools, and the diplomatic area is the location of ministries. As for P7 believes there needs to be more primary services in new cities like Diyar Al-muharraq and Durrat Al-Bahrain, such as public hospitals and schools. This challenge must be solved to increase mixed land use in Bahrain.

K. Social Needs

P14 and P15 believe mixed land use should be based on the actual needs of the users and inhabitants. Awareness of the society should lead social cooperation to specify where and to what limit mixed land use can be applied. Moreover, P2 believes that since the value of the land in the city center will be higher than the outer lands, the compact city concept tends to be a mixed land use area. This will challenge the people and may lead them to avoid living in a compact city. Therefore, consideration must be given to the needs of society to encourage people to live in a compact city.

L. Lack of Open Spaces

P2 and P5 think there is a shortage of green open spaces in Bahrain, and despite this shortage, people are reluctant to go to these open spaces.

M. Social Integration

P2 and P11 explained that social integration and social mixing are complex in Bahrain, especially in high-density areas, due to Bahraini culture. Also, it is not easy for people to trust each other in such high-density districts.

4.2.2.4 Causes of the Challenges

There are diverging opinions regarding the causes of the challenges in implementing the compact city. Most of the participants thought the most significant reason was the culture of the Bahraini people. Participants P5 and P9 believe that the mentality of the people is an important reason for horizontal expansion. Also, they believe there is a lack of land in Bahrain due to their preference for villas rather than apartments. As for P6, P9, and P14, they assert that culture is one of the reasons why people are reluctant to use public transportation. Furthermore, P8 showed that people's minds are responsible for most of the challenges associated with the application of compact cities.

Participant 14 believes the main reason for the reclamation challenge is the lack of land. While P7 explained that the development projects lack primary services, such as government schools and hospitals because there are no governmental lands in these projects.

P1 and P14 believe that hot weather prevents people from taking public transportation. While P13 believes it is due to the lack of public awareness. However, P11 thought that the availability of car parks reduced

the usage of public transport. On the other hand, P13 thought that it was also due to the time-consuming nature of Bahrain's public buses and the inconsistency of the arrival times of the buses.

P12 said the way the urban design was initially planned is the leading cause of area zones – (schools /hospitals/ residential) in Bahrain. At the same time, land classification is the cause of the lack of public services in private projects, as Participant 7 explained.

P13 believes that the lack of open spaces is due to the increase in density. At the same time, P2 believes that high density will also reduce social interaction.

P3 believes the infrastructure challenge is due to the high budget that is needed to create an efficient and sustainable infrastructure. However, P11 is concerned about the lack of proper utility connectivity.

P4 believes that the cause of the lack of walking and cycling in Bahrain is due to the lack of footpaths, and the available ones are not suitable for walking due to different widths and being unconnected to the other pathways. However, P14 believes that is due to the higher car ownership.

Urbanization and construction are changing faster than changes in policies and regulations, leading to building regulations and policy challenges in Bahrain, as P1 explained.

4.2.3 Implementation of Compact City concept in the Kingdom of Bahrain

4.2.3.1 Applicability of the Compact City Concept in the Kingdom of Bahrain

Participants believe that it is possible to implement the concept of a compact city in Bahrain. Among them are those who think this concept can be applied under certain conditions. P14 and P13 indicated that the idea could be applied to some extent. As for P15, it is shown that it is only applicable in residential and mixed land-use areas. As for P11, it can be implemented, but it requires the legislation of new policies. While P3 showed that it could be implemented if all challenges were solved.

In contrast, P1 and P2 recognized that the nature of Bahrain is conducive to implementing such projects. P2 explained that we live in a modern, sustainable country that encourages such initiatives. Furthermore, according to P4 and P1, Bahrain's small size allows the concept of a compact city to be applied.

On the other hand, the only respondent that stated that it was not possible to implement a compact city in Bahrain, P9 believes that the challenges are mainly based on the people's mentality; we can solve the planning challenges, but the people's mentality is difficult to solve.

4.2.3.2 Approaches to Implementing a Compact City in the Kingdom of Bahrain

To implement the compact city concept in the Kingdom of Bahrain, both P4 and P7 suggest that each project should be studied appropriately. Additionally, P1 explains that a project must be examined from the perspectives of economics, investment, and administration, as well as the

provision of safety and security. According to P13, city parameters such as open spaces and services must be available. Furthermore, a study should be undertaken of the planning guidelines in Bahrain.

P7 believes that we should use renewable energy to generate water and electricity to implement sustainable projects such as a compact city. P8 also suggests that renewable energy be used for air conditioning.

P1 proposed that the concept be implemented by providing a well-developed public transportation network. Similarly, P4 suggested that providing a whole master plan and the transportation network are well connected.

According to P11 and P14, policies and regulations must be enacted to implement policies.

The implementation of the compact city concept is through urban renewal and regeneration strategies, as explained by P5, and through stakeholders' cooperation; as P4 suggested, the ministry of housing should be the main part of projects as they have been successful in previous housing projects. P4 also believes that the key to implementation is through avoiding the creation of urban division and increasing social integration.

As explained by P2, urban design and architecture should respect tradition and culture while preserving the density for development. Additionally, we need to combine different design and planning concepts, such as transit-oriented development.

P13 thought that is accomplished through public participation, while P6 believed in providing smart solutions.

By building public services such as hospitals and schools, P7 suggested building houses for residents afterwards. Meanwhile, P12

believes that the implementation can be integrated as new standalone cities (so new city encompassing all aspects, facilities, schools, etc.) or built around existing central areas to still benefit from the zoned areas but also be self-sufficient to a 60%-70%. Alternatively, they are replanning some of the zoned areas to be spread out across different areas, enhancing the integration of compact cities in the areas that are relocated.

P11 suggests encouraging investors to invest in this project by limiting parking availability to encourage people to use public transportation and walk and bike more. While P8 advocates for more open spaces in Bahrain.

4.2.3.3 Compatibility of Bahrain's Policies and Strategies with the Compact City Strategy

The number of participants who agree that Bahrain's policies and strategies align with the city's compact strategy is equal to those who disagree. The rest of the participants believe that policies and strategies align with compact city strategies are average. However, only one participant was still determining if the policies and strategies aligned with the city's compact strategies.

P16 states that Bahrain's urban policies and strategies can adapt to any objective or target. Social cooperation is vital in this regard. Nevertheless, P1 believes that with the advent of smart city terminology and sustainable cities, all these upcoming projects are now being studied in Bahrain as part of future. Moreover, P2 explains that the Bahrain strategy plan includes tall building strategies, densification, and polycentric development, all of which are part of the Bahrain national strategy plan. In addition, Bahrain's policies are aligned with the compact city concept, as the country is beginning to work on sustainable urban planning with TOD. P3 believes

Bahrain's policies and strategies are aligned with the compact city strategy, particularly its mixed land use policy, as Bahrain's policies are flexible and renewable based on sustainability.

According to P5 and P6, Bahrain needs to legislate more policies. However, the Bahrain French Town Planning Initiative focuses on green areas, heritage waterfronts, mega projects, and a large master plan (similar to the compact city concept).

Conversely, participants who disagree that Bahrain's policies and strategies are compatible with the compact city strategies believe that new policies and strategies should be legislated to support such initiatives.

