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THE ASSESSMENT OF WALKABILITY AS A SOCIAL ASPECT OF SUSTAINABILITY: THE CASE OF DUBAI NEIGHBORHOODS, UAE

Rania ElSaed ElEsawi

United Arab Emirates University

College of Engineering

Department of Architectural Engineering

THE ASSESSMENT OF WALKABILITY AS A SOCIAL ASPECT OF SUSTAINABILITY: THE CASE OF DUBAI NEIGHBORHOODS, UAE

Rania ElSaed ElEsawi

This thesis is submitted in partial fulfilment of the requirements for the degree of Master of Science in Architectural Engineering

Under the Supervision of Dr. Sahera Bleibleh

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Declaration of Original Work

I, Rania ElSaed ElEsawi, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this thesis entitled "*The Assessment of Walkability as a Social Aspect of Sustainability: The Case of Dubai Neighborhoods, UAE*", hereby, solemnly declare that this thesis is my own original research work that has been done and prepared by me under the supervision of Dr. Sahera Bleibleh, in the College of Engineering at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my thesis have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this thesis.

Student's Signature: Rania Date: 19/01/2020

Approval of the Master Thesis

This Master Thesis is approved by the following Examining Committee Members:

1) Advisor (Committee Chair): Dr. Sahera Bleibleh
   Title: Associate Professor
   Department of Architectural Engineering
   College of Engineering
   Signature _____ Date 6/1/2020

2) Member: Dr. Khaled Galal Ahmed
   Title: Associate Professor
   Department of Architectural Engineering
   College of Engineering
   Signature _____ Date 6/1/2020

3) Member (External Examiner): Dr. Karen Kaddy
   Title: Associate Professor
   Department of Social and Environmental Justice Issues in Architecture
   College of Architecture and Planning
   Institution: Ball State University, Muncie, Indiana, USA
   Signature on beh. _____ Date 6/1/2020

This Master Thesis is accepted by:

Dean of the College of Engineering: Professor Sabah AlKass

Signature _____ Date 19/1/2020

Dean of the College of Graduate Studies: Professor Ali Al-Marzouqi

Signature _____ Date 20/1/2020

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Abstract

In an attempt to reduce car dependency, the process of planning, mainly on neighborhood level, has recently been directed to focus on the accommodation of walkability as a significant factor of planning development. This approach contributes not only in improving urban patterns, but also majorly in addressing issues of sustainability. The social aspect of sustainability has not received much attention and is considered the least described pillar. The positive association between aspects of human behavior and built environment, particularly walkability, suggests that measuring social aspects of sustainability may be conceivable especially in the context of community development. Sustainable neighborhoods offer livability by combining the environmental aspects, balanced social characteristics and economic factors. The concept of walkability is a significant contributor to sustainable cities. This research is intending to assess walkability and its performance as a sustainable social factor in the neighborhoods of Dubai city, UAE. In doing so, the research is aiming to provide insights into the application of walkability principles on the urban form of selected neighborhoods. In addition, the research is studying users' perception regarding walkability in the selected neighborhoods. This research is applying a mixed methodology; qualitative and quantitative, to analyze the selected case studies in Dubai. The qualitative analysis includes observations, questionnaire, and semi-structured interviews. Whereas, the quantitative part of the research is performed using DepthmapX software and questionnaire. The research is concluded with suggestions of major walkability principles that identify the importance of the latter in achieving social sustainability in the selected neighborhoods of Dubai. These suggestions can be also applied to any neighborhood with similar urban form and spatial characteristics of the selected case neighborhoods in Dubai. Moreover, this study highlights the actual challenge that is translated in the weakness of the responsible institution's vision regarding their guidance and coordination in applying walkability principles to the studied neighborhoods in Dubai.

Keywords: Walkability, neighborhood, walkability principles, social sustainability, Dubai, UAE.

Title and Abstract (in Arabic)

تقييم قابلية المشي كأحد معايير الإستدامة الإجتماعية. حالة الأحياء السكنية في دبي، الإمارات العربية المتحدة.

الملخص

في محاولة للحد من الاعتماد على السيارات ، تم توجيه عملية التخطيط وخاصةً على مستوى الأحياء السكنية للتركيز على استيعاب قابلية السير كعامل مهم في تطوير التخطيط. لا يسهم هذا النهج في تحسين الأنماط الحضرية فحسب ، بل يسهم أيضًا بشكل كبير في معالجة قضايا الاستدامة (سينغ، 2016). جوانب الإستدامة الإجتماعية لم تحظ بالكثير من الاهتمام وتعتبر الركن الأقل وصفاً. تشير العلاقة الإيجابية بين جوانب السلوك الإنساني والبيئة وتحديداً قابلية السير إلى أن قياس جوانب الاستدامة الاجتماعية قد يكون أمرًا ممكنًا ، خاصة في سياق تنمية المجتمع.

توفر التنمية المستدامة للأحياء السكنية إمكانية العيش وتجمع بين الجوانب البيئية والخصائص الاجتماعية والاقتصادية المتوازنة. يعد مفهوم قابلية المشي أحد العوامل الرئيسية التي تسهم في إقامة مدينة مستدامة (دي كامبرا وآخرون ، 2012 ؛ أندروز وآخرون ، 2012 ؛ ويلر ، 2013). مع التركيز على قابلية السير ، يهدف هذا البحث إلى تقييم الجانب الاجتماعي للأحياء السكنية في دبي ، الإمارات العربية المتحدة. ويهدف ذلك إلى توفير نظرة ثاقبة لتحقيق عوامل قابلية السير للأحياء السكنية المختارة التي تؤثر على الحالة المكانية وكذلك تأثيرها على مستخدمي هذه الأحياء السكنية.

يطبق البحث المنهجية المختلطة ، النهج الكمي والنوعي. يطبق النهج النوعي القائم على دراسة الحالة, والدراسات الاستقصائية والمقابلات شبه منظمة. بينما في النهج الكمي تم استخدام برنامج يطلق عليه (DepthmapX).

قد حددت نتائج تقييم قابلية السير عوامل الإستدامة الإجتماعية في الأحياء المختارة في دبي ، والإمارات العربية المتحدة بشكل عام. أيضًا ، قد تم تحديد التحديات الفعلية في توجيه وتنسيق الرؤية المؤسسية المعنية في تطبيق مبادئ قابلية السير في الأحياء السكنية المختلفة في دبي.

مفاهيم البحث الرئيسية: سهولة السير، الأحياء السكنية، مبادئ قابلية السير، الاستدامة الاجتماعية، دبي، الإمارات العربية المتحدة.

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Finally, I must express my very profound gratitude to my family and friends for providing me with unfailing support and continuous encouragement throughout the period of my study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them. Thank you.

Dedication

To my beloved parents and family

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List of Abbreviations

DM	Dubai Municipality
DPM	Department of Urban Planning and Municipalities
GBC	Green Building Council
PRS	Pearl Rating System
RTA	The Road and Transport Authority
UAE	United Arab Emirates
UPC	Urban Planning Council
USDM	Urban Street and Design Manual

Chapter 1: Introduction

1.1 Overview

Walkable neighborhoods have recently been encouraged, due to a number of key factors attracting people to live within one of them. Transport for London (2004) defined walkability as "the extent to which walking is readily available to the consumer as a safe, accessible, connected and pleasant activity." The degree to which an area can provide opportunities for walking to the intended destination needs to be measured. Many cities consider walkability as a goal to achieve, which will be discussed later in the literature review section. Many planners studied the issue of walkability and suggested several solutions to achieve a walkable area (Wheeler, 2013). In recent years, infrastructure of cities has been improved by developers in order to include walking as an adequate mode of transportation (Alawadi, 2017).

Walkability is a controversial concept that is considered a key factor in improving the built environment. Moreover, the concept of walkability is discussed as a fundamental base to achieve social, economic and environmental sustainability in cities. Hence, it brings life and safety to the streets (Moura et al., 2017).

1.2 Statement of the Problem

Dubai spatial expansion favors cars as a mobility mode. The urban form of Dubai city supports and prioritizes automobile than humans. In Addition, major research has been conducted regarding the subject of walkability such like the studies of Frank et al. (2010); Azmi and Karim (2012); Jun and Hur (2015) and others. Such studies, however, are mostly focusing on theoretical concepts and has not been executed to the expected levels in practice. In other words, a distinct gap exists

between the literature and implementation practices. Therefore, this research revises walkability literature in theory and practice to identify its principles. Thus, this study aims to assess walkability as a social aspect of sustainability particularly the context of Dubai neighborhoods, and the UAE in general.

This assessment focuses on both physical space as well as on users' perception. The findings of the research support policies to enhance walkability in Dubai neighborhoods and the UAE in general. Dubai is considered a perfect example for studying this issue since it is designed to be automobile-oriented.

1.3 Research Questions

This research aims to assess walkability as a social aspect of sustainability. The following questions will be answered by the end of research:

- Main question: What is the assessment of walkability in Dubai neighborhoods and what is the effect of walkability on social sustainability?
- Sub-questions:
    - How does walkability affect/contribute to social sustainability?
    - How does the physical space dis/encourage people to walk in certain neighborhoods in Dubai?
    - How does people's perception of neighborhoods relate to walkability?
    - What is the impact of Dubai's development policies on walkability?

1.4 Research Objectives

In this research the following objectives are pursued to achieve the main aims of this research:

- Measuring the efficiency of walkability in selected neighborhoods in Dubai.
- Investigating people's perception about walkability in their neighborhoods.
- Highlighting the critical factors that affect/improve walkability in the selected neighborhoods.
- Understanding the policies adopted and developed by Dubai Authorities to achieve walkability.
- Providing recommendations to guide planners and introduce them to the required criteria for developing a walkable neighborhood.

1.5 Relevant Literature

This section discusses relevant academic literature that was reviewed for this study. It presents the opinions of several researchers and helps in answering the research questions. It firstly discusses urban form under two main titles; the elements of urban form and sustainable urban form. After that, it argues the quality of life by examining walkable neighborhoods based on definition and purpose. Finally, it discusses sustainable development, social sustainability, local sustainability initiatives, and planning development, as well as the involved stakeholders in Dubai.

1.5.1 Urban Form

Urban form is primarily a spatial construct associated with building layout as related to street, pattern of development, and human activities. It is also usually defined in terms of connectivity, mix land use, proximity, density and the built environment (Nedovic-Budic et al., 2016).

1.5.1.1 Elements of Urban Form

Dempsey et al. (2010) noted that urban form includes different elements. First is density, which is considered the most significant variable used to measure urban structure and urban form. It can be calculated according to the average number of populations per square kilometer of a developed land. Second is mix land use, which is a term used to describe different functions of land use. Mix land use usually includes residential, industrial, rentals, offices, infrastructure and other uses. The third element is the transportation infrastructure and it is associated with accessibility. Accessibility covers the location of particular destinations, and how the transport system connects with the distributed locations. Fourth is the layout, which describes the arrangement of streets, blocks and buildings. Layout can also refer to street patterns. This concept was developed by Marshall (2004) as shown in Figure (1). Street pattern functions at two levels; macroscopic and microscopic street network. In terms of the macroscopic level, streets are generally continuous; as a substantial portion of city dwellers travel from one part of the city to another. The microscopic level refers to the neighborhood street network that serves the requirements of residential neighborhood travel. Marshall (2004) also defined the types of street pattern for each level. City-wide street networks (macroscopic) are linear, tributary, radial or gridded. However, on the next level, neighborhood street networks can be marked as trees or grids. Nevertheless,

Southworth and Ben-Joseph (2013) had classified street patterns into five categories; gridiron, fragmented, warped parallel, loops and lollipops, and lollipops on a stick as shown in Figure (2). The final element describing urban form is the characteristics of houses and buildings. The latter can have a demonstrable effect on everyday living. Residents living in low-rise buildings have a different experience from people inhabiting high-rise buildings. Thus, building height, type, age and orientation can have a large effect on the experience of urban living (Dempsey et al., 2010).

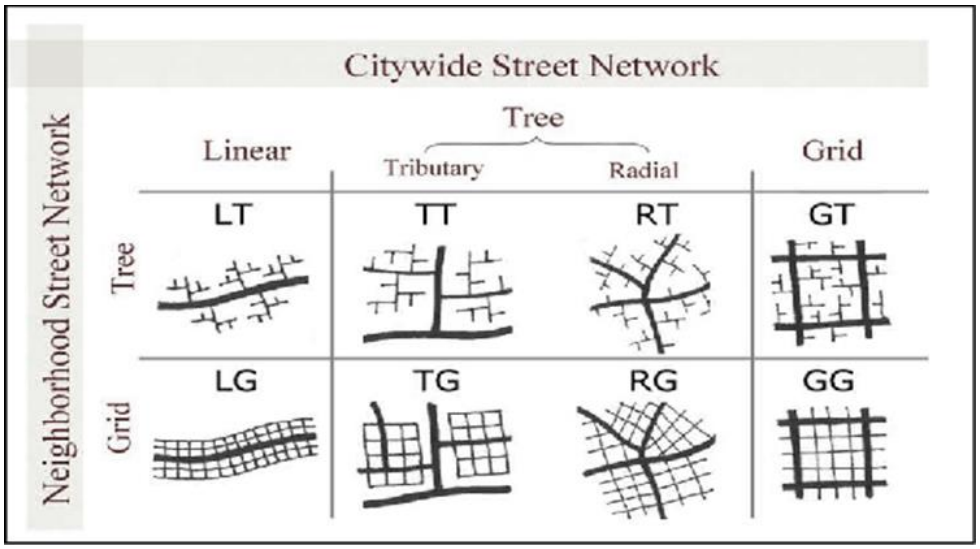

Figure 1: Neighborhood Street Network (Narshall, 2004)

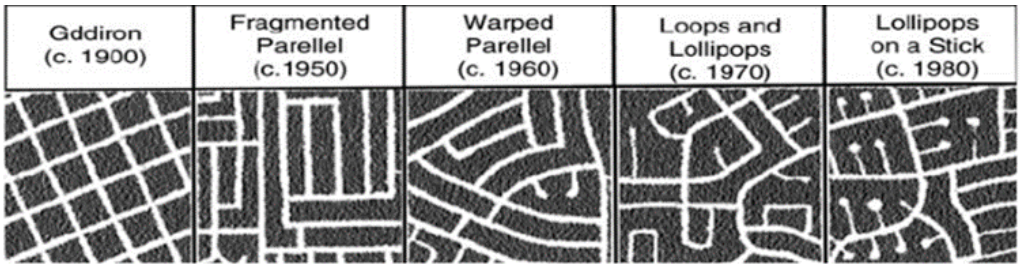

Figure 2: Street Network (Southworth and Ben-Joseph, 2013)

1.5.1.2 Sustainable Urban Form

There are several types of urban form, but which type is sustainable? This question was raised and answered by numerous researchers. Jabareen (2006) provided a matrix to assess sustainable urban form as a way to help planners evaluate the level of sustainability in studied or designed urban forms. The matrix identifies seven different design concepts of urban form; compactness, sustainable transport, density, mix land use, passive solar design and greening. These design concepts of urban form were classified into four types of sustainable urban form; urban containment, eco-city, compact city and neo-traditional development. Previous studies of urban forms (Jabareen, 2006; Sharmin, 2011; Burgess and Jenks, 2002 and others) concluded that the compacted city is the most sustainable urban form. Research by Coppola et al. (2014) supports similar theory and findings in terms of the correlation between urban forms; mainly it is compacted compared to sprawl and Transit Oriented Development (TOD).

Compacted form refers to the physical layout and the spatial arrangement of the city. It suggests that higher densities in the built area lead to a better urban economy, social and cultural activates (Burgess, 2000). The compact form of a city is understood as a prototype for interactive, livable and sociable urban life. The form structures cities in a way that locates buildings close to each other in a particular place of high density (Shirazi and Falahat, 2012). However, it is associated with many indicators, as studied by different researchers. Tsai (2005), for instance, collected and classified a lot of data to show the usage of different indicators when measuring urban form. Tsai (2005) found that the most used indicators for measuring the compacted city are density, continuity, proximity and land use. In addition, Nedovic-Budic et al. (2016) studied the change of urban form in terms of residential and commercial

density, mix land use, and internal and external connectivity at the community scale. Measuring urban form according to different scales helps in devising different urban policies and urban planning approaches. Based on earlier studies, Tsai (2005) and Nedovic-Budic et al. (2016) identify several indicators that have proven applicable when evaluating compactness in any context. Therefore, Sustainable urban form can improve quality of life by producing healthier, attractive, and more livable communities.

1.5.2 Quality of Life

Quality of life is an urban concept that affects the overall experience of human life. Shumi et al. (2015) discussed the important of walkability in improving the quality of life. Walkability has been proven to have an impact on different domains of the overall quality of life such as personal safety, security, personal interaction with others in the street, social involvement and sense of belonging to the community. Moreover, walkability is positively affecting the quality of life in many other ways; health benefits from the physical activity, access benefits from being able to walk for ones' daily needs, and social benefits of reduced isolation and better engagement with the society. These are few of many other positive impacts (Rogers et al., 2011).

Costanza et al. (2007) defined quality of life as a general term representing how well human needs are insured, and the extent to which individuals or groups perceive satisfaction or dissatisfaction in several life domains. This term has been commonly articulated according to multiple aspects including psychology, medicine, economics, environmental sciences, public health, sociology and urban planning. It is also known as a complex concept in human life because it deals with human satisfaction and its effect on people's lives.

Improving quality of life is important in every city, especially cities under development (Ebrahimzadeh et al., 2016; Khalil, 2012). Moreover, they had suggested that architects, urban planners, designers and developers should work together to achieve this objective.

Mccrea et al. (2005) studied quality of life at three demographic levels, by focusing on specific factors at each level; regional satisfaction, neighborhood satisfaction, and housing satisfaction. In regional level, the study focused on cost of living, governmental services (health, education), pollution and transportation. At the neighborhood level, they studied social interaction, neighborhood crime, public facilities (parks, libraries), accessibility and transportation. In terms of housing satisfaction, they studied the age of houses, size, home ownership and temperature. It is worth mentioning that choosing certain variables might only be significant according to identifiable demographic characteristics. Therefore, improving and increasing quality of life in any selected area can be achieved by studying the space itself, and its users.

1.5.3 Walkability in Neighborhoods

Urban spaces consist of different levels. Neighborhoods are one level of the hierarchy. Neighborhoods are the places where people are tied with the rest of the community as their lives become interlinked and interdependent. This relationship is a result of the socioeconomic effect (Mumford, 1954). Park and Rogers (2015) defined the neighborhood as a certain geographical place where group of people share services and cohesion of different levels. Neighborhoods, on the other hand, can be classified into different hierarchal levels according to their size, level of cohesion and the services shared.

In recent years, planners and policymakers had begun to understand the implications of city's urban design on humans' interactions. Walkability has a different scope according to different scales. Turon et al. (2017) have classified three different scales; planning scale, street scale and detailed scale:

- Planning scale considers the following actions: planning a compact city structure, standardizing green areas, avoiding large areas that are inaccessible to pedestrians, clearing special structures, considering squares for pedestrians, providing a high level of attractiveness, creating public transport nodes and paths for disabled persons, and finally avoiding blind footpaths.
- Street scale considers certain actions such as widening pedestrian pathways, providing pedestrian crossings, removing parking places on pavements, increasing the safety of pedestrians, reducing the amount of traffic lights and crash barriers, etc.
- Detailed scale, however, cares about the following: providing good quality pavement surfaces, increasing the number of trees, bushes and flowers, proper placement of architectural elements, etc.

Walkability has been proved to enhance the experiences and interactions within the local environment and the overall urban spaces in the city (Cervero & Radisch, 1996). Moreover, walking has been discussed as an important factor that can improve the quality of life in cities. Therefore, one can easily identify the strong relation between this physical activity and the layout of the built environment. Pedestrian characteristics such as young/old, male/female, fit/unfit, and the purpose of walking such as utilitarian or/and leisure, have huge effects on walkability. As mentioned, walking is performed for different reasons. First, walking can be performed as a mode

of transportation; to get to school or work (Andrews et al., 2012). However, it can be a leisure activity; to have fun and spend time (Andrews et al., 2012). Moreover, walking is considered an ideal sport that improves the overall physical health of performers; it is an ideal way to lose extra kilos or remain at an optimum weight (Andrews et al., 2012). Walkability also differs in different levels of planning (i.e. community, neighborhoods or district). Differences in either the purpose or level of planning can affect walkability.

Reinhart et al. (2013) have discussed walkability as an important concept when considering how pedestrianism is defined, and how it shapes walking spaces. It is important for planners and urban designers to outline the key principles of walkability to design and provide walkable urban spaces. Koohsari et al. (2016) have implied that changes in a walkable neighborhood convey a different meaning in different cultures. Therefore, each scenario requires different implication to obtain optimum results regarding walkability.

In Andrews et al. (2012) research of urban public spaces in the UK, it has been concluded that walkable spaces are essential in providing different areas for local people taking local trips. Moreover, they added that UK's urban spaces are accessible to public transportation and provide community cohesion. Accordingly, one can conclude that authorities should understand the need for walkable spaces in cities (Atef Elhamy Kamel, 2013). Nevertheless, authorities should plan and design for walkability especially around residential areas (Atef Elhamy Kamel, 2013). In the planning and designing process, authorities can benefit from the community's feedback in order to develop a sustainable master plan (Andrews et al., 2012). The approaches utilized by designers ensure that they can engage community members when improving

neighborhood facilities. Considering and bringing people's perception and needs to the picture will help to put walkability in right track.

De Cambra et al. (2012) discussed the importance of walkability as a foundation for the sustainable city; providing social, environmental and economic benefits. From a social perspective, walkability brings life to the streets and helps in creating safer urban environments. On the environmental side, walkability promotes green modes of transport that reduces the dependency on automobiles. Unlike other modes of transportation, walking has no negative environmental impact and it creates no air or noise pollution. Moreover, reducing resource consumption can lead to economic benefits. In addition, walking can increase local street shopping and benefit public health.

1.5.4 Walkability as a Social Aspect of Sustainability

The concept of sustainability emerged in the early to mid-1980s, defining the associated aspects of sustainability as environmental, social, and economic (Robinson, 2004). Sustainability is a complex concept that combines many sub-concepts. Sustainability is defined as "[a] development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" as mentioned in the report of Our Common Future from the United Nations WCED (1987). In other words, sustainable developments can be defined as "a process in which communities anticipate and accommodate the needs of current and future generations in ways that reproduce and balance local social, economic, and ecological systems, and link local actions to global concerns" (Berke and Conroy, 2000).

At the core of development, the concept of sustainability is significance in planning of urban areas since sustainability fulfills various needs. Neighborhoods have

been an interesting topic for planners and developers. Many concepts and theories were developed in the early 20th century regarding the design of livable neighborhoods. Sustainability has offered principles to assess neighborhoods' development among three different dimensions; environmental, social and economic (Sharifi, 2016). In developed countries, developing neighborhoods to be sustainable is on the top of their agendas (Moroke et al., 2019). The most disadvantaged neighborhoods are the ones neglected from the sustainability initiative. In addition, sustainability principles within the neighborhood level can be utilized as a scale of analysis of social and economic aspects. Moreover, in such case, the involvement of citizens can be easier and meaningfully facilitated. It has been argued that sustainable urban development should be analyzed according to multi-levels; from regional scale to project scale. As a basic planning unit, the neighborhood has gained huge attention. The sustainable neighborhood is a place which can achieve economic, social and environmental sustainability (Figure 3).

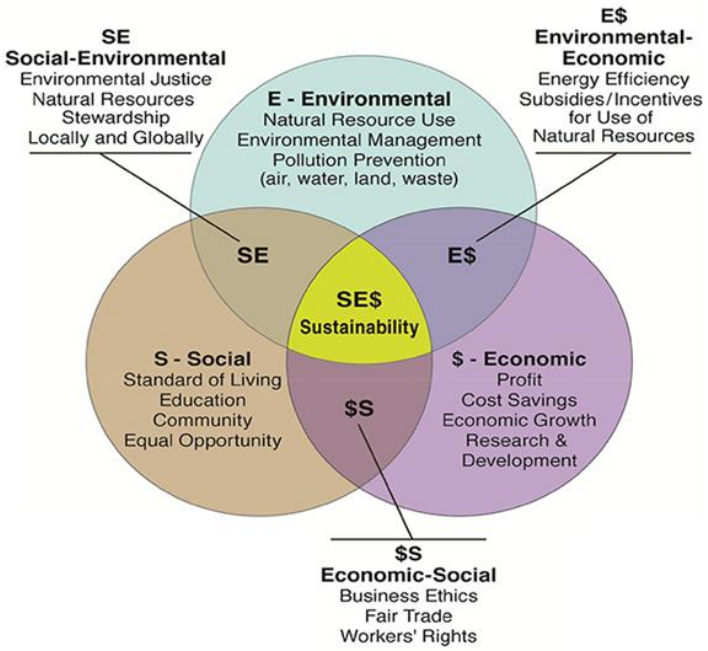

Figure 3: Sustainable Aspects (Baker et al., 2012)

Social aspect is one pillar of sustainability. This aspect considers people and their interactions with the surrounding built and natural environment. “Social sustainability occurs when formal and informal processes, systems, structures and relationships actively support the capacity of current and future generations to create healthy and livable communities. Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life” (McKenzie, 2004). The wider community needs to ensure a good quality of life for users at the individual, group and community levels. Social sustainability encourages equal opportunities and social interactions. In addition, it provides equity in human rights, allows people to be part of the decision-making process, and ensures access to key services and amenities including health, education, transport, housing and recreation. Social sustainability promotes wellbeing, improves safety, and supports social coherence (Hediger, 2000; Murphy, 2012). Different urban design concepts can improve social sustainability such like density, mix land use, accessibility, connectivity, mobility, sense of place/identity, social capital, equity and etc. These urban principles are studied by several researchers (Barton, 2000; Rattan, Campese & Eden, 2012; McDonald et al., 2012; Marquet & Miralles-Guasch, 2015; Talen, 2002; Cerin et al., 2006; Buck et al., 2015; Koohsari et al., 2015 and others). Walkability is one of the aspects used to promote and create a social sustainable neighborhood. To increase walkability, the design of the neighborhood needs to apply several sustainability principles (Rogers et al., 2013). Walkable cities consider social environment, people’s perception, physical activities, comfort and safety of users, connectivity with the surrounding space and other walk boosting principles.

1.5.5 Walk Boosting Principles

Walk boosting principles are concepts that if applied right, can increase the activity of walking in urban developments. They include development density, mix land use, provision of amenities and facilities, accessibility, safety, and connectivity.

1.5.5.1 Development Density

Density is an indicator of walkability that can be considered as a primary measuring indicator. It is divided into Net and Gross density. Net density refers to the number of dwellings per hectare on land devoted solely for residential development. Meanwhile, it includes private driveways and private open spaces and does not include public roads or public open spaces. Gross density, however, indicates the density of a given area including its infrastructure such as public roads, public open spaces and in some instances non-residential developments like schools and shops (Planning SA, 2006). Sufficient density is needed for a sustainable development. In order to reach that optimum density, the gross density which is the ratio of total population over the area has to be between 40-50 person per hectare (Stead, 1999 as cited in Barton, 2000).

Cerin et al. (2007) suggested that if urban planners had made convenient choices in their designs, they would have been able to look forward to increase walking spaces within their density, and design pedestrian-scaled streetscapes. In urban areas, there have been multiple residential and non-residential densities and destinations offering proximity in retail and service destinations as a way to accommodate the residents of urban areas. However, with changes in density and destinations, factors such as urban planning and design are supposed to be amended to achieve goals and objectives of sustainability (Rattan, Campese, & Eden, 2012). Designers should apply the principles of a sustainable city within society in order to encourage walkability in

urban spaces. There are other advantages for using density to support the sustainable development of walkability. For instance, it increases the quantity of traveling and physical activity among locals. It also increases access to infrastructure services and improves social interactions among people, as comprehended by French et al. (2014).