4.2.3.4 Preference between Re-designing Existing Cities or Building New Ones

The proportions are equal between those who believe it is better to re-design an existing city and those who prefer to build new cities and those who think both options can be implemented in Bahrain.

As P13 explains, some believe that re-design is the right approach to enhance the existing cities.

According to P15, creating new cities is better since current areas with houses and villas, or low-density housing, are hard to change, especially when privately owned. P6 believes it is easier to build a new city in Bahrain than re-design an existing one. P7 explains that a new city is more desirable because of the ease of land classification.

Additionally, for those who think both options can be implemented, P14 explains that building new cities is easy. Still, it is possible to re-design existing cities with vacant spaces like Seef and Riffa. However, it is impossible in Muharraq and old Manama. While P11 believes that building

a new city is easier and more feasible, it is also more expensive. Re-designing could be possible, but it will take time. P1 said both could be in Bahrain, depending on the city's location. According to P2, it is possible to re-design the site, but there will be more concentrations, obstacles, and physical challenges. It is necessary to assist in the classification of land. However, it is easier to create a new city. In contrast, P3 believes that the Urban Regeneration Plan supports the re-design option even if building a new city is more effortless.

4.2.4 The Proposed Solutions and Recommendations with Regard to Applying the Concept of the Compact City in the Kingdom of Bahrain

4.2.4.1 Compact City Challenges Solutions

A. Increase public awareness

Most of the participants believe the first step to solve the compact city challenges is raising public awareness to encourage people to use public transportation and live in apartments rather than villas. As P13 believes, increasing public awareness should be done by increasing public participation.

B. Well-designed public transportation network

Most of the solutions presented by participants focused on properly designing the public transportation network. P15 suggests that it should cover all areas at reasonable times. P1 suggests that this transportation network should contain fully air-conditioned terminals. At the same time, stations should include cafes, prayer rooms, and toilets to comfort passengers while they transit from one bus station to another. This will

encourage people to use public transport. In addition, P1 and P7 agree that separate bus lanes should be provided to reduce traffic congestion.

Meanwhile, P7 suggests that public transport should not be limited to one company. P4, P6, and P11 suggest that pedestrian paths should be shaded. P4 indicates the construction of a skywalk (a pedestrian bridge that connects two or more districts). According to P5, providing a shaded sitting area along walking paths will reduce the phenomenon of the reluctance of people to walk. At the same time, P11 recommend building a separate public car parking area to force people to walk to their house. P4 and P14 suggest that the pedestrian path and cycling lane should be shaded, connected to the other transportation network, and designed hierarchically. In addition, P6 suggests constructing a pedestrian bridge between commercial and residential buildings to encourage walking between them.

C. Applying new modes of transportation

Utilize new modes of transportation; P4, P5, and P9 recommend using autonomous shuttles (self-driving vehicles). Additionally, P1, P8, and P15 recommend using high-tech public transportation systems such as the metro. While P9 thinks using scooters will decrease the usage of private cars. People are more likely to use public transportation if a shuttle taxi is available between their housing unit and public transit, as P10 explains.

D. Developing policies and strategies in the Kingdom of Bahrain

Most of the respondents believe Bahrain should develop its policies and strategies. P2 and P4 recommend that Urban Planning and Development Authority should legislate new policies. P12, P11, and P14 suggest that these policies should be modified and developed. P1 suggests that policies should be aligned with energy-consuming afforestation

strategies. In addition, P1 and P4 believe that developing policies and strategies will facilitate the implementation of sustainable projects.

E. Focusing on mixed land use

Per the recommendations of P10, P11, and P5, Bahrain should develop mixed land use to achieve a more compact city, as mixed land use is an essential element of it.

F. Providing affordable housing units

P2 and P5 believe that if the housing units are affordable and accessible by public transportation, people will be more likely to live in high-density areas, as P6 and P9 stated. In contrast, P10 suggests that the density should be balanced.

G. Innovation of sustainable cities

P6 believes more sustainable developments should be undertaken in Bahrain, similar to P5's suggestion to focus on innovation in sustainable cities.

H. Stockholders' partnership

According to P4, ministries should work together on designing compact cities. At the same time, P7 suggests partnerships between the public and private sectors to achieve a successful compact city project. In addition, the government should encourage investors to invest in compact city projects, according to P1.

I. Focusing on the infrastructure

P3 suggests it should focus more on the infrastructure by developing a suitable infrastructure for the residents to encourage them to use

sustainable transport. Additionally, this would provide more financial resources to implement the compact city concept.

J. Increase open and green spaces

According to P10 and P6, more green and open spaces need to be created, and P5 recommends investing in the public realm. P5 and P9 also recommend increasing shaded open spaces.

K. Rezoning the facilities

P7 proposes that the public services must first build and then distribute housing units. Also, the branches of the ministries should be available in the new cities, which will reduce pressure on the ministry's buildings. Simultaneously, P10 suggests rezoning specific areas and relocating the already grouped facilities to be spread out within different cities.

4.2.5 Stage 2 Findings Summary

The most important compact city factors in the Kingdom of Bahrain relate to density, mixed land use, and transportation, while the most applicable factors in the Kingdom of Bahrain relate to green spaces and structures, along with mixed land use. Based on the interviewees' comments, 13 challenges have been found: 1. Culture, 2. Lack of public transportation, 3. Building regulations and policies in the Kingdom of Bahrain , 4. Infrastructure, 5. Lack of available vacant land in the Kingdom of Bahrain, 6. Budget, 7. Lack of walking and cycling, 8. Bahrain's climate, 9. Reclamation and urban sprawl, 10. Bahrain's zones, 11. Social needs, 12. Lack of open spaces, and 13. Social integration.

Despite those challenges, most respondents believe the compact city concept can be implemented in the Kingdom of Bahrain, mainly by

examining the concept from different perspectives, as well as legalizing new policies and strategies that support the compact city concept. Meanwhile, the number of people who agree that Bahrain's policies and strategies align with the city's compact strategy is equal to the number who disagree. In addition, the proportions are equal between those who believe it is better to re-design an existing city, those who prefer to build new cities, and those who think both options can be implemented in Bahrain. Finally, the participants suggest 11 solutions, of which the most frequently repeated are to increase public awareness and create a well-designed public transportation network, as shown in Figure 4.17.

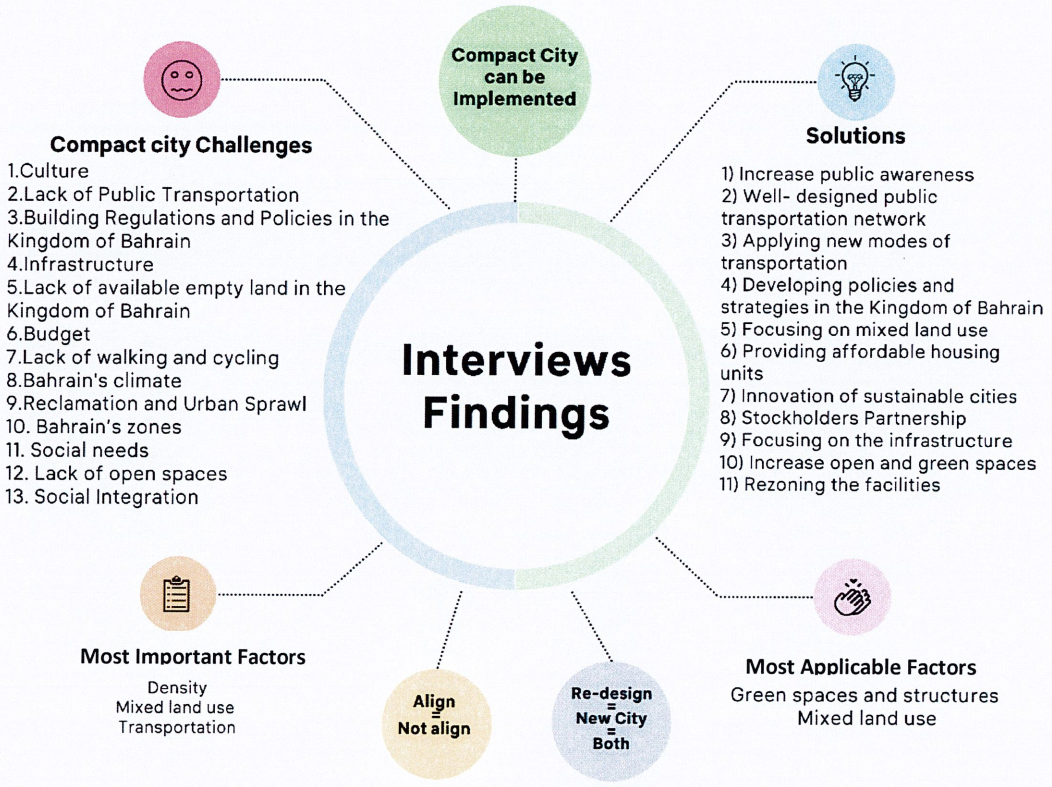


Fig.4.14: Summary of in-depth interview findings

Chapter Five

Discussion, Recommendations and Conclusion

5.1 Discussion

5.2 Recommendations

5.3 Conclusion

5.1.1 Contribution to the knowledge

5.1 Discussion

This research aims to investigate the requirements and explore factors of creating a compact city and identify the challenges of applying compact city concepts in the Kingdom of Bahrain.

The compact city factors categories obtained from the analysis of three case studies are as follows: 1. Mixed land use, 2. Transportation, 3. Density, 4. Green spaces and structures, 5. Climate change, and 6. Social integration.

Regarding the compact city challenges, this study has identified 13 challenges that may affect the implementation of the compact concept in the Kingdom of Bahrain. These issues are as follows: 1. Culture, 2. Lack of public transportation. 3. Building regulations and policies in the Kingdom of Bahrain, 4. Infrastructure, 5. Lack of available vacant land in the Kingdom of Bahrain, 6. Budget, 7. Lack of walking and cycling, 8. Bahrain's climate, 9. Reclamation and urban sprawl, 10. Bahrain's zones, 11. Social needs, 12. Lack of open spaces, and 13. Social integration.

After analyzing the results presented in Chapter 4 and based on the studies of compact city challenges and strategies mentioned in Chapter 2, the results of this study resemble those of other studies in some respects but contrast with them in other respects.

In this study, it is revealed that the main compact city challenge is the culture of the society. Because of this factor, people may not accept the idea of a compact city that depends on public transportation. Likewise, Jenks (2000), believes "that the social acceptability of compact urban" life in societies is a challenge (Jenks, 2000).

The infrastructure challenge exists due to the large budget needed to create an efficient and sustainable infrastructure. Similarly, Jenks and Burgess (2000) believe that one of the challenges facing compact cities in the Middle East is the lack of adequate infrastructure due to budget restrictions.

In the discussion of the implementation of a compact city, the project must be examined from economic, investment, and administrative perspectives. Furthermore, the provision of safety and security should be examined. As this concept is still new to Bahrain, it should be studied in several ways. A similar argument has been expressed by Shirazi and Falahat (2012), who believe that empirical studies and scientific proof are essential.

According to Shirazi and Falahat (2012), a limited city size is an essential contributory factor to the success of compact cities. Identical outcomes are evident in this study; Bahrain's small size allows the concept of a compact city to be applied.

Gehl (2010) states that the most effective approach to designing exceptional cities for people is to "follow the order of life, space, and buildings." The same approach is clear in this study as public participation is the key to implementing compact cities successfully.

This study emphasizes the importance of combining different design and planning concepts, such as transit-oriented development. Similarly, Mahriyar and Rho (2014) believe that compact cities and transit-oriented development can be integrated.

As for the solutions to the compact city challenges, Bahrain should develop its policies and strategies. The Urban Planning and Development Authority should legislate new policies, which need to be modified and

developed. In addition, the implementation of sustainable projects will be facilitated by policies and strategies. An identical idea has been expressed by Kaido (2005), who believes it is essential "for local and central governments to have efficient planning policies".

One solution to the compact city challenges presented here is to provide more primary services in new cities. Branches of ministries should be available in these cities to enhance access to public services. Similarly, a high level of accessibility to public services and facilities can support higher densities, as stated by Kaido (2005).

This study suggests that Bahrain should build vertically and encourage people to live in apartments. This is in line with Mahriyar and Rho (2014), who advocate vertical expansion and mixed land use.

The results of this study show that new cities are more desirable than re-designed existing cities. In contrast, Kotharkar et al. (2012) believe that building new cities with sustainable forms is unacceptable.

Finally, the Kingdom of Bahrain fulfils many compact city factors, including those of mixed land use and green spaces. However, other factors related to transportation, density, climate change, and social cooperation need to be developed further.

The Kingdom of Bahrain should find alternatives to public transport buses, such as the metro, trains, and vehicles without a driver, in order to activate the transportation factor. It is also important to develop walking paths to promote walking. Regarding the mixed land use factor, it would be beneficial to classify Bahraini land as more mixed and diverse.

Moreover, the main challenges of implementing the compact city concept in the Kingdom of Bahrain are culture, the lack of modes of public transportation, and the lack of urban policies and regulations. The solutions

to these challenges can be achieved through public awareness, new forms of public transportation, and the development of urban policies and regulations that correspond to sustainable urbanization strategies like compact city concepts.

The factors of compact cities discussed in previous chapters (transportation, mixed land use, density, green spaces, and structure), are an integral part of sustainable urban planning. Which are all aimed at urban sustainability. Moreover, solutions proposed by the participants to the challenges of implementing the compact city in Bahrain were also based on sustainability principles in urbanization.

5.2 Recommendation

This study is the first step in identifying challenges associated with compact cities in Bahrain. However, due to the small sample size used in this study, the results should be interpreted with caution.

The results could be used by the UPDA in their future plans and in implementing the TOD concept. This implementation of this concept is currently being studied in the Buri area since it is similar in many ways to the compact city concept. The results of the current study will help the UPDA to solve the implementation challenges.

Transportation and mixed land use are main factors on which to focus in the regulations and legislation of the Kingdom of Bahrain.

The investigation of compact city challenges revealed that the most significant challenge in Bahrain is culture. Therefore, future research should examine the extent to which people accept living in a compact city.

Based on the preference between redesigning existing cities or building new ones in Bahrain, an applied study to redesign a Bahraini city would be beneficial in the future. There is the possibility of considering the suggestions of one of the participants who took part in this study, who believes that the Seef District or Riffa can be redesigned to become a compact city.