1.5.5.2 Mix Land Use

Mix land use can be utilized to make it convenient and easy for users to access different services and facilities, especially their workplaces (McDonald et al., 2012). Additionally, it generates some opportunities for individuals who are involved in physical activities and active traveling. These areas include revitalizing projects such as local parks for residents and visitors (Marquet & Miralles-Guasch, 2015). This kind of mix use development provides users with functional places that include activities and make it possible to stay connected with nature and improve distressed neighborhood areas that could otherwise be considered walkable.

Talen (2002) offered a study of how mix land use enables a range of land uses such as residential, industrial, and commercial, to be located in a way that supports a sustainable form of walkability. A mix land use neighborhood should include different dwelling types, home businesses, health care facilities, nursery and schools as a way to encourage walkability within walkable distances in the area. According to Barton (2000), mix land use can be achieved by:

- Providing various open spaces with services suiting all users.
- Locating development areas within easy walking distance, high-quality public transport corridors or other public transport operations.
- Providing a range of development types which allow people to use the space during the day and at nighttime.

1.5.5.3 Provision of Amenities and Facilities

Different amenities should be provided in neighborhoods such like parks and green spaces, and other convenient facilities and pedestrian amenities which are needed in daily life. Neighborhood facilities are the services or amenities utilized by local communities for various purposes. They may include food retail, transport, education, recreation, and etc. Diversity of amenities increases pedestrians' use and improves the feeling of safety and social capital. The differential access to services and amenities impacts in neighborhood's collective efficacy, and the relationship between social capital and health (McKenzie et al., 2013).

Livable Neighborhoods present a compact urban form based on walkable area. They include a mix of amenities and facilities, and an interconnected street patterns to enable all modes of movement. Residents are encouraged to walk when amenities and facilities are offered within direct, safe, amenable and exciting routes (Jones, 2001).

1.5.5.4 Accessibility

Accessibility is a function of proximity to destinations and the directness of routes leading to those destinations. An initial round of measures includes playful concepts like the "popsicle test". This concept deems a neighborhood walkable if an 8-year-old can buy a popsicle and return home before it melts (Larabee, 2008 as cited in Talen & Koschinsky, 2013). Another commonly accepted rule of thumb is that a neighborhood can be considered walkable if the services that are needed for daily life are within 0.25 miles (5 minutes), 0.5 miles (10 minutes) or a one-mile (20 minutes) distance (Turner et al., 1998). Proximity to workplaces and proximity to commercial destinations is positively associated with walking for transport (Cerin et al., 2007; King et al., 2015). Proximity to destinations creates a livable community and a social

welfare. As shown in Figure (4), Barton et al. (1995, as cited in Barton, 2000) provided the required standards for a catchment area to be accessible to all dwellers wishing to choose walking or cycling as follows (this has been integrated in the research analysis of accessibility):

- 200 meters: toddler play area.
- 200- 400 meters: allotment/ community gardens
- 300-400 meters: bus stop
- 400- 600 meters: playground/primary school.
- 400- 800 meters: local shops/ Pub
- 800-1000 meters: health center/open space/playing fields.
- 1000-1500 meters: secondary school (open access).
- 1500-2000 meters: district center and leisure center.
- 2000-3000 meters: technical college and major natural greenspace.
- 5000 meters: cultural and entertainment facilities, major commercial center and a general hospital.

According to Leslie et al. (2007), relatively dense localities are required to facilitate residents and provide walking spaces near to their localities. This can be achieved by managing a determined radius as provided by the Barton (2000) in his book of sustainable community development, in an attempt to reduce net vehicle miles travelled directing people towards the street to access nearby amenities easily.

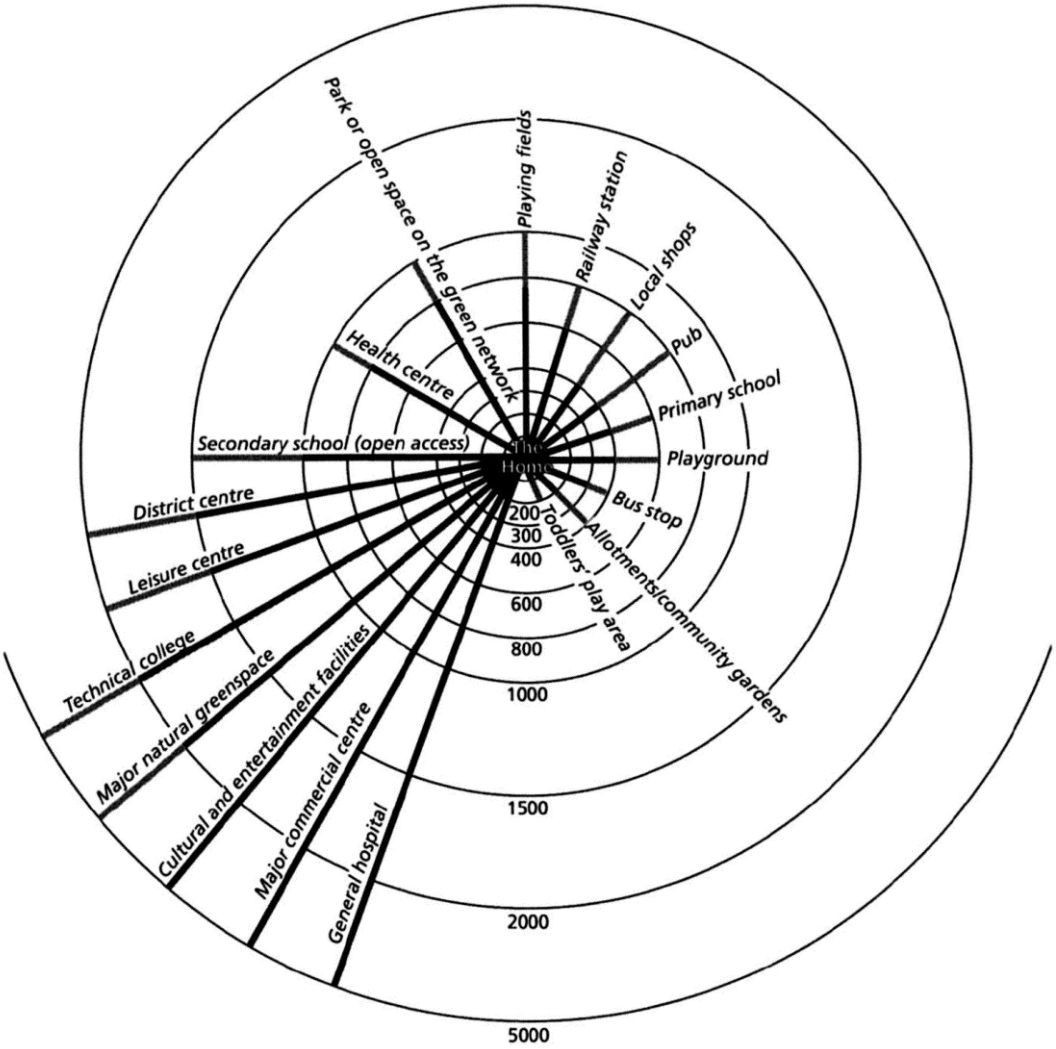

Figure 4: Standards for the Catchment Area (Barton et al., 1995 as cited in Barton, 2000)

Forsyth and Southworth (2008) and Galanis and Eliou (2011) noted that street furniture affects pedestrians and it needs to be well considered at the design stage. It contains signage and wayfinding system, shading devices, lighting fixtures, benches and etc. Developing clear signage and wayfinding system improves accessibility and the awareness of possible destinations to amenities and services for both residents and visitors. When developing a wayfinding system, considerations should be given to the design and placement of the signage, so it is accessible for all users. This can be achieved by using a special color and font making it more legible. Signs should also

use common international symbols for highlighting services and directions. Signs should be located at a height that is visible for people to read, whether standing, walking or seated. Shading elements, on the other hand, should also be included along the primary pedestrian network within neighborhoods, and on street networks that connect transport nodes/stops with surrounding communities. This can be achieved by using trees and/or structural elements as shading for pedestrians' networks. Moreover, buildings can be oriented in a way that provides shading and takes advantage of the prevailing wind direction. Other street furniture, such as benches, should also be provided on the sidewalk in a way that does not obstruct the footway zone nor make them prone to damage by vehicles.

Accessibility refers to the ability of everyone including people with special needs, children, and elderly to access and use the street. They should easily find their way in any public space. The provision of accessible infrastructure should be engaging with people with special needs to meet their physical capacities and provide unlimited choices for them. There is a fact of equal rights for people with special needs which means that all mobility requirements of society members are equally important and has to be met. Considering every user's needs in the design creates a strong foundation of the society and this should be considered while designing the urban space on each planning level (Mahmoudi & Fanaei, 2010; Pettersson, 2009).

1.5.5.5 Sense of Safety

Safety is one of the important aspects while designing a walkable neighborhood. The streets should be designed to ensure pedestrians' safety. Koohsari et al. (2015) investigated how separate street networks become problematic for individuals. The concept of new urbanism regarding walkability is discussed

thoroughly in different countries as a way to promote safety for walking people. However, even in developed countries, the concept requires intensive research and design to build a system that will meet the objectives of becoming a walkable city.

Safety can be achieved by providing welcoming streets for users allowing them to walk in a safe and comfortable environment. Additionally, reducing the accessibility of cars within the area reduces traffic accidents. Sidewalks are essential for protecting people when walking within the built environment. Sidewalks can be safe by providing sufficient sidewalk width, crossing, lighting and barriers. Sidewalk width should be designed in a way considering pedestrian volumes, vehicle flows, and loading activity. As mentioned, to ensure safety, footways must consider the different needs of all users, including people of different determinations.

Ewing (1999) provided a manual for traffic engineering regarding the design of pedestrian sidewalks. The minimum width should range between 4 to 8 feet depending on the functional class of the road. While 5 to 6 feet sidewalk are enough to ensure the comfortability of walkers.

Pedestrian crossings should be integrated in the design of pedestrian networks, considering desirable pathways and the need for universal access. These should be marked well to enhance visual presence and should be provided with lights at crossing for night visibility. Moreover, lights should be provided along pedestrian pathways. The design of lighting fixtures, in terms of style and materials, should fit in with the local streetscape furniture. The height of street lighting columns should also be considered. Furthermore, using barriers is essential to create a buffer between the footway zone, surrounding roads, and parking surfaces and/or buildings. This can be achieved by using landscape or structure elements. Streets are safer when their design

avoids sharp corners, provides marked intersections, and keeps the car speed low (Road and Transportation Authority, 2016).

Serag El Din et al. (2013) believed that a walking audit is outlined by survey audit tools and sidewalks to improve people's health and safety. In addition, Pinto and Remesar (2015) stated that the concept of walkability design considers safety, intersections in design, and accessible pedestrian ramps and signals so as to ensure that such spaces are completely safe and to secure an approach differentiating between urban and rural areas.

1.5.5.6 Connectivity and Integration

Leslie et al. (2005) indicated that designers are often focusing on underpinning different concepts regarding urban liveliness as an essential component of street connectivity. It has been said that the impact of street connectivity focuses on integrating transit walking as a successful way to achieve goals. It is vital for individuals to look forward to a transit system that helps them provide a stable urban culture. It was noted, when considering a study by Frank et al. (2010), that working on connectivity can serve to encourage use of walking spaces. Connectivity of street networks can increase accessibility in different ways. For instance, connectivity provides short but direct routes to an original destination. To achieve exceptional results based on urban networks, interconnected streets should be designed to improve transit in a way offering travel opportunities for pedestrians and reducing the distance between origin and destination when individuals are keen to reach.

Cerin et al. (2006) provided a study revealing requirements of street connectivity. This study suggests providing a suitable connection between the main locations and the streets. It also ensures that pedestrians have access to spaces such as

cafes, tree canopies, shelters, and arcades, so individuals can enjoy the design while increasing their walking period. Reinhart et al. (2013) noted that walkable places also incorporate healthy corridors along which city dwellers can access commercial strips. Having these commercial corridors helps urban planners, designers, and architects in designing safe accesses for pedestrians with sidewalks and intersections. This approach of integrating commerce and street networks has been adopted in developed cities such as London and New York (Ortolani & Vitale, 2016). It assists cities in redeveloping corridors that positively affect the health of residents within their communities.

However, the impact of a street network design is associated with the design of public transportation that connects streets and measures the average properties located along the street network (Buck et al., 2015). It is essential for urban planners to undertake prevalent measures to manage street connectivity within each buffer. The total street length, as calculated within each buffer depends on the radius. It helps designers to work with a successful design, without facing any dangers that might directly or indirectly affect the practicality of local community space.

The design of street network of neighborhoods has a huge impact on the ability of pedestrians to use the street easily. Street intersection density is one indicator that is used to assess connectivity. Intersection density can be calculated by the number of intersections per square kilometers. The area with high intersection density requires less out of the direction travel to get from one place to another where the distances are shorter. The neighborhood with higher intersection density might be more connected and accessible than those neighborhoods with lower intersection densities. These neighborhoods, accordingly, can be considered as more walkable (Frank et al., 2010; Hickman et al., 2015). UN-Habitat recommends about 100 intersection per square

kilometer, and such a level makes the city to use the non-motorized transport (Wagai, 2016). The score of 1.4 is used as the threshold of the high street connectivity (Street Networks 101, n.d.; Hickman et al., 2015).

1.5.6 Imageability and Legibility

The concept of imageability and legibility is developed by Kevin Lynch. Lynch (1960) developed a method classifying city's images. He looked at connections between human values and the physical forms of cities. The city can be described by mentioning its surrounding elements.

Imageability is a quality of place describing the place as memorable and recognizable. Place is where some elements of space can give positive feeling. It is a visual aspect of urban environment which helps users generate an image of their surroundings and assign meanings to it. So, it can create a relation between the built environment and users of space.

The role of legibility in urban form is summarized in a concept of place legibility. According to Lynch (1960), there are some important urban elements that shape the urban space; paths, edges, nodes, districts and landmarks. Paths are a channel where people move along through urban environment including sidewalks and streets. The junctions of paths form nodes, and these can be used as open public spaces in the area. Edges are boundaries surrounding a particular district such as walls, seashores, railway lines and etc. Districts are large areas that share homogeneous characteristics including size, texture, space, form, facades of building, material, patterns of movement and etc. Landmarks, finally, are external physical objects that act as reference points for most people such as towers, sculptures, signs, trees and etc.

1.5.7 Planning Development and Involved Stakeholders in Dubai

The planning development units lay down the objectives, policies and strategies of any organization. This research will discuss two main developers of urban areas in Dubai; Dubai Municipality (DM) and Road and Transportation Authority (RTA).

The vision and mission of Dubai Municipality are developed along with developing the strategic plans of Dubai city. Dubai Municipality had developed three strategic plans for the city of Dubai; 2010-2014, 2013-2015 and 2016-2021. In 2010-2014, the city's vision was to create a city that provides success and comfortable living. However, in 2013-2015, they began enhancing urban planning policies to achieve a balance between land use and sustainable urban development and to ensure the availability of services. In addition, they aimed to ensure environmental protection, health, food safety, and maintenance of natural resources as a component of sustainability. In addition, they wished to provide and motivate the preservation of infrastructure of resources. Finally, in 2016-2021, they outlined a vision to develop a happy and sustainable city. In the final planning version, they are considering six themes, each highlighting a group of strategic developmental aims for Dubai. First, people of Dubai are concerned. "City of Happy, Creative & Empowered People" program focuses on the feeling of responsibility towards each individual by promoting education and personal development, maintaining a healthy lifestyle that will enable them to be an active, productive, and innovate in all aspects of society and economy. Second, the society is concerned. "An Inclusive & Cohesive Society" program focuses on preserving Dubai's traditions, discussing the importance of family as the basic building unit of society, and highlighting the importance of social inclusion for all

vulnerable groups in the society. Third, the experience in Dubai city is concerned. “The Preferred Place to Live, Work & Visit” program focuses on improving Dubai’s livability. It highlights the need for the best educational, health, housing services to all residents. Fourth, the place of Dubai is concerned. “A Smart & Sustainable City” program focuses on having an integrated and connected city. This will be achieved by using sustainable resources, enjoying a clean and healthy environment, and considering safety standards across the built environment. Fifth, the economy of Dubai city is concerned. “A Pivotal Hub in the Global Economy” program focuses on sustainable economic growth and aims to enhance its standing as a global business center, rising to be among one of the five tops centers of trade, logistics, finance, and tourism. Sixth, the government of Dubai is concerned. “A Pioneering and Excellent Government” program focuses on the satisfaction and contentedness of people toward governmental services and policies. Additionally, it considers governmental efficiency and transparency in all aspects. In this strategy, Dubai considers the place as a main point to be developed to reach a sustainable and happy city in all aspects (Strategic Plan of Dubai municipality, 2019). The previous plans show that Dubai is considering people as a first priority. People of Dubai’s needs are accounted by supporting a comfortable, easy, and healthy life. One of their aims is to have a sustainable city, which fulfils the important requirement for walkable spaces.

Regarding Road and Transportations Authority (RTA), their vision is to have “safe and smooth transport for all”, while the mission is to “develop integrated and sustainable transportation systems and provide distinguished services to all stakeholders to support Dubai’s comprehensive growth plans through preparing policies and legislations, adopting technologies and innovative approaches, and implementing world-class practices and standards” (Dubai RTA, 2019).

To conclude, Dubai is developing plans that are provided by the municipality as a way to consider and enhance the integrated infrastructure. These plans are ensuring easy mobility for all residents and tourists and are providing easy access to all economic centers and social services. Whereas, RTA responds to all study criteria, by initiating and developing walkability throughout the neighborhoods of Dubai. RTA seeks to achieve a better provision for pedestrian movement across all services and public transportation in an attempt to reduce dependence on private transportation. However, there is ambiguity in term of coordinating and implementing of walkability development plans between the two governmental organization; DM and RTA. There are some problems related to the policies applied for improving the walkability in Dubai which will be discussed in the coming chapters.

1.5.8 Local Initiatives in the UAE

Emirates Green Building Council (GBC) encourages the use of recognized green building rating tools as a guide to develop more sustainable built environment. There are several rating systems in the global market but those used specifically in the UAE market include Estidama, LEED and etc.

1.5.8.1 Abu Dhabi

In Abu Dhabi city, the capital city of the UAE, Estidama program was established in 2008 by the Department of Urban Planning and Municipalities (DPM). Estidama in Arabic language means sustainability. This green building rating system is developed to promote sustainability and enhance quality of life. The purpose of Estidama is to create a new sustainability framework that supports the specific sustainability needs of the UAE and preserves UAE’s local culture. Estidama has a special rating standard named as the Pearl Rating System (PRS).

The Pearl Rating System has been the implementation tool for Estidama for the past two years. Every new building in the Emirate must now adhere to minimum sustainability requirements throughout the design and construction stages, with the operation and maintenance also assessed to ensure developments remain sustainable. Ensuring continuity of building performance remains a key concern for the Urban Planning Council (UPC), which officially unveiled its Estidama Pearl Operational Rating System, the first initiative of this type in the region, at Cityscape in 2013 (Abu Dhabi Planning Council, 2016).

The institute has developed Abu Dhabi's Urban Street and Design Manual (USDM) which represents excellence in the planning and design of urban streets. The USDM design principles are adapting with the main principles of Abu Dhabi Vision of 2030 including overarching principles to promote walkable neighborhoods, enhancing connectivity, and creating a sustainable urban environment. Accordingly, USDM design priorities emphasize the need to create a pleasant and safe environment for pedestrians and cyclists, the most vulnerable users on urban streets. In doing so, walkability, sustainability, and public health will be enhanced in the city (Abu Dhabi Planning Council, 2013). This manual, as described, gives the priority for pedestrians, transit users, cyclists and then motor vehicles. Figure (5) shows the criteria to design a street in residential areas for different street types. According to this design manual, the pedestrian catchment distance to public transit stations or to key amenities and facilities is to be within a 350 m catchment area. The street hierarchy, therefore, is divided into different categories (Table 1); boulevard is a high vehicle priority with three lanes in each direction, avenue is a medium vehicle priority with two lanes in each direction, street is a low vehicle priority with one lane in each direction, and

finally access lane is a very low vehicle priority with one lane in each direction or could also be a one-lane shared street (Abu Dhabi Urban Planning Council, 2016).

Table 1: Street Hierarchy (Abu Dhabi Urban Planning Council, 2016)

Street Family	Transport Capacity		Land Use Context					
	Vehicle Priority	Travel Lanes	City (7stories +)	Town (3-6 stories)	Commercial (1-3 stories)	Residential (1-3 stories)	Industrial	No Active Frontage
Boulevard	High	3+3	City Boulevard	Town Boulevard	Commercial Boulevard	Residential Boulevard	Industrial Boulevard	General Boulevard
Avenue	Medium	2+2	City Avenue	Town Avenue	Commercial Avenue	Residential Avenue	Industrial Avenue	General Avenue
Street	Low	1+1	City Street	Town Street	Commercial Street	Residential Street	Industrial Street	General Street
Access Lane	Very Low	1+1 1 shared	City Access	Town Access	Commercial Access	Residential Access	Industrial Access	General Access

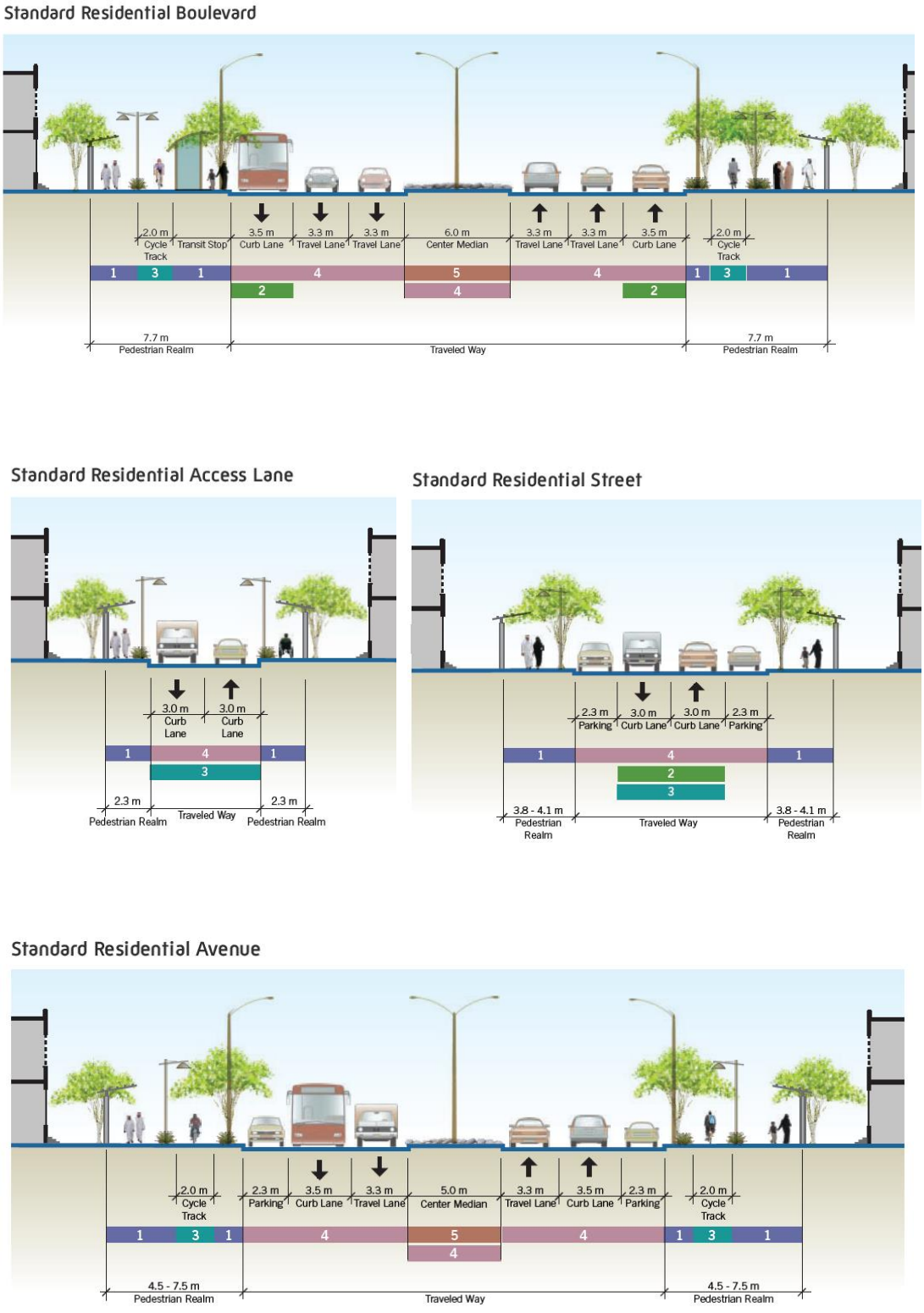

Figure 5: Street Design for Different Street Types (Abu Dhabi Urban Street Design Manual, 2016)

1.5.8.2 Dubai

In Dubai, LEED for Neighborhood Development is a rating system that incorporates principles of smart growth, New Urbanism, and green building into a national standard for green neighborhood design. According to LEED for Neighborhood Development, the creation of walkable communities should integrate the framework of the surrounding environment. This is achieved by considering the quality of networks (including pedestrian/bicycle) or the locations that require walkable streets to have a continuous sidewalks or equivalent all-weather routes. The design of walkable streets should provide walking routes along both sides of 90% of the circulation network block length within any project, including the project side of circulation network bordering the project. Bicycle- and pedestrian-only paths meet this requirement. Moreover, the design of walkable streets should provide sidewalks that are at least 8 feet (2.5 meters) wide on retail or mixed-use blocks and at least 4 feet (1.2 meters) wide on all other blocks (U.S. Green Building Council, 2018).

Accessibility code standards for the built environment developed by Dubai Creative Clusters Authority is designed to promote good practice in the design of buildings and the public realm with respect to accessibility. The document shows the proper dimensions needed for pedestrians' walkways as shown in Figures (6 & 7). Principal routes should be designed with a minimum of 1.80 meters wide, while secondary routes should be designed with a minimum of 1.50 meters wide. The code covers all related design parameters for pedestrian routes like width, shades, furniture, lighting and even drainage (Dubai Creative Clusters Authority, 2016).

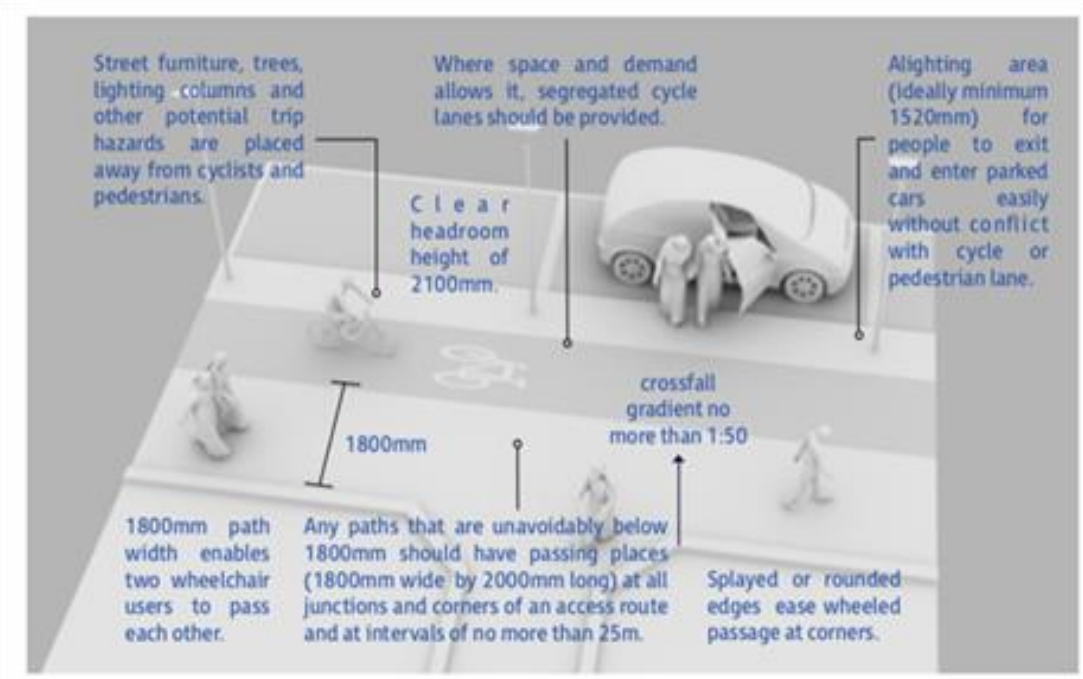

Figure 6: Path Design Dimensions (Dubai Creative Clusters Authority, 2016)

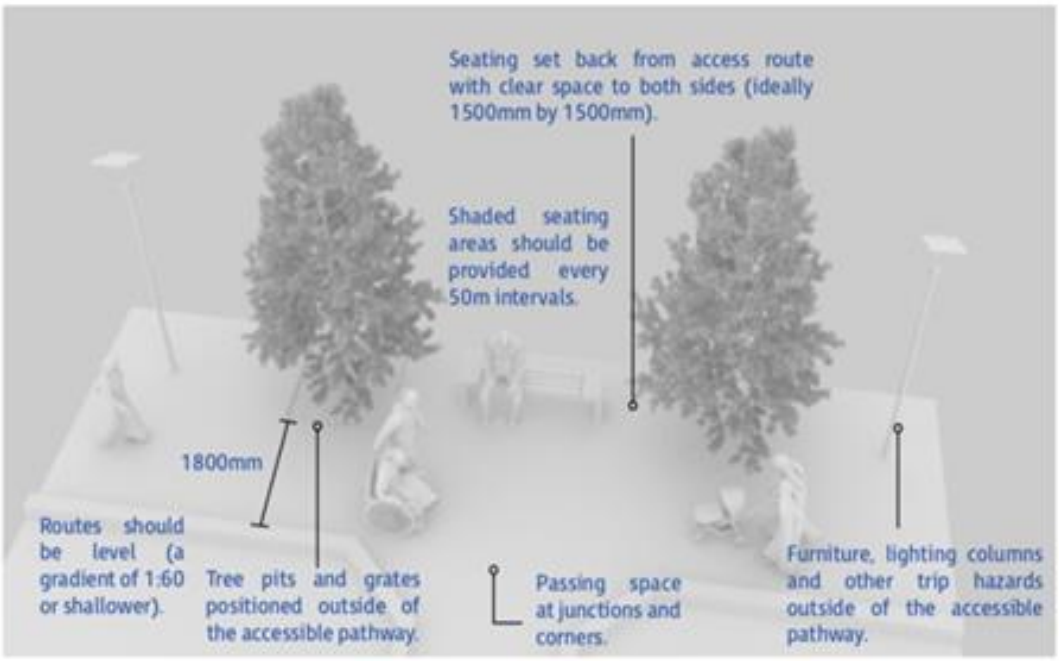

Figure 7: Passing Bays and Seating Design on Access Routes (Dubai Creative Clusters Authority, 2016)

In Addition, the planning department in Dubai Municipality provides special standards for the facility based on each planning level with different density as shown in Tables (2 & 3 & 4). In this research, however, the neighborhood level is the focus.

Table 2: Summary of Community Facilities Standards for Low Density Areas (Planning Department in Dubai Municipality, 2010)

Planning level	Type of facility	Pop. served	Min site area (m^2)	Min site area / person (m^2)	Max. Dis. to facility (m^2)	Building height	Total coverage area
Neighborhood level	Local mosque	2000	1800	0.9	500	Ground	40%
	Retail facilities	2000	400	0.2	400	Ground	-
	Post shelter	2000	35	-	400	Ground	-
	Local plaza	2000	1500	0.75	400	NA	-
	Tot lot	2000	1500	0.75	400	Ground	-
	Neighborhood park	2000	4000	2	400	NA	-

Table 3: Summary of Community Facilities Standards for Medium Density Areas (Planning Department in Dubai Municipality, 2010)

Planning level	Type of facility	Pop. served	Min site area (m^2)	Min site area / person (m^2)	Max. Dis. to facility (m^2)	Building height	Total coverage area
Neighborhood level	Local mosque	3000	1500	0.5	500	G+1	50%
	Retail facilities	3000	500	0.16	350	G+Mez.	-
	Post shelter	3000	35	-	-	Ground	-
	Local plaza	3000	1200	0.4	350	NA	-
	Tot lot	3000	1200	0.4	350	Ground	-
	Neighborhood park	3000	3500	1.2	350	NA	-

Table 4: Summary of Community Facilities Standards for High Density Areas (Planning Department in Dubai Municipality, 2010)

Planning level	Type of facility	Pop. served	Min site area (m^2)	Min site area / person (m^2)	Max. Dis. to facility (m^2)	Building height	Total coverage area
Neighborhood level	Local mosque	4000	1200	0.3	500	G+1	65%
	Retail facilities	4000	550	0.14	300	G+Mez.	-
	Post shelter	4000	35	-	-	Ground	-
	Local plaza	4000	1000	0.25	300	NA	-
	Tot lot	4000	1000	0.25	300	Ground	-
	Neighborhood park	4000	3000	0.75	300	NA	-

However, Road and Transport Authority (RTA) has a specific guideline for pedestrians' streets and zones. The pedestrian area includes three zones; the frontage, the thoroughfare, and the furnishing zones (Figure 8). The minimum width of the sidewalk should be 1.80 m for the thoroughfare zone, to allow two people to comfortably walk side-by-side. The furnishing zone is a minimum of 1.20 m wide, in order to have a buffer between pedestrians and vehicles. However, wider zones should be considered when providing planting and seating. Finally, the frontage zone should be a minimum of 0.60 meters (Dubai RTA, 2016).

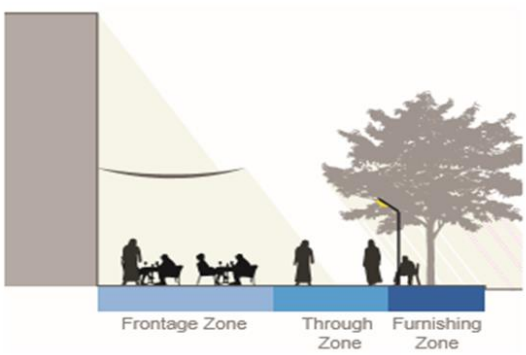

Figure 8: Pedestrians' Zones (Dubai RTA, 2016)

1.5.8.3 Recent Initiatives in UAE

UAE has established the first happiness and wellbeing strategies for its communities. The government at the local level began to place emphasis on designing communities and neighborhoods that promote happiness and wellbeing. The UAE seeks to be the first country in the world to establish and provide a guideline to create happy communities and neighborhoods. This program offers collaboration between the national program for happiness and wellbeing, the Ministry of Infrastructure Development and the Sheikh Zayed housing program. Creating happiness should involve collaboration with other entities such as municipalities, road and transportation authorities, housing authorities, water and other services infrastructure authorities and private developers. This collaboration has developed several design principles to achieve happy communities; improving health, equity, ease, resilience, meaning and belonging, social relationships and joy. These principles are used to evaluate strategies for six community design realms to maximize happiness. First, the prime location that helps to reduce isolation, increase ease of movement, and improve access to all amenities. Second, the appropriate ingredients to provide a mix of civic facilities, businesses, and housing types. Third, connected communities to configure street and transit networks, and provide comfort quickly. Fourth, places for people wishing to design streets, public spaces and buildings to support experiences of joy and ease outdoors. Fifth, the necessary cultural expression to help engage residents in improving their communities to help develop a sense of meaning and belonging. Sixth, smart systems using data, and smart systems to enhance the happiness and wellbeing of residents in the communities (National Program for Happiness and Wellbeing, 2019). However, these indicators are mostly targeting new housing development, where the existing neighborhoods are yet to follow in assessment.

1.5.9 Gaps in Literature Review

Dubai as an urban space was discussed by several authors such as Pacione (2005); Alawadi (2017); Akhavan (2017) and others. In addition, walkability in Dubai was discussed as a significant aspect in developing the city. There are many principles considered for measuring walkability in any neighborhood as discussed in previous literature reviews by several authors such as Cerin et al. (2007); King et al. (2015); McDonald et al. (2012); Cowie et al. (2016); Buck et al. (2015); Leslie et al. (2005); Frank et al. (2010); Gilderbloom et al. (2015); Lotfi and Koohsari (2011); Rattan et al. (2012) and others.

However, there is no direct research that studies walkability principles in the context of existing Dubai neighborhoods. This research aims to assess the most highlighted characteristics of walkability principles in two selected neighborhoods in Dubai in term of users' perception and physical space. This study explores the potential applicability of these principles to enhance walkability, continues the ongoing efforts of local institutions to verify the actual implementation, and builds on other studies of walkability in Dubai.

1.5.10 Conceptual Framework

Neighborhoods should be developed and designed to attain a lively environment in which people can walk. Based on the preceding literature review (Cerin et al., 2007; King et al., 2015; McDonald et al., 2012; Cowie et al., 2016; Buck et al., 2015; Leslie et al., 2005; Frank et al., 2010; Gilderbloom et al., 2015; Lotfi & Koohsari, 2011; Rattan et al., 2012; French et al., 2014), several responsible principles were identified to ensure walkable neighborhoods; mix land use, density, local amenities and facilities, accessibility, connectivity and integration, and sense of

safety. These principles are related to the neighborhoods' physical space and users'/people's perception. In Addition, the interrelationship between the imageability and legibility shows the impact of physical urban setting in correlation to users' perception. Physical space can be evaluated in terms of design, following certain criteria associated with walkability as a social aspect of sustainability. These physical spaces can affect people's perspective. They are related to how the mentioned principles can affect people's perception and usage of neighborhood spaces, with an impact on their lifestyle. Figure (9) expresses the obtained conceptual framework for this research based on the literature above.

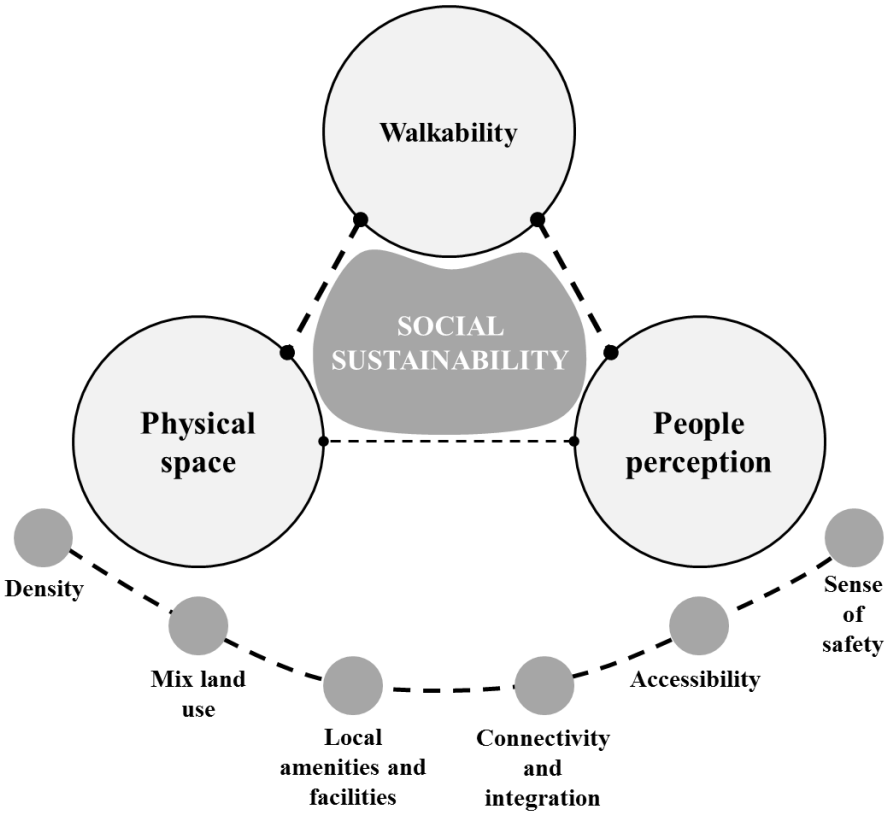

Figure 9: Conceptual Framework

1.5.11 Context of Dubai

Dubai (Figure 10) is one of the seven emirates in UAE and has been the first to undergo major developments creating a strong base for business growth and investment (Pervan et al., 2015). Dubai had experienced a rapid growth in many aspects. Transforming it from a small fishing village, to a global city and a regional hub for the area (Akhavan, 2017). The city covers a small area of 27.54 km^2 and was developed over four distinct periods (Alawadi, 2017), as shown in Figure (11):

- 1900 - 1955: period of slow expansion; small, not well-developed city.
- 1955 - 1970: era of compact development.
- 1970 - 1990: period of sprawling to suburb areas. In 1990, the city attained international status, being described by Jones Long as one of the three most successful cities by economic growth and real estate activity (Pacione, 2005).
- 1993 - present: period of globalization.

Figure 10: Location and Boundary of Dubai City (Google Maps, 2019)

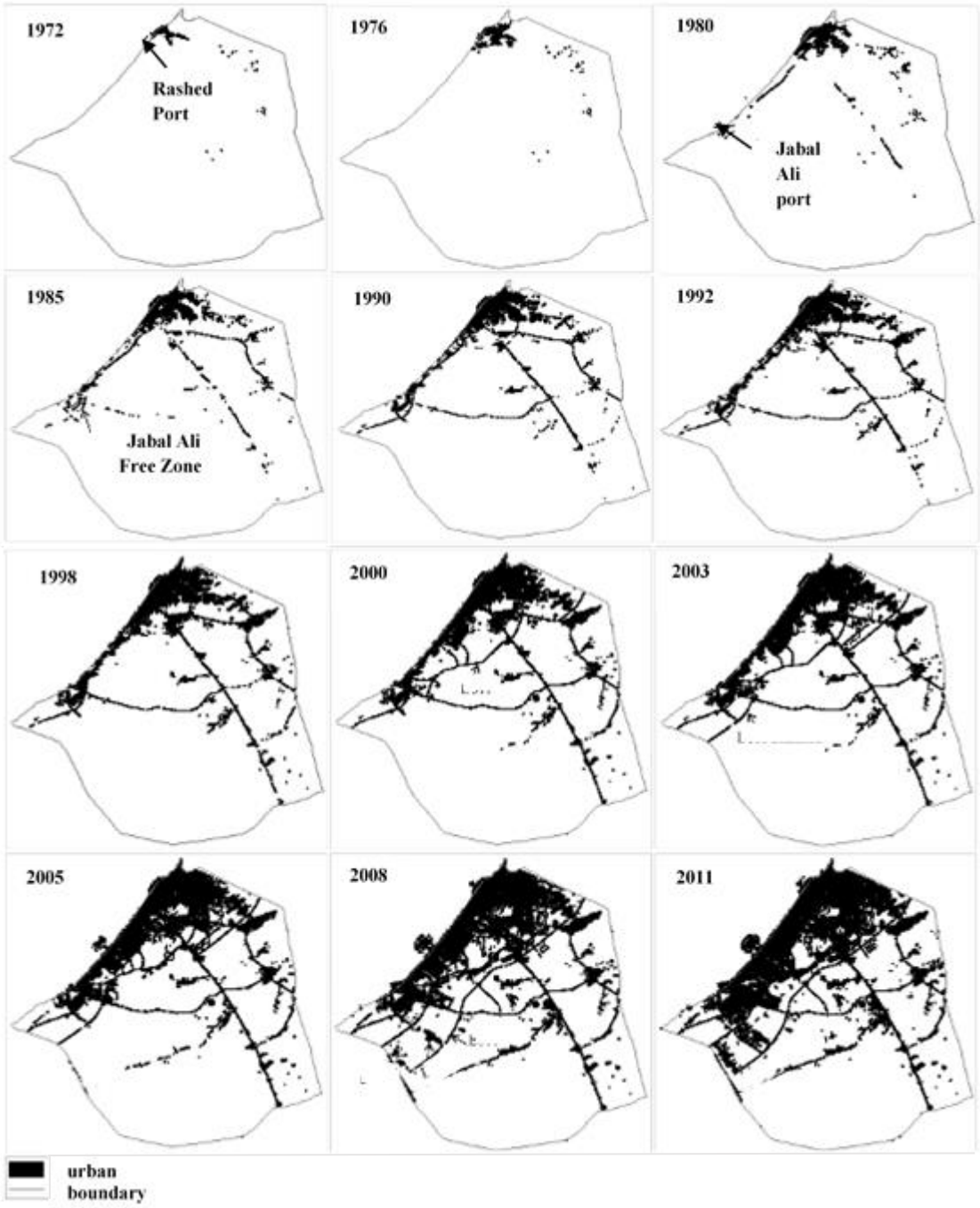

Figure 11: Changes in Urban Extent in Dubai Emirate (Nassar et al., 2014)

Dubai has an estimated population of 3,282,036 (Dubai Statistics Center, 2018). Dubai's oldest neighborhoods are Deira and Bur Dubai. The old area is at the heart of Dubai where the main commercial district along Dubai Creek is Deira; a place of tradition. It consists of multiple areas which are still developing (Akhavan, 2017).

Dubai provides a good database for the city to be easily studied for re-planning or re-configuration of urban areas in the future.

In explaining the main divisions of Dubai, Eng. Mohammed Mustafa from planning department in Dubai Municipality mentioned “Dubai consists mainly of nine sectors, each sector consists of several communities, then it is divided into residential subcommunities, neighborhoods, special uses and public facilities. The sectors are characterized by a homogenous urban fabric with similar physical, social or economic profiles. Each sector is represented by a single number. These have different numbers dependent on the developers, type of housing, the economic issues. The communities mainly have a population ranging from (20,000-30,000), it is most defined by main roads or natural elements and each area is symbolized by three digitals. The residential sub communities have a population ranging from (5000-10,000). The neighborhoods are made from multinational society. It [neighborhood] is the unit of planning areas and has a population ranging from (2000-3000 person) and surrounded by sub roads. The special use areas are all non-residential and non-public use areas which have been identified separately and include the following; palaces, industrial zones, military zones and etc. While the public facility is the area or territory in which services are provided at different levels” (personal communication, 29th Oct 2018).

In addition, Dr. Aomar Qussadou from the planning department in Dubai Municipality argues that “each division in Dubai has different facilities dependent on density” (personal communication, 29th Oct 2018).

The previous has discussed the research problem, research’s main and sub-questions, the research objectives and the related literature. This thesis consists of five chapters; introduction, methodology, data analysis and assessment, discussion and interpretation, and conclusion and recommendations.

Chapter 2: Methodology

This chapter discusses the methodology used in assessing walkability as a social aspect of sustainability. Based on the revised literature of walkability principles, the physical space is found to be a significant factor affecting walkability. Likewise, people's or pedestrians' perception is also important in investigating the in-depth of this research phenomenon. Mixed methods of qualitative and quantitative approaches are used. The qualitative approach uses tools of observations, and survey by conducting questionnaires and semi structured interviews. On the other hand, the quantitative approach is utilizing DepthmapX software and questionnaires. A mixed methodology is appropriate to use since it allows for triangulation and increases the validity of research findings. In addition, the integration of methods gives the reader greater confidence in the results and allows the researchers to be more certain of their findings (Mckim, 2017).

Based on the conceptual framework (Figure 9), some principles have been set to analyze the physical space, and to requisite perception to understand the correlation in relation to the users of space. These principles include density, mix land use, local amenities and facilities, accessibility, connectivity and integration, and sense of safety. Both physical space and users are subject to interrelated variables, as each principle can affect both categories.

2.1 Research Design

Based on the revised literature, walkability principles can mostly be assessed through physical spatial characteristics and the way in which the urban fabric of neighborhood planning supports or fulfills these principles. However, some

walkability principles are subjective, and need to be assessed through perception of users. The conceptual framework concluded upon establishes an interrelationship between both physical space and the perception of pedestrians with regard to these physical aspects. The assessment of walkability in selected neighborhoods indicates their social sustainability, due to the clear connection between social sustainability and walkability. The literature identifies groups of indicators for each principle, all of which are presented in Table (5).

Achieving a comprehensive view of achievement, requires collecting data related to both aspects of physical spaces in neighborhoods and people's perception. Collecting data is performed, as mentioned before, by both qualitative and quantitative methods. The qualitative method employed tools of observations and survey by questionnaire and interviews, while the quantitative method utilized tools as DepthmapX software and questionnaire. To provide an in-depth understanding of how to assess walkability, case studies are analyzed by both methods. The phenomenon of walkability in Dubai's neighborhoods will be assessed to answer the research main and sub questions:

- What is the assessment of walkability in Dubai neighborhoods and what is the effect of walkability on social sustainability?
- How does walkability affect/contribute to social sustainability?
- How does the physical space dis/encourage people to walk in certain neighborhoods in Dubai?
- How does people's perception of neighborhoods relate to walkability?
- What is the impact of development policies on walkability?

Table 5: Walkability Principles and Their Indicators

Principles	Indicators	Tools
Density	✓ Gross population density of 40-50 person per hectare for neighborhoods	✓ Statistical data
Mix Land Use	✓ Provision of integrated residential, recreational, and civic uses that are basic to everyday life and connected to public transportation ✓ Diversity of local job opportunity and appropriate workspace ✓ Provision of housing variety ✓ Provision of multi-function trips	✓ Observations ✓ Questionnaire ✓ DepthmapX software
Local Facilities and Amenities	✓ Local provision of services and facilities, including open space and green spaces accessed by foot and public transportation	✓ Map analyzing ✓ Observations ✓ Questionnaire
Accessibility	✓ Providing walking network ✓ Provision of amenities and public transportation nodes within a walkable distance ✓ Accessibility to public transportation ✓ Provision of local services and facilities around a public transportation ✓ Provision of proper signage system ✓ Provision of street furniture such as softscape, shading devices, etc. ✓ Visibility of services and amenities from the main street ✓ Accessible buildings and spaces for kids, special needs, women and elderly people	✓ Observations ✓ Questionnaire ✓ DepthmapX software
Sense of Safety	✓ Provision of pedestrian sidewalk, crosswalks and barriers ✓ The minimum sidewalk width ✓ Provision of streetlights ✓ Provision of traffic calming and speed limit ✓ Providing permeability/ eye on the street/ Surveillance through having an active street frontages and rooms facing the streets	✓ Observations ✓ Questionnaire
Connectivity and Integration	✓ Connected housing clusters (houses are interconnected with other clusters, neighborhood center, surrounded area and to the city) ✓ Neighborhood physical connections ✓ Providing multi-function services and spaces ✓ Provision of public transportation ✓ Street intersection density	✓ Map analyzing ✓ Observations ✓ Questionnaire ✓ DepthmapX software

A pilot study was initiated to test the following; the methodology, the chosen sites, the variables, questionnaire design, field work conditions, and the actual time needed. The findings of the pilot study helped with modifying and updating the research approach. The pilot study was intended to get a sense of what research phenomenon might emerge and to test the survey method. At present, it appeared that more research is needed to confirm the preliminary findings.

The actual fieldwork started with two selected case studies. The two neighborhoods are; Al Khawaneej First neighborhood (the same location as the pilot study), and Al Qusais First neighborhood. The preliminary findings from Al Khawaneej First were not enough to understand the actual walkability characteristics/principles in the selected site. Therefore, this neighborhood was part of the official fieldwork.

2.2 Case Study Method

This research aims to investigate and assess walkability as a social aspect of sustainability in Dubai's neighborhoods. The selected neighborhoods involve a detailed contextual analysis of the phenomenon. Studying these principles in the context of Dubai requires selecting representative neighborhoods to apply and /or run the survey. The selection should be based on the levels of planning in Dubai. The municipality classifies different levels of planning; starting with sectors, communities, residential sub communities, neighborhoods, special use and public facilities. Each has a specific size, number of residents, codes and names as discussed before. This research aims to study this phenomenon on the neighborhood level.

Case study is a term used to describe systemized observations. It aims for in-depth understanding of the context of a phenomenon and allows for the study of a

different number of variables and different aspects associated with phenomenon (Weick, 1984). Yin (1984) defined the case study research method "as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; in which, boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used." The case study is focused on a particular situation, and provides a detailed description of the situation, allowing the researcher to focus only on the most useful data (Merriam, 2001).

In this research a multiple-case studies are used. This enables the researcher to explore similarities and variations among cases. The goal is to verify findings across cases. Because comparisons can be drawn, it is imperative that cases are chosen rigorously, in order for the researcher to predict similar results across cases, or to predict contrasting results based mostly on a particular theory (Yin, 1984). In this research, two neighborhoods in Dubai are selected to be studied; Al Khawaneej First and Al Qusais First (Figure 12). The planning levels classification found in official documents is clear but not reflecting the reality. This is shown specially in the chosen case studies' areas where the difference between the documents and real-life situation have created a confusion in classifying the boundaries of the community, neighborhood and district. The identification of the boundaries of each neighborhood is blurry with no clear edges or services. The community itself has services that don't apply even in the community level as some communities have services categorized for a sector or district.

In Al Khawneej First, the population is entirely consisting of local nationalities. However, in Al Qusais First, there are residents of multiple nationalities; Indians, Syrians, Pakistanis, etc. Each studied neighborhood inhabits a different housing typology. For instance, in Al Khawneej First, the dominant style of residential units is

villas. On the other hand, in Al Qusais First neighborhood, the dominant style is high-rise buildings over different floors. They are both located in the eastern part of Dubai. Both neighborhoods have different services and amenities. In addition, both have different styles of urban development at street level and in terms of the buildings and surrounding areas, as will be detailed in this research.

Figure 12: Neighborhoods of Dubai (Google Map, 2018; AutoCAD Maps, 2018)

A. Dubai, B. Al Qusais First, C.Al Khawaneej First

Although Al Khawaneej First and Al Qusais First are located in the eastern part of Dubai, each case has different characteristics. Both case studies were selected according to certain criteria. The housing typology was a starting point when selecting a proposed area for the study. By consulting Dubai Statistic Center (2018), the researcher had identified two types of housing; multi-story buildings, and one-floor buildings (villa and Arabic house). Additionally, the selection of these two cases are based on the urban development history, residents' nationalities and culture, proximity to public transportation and density as explained in Table (6).

Table 6: Criteria for Site Selection

Criteria	Explanation	Source
Housing Typology	➢ Multi-story building, one-floor building such as villa/ Arabic house (Dubai Statistics Center, 2018) ➢ The housing typology in *Al Khawaneej First* is villas ➢ The housing typology in *Al Qusais First* is multi-stories buildings	✓ Pilot study ✓ Observations ✓ Interviews with Dubai Municipality
Urban Development History	➢ Different time of urban development ➢ In *Al Khawaneej First* development started in 1988 ➢ In *Al Qusais First* development started around 1970	✓ Dubai Municipality data
Residents' Nationalities and Culture	➢ In *Al Khawneej First*, the population is entirely including local nationalities. ➢ However, in *Al Qusais First*, there are residents of multiple nationalities; Indians, Syrians, Pakistanis, etc.	✓ Observations ✓ Dubai Municipality data ✓ Questionnaire
Proximity to Public Transportation	➢ Easily accessible from the selected area to public transportation. ➢ In *Al Khawaneej First*, there are only buses used in some areas. ➢ While in *Al Qusais First*, there are different type of public transportation such as buses and metro.	✓ Interviews with RTA
Density	➢ It is calculated as a number or residents per area. ➢ In *Al Khawaneej First* it is remarkably low-density area ➢ *Al Qusais First* is a high-density area	✓ Dubai Statistical Center data

2.3 Data Collection

This part of the research discusses the data collection process and tools. It starts by explaining sample selection process. After that, it elaborates on the qualitative and quantitative approaches of the research and the tools used in each method. Finally, it discusses the need, process, and result of a preliminary pilot study.