It is evident from the findings of this study that the policies and legislation in the Kingdom of Bahrain need to evolve, to be aligned with the strategies of sustainable cities, such as the compact city strategy. Thus, it is imperative to examine and identify gaps in the policy and legislation which are in force in the Kingdom of Bahrain and then develop these policies to promote sustainability in the Kingdom of Bahrain.

5.3 Conclusion

Urban sprawl is currently one of the main causes of environmental degradation due to its adverse impact on the environment. The Kingdom of Bahrain suffers from urban sprawl which directly impacts the marine environment. In addition, the expansion of highways, the use of private cars, and the refusal to use public transportation have all contributed to the increase in air pollution. All of these factors directly affect sustainability and the environment. The urbanisation effect has been reduced in many countries through several solutions. A compact city is one way to maintain sustainability and preserve the environment.

As the compact city concept is new to the Kingdom of Bahrain, many challenges may affect the adoption of this concept. This study is conducted to identify these challenges and to explore the factors needed to implement the compact city concept in the Kingdom of Bahrain.

The first objective is achieved by utilizing a case study approach to identify the compact city factors. Meanwhile, the second objective was achieved by conducting an in-depth semi-structured interview to identify the challenges of implementing the compact city concept in the Kingdom of Bahrain.

The compact city factors extracted from the case studies are mixed land use, transportation, density, green space and green structure, social cooperation, and climate change. All of these factors form the base of this study because they give a greater understanding to the participants regarding the compact city concept.

This study finds that the cultural element is the main challenge in creating compact cities in the Kingdom of Bahrain, followed by lack of public transportation and the fact that Bahrain's policies and regulations are not aligned with some compact city strategies. Despite the existing challenges, there is the chance for the success of this idea in the Kingdom of Bahrain through the solutions presented in this study such as increasing public awareness, creating a well-designed public transportation network, applying new modes of transportation, and developing policies and strategies in the Kingdom of Bahrain.

This study is the first step in identifying the challenges of creating a compact city in the Kingdom of Bahrain. However, due to the time constraints and small sample size in this study, the results should be interpreted with caution.

This research has several limitations. The selected case studies focused on cities at the global level only due to the lack of successful compact cities in Middle Eastern countries. Furthermore, finding English versions of the reports and legislation for the selected cities involved a lot

of work to avoid mistranslation; thus, many non-English documents were excluded. Finally, the researcher could not interview all the target academics due to time constraints.

Given the paucity of empirical evidence on implementing a compact city concept in the Kingdom of Bahrain, the present study can assist to identify the issues to be addressed.

In the future, it will be beneficial to conduct applied research to redesign an existing city in the Kingdom of Bahrain. Further research should be conducted on the acceptability of living in a compact city. Several legislative and policy changes should also be adopted by the Kingdom of Bahrain in order to support sustainable city concepts such as the compact city model.

5.3.1 Contribution to the existing knowledge

This study attempts to bridge some knowledge gaps and, in doing so, contributes significantly to the literature.

First, the study extends the limited research on compact city factors in Bahrain, being one of the first to investigate these factors in Bahrain.

Second, only limited studies have been undertaken of the methods of implementing a compact city concept in Bahrain. This study illustrates, to some extent, how this concept should be applied.

Third, no previous study has examined the challenges of implementing a compact city in Bahrain. Therefore, this study identifies the challenges of implementing the compact city concept and the solutions to those challenges.

References

A Strategy for the Development of the Greater Copenhagen Area the Finger Plan. (2015). www.naturstyrelsen.dk

Adams, W. (2015). *Conducting Semi-Structured Interviews.* 10.1002/9781119171386.ch19.

Alkhani, R. (2020). Understanding private-sector engagement in sustainable urban development and delivering the climate agenda in northwestern europe—a case study of london and copenhagen. Sustainability (Switzerland), 12(20), 1–35. https://doi.org/10.3390/su12208431

Anderson, W. P., Kanargoglou, P. S. and Miller, E. (1996*) Urban Form, Energy and the Environment: A Review of Issues*, Evidence and Policy. Urban Studies,33, pp. 17–35

Angel, S. (2011). *Making Room for a Planet of Cities*, Lincoln Institute of Land Policy.

Arifwidodo, S. D. (2012). *Exploring the effect of compact development policy to urban quality of life in Bandung, Indonesia.* City, Culture and Society, 3(4), 303–311. https://doi.org/10.1016/j.ccs.2012.11.007

Barton, H., Grant, M. and Guise, R. (2003) *Shaping Neighbourhoods: a guide for health, sustainability and vitality*, Spon Press, London.

Benfield F. Kaid, Terris Jutka et al. (2001). "*Solving Sprawl: Models of Smart Growth in Communities Across America"*, Natural Resources Defense Council: New York, p2

Bergink, J. (2014, February 3). *The Happy City.* For a state of happiness. http://www.forastateofhappiness.com/tag/utrecht/

Besser,L & Dannenberg, A .(2006). *Walking to public transit.* Steps to help meet physical activity recommendations. American Journal of Preventive Medicine, 29(4): 273-280.

Bhatta, Basudeb (2010). *Analysis of Urban Growth and Sprawl from Remote Sensing* Data, ISSN: 1867-2434, Canada: Springer.

Bianca, S. (2000*). Urban form in the Arab world, past and present*. New York (NY): Thames and Hudson.

Bibri, S. E., Krogstie, J., & Kärrholm, M. (2020). *Compact city planning and development: Emerging practices and strategies for achieving the goals of sustainability.* Developments in the Built Environment, 4. https://doi.org/10.1016/j.dibe.2020.100021

Broome K, McKenna K, Fleming J & Worrall L. (2009). *Bus use and older people: A literature review applying the person-environment-Occupation model in macro practice.* Scandinavian Journal of Occupational Medicine, 16: 3-12.

Brueckner JK. (2000). *Urban sprawl: Diagnosis and remedies*. International Regional Science Review 2000;23: 160–7.

Burton,E. (2000) *'The Compact City: Just or Just Compact?* A Preliminary Analysis', Urban Studies, vol.37,no.11,pp.1969-2001.

Burton,E. (2002) *'Measuring Urban Compactness in UK Towns and Cities', Environment and Planning B: Planning and design*, vol.29, pp. 219-250.

Cairncross, L. (2016). *Active Ageing and the Built Environment Practice Briefing.* www.housinglin.org.uk

Calthorpe, p.(1993). *"The Next American Metropolis: Ecology, Community and the American Dream"*, New York, Princeton Architectural Press, p.56

Category. (n.d.). Oxford learners' dictionaries. https://www.oxfordlearnersdictionaries.com/definition/english/category

Cereda, V. (n.d.). Compact City and Densification Strategies The Case of Gothenburg.

Chen, H., Jia, B., & Lau, S.S. (2008). *Sustainable urban form for Chinese compact cities: Challenges of a rapid urbanized economy.* Habitat International, 32, 28-40.

Chicago Metropolitan Agency for Planning (CMAP)(2014).*Form-Based Codes: A Step-by-Step Guide for Communities.* http://www.formbasedcodes.org/files/CMAP_FBCI_GuideforCommunities.pdf

Colofon. (2014). *Utrecht: A Global Goals City Utrecht's Approach to Localising the UN Sustainable Development Goals.*

Cowan, R. (1997). *The Connected City: a new approach to making cities work*, Urban Initiatives, London.