2.3.1 Sample Selection

According to Groat and Wang (2013), the most important concern for the researcher is the sample selection process. There are two main types of samples; probabilistic and non-probabilistic. The goal of a probabilistic sample is to truly represent a large population. This typically involves some form of random sampling, which means each person in the population has an equal, or at least a known chance of being selected. Whereas, in non-probabilistic sampling, the researcher is less concerned about generalizing to larger population. Therefore, some people have a greater probability than others of being selected. In this research, the sample selection is based on a probabilistic sample, where random samples are from different genders, ages and ethnicities. However, the number of individuals in the sample will depend on the results; the sample needs to be large enough for a clear pattern of results to emerge. This research is targeting two groups. The first group is people/users/pedestrians in the Al Khawaneej First and Al Qusais First neighborhoods. The second group is the official institution representatives (Dubai Municipality and Road and Transportation Authority); they will share their institution's vision and policies in terms of walkability.

2.3.2 Qualitative Approach

The qualitative research produces a detailed description of the participants' feelings, actions, opinions and experiences. It offers a holistic understanding of the human experience within specific physical settings by enabling access to a wider range of epistemological viewpoints. Qualitative approach's data collection tools include observations, interviews, surveys, and describing records (Rahman, 2017).

This research follows a qualitative approach that utilizes observations and survey (including questionnaires and interviews) to assess walkability as a social aspect of sustainability in the chosen neighborhoods. In this research people's perception and needs are discussed, which highlights the need of a qualitative approach.

2.3.2.1 Observations

A general overview of the site and an exploration of everyday pedestrian life are intended. Observation is a unique and underused technique for gathering information. It is necessary to use our eyes as well as our ears (Mulhall, 2002). Different types of observation can take place during any fieldwork, both structured and unstructured observations (Pretzlik, 1994). Structured observations consist of a checklist to be observed in a situation which would either support or refute the theory. While unstructured observations are used to understand and interpret culture and social behaviors. Observations serve as a useful tool to round out the research by offering a real-world component to understand the hypothesis. It also offers a better description of the study area. In addition, it can improve the quality of an initial behavioral analysis based on demographics, thereby increasing the validity of the research (Moyles, 2002).

This research follows a structured observation with written checklist/field notes designed to assess the areas based on specific points. Observations started prior to interviewing people, to familiarize with the site and provide a sense of the neighborhood dynamic. Observations can be very useful especially in having better description of the selected neighborhoods.

2.3.2.2 Surveying by Questionnaires and Interviews

Survey research involves acquiring information about one or more groups of people and capturing a feeling or moment in time, people's characteristics, opinions, attitudes, and previous experiences. This is performed by asking people questions related to the research topic. Surveys consist of questionnaires and interviews (Leedy & Ormrod, 2005). This research involves both types, since most of the research questions are related to people's experiences and perception. The latter can be evaluated through questionnaires and interviews. This research uses qualitative and quantitative questionnaires. In addition, both questionnaires and interviews are semi-structured.

2.3.2.2.1 Questionnaires

A questionnaire is one of the most effective research tools, comprising of a sequence of queries designed for the purpose of collecting data from participants or a target audience. The goal is to learn about a large number of people by surveying a sample of the population. It can be as qualitative or quantitative. This section will discuss the qualitative questions. These questionnaires, considered qualitative, are questions designed to elicit a meaningful answer based on a person's feelings, thoughts and knowledge. It helps to gain information about people's motivations, thinking and attitudes (Paragon, 2016; Leedy & Ormrod, 2005).

The questionnaires in this research help to learn about the views of a large number of people. Although the questions were originally prepared in English, they were also translated into Arabic, since some respondents were Arabic speakers. The survey is divided into two main sections. The first section collects demographic data, using questions such as the name of the participant's neighborhood, gender, age and

ethnicity. The second section includes questions about the principle of walkability. A sample of the used questionnaire is attached in Appendix A. The distribution of the questionnaire took place over different periods and different times of the day in October, November and December of 2018 in both neighborhoods. The number of surveys initially distributed in Al Khawaneej First was 500 questionnaires, with only 400 questionnaires answered from a possible population of 11169. Meanwhile, in Al Qusais First, 750 questionnaires were distributed and 600 questionnaires per household were completed from a total population of 41225. The number of inhabitants that would have potentially formed the sample was 3,282,036.

2.3.2.2.2 Interviews

The purpose of using interviews for this research is to gain a comprehensive understanding of Dubai neighborhoods, and the urban classifications of the city. In addition, interviews are essential to determine how walkability is integrated into the studied neighborhoods. Interviews provide researchers with rich and detailed qualitative data which helps to understand participants' experiences, how they describe those experiences, and the meanings they attribute to them (Knox & Burkard, 2009). It is also very useful to obtain detailed information about personal feelings, perceptions, and opinions. The interviews consist mainly of two types; structured and semi-structured. Structured interviews follow a rigid procedure in which questions are planned and created in advance; which means that each participant is asked the same questions in the same order. Meanwhile, the semi-structured interviews follow a more flexible approach (Kothari, 2004). This supports the asking of more detailed questions to provide insights and understanding into the study. Moreover, interviews are a very beneficial way to ask follow-up questions based on emerging questions and ideas.

Leedy and Ormrod (2005) mentioned that semi-structured interviews consist of face-to-face and telephone interviews. Face-to-face interviews provide opportunities to observe participants in interactions with others, as a way to observe space. Also, it allows participants to feel more comfortable with the researcher. Thus, it is considered the main source of information regarding the development process loop as a way to provide an in-depth understanding of the perspective of key actors in the study, and to allow them an opportunity to contribute to their own thoughts and comments. In addition, it is a way to understand relationships and seek out feedback from engaged parties. Thus, in order to cover a sufficient amount of information, more detailed questions can be asked to add insights into the study. As an alternative, telephone interviews are less time consuming and less expensive, but the response rate is less than it would be face-to-face.

This research uses semi-structured interviews, face-to-face and telephone interviews with the planning department in Dubai Municipality (DM) and Road and Transportation Authority (RTA). At the Dubai Municipality, the researcher encountered Dr. Saif Ali Al Sadah, Urban Design Manager; Dr. Aomar Qussadou, the principle housing specialist in planning development; and Eng. Mohammed Mustafa, from the same department, to discuss progress in Dubai and how walkability is adopted in current and futuristic plans. What are the main criteria to develop walkability in Dubai? How walkability is taking strides in UAE especially Dubai? and is there any collaboration between Dubai Municipality and RTA regarding developing walkability?

Meanwhile, at RTA, the researcher met Hazem Wa'el Elias Nowwara, Chief specialist in the traffic department; and Eng. Amna Belselah from the traffic

department, to discuss the criteria for developing Dubai and the important features included in the walkability plan development.

2.3.3 Quantitative Approach

A quantitative approach is a strategy that emphasizes quantification in the collection and analysis of data. This method quantifies the problem by generating numerical data that can be transformed into visible statistics. It uses measurable data to formulate facts and uncover patterns (Rahman, 2017). This approach will help to evaluate some principles of walkability especially those related to physical spaces. In this research, DepthmapX software and questionnaire are utilized, while Walk Score program is used only in selecting the site for pilot study.

2.3.3.1 Questionnaires

Questionnaire in the previous section was discussed as qualitative approach. This section discusses the quantitative questions. The questionnaires can be considered as quantitative, when there are numerical data that can be transformed into visible statistics. The quantitative questionnaires are defined as objective questions and they provide support while drawing general conclusions from the research. It can analyze the data quickly. The questions with multiple choice answer are analyzed using quantitative methods based on the specific application of data; pie-charts, bar-charts and percentages (Korner et al., 2004; Frangopoulos et al., 2014).

The general description about the questionnaires as the format, design of the questions, number of the questions and etc. will be discussed in later sections.

2.3.3.2 DepthmapX Software

Space syntax is a set of theories and techniques used for the analysis of spatial configurations. These theories were developed to compare similarities and differences between different scales and settings in the built environment (Penn & Turner, 2002).

According to Hillier et al. (2007), space syntax demands four components in urban form analysis. Firstly, space syntax operates by applying a brief definition of urban space. Secondly, it uses several techniques when analyzing cities such as spatial networks consisting of grouping, placing and orienting any buildings. Thirdly, it consists of multiple techniques as a way to observe these networks of space according to functional patterns such as movement, land use, area differentiation, migration patterns, and social wellbeing. Fourthly, based on the results obtained from the first two components, it makes it possible to develop a theory concerning how urban space networks relate to the social, economic and cognitive factors which shape the urban space.

Hillier and Hanson (1984) offered a tool to help architects simulate the likely social effects of architectural and urban designs. The general idea here is that spaces can be broken down into components, and analyzed as networks of choice, then represented as maps and graphs describing the relative connectivity and integration of spaces in urban form.

Space syntax software such as Axman, Spatialist, Axwoman, Webmap, DepthmapX and etc. varies in different ways. Some options are free for academic users, and others are open source. DepthmapX, has been identified as a platform-based software designed to work on a different set of spatial networks to analyze the design (Serra & Hillier, 2017). The software was developed by Alasdair Turner at the Space Syntax Laboratory to help architects and artists set out designs using open source

versions of the software (Natapov et al., 2015). DepthmapX used to convert the open space to convex map then to axial map of an urban area as shown in Figure (13). It measures the integration, connectivity, and choice of street.

Integration relates “to movement”, and measures how close each segment is to all others within a given radius, using a least angle measure of distance. In other words, it calculates how spatially integrated street axis is in terms of the total number of directional changes in relation to all the other streets in the area. The fewest changes in a given direction mean the highest integration value (Jiang et al., 2000). Figure (14) represents an example of the integration map using the software where the red color represents the highest local integration value and blue represents the lowest value.

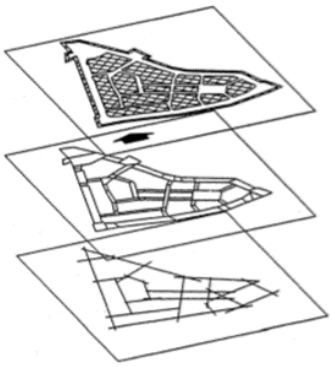

Figure 13: Open Space Map, Convex Map, and Axial Map (Teklenburg et al., 1993)

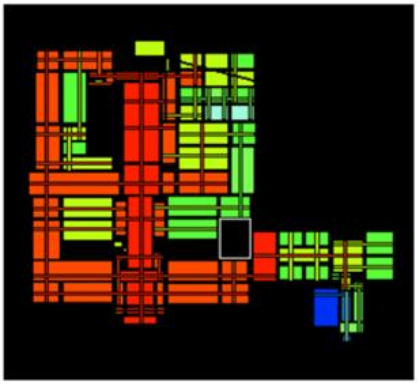

Figure 14: Result of DepthmapX Analysis (Jiang et al., 2000)

While choice of street relates to “through movement”, it is essential to measure the degree to which each segment lies on least angle routes between all other pairs of segments within the radius. People tend to choose minimal angular deviation, with an angle close to 90 or 180 degrees. However, connectivity refers to number of paths,

streets, or nodes, which are directly linked to each individual street node in the street network.

There are some correlations when measuring connectivity and integration such as synergy, harmony, and intelligibility. Synergy describes a correlation coefficient (R2) between the local (Different radii) and global integration (RN). Harmony describes the correlation coefficient (R2) between a correlation, integration and choice measurements. Finally, intelligibility describes the correlation coefficient (R2) between connectivity and the global integration values (Aleksandrowicz, Yamu, & van Nes, 2018). DepthmapX is used in this research as a software to measure principles of walkability, covering connectivity and integration, accessibility and choice.

This program has several limitations; it will not, as people might expect, explain everything. It does however cover pedestrian movement, land use patterns and certain degree of social and economic sustainability aspects. The instrument takes time to understand and to work on; thus, this make it more difficult to use when the time spent on the investigation is limited (Charalambous & Mavridou, 2012). In addition, a two-dimensional floor plan is an insufficient source for inferring the social dimensions of societies (Osman & Suliman, 1994; Tesar, 2015).

As mentioned above, this software is used in this research as a tool to measure connectivity and integration, accessibility and choice of the selected case study. Additionally, it will help in triangulation of data where the previous principles are measured using other tools such as observation, questionnaire and interviews.

2.3.3.3 Walk Score Website

Walk Score: (www.walkscore.com) is a web-based application, which rates the urban area, expanding outward from the neighborhood scale to the entire city, on a

scale of 0-100. Where, 0 refers to a low walkability score, and 100 to high walkability. Thus, users can pick any area on Google Maps and establish a walkability score. This considers the number, type and spatial distribution of activities and utilities (e.g. grocery shops, parks, restaurant, office and etc.). Walk Score has several limitations. For instance, it does not calculate all physical indicators related to walkability such as the availability of sidewalks, and how much crime occurs in the area, if there is any signage system or not, etc. It only considers the number of amenities around the selected area but at the same time fails to differentiate between the types of these amenities. Using Walk Score in this research offers an approximate evaluation of walkability for selecting the area of the pilot study only (Al Khawaneej First).

2.4 Pilot Study

A pilot study is ideally completed before formal fieldwork to test the validity of the following: research questions, methodology, chosen site(s), variables used in the research, questionnaire design, fieldwork conditions, the actual time needed for the fieldwork.

Considering the structure of Dubai neighborhoods as explained in Chapter 1 and based on Walk Score, Al Khawaneej First was chosen as a case study to assess walkability. Car dependency was determined according to a score of 15 as shown in Figure (15). The researcher has visited the place several times before starting to interview people. This was essential so that the researcher would become familiar with the environment of the surrounding neighborhood. Visiting the studied locations made it easier for the researcher to start interviewing and having conversations with the residents of the area. The pilot study took around ten days, starting from 05-07-2018 until 26-07-2018. The pilot study was carried out at certain times of the working and

weekend days over certain hours (from 7 am to 9 pm). The schedule of visits is included in Appendix D. All the research tools were tested in the pilot study such as observations, interviews and questionnaires. The first tool was observation. The check list used for observation was written in a yes/no format to help assess, monitor and record the information on the selected site and people's behavior easily. Observing the neighborhood provided an in-depth and rich understanding of both the selected site and people. The second tool was the questionnaire. The main target group was the daily users of public space. It is essential to understand the participants' experiences in the space, and how they feel regarding the study area. After observation of space and questionnaire, the third tool was interviews. An unstructured interview was conducted with the planning department in Dubai Municipality as they were the main source of data. General data was collected regarding Dubai and the chosen neighborhood.

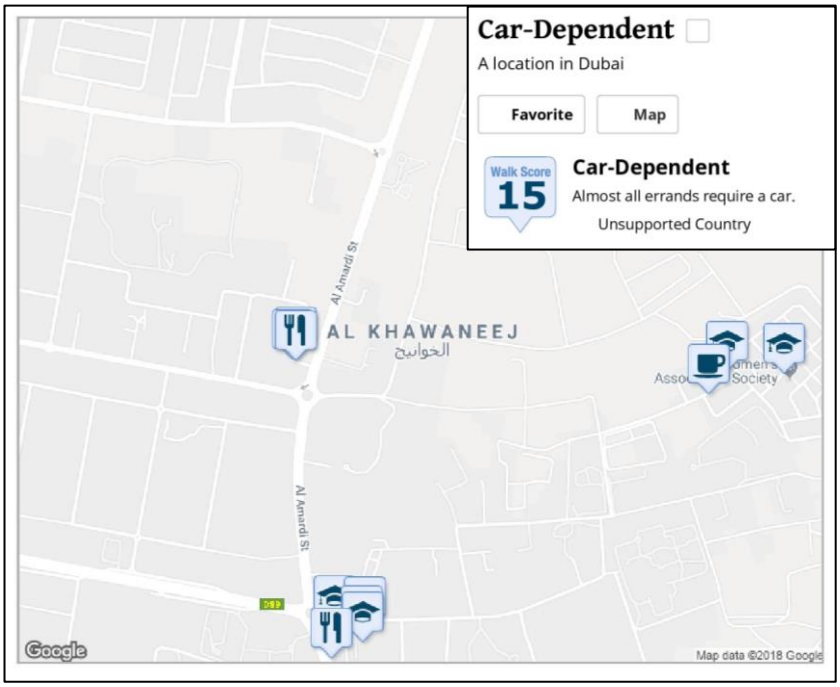

Figure 15: Score of Car Dependency in Al Khawaneej First, developed using Walk Score Website

After conducting the pilot study, several points needed to be considered for the formal fieldwork. These points were considered in both general and specific comments. The general comments are:

- Climate: most people spend their time in malls, since the weather in July is not conducive for the movement and use of outdoor space. In the official fieldwork, the visits were in different months during different season as the weather was better. The location for meeting people is on the street, so people would search for a shaded place to talk, since they cannot spend a long time under the sun. In official fieldwork the meeting was done in some shaded areas like cafés, external shared seats, shaded areas by the surrounding builds and etc.
- Time: the pilot study was conducted in July 2018, and was not really appropriate, since most people were traveling. The official fieldwork is done after the summer vacation.
- People's perception: some people are prejudiced when asked to fill in a survey, either because they think that Dubai does not need further development, or because they suppose their voices will not influence the results. In the official fieldwork a deeper brief was given to participants with explaining the benefits of their cooperation to the study.

However other specific comments were all related to the survey questions as follows:

- Research's language is English; however, some people cannot speak English, so all questions in the guide were translated into Arabic.

- Some questions are not easy to understand, and jargon related to the discipline. So, a simplified question version was considered in the formal fieldwork.
- The guidelines differ in terms of the depth of questioning, which is dependent on the level of responsiveness of the people. Experience shows some individuals might have fewer opinions regarding space; for example, those who have accessed space for the first time. In official fieldwork more participants were included to reach a clear pattern of answers.
- The articulation and sequence of asking questions needed to be checked and practiced and that was done in the formal fieldwork.
- Questions needed to be organized according to relation, and main topic. Additionally, the length of a survey needs to be reduced to save time by merging questions. A modification of the survey was done in the actual fieldwork.
- In the case of the surveys, the answers needed to be studied to guild data analysis. This was done in the actual fieldwork.

This chapter has described the methodology and has discussed the research design, case study method, data collection methods, and the pilot study. The next chapter will discuss the data assessment and analyze of the two selected neighborhoods; Al Khawaneej First and Al Qusais First.

Chapter 3: Data Analysis and Assessment

This chapter discusses all the results of data collection and analyzing processes applied in both case studies. It evaluates the principles and highlights the indicators of walkability. After conducting a pilot study, the actual fieldwork started with a profound consideration of the pilot study results, as mentioned in Chapter 2. In the actual fieldwork, two case studies are selected; Al Khawaneej First neighborhood (the same location as the pilot study), and Al Qusais First neighborhood. The first case study is chosen, regardless of the fact that it was chosen before in the pilot study, to fulfil the scope of having more research about the behavior associated with walkability. Meanwhile, the second case study is selected based on the criteria mentioned in Chapter 2.

Al Khawaneej First is a residential area located in the eastern part of Dubai city. The neighborhood has a population comprising around 100% locals. The neighborhood is 15 minutes' drive away from one of the largest shopping malls in Dubai; Mirdif City Center. While it is around 11 minutes' drive away from the Arabian Center in Mizhar. It includes different public amenities and facilities such as mosques, restaurants, shops, etc. It is home for a picturesque leisure and serves as a destination for people seeking outdoor activities and sports. Meanwhile, Al Qusais First neighborhood is located in Deira, also in the eastern part of Dubai city. Al Qusais First is a culturally rich area, including many diverse nationalities; Indians, Pakistanis, Syrians, etc. It offers different services and facilities within such as schools, offices, restaurants and etc.[1]

1 The locations of the selected sites are shown in Chapter 2

As explained in the literature review, certain principles with their associated indicators were discussed to measure walkability. The following sections present assessment of walkability in each neighborhood based on these principles. The principles of walkability, as mentioned previously, include density, mix land use, local amenities and facilities, accessibility, sense of safety, in addition to connectivity and integration.

3.1 Case One: Al Khawaneej First

Firstly, the research will discuss the results of data collection in Al Khawaneej First neighborhood. As mentioned, data collection is based on walkability principles. Each principle consists of different indicators. Each indicator is measured using one or several tools mentioned in each step.

3.1.1 Development Density

Development density is measured by calculating the gross population density of the selected neighborhood. The later can be obtained by dividing number of people over the occupied area.

3.1.1.1 Gross Population Density

Calculating the gross population density of Al Khawaneej First neighborhood required the researcher to seek statistical data from the responsible governmental authorities.

3.1.1.1.1 Statistical Data

The area of the Al Khawaneej First neighborhood covers approximately 1640 Hectares, while the total area of Dubai is around 411400 Hectares. It has a population

of 11169 people. Therefore, the gross population density of Al Khawaneej First neighborhood is about 6.8 person/Hectare. This density is considered a very low density, based on the required density for sustainable development (40-50 person/Hectare). The housing typology in the neighborhood is single family houses with approximate plot area from 1114.8 m^2. This reflects that the number of people per Hectare is low, which stresses the fact that the development doesn't have a dense urban form.

3.1.2 Mix Land Use

Mix land use developments are the ones including integrated and proximate various functions of the city; residential, recreational, civic uses and public commuting infrastructure. In addition, they are the developments offering different and close job opportunities for its residents. Finally, mix land use developments are the ones offering variety of housing typologies for the inhabitants.

4.1.2.1 Provision of Integrated Residential, Recreational, and Civic Uses

Residential, recreational, and civic uses are the components of everyday life. Walkable neighborhoods should ensure having these functions integrated with each other and connected with walkability and public transport infrastructures. This indicator is measured by analyzing the land use map of Al Khawaneej First neighborhood.

3.1.2.1.1 Map Analysis

In Al Khawaneej First, the integration of different land uses such as residential, recreational and civic use, is poor as shown in Figure (16). Land uses are not connected to available public transportation lines (buses).

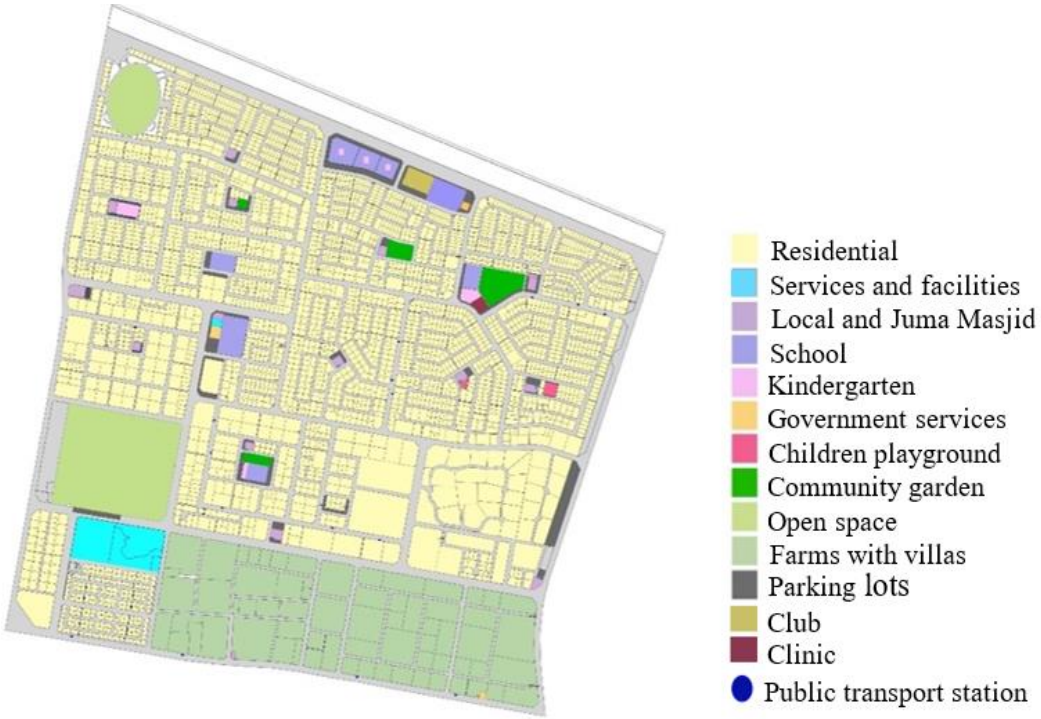

Figure 16: Al Khawaneej First Land Use Map

3.1.2.2 Diversity of Local Job Opportunities

Diversity of local job opportunities and relevant workplaces is an indicator of a mix land use development. This indicator is assessed using both observations and questionnaires.

3.1.2.2.1 Observations

The provided services, that are able to generate jobs, are restaurants, supermarkets, and shops. The neighborhood layout facilities are not providing local job opportunities where most of the workers are not from the neighborhood.

3.1.2.2.2 Questionnaire

By questioning the workers about the distance they need to travel to reach their work, the workers responded that “[they] need to use transportation to reach [their

jobs] since most of [them] who work in restaurants, supermarkets, shops, and etc. are not residents of the neighborhood" (personal communications, 2018). In addition, they mentioned the fact that bus stops are far away from their workspace.

3.1.2.3 Provision of Housing Variety

This indicator of a mix land use development is assessed by the own observations of the researcher.

3.1.2.3.1 Observations

The housing typology in Al Khawaneej First neighborhood is comprised of single-family housing units with different number of rooms; ranging from four rooms upwards in different design styles, as shown in Figure (17).

Figure 17: Different Architectural Designs of Family Houses in Al Khawaneej First (Dubai Municipality, 2018)

3.1.3 Local Facilities and Amenities

Neighborhood facilities are the services or amenities utilized by local communities for various purposes. They may include food retail, transport, education, recreation, and etc.

3.1.3.1 Local Provision of Services and Facilities

As mentioned, local services include open spaces and green spaces. This indicator is assessed using map analyzing, researcher's observations and questionnaires.

3.1.3.1.1 Map Analysis

In Al Khawaneej First, as shown in Figure (16), there are different land uses in the area such as residential, recreational and civic use. However, they are poorly integrated. Moreover, they are randomly distributed in the area.

3.1.3.1.2 Observations

Available services and facilities include residential units, retail facilities (shops, supermarket, restaurant, café), mosques, children's playground, neighborhood parks, as observed and collected in fieldwork notes. These services were randomly distributed around the neighborhood.

3.1.3.1.3 Questionnaire

When the inhabitants of the neighborhood were asked about the available types of amenities and facilities in the neighborhood, the answers included restaurant, cafes, mosques, park, children playgrounds. However, the selection of these services was based on each participant's experience and usage. Also, participants have mentioned that there are new facilities opening in the area including new restaurants, supermarkets, shops, and schools.

3.1.4 Accessibility

Accessibility is a function of proximity to destinations and the directness of routes leading to those destinations. Indicators of accessibility include providing walking network, provision of proper signage system, provision of amenities and public transportation nodes within a walkable distance, visibility of services and amenities, provision of street furniture, and accessible spaces for all.

3.1.4.1 Providing Walking Network

This indicator of providing walking network is assessed by map analyzing and questionnaires.

3.1.4.1.1 Map Analysis

There are different levels of street hierarchy in Al Khawaneej First neighborhood, as shown in Figure (18). Mainly it consists of three types. The first type is main roads colored in red. The neighborhood has four main roads surrounding it from all sides; Amman Street to the north, Al Khawaneej Street to the south, Sheikh Zayed Bin Hamdan Al Nahyan Street to the west and Al Amardi Street to the east. In addition, it consists of collector roads that are in blue color. Finally, the last road type is the local roads colored in green.

In Al Khawaneej First, the walking network provided does not cover the entire neighborhood, as shown in Figures (19 & 20 & 21). The network is not connected to any service or facility within the neighborhood (more detailed discussion will be offered in Connectivity and Integration section).

Figure 18: Street Hierarchy of Al Khawaneej First

Figure 19: Walking Network - Sidewalk Network of Al Khawaneej First

Figure 20: Sidewalks in Al Khawaneej First, taken by author (2018)

Figure 21: Areas with no Sidewalks in Al Khawaneej First, taken by author (2018)

3.1.4.1.2 Questionnaire

According to the conducted questionnaire, 40% of participants commented that the sidewalks are not continuous. In addition, 20% shared that sidewalks are only on one side of some streets. However, 20% reported that sidewalks exist on both sides on some streets and 20% mentioned that sidewalks are on both sides of almost of all streets.

3.1.4.2 Provision of Proper Signage System

Proper signage system includes street signs for wayfinding. This indicator is assessed by the own observations of the researcher and questionnaires.

3.1.4.2.1 Observations

Regarding the signage system, there is no signage system used within the neighborhood to guide people to their destinations including mosques, grocery stores, etc. This can actually limit the accessibility of services to all people and can be an obstacle for people navigating to their destination. The researcher had noticed this issue while navigating the area, and this issue was also reported by participants who are unfamiliar with the street. However, few signs are available for The Last Exit and Al Quran Park.

3.1.4.2.2 Questionnaire

In terms of street signs, 67% of participants thought that there are no street signs and they feel lost when using the street. Moreover, people reported that anyone who comes to the neighborhood for the first time needs a navigator or needs to ask questions to reach their destination. While 13% disagreed and thought that adequate street signage is available. However, 20% were not sure.

3.1.4.3 Provision of Amenities and Public Transportation Nodes within a Walkable Distance

This indicator is assessed by questionnaires and by analyzing maps generated using DepthmapX software.

3.1.4.3.1 Questionnaire

In Al Khawaneej First, participants agreed that there are some local services and facilities that are accessible by walking as the following results; 23% for supermarket, 8% for café, 18% for restaurant and 54% for other amenities such as parks (Appendix B).

3.1.4.3.2 DepthmapX Software

The study area has a range of services and facilities such as residential units, shops, mosque, children's playground, neighborhood park, and open spaces. These should include opening options for pedestrians to walk or cycle within a reasonable catchment distance. According to the step depth results, using DepthmapX, it can be noticed that more than 20% of houses are out of the required catchment area for services, moreover facilities and are not located within a walkable distance as shown in figures (22 - 25 & 27). However, the mosque shown in Figure (26) covers a huge area. There are limitations in terms of available public transport choices, since the only available mode of transportation is buses. In addition, these bus stops are not within the required catchment area as shown in Figure (28). Therefore, public transportation is not affective to provide access to different facilities.

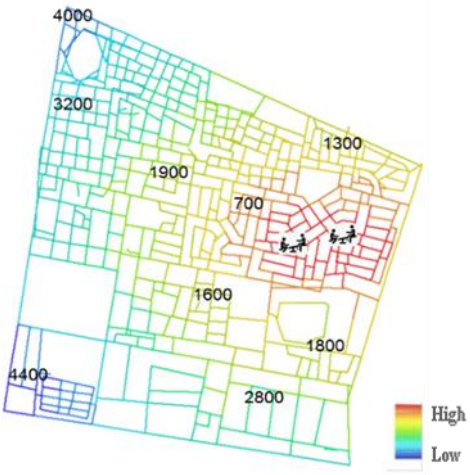

Figure 22: Children Playground in Al Khawaneej First (400m), developed by author using DepthmapX

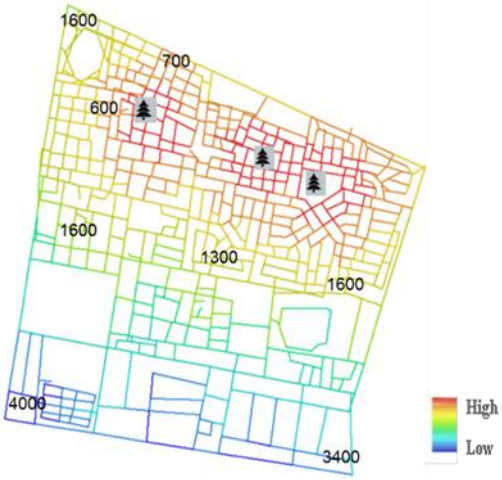

Figure 23: Neighborhood Park in Al Khawaneej First (400m), developed by author using DepthmapX

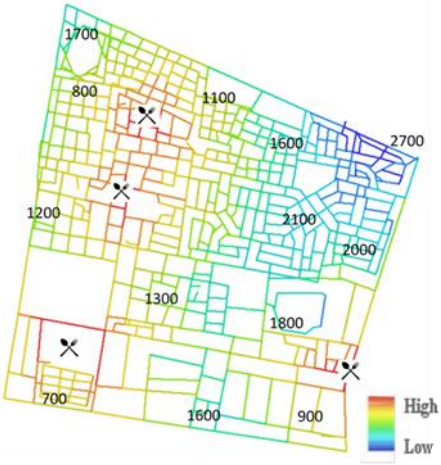

Figure 24: Restaurant in Al Khawaneej First (400m), developed by author using DepthmapX

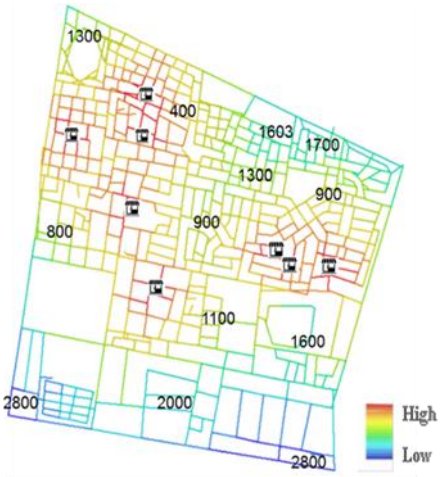

Figure 25: Supermarket & Grocery in Al Khawaneej First (400m), developed by author using DepthmapX

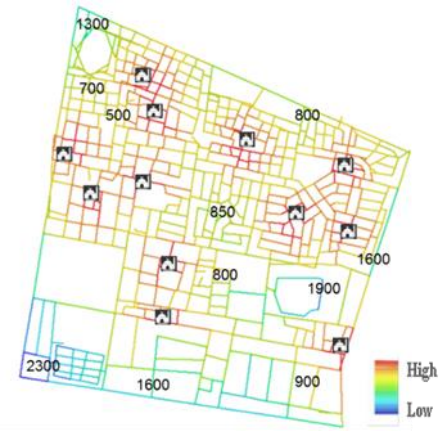

Figure 26: Mosque in Al Khawaneej First (500m), developed by author using DepthmapX

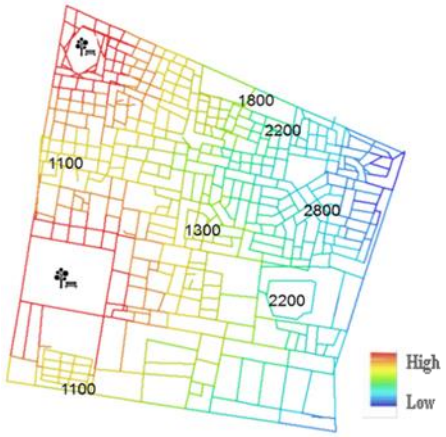

Figure 27: Open space in Al Khawaneej First (400m), developed by author using DepthmapX

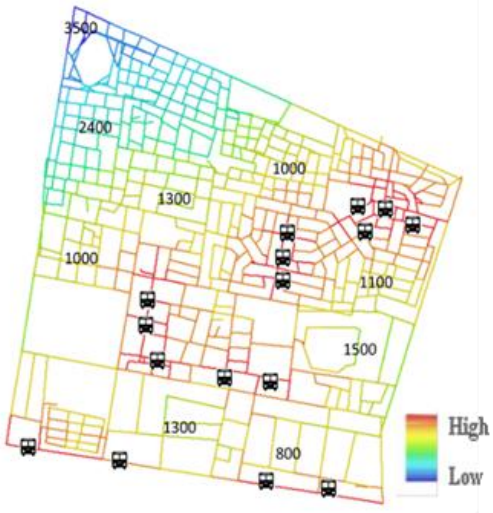

Figure 28: Transportation Nodes in Al Khawaneej First (300-400m), developed by author using DepthmapX

3.1.4.4 Visibility of Services and Amenities from the Main Street

This indicator is assessed by the researcher's observations and by analyzing the maps generated using DepthmapX software.

3.1.4.4.1 Observations

Houses and trees are blocking the view of Al Khawaneej First neighborhood, looking from the main streets. Some provided services in the neighborhood such as The Last Exit and AL Quran Park, are blocked from the view of visitors. If a visitor needs to visit these places, they need to know in advance the location of the services to minimize the chance of getting lost.

3.1.4.4.2 DepthmapX Software

Space gains a strong choice value when there are several alternative short paths connecting the spaces passing through them. According to Figure (29), there is no direct access to all facilities or open spaces within the neighborhood area. The Map shows that there are only two segments with a strong choice, they are shown in red in Figure (29). This means that there are no short paths connecting the spaces together. In addition, integrated streets should include most of the amenities and facilities. However, in Al Khawaneej First these amenities and facilities are not located within these streets, as shown in Figure (29).

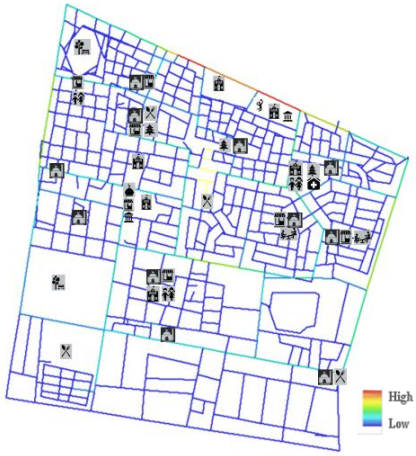

Figure 29: Choice Map (Rn) of Al Khawaneej First, developed by author using DepthmapX

3.1.4.5 Provision of Street Furniture

Street furniture includes softscape, shading devices, etc. This indicator is assessed by the researcher's observations and questionnaire.

3.1.4.5.1 Observations

As observed, street furniture in Al Khawaneej First is not well maintained to serve pedestrians using the street. The signage and wayfinding system in Al Khawaneej First are unclear, but there is a small area at The Last Exit with a sufficient signage system that encourages people from outside to enter the area. However, shading elements are not available in Al Khawaneej First, which motivates pedestrians to avoid using the street during the day, as shown in Figure (30).

Regarding the softscape and landscape, in Al Khawaneej First, there is a lack of attention to both. Inside the neighborhood there are no proper softscape or landscapes except around parks; where they provided only few benches for rest and some trees as shown in Figures (30 & 31).

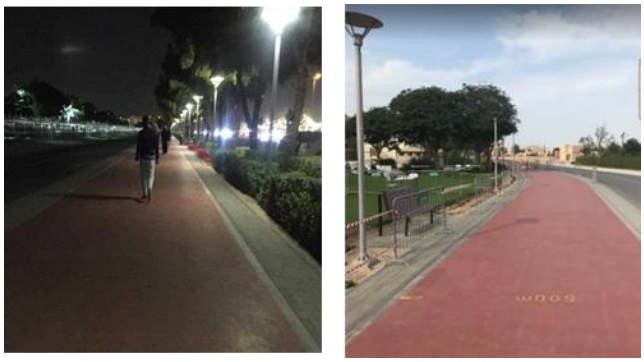

Figure 30: Sidewalks in Different Times of the day in Al Khawaneej First - Al Quran Park, taken by author (2018)

Figure 31: Street Furniture in Al Khawaneej First – Al Quran Park, taken by author (2018)

3.1.4.5.2 Questionnaire

As discussed in reference to accessibility, high percentage of people referred to inadequate signage system. Only 19% felt that the lighting provided is sufficient for walking at night, and no one mentioned the existence of appropriate shading elements during the day. People reported (50% of participants) the lack of street furniture for resting along the sidewalks. However, 30% mentioned that there is sufficient furniture on the walking path around Al Quran Park. In addition, 20% of participants expressed uncertainty. Based on the previous answers regarding street furniture, it is apparent that the street furniture is insufficient in Al Khawaneej First as a whole, although it has been considered a little around Al Quran Park.

3.1.4.6 Accessible Spaces for All

Streets and spaces should be accessible for all groups in the society including kids, people with special needs, mothers and elderly people. This indicator is assessed by the researcher's observations.

3.1.4.6.1 Observations

In Al Khawaneej First, most of the streets don't consider the accessibility factors for different ages and physical abilities. Therefore, people with special needs, elderly people, and parents with stroller may not be able to walk independently due to limited choices of offered services, mobility and accessibility as shown in Figure (32).

Figure 32: Inadequate Accessibility of Streets in Al Khawaneej First, taken by author (2018)

3.1.5 Sense of Safety

Safety is one of the important aspects while designing a walkable neighborhood. The streets should be designed to ensure pedestrians' safety. Indicators of safety include provision of sidewalks, crosswalks and barriers, provision of streetlights, provision of traffic calming and speed limits, in addition to providing permeability and eyes on the street.

3.1.5.1 Provision of Pedestrian Sidewalk, Crosswalks and Barriers

This indicator is assessed by the researcher's observations and questionnaire.

3.1.5.1.1 Observations

In Al Khawaneej First, some areas have a sidewalk, while other areas don't. Therefore, the areas without any sidewalk are considered unsafe place for pedestrians to walk. In addition, there are cross areas with humps near each service point. However, they are not provided in all areas. These crosswalks are distant from each other (Figure 34). In Al Khawaneej First, there are no barriers in some areas, while other areas have barriers separating the sidewalk from the street using planting and bollards. The available sidewalks are one meter wide, used for walking in both

directions as shown in Figure (33). Comparing this with safety standards; which is minimum 1.80 m width, these sidewalks are considered as too narrow and unsafe.

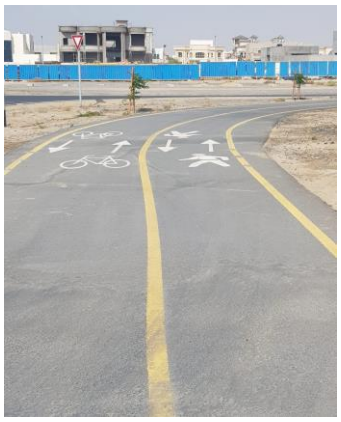

Figure 33: Sidewalk Width in Al Khawaneej First, taken by author (2018)

Figure 34: Pedestrian Crossing Areas in Al Khawaneej First

3.1.5.1.2 Questionnaire

As described in terms of connectivity, the majority (representing around 60% of the participants) believed that sidewalks are not continuous and incomplete. The crossings in the area were described by the participants as follows; 40% think that there are not enough pedestrian crossings, while 20% feel there are enough and 40% are unsure because they do not use the street enough to know.

Regarding the width of the sidewalks, 53% felt that it is not suitable to walk along, because it is narrow and uncomfortable in both directions, while 31% felt that it is suitable for them to use, and 16% were not sure how to describe it.

Sidewalks have no barriers separating them from the street according to 40% of the study group, while 30% said there are barriers and 30% did not know.

3.1.5.2 Provision of Streetlights

This indicator is assessed by the researcher's observations and questionnaire.

3.1.5.2.1 Observations

Efficiency of lighting can create a safe environment for pedestrians. In Al Khawaneej First, the lighting levels provided are insufficient for the sidewalk, since the height of the lighting fixture is not suitable for human scale. Only near Al Quran Park, the lighting level is sufficient, and the lighting fixtures are suiting the human scale, as shown in Figure (35).

3.1.5.2.1 Questionnaires

The majority of participants were walking at night, representing 86% of the sample, while only 14% used the streets to walk during the day.

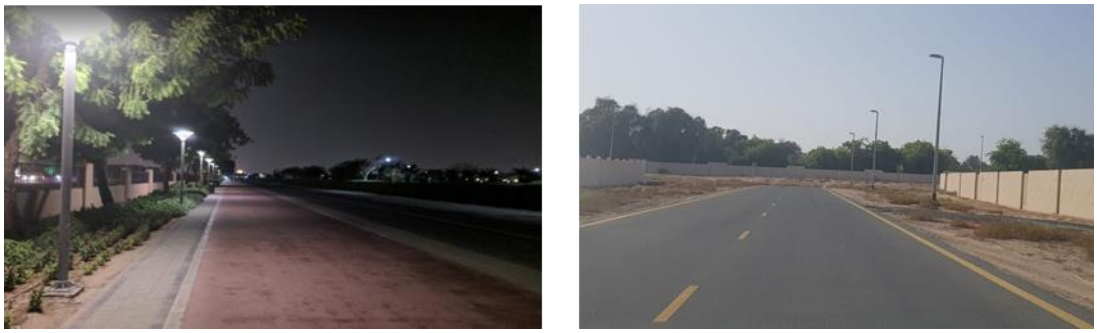

Figure 35: Lighting Fixtures in Al Khawaneej First, taken by author (2018)

3.1.5.3 Provision of Traffic Calming and Speed Limit

Provision of speed limits for cars and traffic calming components are important indicators for the sense of safety. This indicator is assessed by the researcher's observations and questionnaire.

3.1.5.3.1 Observations

There are traffic speed signs distributed throughout the neighborhood to define the speed limit for drivers. However, there are no radar cameras to track and control the speed within the neighborhood.

3.1.5.3.2 Questionnaire

People's perception regarding street safety is reported as follows; 35% of participants felt that the speed is limited in a way allowing them to use the street safely and easily. This is considered a low percentage compared to the majority who think that cars are moving with a very uncontrolled high speed (Figure 36).

Figure 36: Sidewalk (a), traffic speed sign (b), and crosswalk with hump in Al Khawaneej First, taken by author (2018)

3.1.5.4 Providing Permeability and Eye on the Street

Providing permeability, eyes on the street and surveillance is done through having an active street frontages and rooms facing the streets. This indicator will be assessed by the researcher's observations and by analyzing maps generated using DepthmapX software.

3.1.5.4.1 Observations

Regarding visual surveillance, Al Khawaneej First area is supported by rooms facing the street. However, in most areas, high fences and trees interrupt visual surveillance, as shown in Figure (37). To make the sidewalks feel safer, visual connection should be provided.

Figure 37: Visual Surveillance in Al Khawaneej First, taken by author (2018)

3.1.5.4.2 DepthmapX Software

As was shown in Figure (29), the red and orange street segments are the most integrated and used streets. This indicates that these streets are active and vital. Based on that, they are being used by people regularly and this can make the streets feel safer. While the blue streets could not be considered as safe because they are isolated or disconnected. Most of the streets in Al Khawaneej First are indicated as blue streets. In addition, as was shown in Figure (29), the red street segments are the most chosen and the shortest paths used to reach the destination. Since they are used by people regularly, these streets can be considered as active and safe.

3.1.6 Connectivity and Integration

Connectivity and integration principles study how houses clusters are connected with the rest of neighborhood, the neighborhood's physical connections, and street intersection density.

3.1.6.1 Connected Housing Clusters

Connected housing clusters are the ones with houses that are interconnected with other clusters, neighborhood center, and surrounded area. this indicator is assessed using observations, questionnaire and DepthmapX software.

3.1.6.1.1 Observations

Some areas in the neighborhood are connected together by sidewalks but others are with insufficient sidewalks as shown in the pedestrian network (Figure 19). The housing layout within the clusters can help in connecting them with other housing clusters through the existing of *Sekka* (narrow outdoor corridors) between houses next to each other.

3.1.6.1.2 Questionnaire

Regarding the connectivity of the neighborhoods, 56% of participants reported that the neighborhood was not connected by sidewalks, 39% knew it was connected, and 5% did not know. Regarding the availability of alternative roads to reach one's destination, 9% of participants failed to see other than one possible route for a certain destination, and 32% felt there was more than one route, while 59% were unsure or did not know.

3.1.6.1.3 DepthmapX Software

Figure (38) shows the most connected roads in red. There are some high values near the main roads, and some high values for the internal roads, as indicated in red. Some of the roads lead to facilities and services areas. In addition, the roads were helpful to connect housing clusters with other clusters, although there is no direct connection to the other surrounding areas in the city.

Figure 38: Connectivity Map (Rn) of Al Khawaneej First, developed by author using DepthmapX

The correlation; which identifies how strong is the relation between some variables or indicates such as synergy, harmony, and intelligibility, can be used to measure connectivity and integration as explained in the following Figures (39 - 44).

- The synergy graphs, Figures (39 - 42), describe a correlation coefficient (R2) between local (Different radii) and global integration, and (RN) shows the following:
  - Correlation between global integration and local integration (R400) = 0.033, which indicates a low correlation.

- Correlation between the global integration and local integration (R600) = 0.055, which indicates a low correlation.
- Correlation between the global integration and local integration (R800) = 0.094, which indicates a low correlation.
- Correlation between the global integration and local integration (R1000) = 0.134, which indicates a low correlation.

- The harmony graph, Figure (43), describes the correlation coefficient (R2), and the correlation between integration and choice measurements. The correlation coefficient (R2) of the study area is = 0.54, which indicates a moderate correlation between the integration and the choice.
- The intelligibility graph, Figure (44), describes the correlation coefficient (R2) between connectivity and the global integration values. The intelligible system is one in which well-connected spaces also tend to be well integrated spaces. The intelligibility of the study area is (R2) = 0.016, which indicates a low correlation between integration and the connectivity, resulting in less well integrated spaces in the study area.

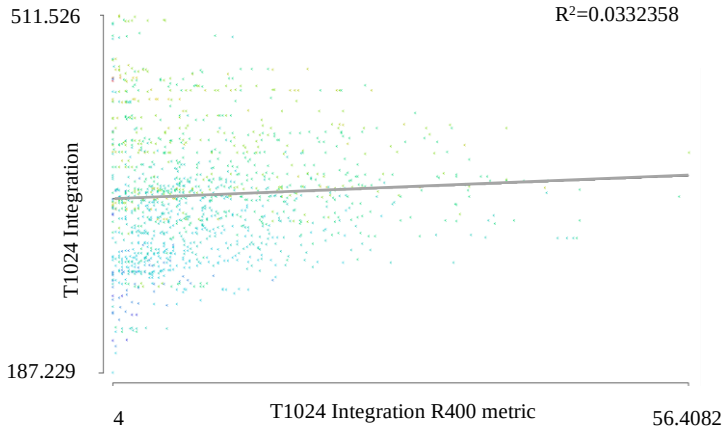

Figure 39: Correlation Between Global Integration and Local Integration (R400) of Al Khawaneej First, developed by author using DepthmapX

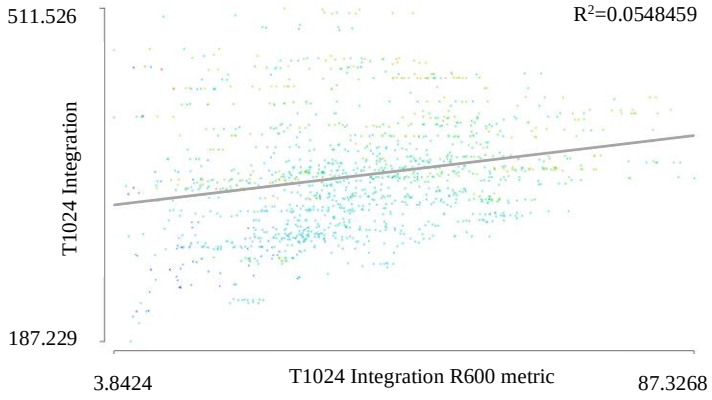

Figure 40: Correlation Between Global Integration and Local Integration (R600) of Al Khawaneej First, developed by author using DepthmapX

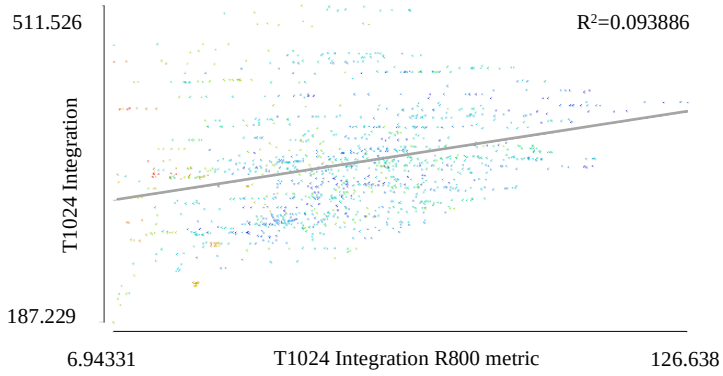

Figure 41: Correlation Between Global Integration and Local Integration (R800) of Al Khawaneej First, developed by author using DepthmapX

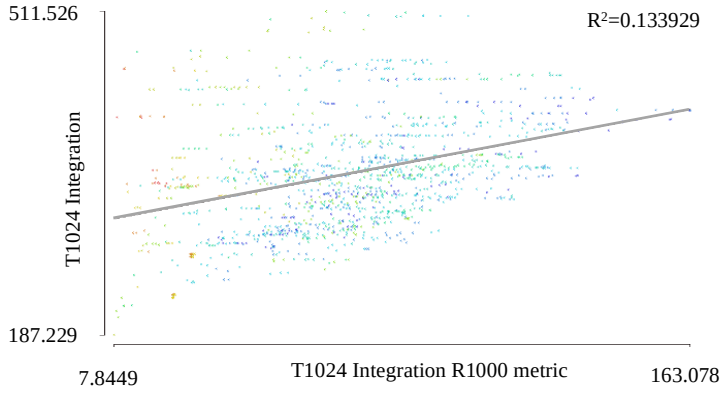

Figure 42: Correlation Between Global Integration and Local Integration (R1000) of Al Khawaneej First, developed by author using DepthmapX

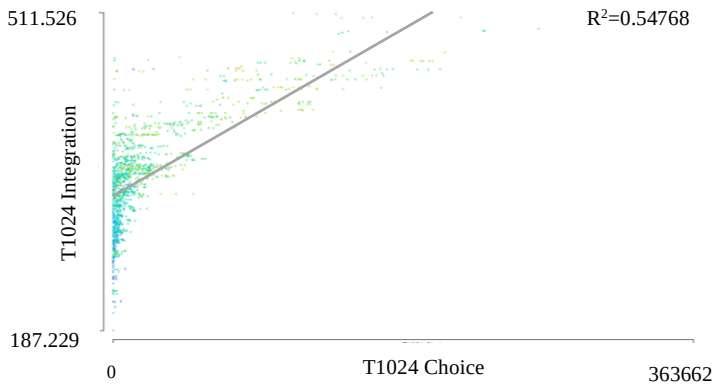

Figure 43: Harmony Graph of Al Khawaneej First, developed by author using DepthmapX

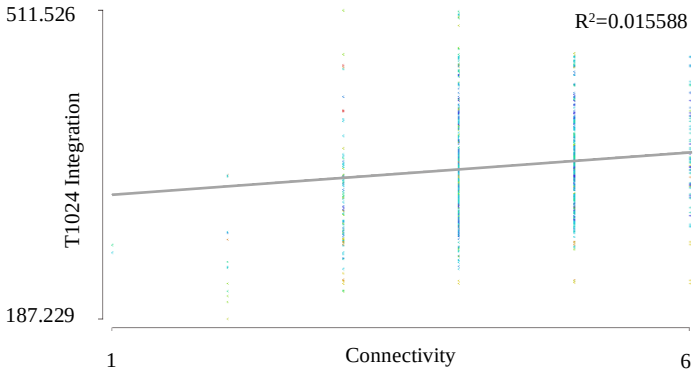

Figure 44: Intelligibility Graph of Al Khawaneej First, developed by author using DepthmapX

3.1.6.2 Neighborhood Physical Connections

This indicator is assessed by researcher's observations, and questionnaire.

3.1.6.2.1 Observations

There are initiatives to connect the neighborhood with nearby neighborhoods through walking paths and pedestrian bridges as a way to encourage walkability. The walking paths are connecting Al Khawaneej First neighborhood with surrounding neighborhoods, as shown in Figure (45 & 46).