Dantzing, G.B., Saaty, T.L., 1973. *Compact City: a Plan for a Livable Urban Environment.* W.H. Freeman, San Francisco.

Dave S. (2010). *High urban densities in developing countries: a sustainable solution?* Built Environ.36(1):9–27.

Davies, S., Burns, H., Jewell, T., & McBride, M. (2011). *Start Active, Stay Active A report on physical activity for health from the four home countries' Chief Medical Officers.* www.dh.gov.uk

Davis, A., & Whyte, B. (2020). *Making the shift to sustainable transport in Scotland. Cities & Health*, 00(00), 1–8. https://doi.org/10.1080/23748834.2020.1812332

Definition of something. (n.d.). In www.dictionary.com. https://www.dictionary.com/browse/something

Dempsey N, Jenks M. (2010). *The future of the compact city*. Built Environ. 36(1):116–121.

Dempsey, N., Brown, C., Raman, S., Porta, S., Jenks, M., Jones, C., & Bramley, G. (2008). *Elements of Urban Form* (pp. 21–51). https://doi.org/10.1007/978-1-4020-8647-2_2

Department of the Environment Transport and the Regions (DETR) (2000). *Planning Policy Guidance Note 3: housing*, DETR, London.

Dutton, J. (2000). *New American Urbanism: Re-forming the Suburban Metropolis.* Sikra.

Elghonaimy, I.; Javed, N. *Concomitant of global warming and land reclamation: Designing a new interface between human kind and sea.* In Proceedings of the International Conference on Industrial Engineering and Operations Management (IEOM), Pretoria, South Africa, 29 October–1 November 2018; pp. 2175–2186.

Elghonaimy, Islam & Mohammed, Wisam. (2019). Urban Heat Islands in Bahrain: An Urban Perspective. Buildings. 9. 96. 10.3390/buildings9040096.

Elkin, T., McLaren, D. and Hillman M. (1991) Reviving the City: Towards Sustainable Urban Development, Friends of the Earth, London.

Elkin, Tim, Duncan McLaren, and Mayer Hillman. 1991. Reviving the city: Towards sustainable urban development. London: Friends of the Earth.

Elliott, D.; Goebel, M.; Meadows, C.(2012). *The Rules That Shape Urban Form; Planning Advisory Service Report 570*;American Planning Association: Chicago, IL, USA.

Environmental Justice Atlas. (2000). *Coastal Development and Land Reclamation, Bahrain* https://ejatlas.org/print/coastal-development-bahrain

Ewing, R, Pendall, R, Chen D.(2008). *Measuring Sprawl and its Impact*. Washington: Smart Growth America. 2–31.

Ewing, R.(1997). *Is Los Angeles-Style sprawled desirable?* Journal of the American Planning Association. 63(1): 107–126.

Faculty, S. P. (2018). *A Liveable Compact City ?* Local Perspectives from Hong Kong. February.

Fertner, C. (2012). *Urbanisation, urban growth and planning in the Copenhagen Metropolitan Region with reference studies from Europe and the USA.* https://www.researchgate.net/publication/261367605

Fraser, S. D. S., & Lock, K. (2011). *Cycling for transport and public health: A systematic review of the effect of the environment on cycling.* In European Journal of Public Health (Vol. 21, Issue 6, pp. 738–743). https://doi.org/10.1093/eurpub/ckq145

Galal, S (2021). *Population density of Egypt 2020, by governorate*. https://www.statista.com/statistics/1230835/population-density-by-governorate-in-egypt/

Galster, J., Hanson, R., Ratcliffe, MR., Wolman, H., Coleman, S., Freihage, F.(2001). *Wrestling sprawl to the ground: Defining and measuring an elusive concept.* Housing Policy Debate. 12(4): 681-717.

Garde, A. (2020). *New urbanism: Past, present, and future*. Urban Planning, 5(4), 453–463. https://doi.org/10.17645/UP.V5I4.3478

Gehl, J. (2001). *Life Between Buildings: using public space*, Arkitektens Forlag, Copenhagen.

Gehl, J. (2010). *Cities for people*. Island Press. http://public.eblib.com/choice/publicfullrecord.aspx?p=3317503.

Gehl, J., Gehl, A., Transport for London and Central London Partnership (2004). *Towards a Fine City for People: public spaces and public life* - London 2004,Gehl Architects, Copenhagen.

Gemeente Utrecht. (n.d). Our vision for Utrecht in 2040. Healthy urban living. https://healthyurbanliving.utrecht.nl/our-vision-for-utrecht-in-2040/

Geospatial Technologies and Human Rights Project. *Investigating Land Use and Land Cover Change in Bahrain*: 1987–2013. Available online: https://www.aaas.org/resources/investigating-land-use-and-land-cover-change-bahrain-1987-2013 (accessed on 2 February 2019).

Gill, P. Stewart, K. Treasure, E. and Chadwick, B. (2008) *`Methods of data collection in qualitative research: interviews and focus groups`*. British Dental Journal, 204 (6), 291–5.

Glaeser E, Kahn M, Chu Ch.(2001). *Job Sprawl: Employment Location in U.S.* Metropolitan Areas. Center for Urban & Metropolitan Policy. Washington, D.C.: The Booking Institution.

Goldstein, D.; Gowder, W.; Slone, D.A Legal (2008). *Guide to Urban and Sustainable Development for Planners,* Developers and Architects, 1st ed.; John Wiley and Sons: Hoboken, NJ, USA.

Gordon P, Richardson H.(2000). *Critiquing sprawl's critics*. Policy Analysis. 365: 1–18.

Gothenburg stud.(n.d) .*Innovation and development for the smart traffic of the future in Gothenburg.* https://goteborg.se/wps/portal/enhetssida/Innovation-och-utveckling-far-framtidens-mobilitet-i-Gateborg/in-english#:~:text=Innovation%20and%20development%20for%20future%20smart%20traffic%20in,transports%20that%20will%20make%20the%20city%20more%20connected.

Gulf Regional Planning Advisory Committee . *Gulf Regional Development Plan;* Gulf Regional Planning Advisory Committee: Manama, Bahrain, 2000.

Haas, T. (2012). *Sustainable urbanism and beyond: Rethinking cities for the future*. Rizzoli.

Habibi, S., & Asadi, N. (2011). *Causes, results and methods of controlling urban sprawl.* Procedia Engineering, 21, 133–141. https://doi.org/10.1016/j.proeng.2011.11.1996

Hakim B. (1982). *Arab-islamic urban structure*. Arabian JSci Technol. 7(2):69–79

Hillier, B. (1996). *Space is the Machine: a configurational theory of architecture*, Cambridge University Press, Cambridge.

Hillier, B. and Hanson, J. (1984). *The Social Logic of Space*, Cambridge University Press, Cambridge.

Holmes, C. (2007). *New Opportunities for an Ageing Population, Town and Country Planning*,76(11), pp. 382–384.

Hunkin, S., & Krell, K. (2019). *Promoting Active Modes of Transport.* February.

Ibrahim, A. a. (2011). *Veracity of Compact Urban Form for New Egyptian: Measuring Urban and Socail Sustainability of the Low Income Neighbourhoods.* November.