Figure 45: Construction of a Pedestrian Bridge in Al Khawaneej First, taken by author (2018)

Figure 46: Location of Proposed Pedestrian Bridge Al Khawaneej First

3.1.6.2.2 Questionnaire

According to neighborhood connectivity, 93% of participants thought that it is not easy to reach the nearby neighborhoods by walking. While 7% disagreed with that since they have begun to use the new pedestrian bridge.

3.1.6.3 Street Intersection Density

Calculating the street intersection density of Al Khawaneej First neighborhood required the researcher to seek statistical data from the responsible governmental authorities.

3.1.6.3.1 Map Analysis

To calculate the street intersection density, the number of intersections and the area need to be known. As mentioned before the area of Al Khawaneej First is around 1640 Hectares which equal to 16.4 km^2. Intersection density is calculated by the number of intersections per square kilometers; which means 140/16.4 = 8.5 This number compared with the reference point of 100, is considered as low.

3.2 Case Two: Al Qusais First

Secondly, the research will discuss the results of data collection in Al Qusais First neighborhood. As mentioned, data collection is based on walkability principles. Each principle consists of different indicators. Each indicator is measured using one or several tools mentioned in each step.

3.2.1 Development Density

Development density is measured by calculating the gross population density of the selected neighborhood. The later can be obtained by dividing number of people over the occupied area.

3.2.1.1 Gross Population Density:

Calculating the gross population density of Al Qusais First neighborhood required the researcher to seek statistical data from the responsible governmental authorities.

3.2.1.1.1 Statistical Data

Al Qusais First neighborhood is approximately 273 Hectare and it is considered as small area compared with the total area of Dubai, which is around 411400 Hectares. With a population of 41225 people, the gross population density; which is rate between number of people to the area occupied, is about 151 person/Hectare. This density is considered a very high density, based on the minimum density for sustainable development (40-50 person/Hectare). The typology of residential units is multi-story buildings with different designs and different number of floors. The area consists of three blocks. The first block has certain services and amenities; playground,

neighborhood park, mosques, shop and etc. The other two blocks have mostly residential units surrounded by different services and amenities around the edges.

3.2.2 Mix Land Use

Mix land use developments are the ones including integrated and proximate various functions of the city; residential, recreational, civic uses and public commuting infrastructure. In addition, they are the developments offering different and close job opportunities for residents. Finally, mix land use developments are the ones offering variety of housing typologies for inhabitants.

3.2.2.1 Provision of Integrated Residential, Recreational, and Civic Uses

Residential, recreational, and civic uses are the components of everyday life. Walkable neighborhoods should ensure having these functions integrated with each other and connected with walkability and public transport infrastructures. This indicator is measured by analyzing the land use map of Al Qusais First neighborhood.

3.2.2.1.1 Map Analysis

In Al Qusais First, there are an integration of different land uses; residential, recreational and civic use, as shown in Figure (47). They are connected to public transportation; buses and Dubai Metro.

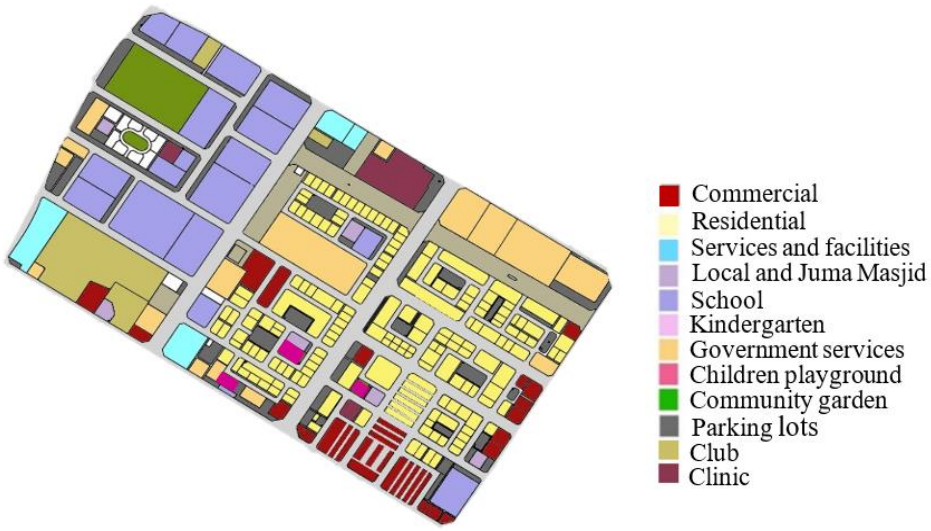

Figure 47: Al Qusais First Land Use Map

3.2.2.2 Diversity of Local Job Opportunities

Diversity of local job opportunities and relevant workplaces are an indicator of a mix land use development. This indicator is assessed using both observations and questionnaires.

3.2.2.2.1 Observations

The neighborhood layout provides local job opportunities, since it includes variety of facilities and amenities; supermarket, shops, café, and restaurants. In addition, there are some workers from other neighborhoods who use public transportation to reach their workplace in the neighborhood. This was noticed from the multiple site visits during early morning and late evening to the neighborhood.

3.2.2.2.2 Questionnaire

By questioning the workers about the distance of travel to reach their work, the workers responded that “[they] live in this area and there is no need to use any

transportation to reach work" (personal communications, 2018). However, some workers are living outside the neighborhood and most of them use metro or other public transportation to reach their work. Public transportation modes are both easy and cheap to use.

3.2.2.3 Provision of Housing Variety

This indicator of a mix land use development is assessed by the own observations of the researcher.

3.2.2.3.1 Observations

The housing typology in the neighborhood is multi-story housing buildings with a different number of rooms and different architectural design (Figure 48).

Figure 48: Different Architectural Design Styles of the Houses in Al Qusais First, taken by author (2018)

3.2.3 Local Facilities and Amenities

Neighborhood facilities are the services or amenities utilized by local communities for various purposes. They may include food retail, transport, education, recreation, and etc.

3.2.3.1 Local Provision of Services and Facilities

As mentioned, local services include open space and green spaces. This indicator is assessed using map analyzing, researcher's observations and questionnaire.

3.2.3.1.1 Map Analysis

In Al Qusais First, as shown in Figure (47), there are different land uses in the area such as residential, recreational and civic use. According to Figure (47), it can be noticed that there are different services and facilities distributed around the area of Al Qusais First neighborhood.

3.2.3.1.2 Observations

In Al Qusais First, different range of services and facilities are provided; restaurants, groceries, supermarkets, mosques, neighborhood park, shops, and children playgrounds.

3.2.3.1.3 Questionnaire

By asking the participants about the type of available amenities and facilities in the neighborhood, the answers included restaurants, groceries, cafes, mosque, park, and children playgrounds. However, the selection of these services was based on each participant usage or need on a daily base.

3.2.4 Accessibility

Accessibility is a function of proximity to destinations and the directness of routes leading to those destinations. Indicators of accessibility include providing walking network, provision of proper signage system, provision of amenities and

public transportation nodes within a walkable distance, visibility of services and amenities, provision of street furniture, and accessible spaces for all.

3.2.4.1 Providing Walking Network

This indicator of providing walking network is assessed by map analyzing and questionnaire.

3.2.4.1.1 Map Analysis

Figure (49) shows the road hierarchy in Al Qusais First. Mainly the road network consists of three types. The first type or level of streets is the main roads shown in red (Figure 49). There are four main roads surrounding the boundaries of the neighborhood; Baghdad Street from the north, Al Nahda Street from the south, Amman Street from the west and Damascus Street from the east. In addition, it consists of collector roads colored in blue, and local roads colored in green (Figure 49).

Al Qusais First area lacks a walking network, as shown in Figure (50). However, there is a pedestrian bridge that connects other blocks to the neighborhood by crossing the main street, as in Damascus Street (Figure 51).

Figure 49: Street hierarchy of Al Qusais First

Figure 50: Lack of Pedestrian Sidewalks in Al Qusais First, taken by author (2018)

Figure 51: Pedestrian Bridge in Al Qusais First, taken by author (2018)

3.2.4.1.2 Questionnaire

Based on the conducted questionnaire, 21% of people reported the discontinuity of sidewalks. While 47% noted that sidewalks exist on just one side of some streets, 2% reported that sidewalks are on one side of almost all streets. On the other hand, 12% reported sidewalks on both sides of some streets, while only 6% believed that sidewalks are on both sides of almost all streets. However, 12% of the participants had no idea.

3.2.4.2 Provision of Proper Signage System

This indicator is assessed by observations of the researcher and questionnaire.

3.2.4.2.1 Observations

Regarding the signage system and wayfinding, Al Qusais First lacks a well-integrated signage system to guide people to their destination easily as shown in Figure

(52). The researcher encountered this issue while conducting the fieldwork. Participants also reported the problem of getting lost in their first visit to Al Qusais First neighborhood.

Figure 52: Lack of Signage System in Al Qusais First, taken by author (2018)

3.2.4.2.2 Questionnaire

Regarding street signs, 57% mentioned that there is insufficient signage, while 33% disagreed, mentioning that the street signs are available and 10% were not sure.

3.2.4.3 Provision of Amenities and Public Transportation Nodes within a Walkable Distance

This indicator is assessed by questionnaire and by analyzing maps generated using DepthmapX software.

3.2.4.3.1 Questionnaire

In Al Qusais First, participants agreed that some local services and facilities are accessible by walking as follows; 24% for public transportation, 16% for shops, 9% for restaurants, 6% for café, 19% for supermarket and others (Appendix C).

3.2.4.3.2 DepthmapX Software

According to the step depth results in Figures (53 - 58), it can be noticed that more than 20% of houses are out of the required catchment area of the mosque, the children's playground and neighborhood park. These mentioned facilities are not within a walkable distance. However, other services can be reached by walking as they cover huge areas in the neighborhood. In terms of available transportation options, buses, taxis and metro stations are all integrated within the area and are successful in providing the residents with various commuting options. Bus stops offer detailed information regarding arrival time and the destination for each trip. These bus stations designed with seats and shading area are well. This ensures comfortability for bus users. Al Qusais First neighborhood has a strong choice value when it offers several alternative short paths connecting it to other spaces (Figure 59).

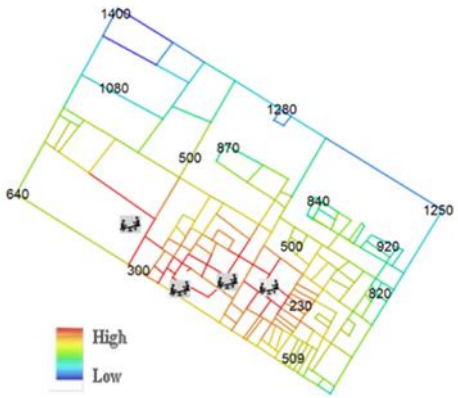

Figure 53: Children Playground (300m) in Al Qusais First, developed by author using DepthmapX

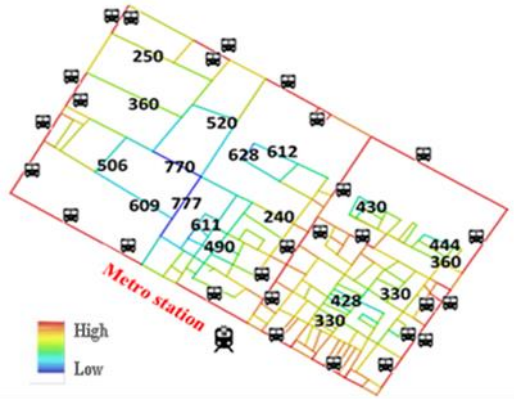

Figure 54: Transportation Stops (300-400m) in Al Qusais First, developed by author using DepthmapX

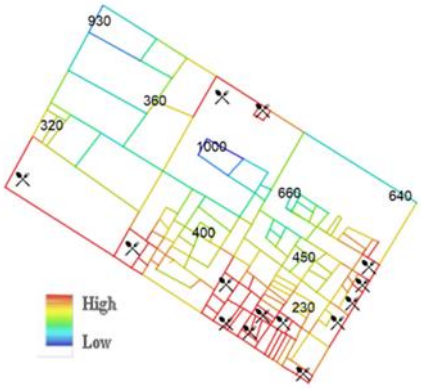

Figure 55: Restaurant and Cafe (300m) in AL Qusias First, developed by author using DepthmapX

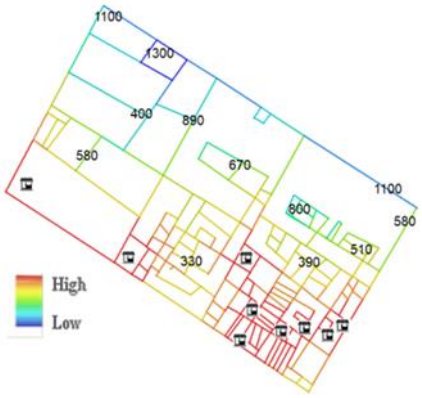

Figure 56: Supermarket & Grocery (300m) in Al Qusais First, developed by author using DepthmapX

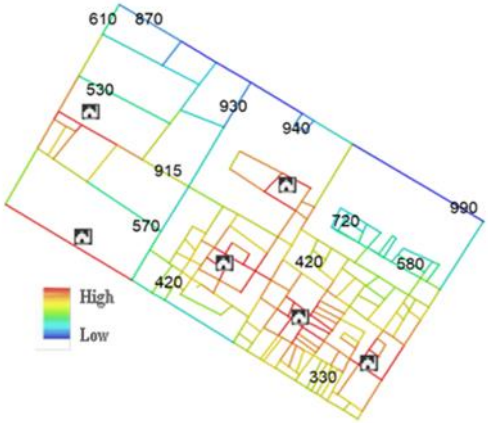

Figure 57: Mosque (500m) in AL Qusias First, developed by author using DepthmapX

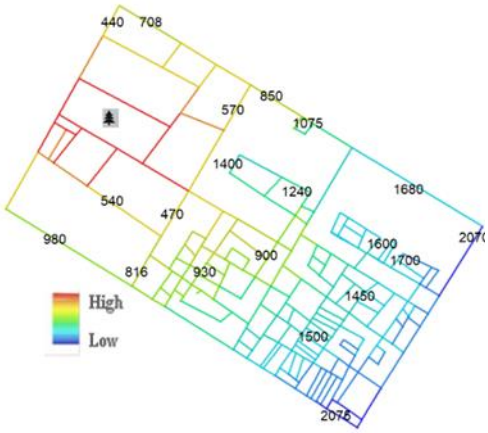

Figure 58: Neighborhood Park (300m) in AL Qusias First, developed by author using DepthmapX

3.2.4.4 Visibility of Services and Amenities from the Main Street

This indicator is assessed by the researcher's observations and by analyzing maps generated using DepthmapX software.

3.2.4.4.1 Observations

In Al Qusais First, some of the facilities and amenities are located towards the main street. This makes major services and facilities easy to identify. These major services that are visible from the main road include Lulu Hypermarket, some restaurants, cafés and shops.

3.2.4.4.2 DepthmapX Software

A space has a strong choice value when there are several short alternative paths connecting the spaces passing through them. According to Figure (59), there is no direct access to all facilities and open spaces within the area of the neighborhood. Figure (59) also shows that there are only two segments with a strong choice, the ones colored in red. In addition, most of these amenities and facilities are located on Al Nahda Street, which is considered as a very integrated street, as shown in Figure (59).

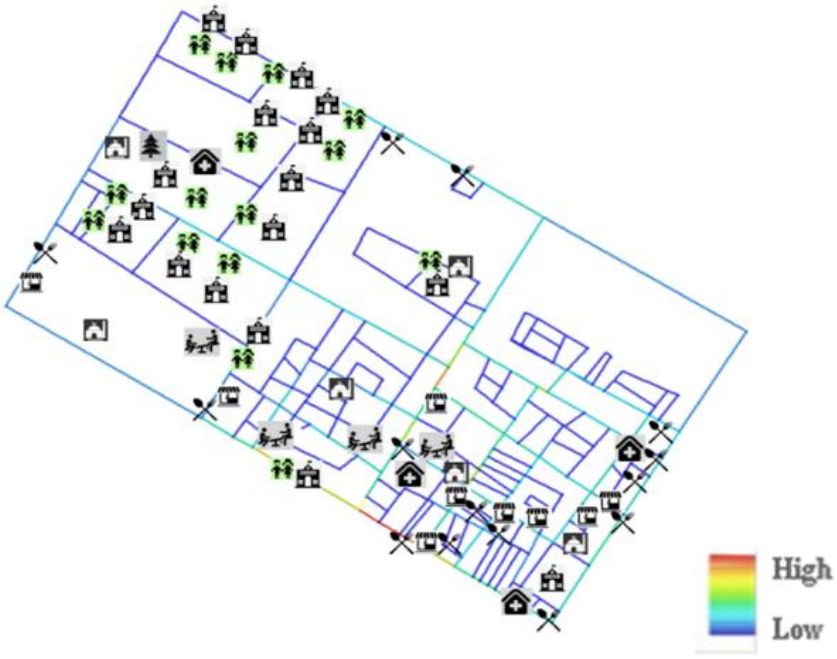

Figure 59: Choice Map (Rn) of Al Qusais First, developed by author using DepthmapX

3.2.4.5 Provision of Street Furniture

Street furniture includes softscape, shading devices, etc. This indicator is assessed by the researcher's observations and questionnaire.

3.2.4.5.1 Observations

The signage and wayfinding system are mainly provided on the main streets surrounding the Al Qusais First neighborhood. There is a lack of proper signage and wayfinding system in the inner street areas (Figure 60). This is reported as a problem especially that the neighborhood has some services like schools and playgrounds in the inner area.

In Al Qusais First neighborhood, there are no shading elements. The only shade in the neighborhood is provided by the buildings on the streets as shown in Figure (61). This was clearly identified along narrow streets where the multi-story buildings provided shade. Some people reported using umbrellas while walking along the neighborhood's streets during daytime. The streets also lack proper furniture as shown in Figure (62). The existence of street furniture can fulfil an aesthetic as well as a functional purpose; both of which are important to encourage walking, cycling and to create a sense of place.

The softscape and landscape of the area is not well designed, but actually disorganized and random. The use of different types of softscape species is a key element in creating a pleasant walking environment and good experience for the public.

Figure 60: Al Qusais First Map, shown in a street sign, taken by author (2018)

Figure 61: Shadow of High-Rise Buildings in Al Qusais First, taken by author (2018)

Figure 62: Lack of Landscape and Street Furniture in Al Qusais First, taken by author (2018)

3.2.4.5.2 Questionnaire

As discussed in terms of accessibility, a high percentage of people reported inadequate signage system on the streets. Regarding lighting efficiency, 25% of participants thought that the lighting provided is sufficient for walking at night. Regarding shading elements, 15% of participants thought that there is adequate shading during the day. Regarding other street furniture, 54% of participants reported a lack of available street furniture along sidewalks, while 40% of participants thought there is enough street furniture. However, 6% of participants had no clear idea. Therefore, it is apparent that there is a lack of street furniture in Al Qusais First.

3.2.4.6 Accessible Spaces for All

Streets and spaces should be accessible for all group in society including kids, special needs, mothers and elderly people. This indicator will be assessed by the researcher's observations.

3.2.4.6.1 Observations

In Al Qusais First, the streets are not welcoming for elderly and disable people to fulfil their own needs and to live independently. That offers a limited movement to small number of destinations. Inclusive design of streets is considered partially in some areas. Few streets are providing slops to the sidewalk, especially wherever important entrances or destinations exist. On the other hand, it is important to mention that the design of bus stops respects the inclusive design. In addition, elevators are added to the pedestrian bridge in order to help pedestrians cross the street easily as shown in Figure (63).

Figure 63: Inaccessible Streets in Al Qusais First, taken by author (2018)

3.2.5 Sense of Safety

Safety is an important aspect while designing walkable neighborhoods. The streets should be designed to ensure pedestrians' safety. Indicators of safety include provision of sidewalks, crosswalks and barriers, provision of streetlights, provision of traffic calming and speed limit, and providing permeability and eyes on the street.

3.2.5.1 Provision of Pedestrian Sidewalk, Crosswalks and Barriers

This indicator is assessed by the researcher's observations and questionnaire.

3.2.5.1.1 Observations

Al Qusais First neighborhood does not offer sufficient sidewalks for pedestrians. The absence of sidewalks creates confusion for pedestrians wishing to identify a safe path to use while walking along the streets, as shown in Figure (64). The neighborhood has crosswalks distributed across certain streets, such as the main streets and Al Wehda Street. The crosswalks around Al Qusais First neighborhood are associated with street humps. The locations of the street crosswalks are shown in Figure (65). No physical barriers exist to separate the available sidewalks from street.

Figure 64: Lack of Sidewalks in Al Qusais First, taken by author (2018)

Figure 65:Pedestrian Crossing in Al Qusais First, developed by author (2018)

3.2.5.1.2 Questionnaire

As described in terms of connectivity, around 68% of participants reported that sidewalks are not continuous and incomplete. The crosswalks in the area were described by the participants as follows: 68% thought that there are too few pedestrian crossings, while 20% felt there are enough pedestrian crossings, and 12% were unsure.

Regarding the width of sidewalks, 66% of participants stated that they are not suitable for walking, while 22% found that the width of sidewalks is sufficient, and 12% did not know.

Sidewalks have no barriers that separate pedestrians from the street according to 77% of the study group, while 18% of participants reported that there are barriers, and 5% did not know.

3.2.5.2 Provision of Streetlights

This indicator is assessed by the researcher's observations and questionnaire.

3.2.5.2.1 Observations

The installed lighting fixtures in Al Qusais First neighborhood are not respecting the human scale, therefore they benefits car users more than pedestrians, as shown in Figure (66).

Figure 66: Lighting Column in Al Qusais First, taken by author (2018)

3.2.5.2.2 Questionnaires

Most of participants (representing 53% of the sample) are used to walking during nighttime, while 47% of the study group used the streets during daytime.

3.2.5.3 Provision of Traffic Calming and Speed Limit

Provision of speed limits for cars and traffic calming components are important indicators for the sense of safety. This indicator is assessed by the researcher's observations and questionnaire.

3.2.5.3.1 Observations

Speed limits are readily identifiable, especially on local roads leading inside the neighborhood. Speed limits inside the neighborhood are set 40 km/hour. Cars in most streets are forced to reduce their speed due to the existence of pedestrians on the streets; there is no sidewalks in most streets. Also, there are some street humps that are distributed in areas of the neighborhood, as shown in Figure (65). However, most of the internal streets are without humps.

3.2.5.3.2 Questionnaire

Regarding sense of safety in streets, 52% of participant felt that the speed is limited in streets and that allows them to use the street safely for walking (Figure 67).

Figure 67: Street Speed Signs in Al Qusais First, taken by author (2018)

3.2.5.4 Providing Permeability and Eye on the Street

Providing permeability, eyes on the street and surveillance is done through having an active street frontages and rooms facing the streets. This indicator is assessed by the researcher's observations and by analyzing maps generated using DepthmapX software.

3.2.5.4.1 Observations

In terms of visual surveillance, Al Qusais First offers a special visual connection. This is achieved by having rooms or shops facing the street and having no high fences or trees to block visual surveillance.

3.2.5.4.2 DepthmapX Software

As shown in Figure (59), Al Wahda Street and Al Nahda Street are the most integrated and used streets. This indicates that these two streets are active and vital. Based on that, they are used by people regularly and this can make them safer streets. While the blue streets, as indicated in Figure (59) are not considered as safe because they are isolated or disconnected. Most of the inner streets in Al Qusais First are indicated as blue streets. In addition, as shown in Figure (59), red street segments are the most chosen and have the shortest path to reach the intended destination. Since they are used by people regularly, these streets can be considered as an active and safe.

3.2.6 Connectivity and Integration

Connectivity and integration principles study the extend houses clusters are connected with the rest of neighborhood, the neighborhood's physical connections, and street intersection density.

3.2.6.1 Connected Housing Clusters

Connected housing clusters are the ones with houses that are interconnected with other clusters, neighborhood center, and surrounded area. This indicator is assessed using observations, questionnaire and DepthmapX software.

3.2.6.1.1 Observations

In Al Qusais First, there are some areas where the houses are interconnected with other clusters and surrounding area by a pedestrian network. However, there are some areas with disconnectivity with the surrounding.

3.2.6.1.2 Questionnaire

Regarding the connectivity of the neighborhood with destinations reachable by sidewalk, 57% of participants reported the neighborhood as not connected by sidewalks, while 31% of them felt it was connected, and 12% were uncertain. Regarding the availability of alternative roads for getting from one place to another in the neighborhood, 54% of participants were aware of more than one route, while 13% of them just knew one route to reach their destinations, and 33% were not sure or did not know.

3.2.6.1.3 DepthmapX Software

The most connected roads are represented in red in Figure (68) and these lines are near the residential areas. However, there are some services such as schools and children playground that are far away from the residential areas and are not within a walkable distance.

Figure 68: Connectivity Map (Rn) of Al Qusais First, developed by author using DepthmapX

There is correlation when measuring connectivity and integration; synergy, harmony, and intelligibility graphs. This is explained in Figures (69 - 74):

- The synergy graphs, Figures (69 - 72), describe a correlation coefficient (R2) between local (Different radii) and global integration (RN:
    - Correlation between global integration and local integration (R400) = 0.195, which indicates a low correlation.
    - Correlation between global integration and local integration (R600) = 0.33, which indicates a low correlation.
    - Correlation between global and local integration (R800) = 0.43, which indicates a moderate correlation.
    - Correlation between global integration and local integration (R1000) = 0.48, which indicates a moderate correlation.

- The Harmony graph, Figure (73), describes the correlation coefficient (R2) between integration and choice measurements. The correlation coefficient (R2) of the study area is = 0.59, which indicates a high correlation between the integration and choice.

- The Intelligibility graph, Figure (74), describes the correlation coefficient (R2) between connectivity and the global integration values. The intelligible system is one in which well-connected spaces also tend to be well integrated spaces. The intelligibility of the study area is (R2) = 0.07, which indicates a low correlation between integration and connectivity, and this means less integrated spaces in the study area.

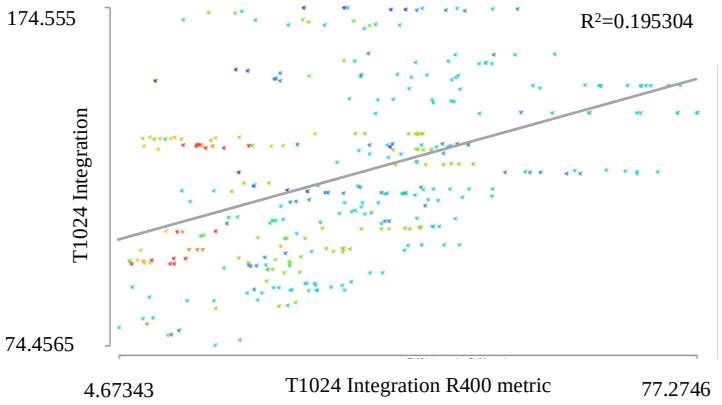

Figure 69: Correlation Between Global Integration and Local Integration (R400) of Al Qusais First, developed by author using DepthmapX

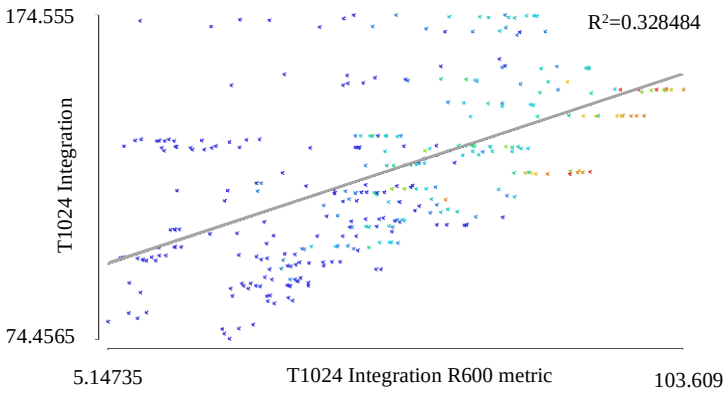

Figure 70: Correlation Between the Global Integration and Local Integration (R600) of Al Qusais First, developed by author using DepthmapX

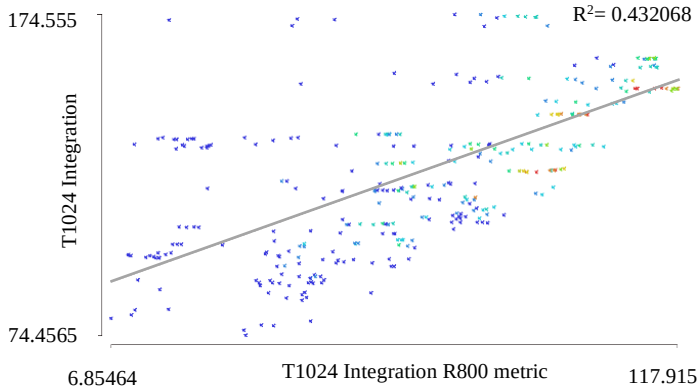

Figure 71: Correlation Between the Global Integration and Local Integration (R800) of Al Qusais First, developed by author using DepthmapX

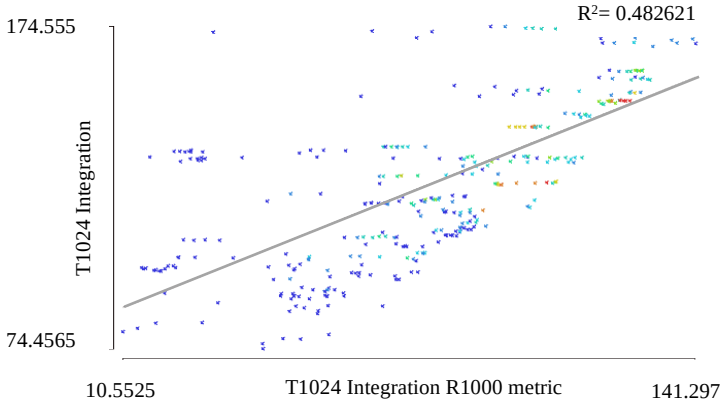

Figure 72: Correlation Between the Global Integration and Local Integration (R1000) of Al Qusias First, developed by author using DepthmapX

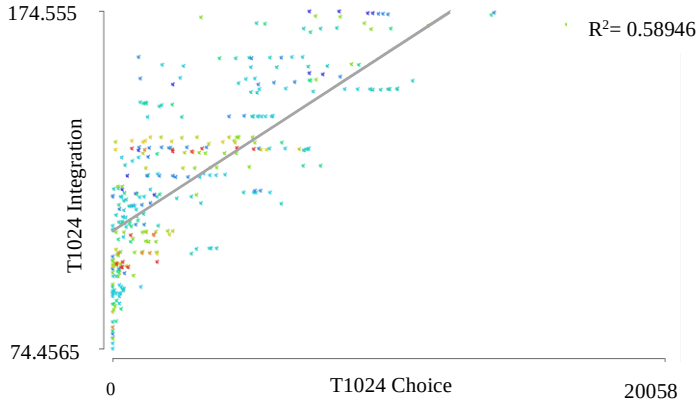

Figure 73: Harmony Graph of Al Qusais First, developed by author using DepthmapX

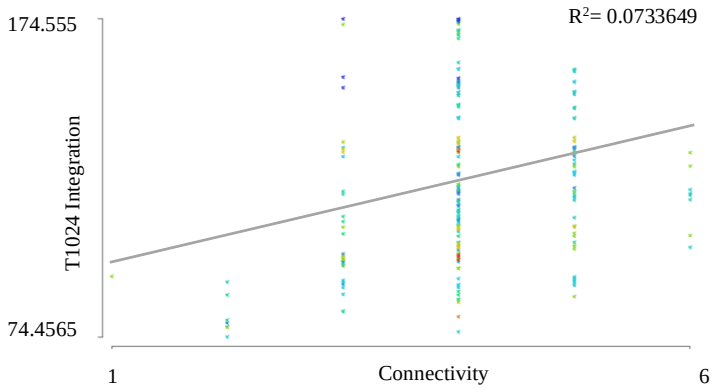

Figure 74: Intelligibility Graph of Al Qusais First, developed by author using DepthmapX

3.2.6.2 Neighborhood Physical Connections

This indicator is assessed by observations, and questionnaire.

3.2.6.2.1 Observations

Al Qusais First neighborhood is connected, but its walkability infrastructure is insufficient. It is connected to other neighborhoods by pedestrian bridges and metros, as shown in the analysis of accessibility principle.

3.2.6.2.2 Questionnaire

Regarding the neighborhood's connectivity, 70% of participant thought that it is easy to reach the adjacent neighborhoods by walking using the available pedestrian bridge and crosswalks. However, 30% disagreed with that.

3.2.6.3 Street Intersection Density

Calculating the street intersection density of Al Qusias First neighborhood required the researcher to seek statistical data from the responsible governmental authorities.

3.2.6.3.1 Map Analysis

To calculate the street intersection density, the number of intersections and the area need to be known. As mentioned before, the area of Al Qusais First is around 273 Hectares which equals to 2.73 km^2. Intersection density is calculated by the number of intersections per square kilometers, which is 80/2.73 = 29.3 This number compared with the reference point of 100, is considered as low. This indicates that street connectivity of the neighborhood is low.

This chapter showed the analysis of assessing walkability in both case studies as per several principles and their indicators, summarized as density, mix land use, local facilities and amenities, accessibility, sense of safety and connectivity and integration. The following chapter will discuss the main findings for both case studies in details and interprets them in reference to the revised literature and established conceptual formwork.

Chapter 4: Discussion and Interpretation

This chapter discusses the main findings and results from the conducted fieldwork and interprets them in reference to the revised literature and established conceptual formwork. The study assesses walkability as a social aspect of sustainability. It relies on certain conceptual walkability principles presented in two case studies; Al Khawaneej First and Al Qusais First neighborhoods. The data was acquired using mixed methods; qualitative (observations, surveys which include questionnaires and interviews) and quantitative (DepthmapX Software and questionnaires). This chapter seeks to discuss and compare the results of the two cases Al Khawaneej First and Al Qusais First according to walkability purpose and principles.

4.1 Walkability Purpose

Cervero and Radisch (1996) described walkable neighborhoods according to leisure or utilitarian options. In this study each neighborhood's user walk for a different purpose. For instance, in Al Khawaneej First, walkability is mostly conducted for the sake of exercise of leisure. Meanwhile, in Al Qusais First, walkability is combined with commuting patterns and available public transport modes to reach work, schools and other everyday activities.

4.2 Walkability Principles and Social Sustainability

This section discusses walkability as a social aspect of sustainability. The following presents detailed discussion of walkability principles; density, mix land use, local facilities and amenities, accessibility, sense of safety, in addition to connectivity and integration.

4.2.1 Density

In Al Khawaneej First, the gross population density is about 6.8 persons/Hectare. This rate is considered as very low density based on the sustainable development reference of 40-50 persons/Hectare (Stead, 1999 as cited in Barton, 2000). Due to the low rate of density in Al Khawaneej First, this walkability principle is not considered in the planning of the area (Table 7).

However, in Al Qusais First, the gross population density is about 151 persons/Hectare. This density is considered high compared with the sustainable development reference of 40-50 persons/Hectare (Stead, 1999 as cited in Barton, 2000). This was actually visible in the observations conducted, since the housing typology of this area is multistory buildings. With such a high rate of density, this area can be fully considered for sustainable planning (Table 8).

Table 7: Density Indicators in Al Khawaneej First

Density indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Gross population density of 40-50 person per hectare for neighborhoods.					
Density Rank					

Table 8: Density Indicators in Al Qusais First

Density indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Gross population density of 40-50 person per hectare for neighborhoods.					
Density Rank					

4.2.2 Mix land use

Regarding Al Khawaneej First neighborhood, the provision between residential, recreational and civic uses, that are basic to everyday life, is weakly considered as there is a bad integration between different land uses, and it has a poor connection to public transportation. However, lately new job opportunities are emerging in the area. It was mentioned before that Al Khawaneej First consists of only one type of housing; single family houses. Therefore, mix land use principle is weakly considered in Al Khawaneej First (Table 9).

Regarding Al Qusais First, there are obvious integration between residential, recreational and civic uses that are basic to every daily life. Moreover, these land uses are connected to public transportation modes such as buses and metros. This diversity provides variety in local job opportunities particularly that the area is consisting of multi-story buildings. The ground floor for most buildings are used for commercial purposes. This makes the principle partially considered (Table 10).

Table 9: Mix Land Use Indicators in Al Khawaneej First

Mix land use indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Provision of integrated residential, recreational, and civic uses that are basic to everyday life and connected to public transportation.					
Diversity of local job opportunity and appropriate workspace.					
Provision of housing variety.					
Provision of multi-function trips.					
Mix land use Rank					

Table 10: Mix Land Use Indicators in Al Qusais First

Mix land use indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Provision of integrated residential, recreational, and civic uses that are basic to everyday life and connected to public transportation.					
Diversity of local job opportunity and appropriate workspace.					
Provision of housing variety.					
Provision of multi-function trips.					
Mix land use Rank					

4.2.3 Local Facility and Amenities

The provided facilities and amenities in Al Khawaneej First are mainly mosques, children playground, parks and some retail facilities. However, these facilities are randomly distributed or allocated along the area of the neighborhood. This makes this principle of walkability partially considered (Table 11).

On the other hand, in Al Qusais First, there are different types of facilities and amenities like restaurants, groceries, supermarkets, and mosques. As demonstrated before in Chapter 4, the location of these amenities is within the most integrated streets in the neighborhood. Therefore, this principle is significantly considered (Table 12).

Table 11: Local Facilities and Amenities Indicators in Al Khawaneej First

Local facilities and amenities	Fully considered (5)	Significantly considered (4)	Partially considered (3)	Weakly considered (2)	Not considered (1)
Local provision of services and facilities, including open space and green spaces.					
Local facilities and amenities Rank					

Table 12: Local Facilities and Amenities Indicators in Al Qusais First

Local facilities and amenities	Fully considered (5)	Significantly considered (4)	Partially considered (3)	Weakly considered (2)	Not considered (1)
Local provision of services and facilities, including open space and green spaces.					
Local facilities and amenities Rank					

4.2.4 Accessibility

In Al Khawaneej First, the provided walking paths are not covering the entire neighborhood area. Therefore, they are connecting partially some facilities within the neighborhood. It's difficult to reach services and facilities walking since most of facilities are not located within a walkable distance. Moreover, the provided public transport is limited to buses and the provided bus stops are not within the required catchment area. Consequently, the provided public transportation is not affective to provide access to different facilities. It's difficult to identify the available facilities and amenities in the neighborhood from the main road due to the allocation of these

amenities. Also, there is no direct access to all facilities or open spaces within the neighborhood. The signage system within the neighborhood is poor. However, signage is provided around key locations only. Therefore, wayfinding for those who are visiting the neighborhood is difficult. Additionally, there is a lack of shading elements in streets, which leads pedestrians to avoid using the street during the day. Moreover, proper design of softscape and landscape is lacking except around the parks, where few benches and trees are provided in certain location. Furthermore, design of the street is not inclusive for those with special needs. If accessibility is a challenge for this group, their overall movement will be limited in the neighborhood. All of the above ensures that this principle is weakly considered (Table 13).

Table 13: Accessibility Indicators in Al Khawaneej First

Accessibility indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Providing walking network					
Provision of amenities and public transportation nodes within a walkable distance.					
Visibility of services and amenities from the main street.					
Provision of proper signage system.					
Provision of street furniture					
Accessible spaces for all					
Accessibility Rank					

Regarding the accessibility of Al Qusais First neighborhood, many indicators were discussed. The neighborhood suffers from a lack of walking paths or network; the provided sidewalks are either not connected, only on one side of the street, or do not exist as noticed in most of the area. However, there is a pedestrian bridge that connects other blocks to Al Qusais First area. Moreover, some of the provided facilities and amenities in the area are in a walkable distance for pedestrians. There are different modes of public transportation like buses, taxis and metro, in which the stations of public transport are all integrated within the area. This provides the residents with various commuting options. Also, some of the facilities and amenities are located towards the main street which allows for visual connectivity and identification by the users of these main streets. Moreover, signage and wayfinding systems are provided on the main streets surrounding Al Qusais First neighborhood. However, this wayfinding signage system is not well integrated into the whole area (especially inner streets) to lead people to their destinations. In general, there is no shading elements or proper furniture available in the neighborhood. Likewise, softscape and landscape of the area are not well designed, but actually disorganized and random. Furthermore, accessibility in the neighborhood for people with special needs is both restricted and limited by the available poor permeability design. However, some places in the neighborhood, like bus stations, provide ramps with proper slope to allow easier movement for this group. Moreover, the pedestrian bridge available in the neighborhood has an elevator allowing the bridge to be used by people with special needs. Therefore, one can conclude that this principle is partially considered in Al Qusais First neighborhood (Table 14).

Table 14: Accessibility Indicators in Al Qusais First

Accessibility indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Providing walking network					
Provision of amenities and public transportation nodes within a walkable distance.					
Visibility of services and amenities from the main street.					
Provision of proper signage system.					
Provision of street furniture					
Accessible spaces for all					
Accessibility Rank					

4.2.5 Sense of Safety

As mentioned before, in Al Khawaneej First some areas have a sidewalk, while other spaces don't include sidewalks or have incomplete sidewalks. This incompetence of sidewalks makes the latter unsafe for pedestrians to use. Additionally, there are no barriers in some sidewalks to separate the latter form the street in most of the areas. Only few sidewalks are found to have barriers consisting of either plants or bollards. Furthermore, all the provided sidewalks in the area have a width less than the minimum allowed width; which is 1.80 m. Moreover, the lighting levels provided is insufficient in most areas of the neighborhood. Likewise, the area suffers from a low visual surveillance, as the view of streets is blocked by high fences and trees. Some elements, however, contributes to the overall sense of safety in the neighborhood. For instance,

there are some cross areas with humps near each service point. Moreover, it was noticed that traffic speed signs are distributed throughout the space. Therefore, sense of safety in Al Khawaneej First can be considered partially (Table 15).

Table 15: Safety Indicators in Al Khawaneej First

safety indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Provision of pedestrian sidewalk, crosswalks and barriers.					
Provision of streetlights					
Provision of traffic calming and speed limit.					
Providing permeability/ eye on the street/ Surveillance through having an active street frontages and rooms facing the streets.					
Safety Rank					

Regarding sense of safety in Al Qusais First neighborhood, few indicators are studied. Sidewalks in the neighborhood are insufficient for pedestrians. Moreover, they are not continuous and incomplete. Furthermore, the provided sidewalks have no physical barrier to separate pedestrians from the street. Likewise, the width of sidewalks is not suitable for walking. In addition, the provided lighting in Al Qusais First neighborhood is not considering the human scale. However, there are few positive aspects that increases the sense of safety in Al Qusais First. For instance, speed limits inside the neighborhood are easily identifiable, especially within local roads leading

inside the neighborhood. Moreover, the existence of pedestrians in the streets is forcing the cars to reduce the speed, unknowingly acting as a shared street. Al Qusais First offers a special visual connection, since the area is designed to have rooms facing the street, and there are no high fences or trees to obscure visual surveillance. Furthermore, the neighborhood has crosswalks distributed across certain streets and associated with street humps. Therefore, the above-mentioned indicators make this principle as partially considered (Table 16).

Table 16: Safety Indicators in Al Qusais First

safety indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Provision of pedestrian sidewalk, crosswalks and barriers.					
Provision of streetlights					
Provision of traffic calming and speed limit.					
Providing permeability/ eye on the street/ Surveillance through having an active street frontages and rooms facing the streets.					
Safety Rank					

4.2.6 Connectivity and Integration

Regarding connectivity in Al Khawaneej First neighborhood, few indictors were studied. Houses in one cluster are interconnected with other clusters,

neighborhood center, and surrounded areas. This is achieved by the neighborhood layout and through the existing of *Sikka* between houses next to each other. Moreover, there are some areas in the neighborhood that are connected together by sidewalks. Some of the roads are well integrated to connect housing clusters with each other. However, there are currently no direct connection between the neighborhood and other surrounding areas in the city. Nonetheless, there are initiatives to connect the neighborhood with nearby neighborhoods through planned walking paths and a pedestrian bridge. All of the above makes the connectivity and integration in the neighborhood weakly considered (Table 17).

Table 17: Connectivity and Integration Indicators in Al Khawaneej First

Connectivity and integration indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Connected housing clusters (houses are interconnected with other clusters, neighborhood center, surrounded area).					
Neighborhood physical connections					
Street intersection density					
Connectivity and integration Rank					

In Al Qusais First neighborhood, residential areas are interconnected with other clusters and surrounding areas by pedestrian networks. One can find more than one alternative path to reach their destinations as the neighborhood is considered very connected. The neighborhood is not only connected within, but also connected to other

surrounding neighborhoods by pedestrian bridges and metro. However, one can conclude that overall the walkability infrastructure of the neighborhood is insufficient. Therefore, the connectivity and integration principle in Al Qusais First neighborhood is weakly considered (Table 18).

Table 18: Connectivity and Integration Indicators in Al Qusais First

Connectivity and integration indicators	**Fully considered (5)**	**Significantly considered (4)**	**Partially considered (3)**	**Weakly considered (2)**	**Not considered (1)**
Connected housing clusters (houses are interconnected with other clusters, neighborhood center, surrounded area).					
Neighborhood physical connections					
Street intersection density					
Connectivity and integration Rank					

The previous discussion shows that walkability in Al Khawaneej First ranks as weakly considered, while in Al Qusais First it ranks as significantly considered as shown in (Table 19). This result is supported by the conducted assessment in both neighborhoods. As described in the tables above, the most affecting principles on walkability in Al Khawaneej First neighborhood are the local amenities and facilities and sense of safety. Although more than 20% of the area is not supported by facilities and amenities, the existence of attractive facilities has encouraged users to walk for these places. Moreover, sense of safety in the neighborhood is supported partially by providing sufficient lighting, speed limitation strategies, and sidewalks. On the other

hand, the most affecting principles on walkability in Al Qusais First neighborhood are the density and the local facilities and amenities. Density has shown a significant impact on walkability as it is high and supported by the housing typology (high rise buildings). Moreover, the variety of distributed facilities and amenities has encouraged participants to get their daily needs by walking and to commute to their destinations using the provided public transportation.

The goal of this research was to assess walkability as a mode of commuting not for leisure purposes. However, the results obtained during this research have shown that in Al Khawaneej First neighborhood most of the walking is for the purpose of leisure and sport. On the other hand, results show that in Al Qusais First neighborhood the purpose of walking is mainly for commuting. Other factors can be also affecting the results of this research such as the culture of residents and the characteristics of each neighborhood. This might be supported in further studies.

Table 19: Walkability Principles Results in Al Khawaneej First and Al Qusais First

Walkability principles	***Al Khawaneej First***	***Al Qusais First***
Density	Not considered	Fully considered
Mix land use	Weakly considered	Partially considered
Local amenities and facilities	Partially considered	Significantly considered
Accessibility	Weakly considered	Partially considered
Sense of Safety	Partially considered	Partially considered
Connectivity and integration	Weakly considered	Weakly considered
Total Rank	Weakly considered	Significantly considered

Chapter 5: Conclusion and Recommendations

This study started by questioning the quality of walkability in Dubai neighborhoods. In an attempt to reach generalizable findings, this research offered a rigorous approach to understand and assess the actual quality of walkability principles in the existing urban fabric, and the ways in which people perceive them. Two case studies were selected in Dubai, UAE. They were chosen based on their urban form characteristics and housing typology. This chapter discusses the conclusion, research findings, limitations, contribution and possible future research and recommendations.

5.1 Conclusion

This research aimed to assess walkability as a social aspect of sustainability. Based on revised literature and established research framework, the conducted research measures the efficiency of walkability in two neighborhoods in Dubai (Al Khawaneej First and Al Qusais First) by making connection between physical aspects of walkability in the neighborhoods and how people perceive them. The literature offers several walkability principles and contextual factors. Based on evaluating principles of walkability, connections between theories, actual qualities of walkability principles and the ways in which people experience them were found. These principles include density, mix land use, local amenities and facilities, accessibility, sense of safety, and connectivity and integration. In analyzing the case studies, mixed qualitative and quantitative methods were applied. This research aimed to answer certain questions regarding walkability in Dubai. The following findings answer the main question; what is the assessment of walkability in Dubai neighborhoods and what is the effect of walkability on social sustainability?

The first sub-question tackles the relation between walkability and social sustainability; how does walkability affect/contribute to social sustainability? As proofed in the revised literature, walkability has been known as a foundation of a sustainable city. The concept of walkability is an important principle of social sustainability. The findings of this research support by evidence that walkability helps and supports the social in the neighborhoods. Considering walkability principles to trigger "walkability" and people presence on streets can increases social sustainability. This leads to a better social relations and trust among the community. The more walkable the neighborhood is, the more its residents feel safe and relaxed.

The second sub-question is concerned about the effect of the physical space on walkability; how does the physical space dis/encourage people to walk in certain neighborhoods in Dubai? This research assesses some principles related to the physical space; density, mix land use, local amenities and facilities, accessibility, connectivity and integration. Each principle was assessed based on several indicators for both selected case studies. The results show that the physical space can encourage people to walk in the neighborhood. Designing urban places where people can be active and connect with others is highly needed. Sidewalks in both cases need to be well designed in order to ensure accessibility and integration to the surrounding amenities and facilities and to the available public transportation. This can be achieved by considering the width of sidewalks, barriers, shading areas, access for people with special needs, and the overall quality of sidewalks. Improving the crosswalks, signage system and lighting efficiency can also increase walkability. Providing needed street furniture such as benches can encourage people to walk. In addition, using landscape elements can create visually pleasing view for pedestrians.

In Al Khawaneej First, the area near The Last Exit and Al Quran Park is designed in a way encouraging people to walk, where the design is considering the previous mentioned physical aspects. On the other hand, other areas in Al Khawaneej First and Al Qusais First are poorly designed by ignoring most of walkability principles. Provision of several amenities and facilities within a walkable distance and provision of public transportation within a walkable distance are both required (McKenzie, et al., 2013; Jones, 2001). This proximity of amenities or of transportation modes is important for people to get their needs. This can be noticed in Al Qusais First where there are different amenities and facilities distributed around the area. Additionally, there are different public transport modes to help people reach their destinations. However, in Al Khawaneej First this principle is not considered. Street network is not fully considered in both neighborhoods and that can reduce walkability.

As a conclusion there are several principles of physical space used to encourage walkability. From the analysis it was noticed that high density can support social sustainability by increasing physical activity and social interactions as also been discussed by Rattan et al. (2012) and French et al. (2014). Provision of amenities and public transportation also support the concept of walkability. Moreover, other principles are needed to draw the whole picture about walkability.

The third sub-question discusses people perception of walkability; how does people's perception of neighborhoods relate to walkability? People's perception is one of the important aspects to encourage walkability besides the physical space. People's perception can be translated to the extent they feel safe and comfortable in the environment, the level of accessibility in the space, the level of connectivity with surrounding spaces, and to the ability of a space in providing needs of people. Safety makes walkability more attractive option. Ensuring safety can be obtained by keeping

the path well-maintained and well-lit (Serag El Din et al., 2013; Koohsari et al., 2015; Reinhart et al., 2013; Pinto & Remesar, 2015). Safety is not considered well in both neighborhoods. However, around The Last Exit and Al Quran Park areas in Al Khawaneej First and some areas in Al Qusais First, safety is partially considered.

The fourth sub-question is discovering the role of stakeholders in developing walkability in neighborhoods; what is the impact of development policies on walkability? As discussed in the literature review, several policies are developed and implemented by Dubai Municipality and RTA. Some of these policies are not implemented in the field and there is no assessment have been done regarding their aims and goals. Also, there are doubt in term of coordination between Dubai Municipality and RTA to implement walkability development plans. By considering these selected case studies, it can be noticed that in newer developments, these governmental organizations are starting to consider walkability. However, their approach is not considering people's perception as much it considers the physical space regardless of the fact that people's perception is considered as a very important aspect in developing walkability in neighborhoods. As an example, in Al Khawaneej First, the authorities started to construct walking paths to develop walkability in the neighborhood without assessing people's needs. On the other hand, in Al Qusais First neighborhood, there was no development done to improve the walkability, however the neighborhood showed better example for walkable trends among people. The mix land use, density, provision of public transportation and the connectivity of facilities and services are very effective in the neighborhood despite the absence of infrastructure.

Therefore, the differences in results is a reason of having different urban patterns. For instance, Al Khawaneej First is considered as a sprawl, while Al Qusais

First is considered as a compacted urban form. Each urban form requires different needs and have different objectives to achieve the aim of walkability.

5.2 Research Generalization and Reliability

The application of mixed methods allows to have a verified research analysis and allows to validate findings and outcomes. The generalization allows to extend the results of a small sample or area and then relates it to broad area.

The methodology and the conceptual framework can be generalized to assess the walkability in other neighborhoods with similar characteristics. The results of this analysis can be generalized and applied to other neighborhoods with similar urban development completion dates, urban pattern, densities, housing typology and residential nationalities. To ensure the reliability and validity of this research, variety of methods were used to collect data. In assessing each principle, there were several indicators used. For each indicator more than one tool is used. This helps in giving a balanced picture of the situation and to have a cross-checking data.

5.3 Research limitations

The findings of the study should be seen in the light of some limitations:

- Data collection:
    - Cultural impact: it is challenging to talk with people on the street. They feel uncomfortable and some do not fill in surveys.
    - Institutional constrains: the recording of interviews with institutions and participants is not possible, so taking notes

was the best solution although it's not professional and hard.

- Availability of resources: getting access to information and people is not easy and takes a lot of time.

- Planning policies: There is absence of direct policies, regulation, and clear vision to address walkability.
- Involved institutions: Lack of completed strategic planning and coordination effort between involved institutions to accumulatively achieve comprehensive plan that includes walkability and social sustainability as cohesive development vision.

5.4 Contribution and Future Research

This research identifies some principles that contribute in increasing urban walkability as a step closer to achieve social sustainability in neighborhoods. This research studies walkability in developments with different housing typologies and within different cultural contexts. This is performed to highlight the most important factors that should be considered to improve walkability by each neighborhood. These principles can be generalized to measure walkability in UAE. This research could be used as a guiding tool and it could be incorporated with policies and regulations to achieve walkable neighborhoods. This research helps to highlight the importance of walkability in the existing and new neighborhoods in Dubai and helps to discover the role of walkability in achieving social sustainable neighborhoods.

Further researches need to investigate and assess the effect of other possible aspects on walkability such as culture. The effect of other social sustainability principles can be studied such like social mix, social capital, adaptability, local

autonomy and etc. In addition, further research can consider the environmental and economic benefits of walkability.

5.5 Recommendations

The conducted research opens the door to offer different levels of urban design and development recommendations for implementing walkability principles. These recommendations are summarized as:

- Short-term recommendations:
    - Regarding new neighborhoods, it is necessary to provide a clear design and implementation of walkability infrastructure on the neighborhood level. This design should be developed and agreed on by all stakeholders involved. In addition, local surveys should be included in the decision-making process for each neighborhood. This allows residents to cooperate with decision makers by expressing their needs.
    - Regarding existing neighborhoods, it is necessary to provide a clear plan to improve walkability by incorporating the effective principles of walkability as possible. Spatial assessment of the actual condition should be conducted based on the discussed principles.

- Long-term recommendations
    - Consider walkability as part of any development vision. Therefore, policy makers, local authorities and developers need to engage and establish walkability regulations and

guidelines to consider them in early stages of planning and design.