Integrating Human Health into Urban and Transport Planning, 2019 ISBN : 978-3-319-74982-2 Paul Schepers, Gord Lovegrove, Marco Helbich

Jabareen, Yosef. (2006). Sustainable Urban Forms. Journal of Planning Education and Research. 26. 38-52. 10.1177/0739456X05285119.

Jabareen,Y.R. (2006) *'Sustainable Urban Forms,Their Typologies, Models, and Concepts'*, Journal of Planning Education and Research,vol.26, no. 1, pp. 26-38.

Jacobs, Jane. 1961. The death and life of great American cities. New York: Random House.

Jansson, M. (2014). *Green space in compact cities: the benefits and values of urban ecosystem services in planning*. http://arkitekturforskning.net/na

Jenks, M. (2000). *The appropriateness of the compact city concept to developing countries.* In: Jenks M, Burgess R, editors. Compact cities: sustainable urban forms for developing countries. London (UK):Spon Press. p. 343–350.

Jenks, M., Burton, E., & Williams, K. (1996). *The Compact City: A Sustainable Urban Form?*

Kaido, K. (2005). *Urban densities, quality of life and localfacility accessibility in principal Japanese cities.* In: Jenks M, Dempsey N, editors. Future formsand design for sustainable cities. Oxford (UK):Architectural Press. p. 311–337.

Karakayaci, Z. (2016). *the Concept of Urban Sprawl and Its Causes.* Journal of International Social Research, 9(45), 815–815. https://doi.org/10.17719/jisr.20164520658

Karimi, S., & Zandieh, M. (2016). *The development of modern architectural principles of sustainability in order to compare Iran traditional architecture with five modern sustainable city in the world (case study: vancouver, copenhagen, oslo, curitiba and masdar).* https://doi.org/10.7456/1060NVSE/133

Kingdom of Bahrain's National portal. (2022). *Environment and nature.* https://www.bahrain.bh/new/en/environment_en.html

Kotharkar, R., Bahadure, P., & VYas, A. (2012). *Compact City Concept: It's Relevance and Applicability for Planning of Indian Cities Heat wave and Urban heat island hazard mapping of six coastal cities with potential future impact-under Hydro Meteorology Resilience Action Plan (HmRAP) six coastal cities View project LCZ Classification and UHI study for Indian Cities View project.* https://www.researchgate.net/publication/265915492

Lapidus, IP. (1976). *Muslim cities in the later middle ages.* Cambridge: Harvard University Press.

Lawlor, J (2011). *Gaining ground in the final frontier: Surveying legal issues raised by New England's form-based codes.* Urban Lawyer,43, 1–121.

Lee Siong Aun, B., BSocSci in Geography, E., & Joseph Ferreira, P. (2004). Promoting Sustainable Transportation Through The Integration Of Cycling With Public Transit-Lessons From Copenhagen And Munich For Singapore 01'.

Lee, J. H., & Lim, S. (2017). The selection of compact city policy instruments and their effects on energy consumption and greenhouse gas emissions in the transportation sector: The case of South Korea. *Sustainable Cities and Society*, *37*, 116–124. https://doi.org/10.1016/j.scs.2017.11.006

Lee, R. (2016). *Overcoming barriers and identifying opportunities for everyday walking for disabled people*.

Liu, S. and Zhu, X. (2004) *Accessibility analyst: an integrated GIS tool for accessibility analysis in urban transportation planning. Environment and Planning B: Planning and Design*,31(1),pp. 105–124.

Lund, H.(2003). *"Testing the Claims od New Urbanism: Local Access, Pedestrian Travel, and Neighboring Behaviors"*,Journal of the American Planning Association, 69 (4), pp.414 - 429.

Mardaljevic, J. (2005). *Quantification of Urban Solar Access. In Future Forms and Design for Sustainable Cities*, (eds. M. Jenks and N. Dempsey), Architectural Press, Oxford, pp. 371–391.

Nabielek, K. (n.d.). The compact city: ꜝlanning strategies, recent developments and future prospects in the Netherlands.

Nechyba, T. J., & Walsh, R. P. (2004). *Urban Sprawl.* 18(4), 177–200.

Newton, P., Tucker, S. and Ambrose, M. (2000). *Housing Form, Energy Use and Greenhouse Gas Emissions in Achieving Sustainable Urban Form*,(eds. K. Williams, E. Burton and M. Jenks),E & FN Spon, London, pp. 74–83.

Norwood, P., Eberth, B., Farrar, S., Anable, J., & Ludbrook, A. (2014). *Social Science & Medicine Active travel intervention and physical activity behaviour: An evaluation.* Social Science & Medicine, 113, 50–58. https://doi.org/10.1016/j.socscimed.2014.05.003

O' Neill, David.(2000). *"The Smart Growth Tool Kit. Community Profiles and Case Studies to Advance Smart Growth Practices",* Washington D.C.: ULI-the Urban Land Institute.p2

OECD. (2012). *Compact city policies: A comparative assessment* (OECD Green Growth Studies). OECD Publishing. H.-C. Wang

Office of the Deputy Prime Minister (ODPM) (2005). *Sustainable Communities: homes for all*, The Stationery Office, Norwich.

Parolek, D.; Parolek, K.; Crawford, P.Form (2008). *Based Codes: A Guide for Planners, Urban.* Designers, Municipalities, and Developers, 1st ed.; John Wiley and Sons: Hoboken, NJ, USA.

Parolek, K., Brady, J., Gay, B., Magnum, S., Mekarski, D., & Nilsen, D. (2013). *Form-Based Codes: A Step-by-Step Guide for Communities.* https://www.formbasedcodes.org

Pattacini, Laurence. (2012). *Climate and urban form.* Urban Design International. 17. 10.1057/udi.2012.2.

Paulsen, D (2012). *Crime and Planning: Building Socially Sustainable Communities*, 1st ed.; CRC Press: Boca Raton, FL,USA.

Pendall, R.(1999). *Do land use controls cause sprawl? Environment and Planning.* 26: 555-71.

Petrokofsky, carl, & Davis, A. (2016). *Working Together to Promote Active Travel A briefing for local authorities.* About Public Health England.

Population Density of Bahrain 1950-2023 & Future Projections. Database.earth, 1 Jan. 2023, database.earth/population/bahrain/density. Accessed 24 Apr. 2023.

Porter, Douglas.(2002). *"Making Smart Growth Work"*, Washington D.C. ULI: Urban Land Institute, pp. 1-5.

Public Health England & Royal Society for the Prevention of Accidents (2016) *Road injury prevention –resources to support schools to promote safe active travel.* London: PHE.

Public Health England. (2016). *PHE School Journey Safety Guide.* www.facebook.com/PublicHealthEngland

Raiygani, Ibrahim& Islami, Masud. 2018. *The effect of cultural factors in the formation and persistence of the historical town of Dehdasht during the Safavid and the Qajar.* The Islamic College University Journal،Vol. 12, no. 45, pp.5-31. https://search.emarefa.net/detail/BIM-1246217

Richardson, HW, Bae Ch, Baxamusa MH. (2000). *Compact cities in developing countries: assessments and implications.* In: Jenks M, Burgess R, edi-tors. Compact cities: sustainable urban forms for developing countries. London (UK): Spon Press.p. 25–36.

Rodrigue, J.-P. (2020). *The Geography of Transport Systems (5th ed.).* Routledge. https://doi.org/10.4324/9780429346323

Sabri, A. K., & Galal Ahmed, K. (2019). *Replacing land-use planning with localized form-based codes in the United Arab Emirates: A proposed method.* Land, 8(3), 1–24. https://doi.org/10.3390/land8030047

Sacramento Area Council of Governments (SACOG)(2013). *The Codes Study.* http://www.placemakers.com/wpcontent/uploads/2013/05/CodesStudy_May2013_WEB.htm.

Salingaros, N. A. (2006). *Compact City Replaces Sprawl.* Nikos A. Salingaros University of Texas at San Antonio. 1–14.

Samuels, S and Karasapan, A.(2014) "Copenhagen: a Case Study of one of the Most Sustainable Cities in the World".CLAS: Colby Liberal Arts Symposium. 386. https://digitalcommons.colby.edu/clas/2014/program/386

Samuels, S., College, C., & Karasapan, A. (n.d.). Copenhagen: a Case Study of one of the Most Sustainable Cities Copenhagen: a Case Study of one of the Most Sustainable Cities in the World in the World. https://digitalcommons.colby.edu/clas

San Francisco Bay Area Metropolitan Transportation Commission. in Tumlin, (2012). *Sustainable Transportation Planning*. Thesis Program Magister Manajemen Pembangunan Kota- ITS

Sandkjaer Hanssen Hege Hofstad, G. (2013). Compact City Policies in England, Denmark, the Netherlands and Norway. www.nibr.no

Schenkels, J & Hendriks, R. (2018). City of Utrecht: growing with green ambitions. Oppla. https://oppla.eu/casestudy/19311

Schoon, N. (2001) *The Chosen City,* Spon Press, London. Talen, E. (2003) Neighbourhoods as Service Providers: a methodology for evaluating pedestrian access, Environment and Planning B,30, pp. 181–200

Seto, K. C., Güneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(40), 16083–16088. https://doi.org/10.1073/pnas.1211658109

Seto, Karen & Shepherd, Marshall. (2009). Global urban land-use trends and climate impacts. *Current Opinion in Environmental Sustainability*. 1. 89-95. 10.1016/j.cosust.2009.07.012.

Shirazi, M., & Falahat, S. (2012). Compact urban form, question or solution? Examining the compact city in the Middle Eastern context: challenges and opportunities. *International Journal of Urban Sustainable Development*, *4*(2), 246–259. https://doi.org/10.1080/19463138.2012.694817

Sierra club. (n.d). *The Dark Side of the American Dream: The Costs and Consequences of Suburban Sprawl.* College Park, MD: Challenge to Sprawl Campaign.

Sinha, S. (2018). CHARACTERISTICS OF URBAN SPRAWL: A CROSS-CULTURAL ANALYSIS. https://www.researchgate.net/publication/329196573

Sinnett, D., Chatterjee, K., Williams, K., & Cavil, N. (2012). Sinnett, D et al. (2012) *Creating built environments that promote walking and health.* Journal of the Department of Planning and Architecture of University of the West of England, 4(ISSN: 2042-7654).

Smart Code (2014). Version 9.2. http://www.smartcodecentral.org/

Solanki M. (2018). *The most sustainable municipality in the Netherlands.* EXPAT INFO. https://www.iamexpat.nl/expat-info/dutch-expat-news/most-sustainable-municipality-netherlands

Statutory Guidance for the Delivery of the Active Travel (Wales). (2014). 978 1 4734 2270 4, 1–49.

Steinacker, A. (2003) *'Infill Development and Affordable Housing: Patterns from1996 to 2000'*, Urban Affairs Review vol.38, pp. 492-509.

Stone, D. (2009). *The effects on vegetation of vehicular access on deep peat substrates View project Collaboration for Environmental Evidence (CEE)* View project Dave Stone Natural England. https://doi.org/10.13140/RG.2.1.4190.4720

Stretton, H. (1994) Transport and the structure of Australian cities. Australian Planner, 31 (3), pp. 131–136

Sustainability living (n.d). https://masdarcity.ae/en/live/overview#Sustainability

Sutan. (2021). *Introduction to Transit-Oriented Development (TOD).* The Urban Condition. https://medium.com/the-urban-condition/introduction-to-transit-oriented-development-tod-652bcb2d684f

Swanwick, Carys, Nigel Dunnett, and Helen Woolley. 2003. Nature, role and value of green space in towns and cities: An overview. Built Environment 29 (2): 94-106.

Talen, E. (2003). *Neighbourhoods as Service Providers: a methodology for evaluating pedestrian access*, Environment and Planning B,30, pp. 181–200

The Danish Ministry of the Environment.(2020*). The Danish environmental protection agency.* https://eng.mst.dk/

The Danish Nature Agency (2015). *A Strategy for the Development of the Greater Copenhagen Area: The Finger Plan.* www.naturstyrelsen.dk

The Supreme Council for Environment. (2022). *Our Efforts to Protect our Environment.*

https://www.sce.gov.bh/en/OurEffortstoProtectourEnvironment?cms=iQRpheuphYtJ6pyXUGiNqlRBGRBjMv5O

Thomas, Randall. 2003. Building design. In Sustainable urban design: An environmental approach, ed. Randall Thomas and M. Fordham, 46-88. London: Spon Press.

UNEP (2011). *Towards a Green Economy: Pathways to sustainable development and poverty eradication.*, UNEP.

United Nations. (2022). *Sustainable Cities and Communities*. https://bahrain.un.org/en/sdgs/11

United Nations. Bahrain country profile (2002). *In Proceedings of the Johannesburg Summit 2002, World Summiton Sustainable Development,* Johannesburg, South Africa, 26 August–4 September 2002.

Urban Challenges, Policy and Action in Gothenburg-GAPS project baseline study. (n.d.). www.mistraurbanfutures.org

Urban Task Force (1999) *Towards an Urban Renaissance, E & F Spon,* London.

Useful Community Development (2022). *How Form-Based Code Differs from Traditional Zoning.* retrieved from A Form-Based Code Is an Alternative to Zoning www.useful-community-development.org

Valente-Pereira, L., de Autor, E., & Sinopse, S. (2015). *Leitura da imagem urbana urban form definition.*

Wang, H. C. (2022). *Prioritizing compactness for a better quality of life: The case of U.S. cities. Cities*, *123*. https://doi.org/10.1016/j.cities.2022.103566

Wheeler, Stephen. M. 2000. Planning for metropolitan sustainability. Journal of Planning Education and Research 20:133-45.

Williams, K. (2014). *Urban form and infrastructure: a morphological review*.

Williams, K., Burton, E. and Jenks, M. (eds.) (2000) *Achieving Sustainable Urban Form,*. E&FN Spon, London.

Williams,K. (2000) *Does Intensifying Cities Make Them More Sustainable?*, in K.Williams,E. Burton& M.Jenks(eds),Achieving Sustainable Urban Form,E & NSpon,London,pp. 30-45

World city with responsibility. (2019).

World Health Organisation (2014) *Dementia and age-friendly environments in Europe* (AFEE). WHO: Copenhagen.

Yin, R. K.,(2003). *Case Study Research Design and Methods,* Retrieved from http://faculty.washington.edu/swhiting/pols502/Yin.pdf

Appendances

Appendix A

- **Compact City Factors (based on the studied cities)**
  - **Mixed land use**
    1. Creation of sustainable regional structures.
    2. Development of long-term sustainable infrastructure.
    3. Build and develop centrally.
    4. Complementary and mixed functions.
    5. Reserve outer city areas for future development.
    6. Diverse scales of built objects.
    7. Physical land use mix (horizontal/spread of facilities, vertical mix of uses, amenity, public space, etc.)
    8. Economic mix (business activity, production, consumption, etc.)
    9. Social mix (housing, demography, lifestyles, visitors, etc.)
    10. Greater mix of housing, business, and facilities in strategic nodes.
    11. Multidimensional mixed land use linked with sustainable transportation.
    12. Avoid urban sprawl.
    13. Avoid the construction of new working places along highways.
    14. Reduce ethnic and social-economic segregation, leading to a more mixed city.
  - **Density**
    15. Creation of densely populated areas.

16. High density of built objects in a designed and emergent compact urban form.
17. Distribution of building footprints with more frequent larger buildings.
18. Prioritization of density close to the central points of strategic nodes.
19. High–density linked with multidimensional mixed land use.
20. Population growth balanced with regional development.
21. Increase in population.
22. Maintain the density and thereby the urban qualities and identity.
23. Prevent overcrowded cityscapes.

- **Transportation**

24. Strengthen public transport.
25. Encourage cycling and walking.
26. Use of public transport (metro, buses, trams, etc.)
27. Mobility management.
28. Increased accessibility through public transport infrastructure improvements.
29. Sustainable transportation linked with multidimensional mixed land use and high density.
30. Network structure of linked areas to connect the major transport system nodes.
31. Separate lanes for public transport for faster journey times and a punctual and reliable system.
32. More services along the main corridors to enable greater frequency.
33. An easy-to-understand, safe, and secure system for guaranteeing quality and service.

34. Multi-model traveling in strategic nodes to support the dense, mixed-use central points.
35. Promoting high-quality urban living through good transport links and proximity to recreational green spaces.
36. Minimize the distance to main areas in city centers.
37. Ensure good accessibility by bicycle and public transport.
38. Replace a car-based system with a well-established bus system.
39. Different train stations with connections to all major cities; the central train station is at the heart of the city.
40. Traveling within the city is by bus, bicycle, and tram.

- **Green Spaces and Structures**

41. Green areas and parks.
42. Green areas hand-in-hand with density.
43. Protection and integration of natural, agricultural, and cultural areas through intensification.
44. Keep open spaces as free from urbanization as possible.
45. Improvement of green infrastructure implementation.
46. Make the streets greener and create new parks.
47. Allow grass to grow on tram tracks.
48. Naturalspaces all around the city.

- **Climate Change**

49. Neighborhoods should demonstrate environmental innovation, sustainable technology, and climate-related effort.
50. Integrate climate into the energy supply.
51. Promote healthy urban living through an integrated and systemic approach that combines local climate regulation, noise reduction, recreation, and cleaner air.

52. Save energy and generate more sustainable power by increasing the use of solar power, wind power, geothermal energy, and residual heat from businesses.
53. Develop alternative heat supplies for homes and buildings, enabling the transition away from natural gas.

- **Social cooperation**

54. Emphasize the active participation of public and private actors in delivering sustainable growth.
55. Plan based on the needs of citizens.

Appendix B

Subject: A study on the Challenges of Implementing Practical Compact City Strategies in the Kingdom of Bahrain

Part 1: To address the challenges and obstacles associated with implementing the concept of a compact city in the Kingdom of Bahrain.

1- How would you rank the following factors from high to low based on their importance?
2- Are any of these factors applicable to Bahrain?
3- From your perspective, what are the challenges associated with applying the compact city concept in the Kingdom of Bahrain? And what are the causes of these challenges?

Part 2: To determine how the concept of compact cities can be implemented effectively in the Kingdom of Bahrain.

4- Despite the challenges discussed in the first part of the interview, do you believe compact city concepts can be implemented in Bahrain? If so, how?
5- To what extent are the urban policies and strategies in Bahrain aligned with those of compact cities?
6- Is it possible to redesign the existing cities in Bahrain to be become more compact, or do you think only new cities can truly implement compact city strategies?

Part 3: To assess the solutions and suggestions proposed with respect to the application of the compact city concept in the Kingdom of Bahrain.

7- In your opinion, what are the proposed solutions for implementing the compact city concept in the Kingdom of Bahrain?

الملخص

شهدت مملكة البحرين مؤخرًا ظاهرة الزحف العمراني التي تؤثر بشكل مباشر على البيئة والتنمية المستدامة. لذلك، فإن أحد مناهج التخطيط الحضري التي يمكن أن تقلل من هذه المشاكل البيئية وتساهم في تقليل التلوث والتدهور البيئي هو تطبيق نظرية المدن المتراصة.

تهدف هذه الدراسة إلى استكشاف التحديات الرئيسية التي قد تحد من تطبيق نظرية المدينة المتراصة في مملكة البحرين، وتهدف لوضع المعايير اللازمة لتصميم مدن جديدة أو إعادة تصميم مدينة موجودة مسبقاً في مملكة البحرين، كما تتناول هذه الدراسة أيضًا المتطلبات اللازمة لتطوير مدينة متراصة مزدهرة في مملكة البحرين.

الدراسة المستخدمة في هذا البحث هي دراسة وصفية مقطعية تتضمن نهج التحليل النوعي. تنقسم عملية تجميع البيانات في هذه الدراسة إلى مرحلتين رئيسيتين: أولاً، لتحقيق الهدف الأول والذي يهدف إلى استكشاف متطلبات ومعايير لإنشاء مدينة متراصة كان من خلال دراسة تحليلية لثلاث مدن في العالم وهم كالتالي: جوتنبرج في السويد وكوبنهاجن في الدنمارك وأوتريخت في هولندا. ثانيًا، أجريت مقابلات مع مختصين في القطاع الحكومي والخاص بالإضافة الى أكاديميين وذلك لتحقيق الهدف الثاني والذي يهدف إلى فهم وتحديد تحديات تطبيق مفاهيم المدينة المدمجة في مملكة البحرين.

نتيجة هذه الدراسة تتمثل في أن التحديات الرئيسية التي تواجه المدن المتراصة في البحرين هي ثقافة المجتمع البحريني، ونقص وسائل النقل العام، وعدم توافق سياسات وأنظمة مملكة البحرين مع بعض استراتيجيات المدينة المتراصة. على الرغم من هذه التحديات القائمة، إلا أن هناك رؤية مستقبلية لتطبيق ونجاح هذه الفكرة في مملكة البحرين من خلال زيادة الوعي العام وإنشاء شبكة مواصلات عامة مصممة بطريقة تسهل الوصول لأهداف المدن المتراصة.

جامعة البحرين

كلية العلوم

دراسة حول تحديات التنفيذ العملي لاستراتيجيات المدينة المتراصة في مملكة البحرين

أطروحة مقدمة في استيفاء جزئي لمتطلبات الحصول على درجة الماجستير في البيئة والتنمية المستدامة – العمران المستدام

من إعداد الطالبة

مريم إبراهيم تركي درّاج

20102039

تحت إشراف:

الدكتورة فيّ بنت عبدالله آل خليفة

أستاذ مشارك

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مملكة البحرين

مايو 2023