- Develop a pedestrian master plan that provides an overview of the walking transportation network identifying key concepts that ensure the improvement, enhancement of walkability in Dubai's neighborhoods.
- Conduct an inventory of the existing neighborhoods to suggest a retrofit development plan to engage walkability principles according to actual physical conditions.

5.6 Concluding Remarks

The walkability assessment was developed using relevant principles and indicators, conceptually designed to measure walkability as a social aspect of sustainability within the context of Dubai. The Assessment was applied in two different neighborhoods; Al Khawaneej First and Al Qusais First. The selected neighborhoods can be generalized to include all other neighborhoods in Dubai. Results were helpful in identifying the critical and vital principles in enhancing walkability. Moreover, the conducted walkability assessment is relevant as it provides realistic data for policy makers and institutions to develop more socially sustainable urban forms.

The concept of walkability is requiring more investigation and assessment to be covered. This research can be considered as an initial step in understanding this concept in the context of Dubai in particular, and the UAE in general.

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Appendix A

Questionnaires Sample

Introduction:

Thank you for agreeing to take part in this important survey which assess the walkability in the neighborhoods. This survey will take around 5-10 minutes to be completed. This survey contains two types of questions Yes or No and multiple choose question. Be assured that all your answers will be confidential.

المقدمة :

نشكركم على الموافقة لاستكمال هذا الاستبيان المهم الذي يقيين حركة المشاة في الأحياء السكنية في دبي . قد يستغرق استكمال هذا الاستبيان 5 إلى 10 دقائق. يحتوي هذا الاستبيان على نوعين من الأسئلة: نعم أم لا والاختيار من متعدد. وتأكد من أن جميع الإجابات ستكون سرية.

Demographic data:

1. Name of the neighborhood or area you live in :

2. Exact time:

3. Gender: o Male o Female

4. Age: o Under 18 years old o 18-29 years old o 30-49 years old oAbove 50 years old

5. Ethnicity: o Local o Non local

البيانات الديموغرافية:

1. اسم الحي أو المنطقة التي تسكن فيها

2. الوقت:

3. الجنس: oذكر o أنثى

4. العمر: o أقل من 18 سنة o بين 18 -29 سنة o بين 30 – 49 سنة o فوق 50 سنة

5. الجنسية : o إماراتي o أجنبي

Land use diversity

1. I live in an area that I can walk to the following activities / services:

- Shops
- Restaurant
- Café
- Supermarket
- School
- Office
- Public station
- Others…….

أراضي متعددة الاستخدام

1. أسكن في منطقة بحيث يمكن المشي للنشاطات/ الخدمات التالية:

o محلات

o مطعم

o مقهى

o سوبر ماركت

o مدرسة

o مكتب

o أخرى.....

2. Do these services reached by all users by walking? / Homes are within walking distance of these services?

- Yes
- No
- Don’t know/ not sure

2. هذه الخدمات يمكن للمستخدمين الوصول إليها عن طريق المشي / المنازل على مسافة قريبة من هذه الخدمات؟

- نعم
- لا
- لا أعرف / لست متأكدًا

3. How long it takes to reach your destinations (choose one option):

- Less than 10 minutes (> 10 minutes)
- Between 10 and 15 minutes (10-15 minutes)
- More than 15 minutes (< 15 minutes)
- My block is too long to walk around
- Don't know/ not sure

3. ما المدة المستغرقة للمشي للوصول لوجهتك؟

- أقل من 10 دقائق
- بين 10 و 15 دقيقة
- أكثر من 15 دقيقة
- لا استطيع المشي بسبب طول المسافة
- لا أعرف / لست متأكدًا

Street Furniture:

1.What best describes the sidewalks in your neighborhood: (choose one option)

- Sidewalks are on both sides of almost all streets
- Sidewalks are on both sides of some streets
- Sidewalks are on one side of almost all streets
- Sidewalks are on one side of some streets
- The sidewalks are there but not continuous.
- Don't know/ not sure

البنية التحتية للشارع:

1. كيف تصف ممر/طريق المشاه في الحي : (اختر خيار واحد)

- o يوجد أماكن مخصصة للمشاة على جانبي الطريق في معظم الشوارع.
- o يوجد أماكن مخصصة للمشاة على جانبي الطريق في بعض الطرق.
- o يوجد أماكن مخصصة للمشاة على جانب واحد فقط الطريق في معظم الشوارع.
- o يوجد أماكن مخصصة للمشاة على جانب واحد فقط الطريق في بعض الطرق.
- o يوجد أماكن مخصصة للمشاة ولكن ليست متصلة.
- o لا أعرف / لست متأكداً.

2.The sidewalks in the neighborhood are well maintained (paved, without cracks) and the pattern of the sidewalk is different than the street?

- o Yes
- o No
- o Don’t know/ not sure

2. الأماكن المخصصة للمشاة يتم الإعتناء بها (مرصوفة ، بدون تشققات) ومغطاه بأرضيات تميزها عن الشوارع؟

- o نعم
- o لا
- o لا أعرف / لست متأكدًا

3.There are Street signs at all intersections.

- o Yes
- o No
- o Don’t know/ not sure

3. يوجد لافتات إرشادية في الشوارع في جميع التقاطعات؟

- o نعم
- o لا
- o لا أعرف / لست متأكدًا

4. There are barries to saparate the sidewalk from the street?

- Yes
- No
- Don’t know/ not sure

4. هل يوجد حواجز تفضل ممر المشاة عن الشارع؟

- نعم
- لا
- لا أعرف / لست متأكدًا

5. There are enough pedestrian crossing (you didn’t have to cross mid-block or go too far

out of your way to cross the street):

- Yes
- No
- Don’t know/ not sure

5. أماكن عبور المشاة محددة وواضحة وعلى مسافات متقاربة:

- نعم
- لا
- لا أعرف / لست متأكدًا

6. Cross streets:

- Without problems:(you can choose more than one)
- Safe
- The speed is limited
- The road is defind
- With problems: (you can choose more than one)
    - Road was too wide

- Traffic singals made time interval long.
- Obstical to see clearly (Parked car, plants or trees blocks the view)
- The speed of the street was very high
- The pattern of the street is not push the cars to reduce the speed.

6. عبور الشارع:

o لا يحتوي على مشاكل: (يمكنك اختيار أكثر من واحد)

- آمن
- السرعة مناسبة
- المسار محدد

o يحتوي على بعض المشاكل: (يمكنك اختيار أكثر من واحد)

- كان الطريق واسعًا جدًا
- إشارات المرور جعلت الفترة الزمنية طويلة.
- هناك بعض العوائق (سيارة أو نباتات أو أشجار متوقفة تحجب الرؤية)
- كانت سرعة الشارع عالية جدا
- أرضيات الشارع لا تدفع السيارات لتقليل السرعة.

7. You can walk on the street during these time.

- Night Because…….
- Day Because…….

7. يمكنك المشي في الشارع في الأوقات التالية.

o النهار بسبب.....

o الليل بسبب .....

8. Walking is interesting due to (you can choose more than one)

- Landscape
- Buildings

- The roads is lit at nighr
- The road is shade at day
- activity space
- Others…….

8. المشي ممتع وذلك يعود لـ (يمكنك اختيار أكثر من واحد)

o المناظر الطبيعية

o المباني

o منطقة النشاط

o الطريق مضاء في الليل

o الطرق مظلل في النهار

o لا يوجد عقبات

o آخر .....

9. There are areas that are well furnish to rest along the walk path (benches Stands..)

- Yes
- No
- Don’t know/ not sure

9. هناك مناطق مجهزة بشكل جيد للاستراحة على طول الممشى (مقاعد، مدرجات..)

o نعم

o لا

o لا أعرف / لست متأكدًا

10. There are an open space/ parks adjacent to walking paths?

- Yes
- No
- Don’t know/ not sure

10. هناك مناطق عامة / حدائق مجاورة لمسارات المشي؟

o نعم

o لا

o لا أعرف / لست متأكدًا

Connectivity:

1. The neighborhood is connected with key destinations(shopping,…) by sidewalks.

o Yes

o No

o Don’t know/ not sure

التواصل:

1. الحي متصل بالوجهات الرئيسية (التسوق ، ...) عن طريق أرصفة مخصصة للمشاة ؟

o نعم

o لا

o لا أعرف / لست متأكدًا

2. There are public transportation near the neighborhood that are easy to get to

o Yes

o No

o Don’t know/ not sure

2. هناك وسائل نقل عام بالقرب من الحي يسهل الوصول إليها:

o نعم

o لا

o لا أعرف / لست متأكدًا

3. There are many alternative routes for getting from place to place in the neighborhood (You didn't have to go the same way everytime): (choose one option)

- There is only one routes
- There are more than one route (Number:….)
- Don't know/ not sure

3. هناك العديد من الممرات البديلة للوصول من مكان إلى آخر في الحي (لايتوجب عليك الذهاب من نفس الطريق في كل مرة): (اختر خيارًا واحدًا):

- هناك طرق واحدة فقط
- يوجد أكثر من مسار واحد (العدد: .....)
- لا أعرف / لست متأكدًا

4.The sidewalks are free/ clear of abstacles.

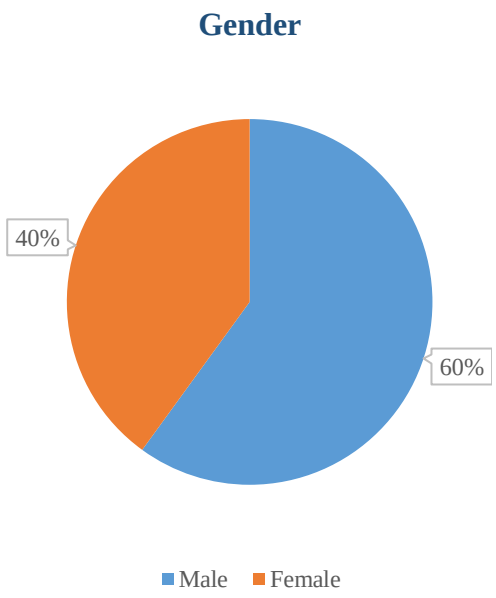
- Yes
- No
- Don't know/ not sure

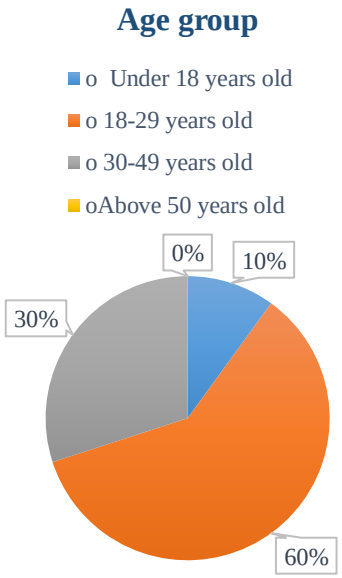
4.ممر المشاه خالي من أي عوائق:

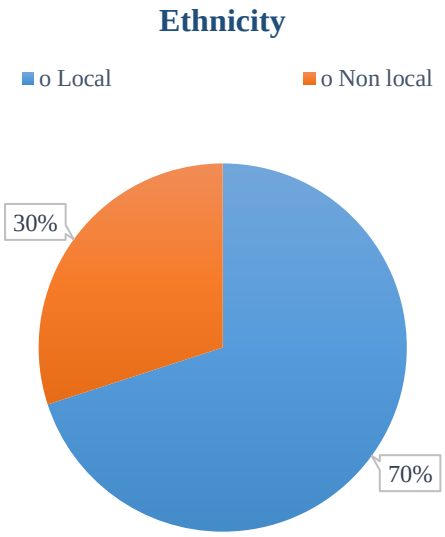
- نعم
- لا
- لا أعرف / لست متأكدًا

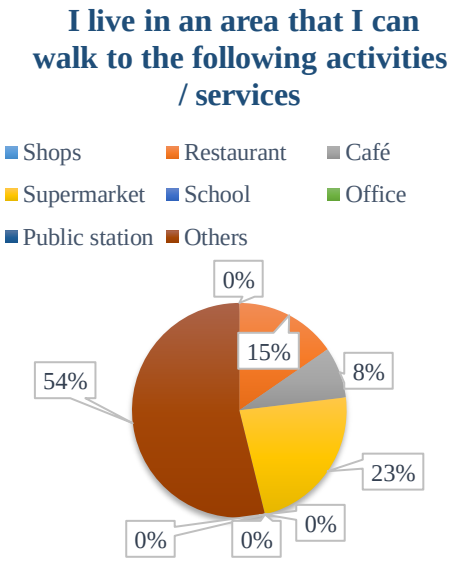
Appendix B

Al Khawaneej First Data Analysis

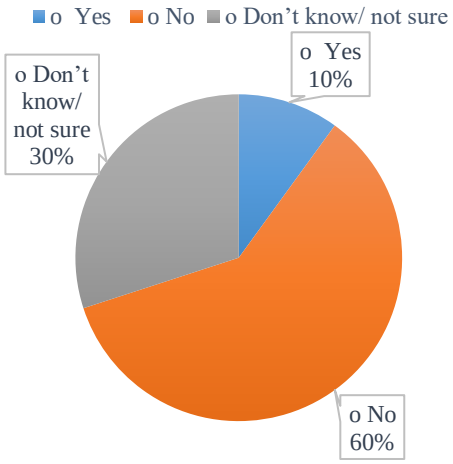




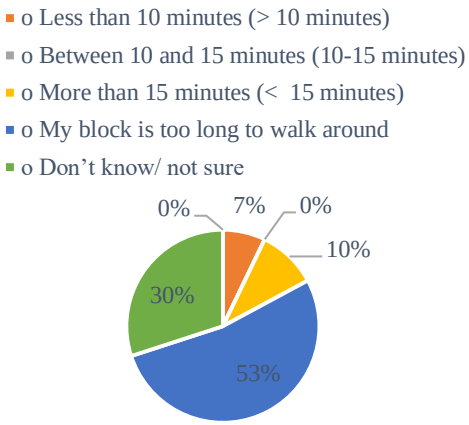




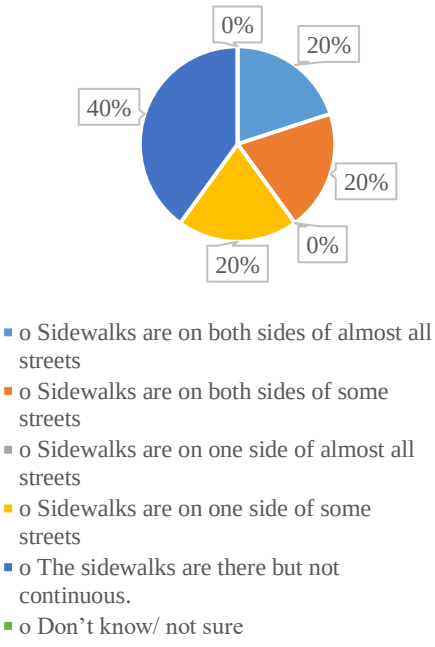
Homes are within walking distance of these services?



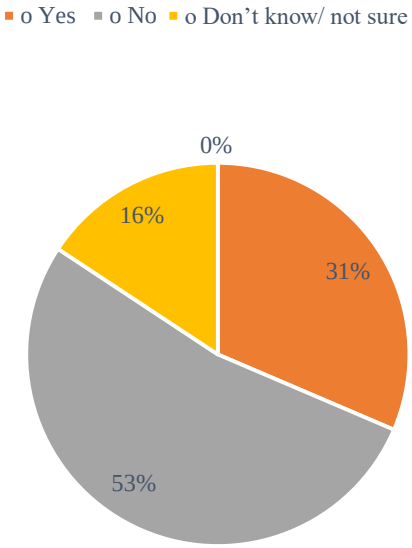
How long it takes to reach your destination



What best describes the sidewalks in your neighborhood

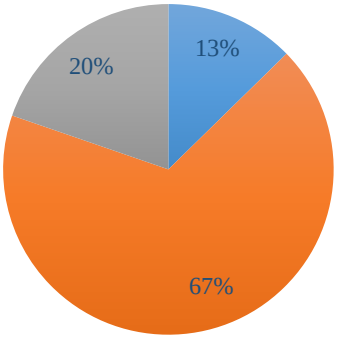


The sidewalks in the neighborhood are well maintained (paved, without cracks) and the pattern of the sidewalk is different than the street?



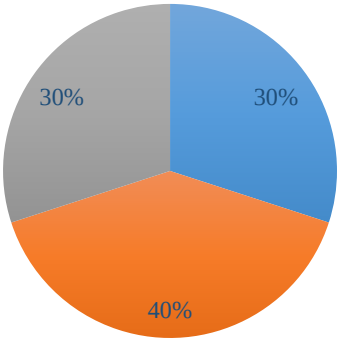
There are Street signs at all intersections

o Yes o No o Don't know/ not sure



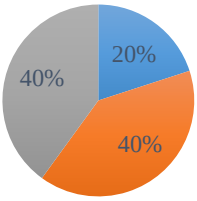
There are barries to saparate the sidewalk from the street?

o Yes o No o Don't know/ not sure



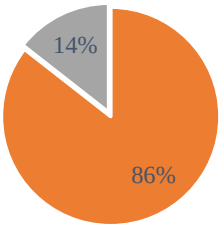
There are enough pedestrian crossing

o Yes o No o Don't know/ not sure



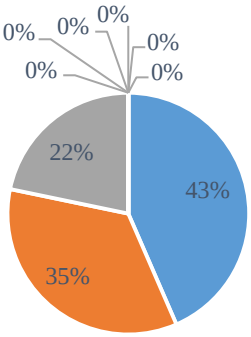
You can walk on the street during these time.

o Night o Day

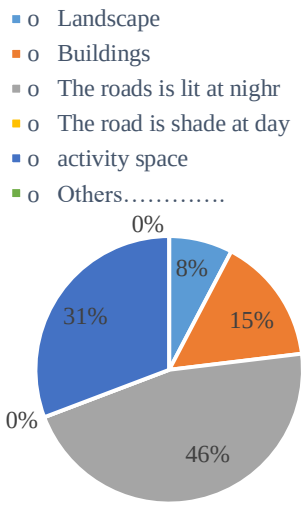


Cross streets without problems

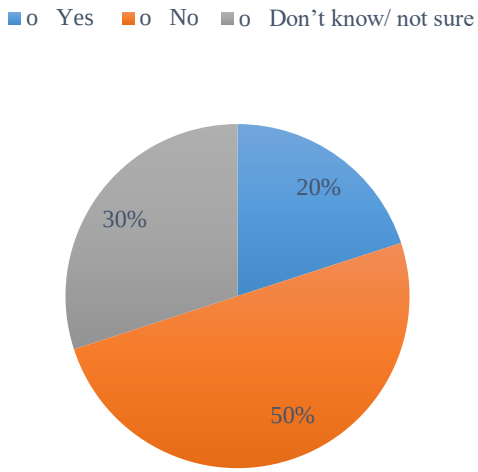
- o Safe
- o The speed is limited
- o The road is defind
- o With problems: (you can choose more than one)
  - · Road was too wide
  - · Traffic singals made time interval long.
  - · Obstical to see clearly (Parked car, plants or trees blocks the view)
  - · The speed of the street was very high
  - · The pattern of the street is not push the cars to reduce the speed.



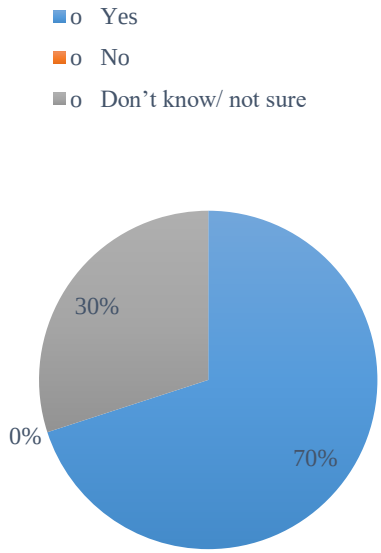
Walking is interesting due to ?



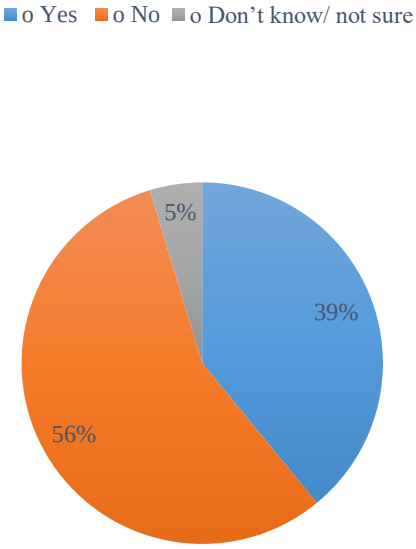
There are areas that are well furnish to rest along the walk path



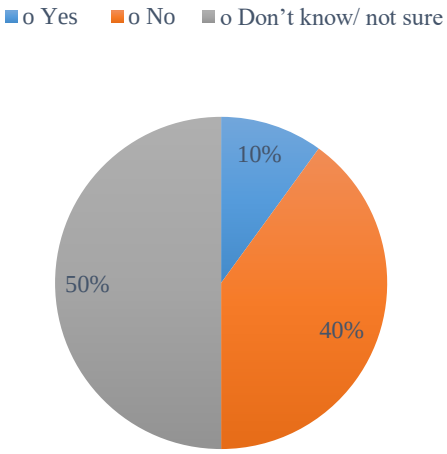
There are an open space/ parks adjacent to walking paths?



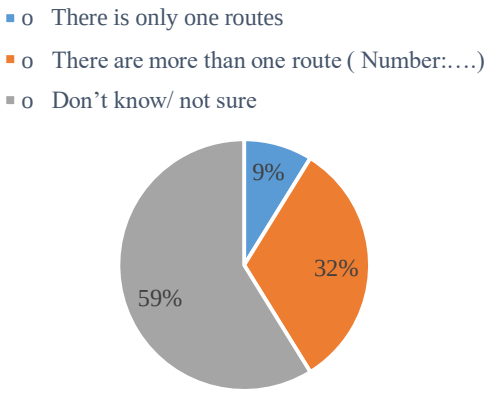
The neighborhood is connected with key destinations by sidewalks.



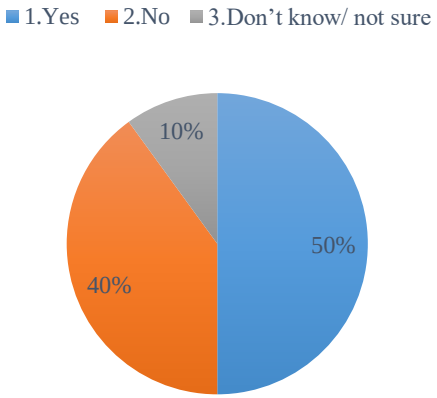
There are public transportation near the neighborhood that are easy to get to



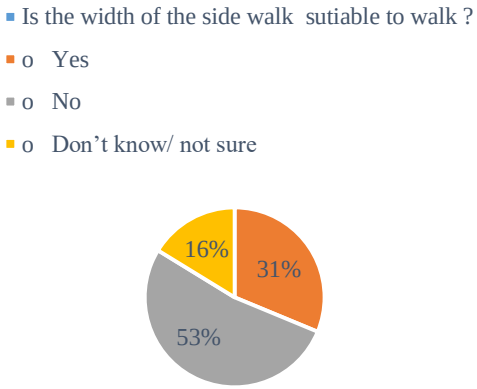
There are many alternative routes for getting from place to place in the neighborhood



The sidewalks are free/ clear of abstacles.



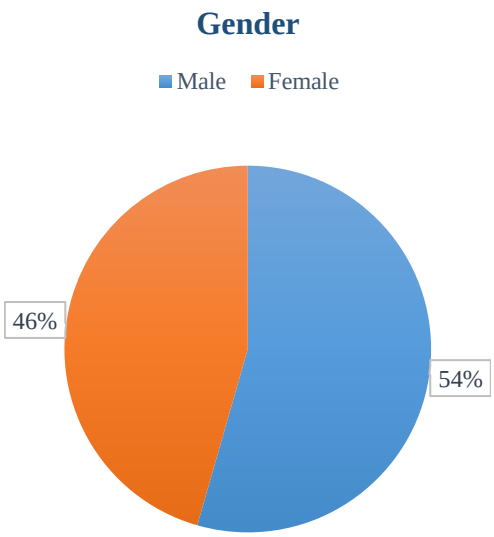
Is the width of the side walk sutiable to walk ?

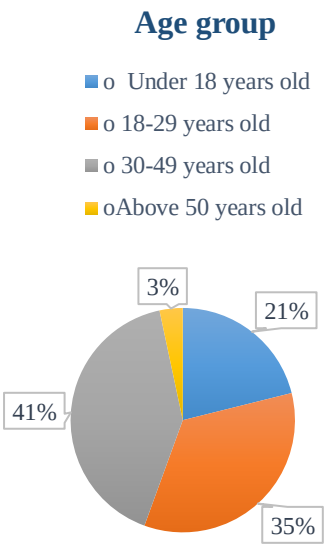


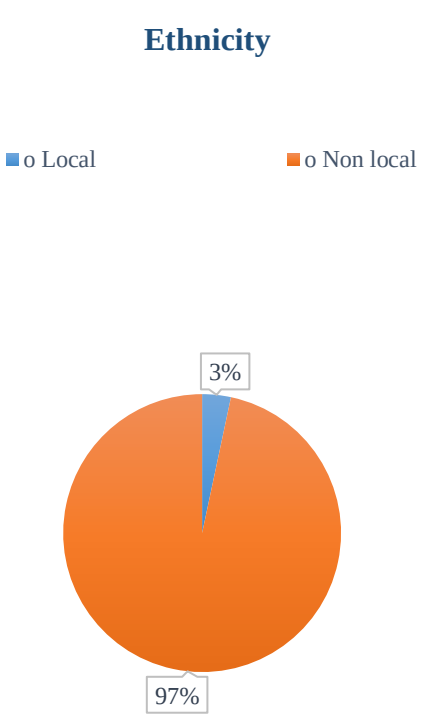
Can you reach near by neighborhoods easily by walking

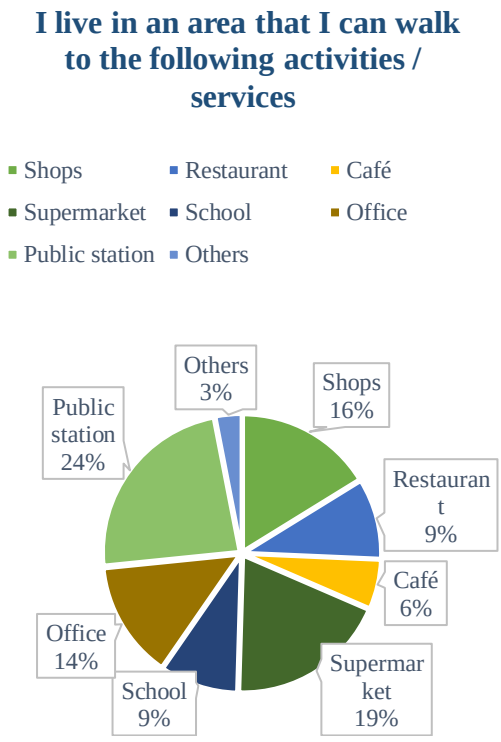
Appendix C

Al Qusais First Data Analysis

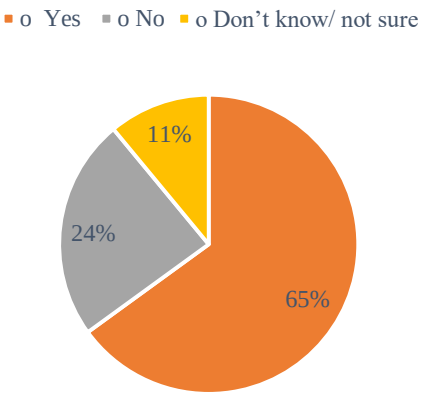




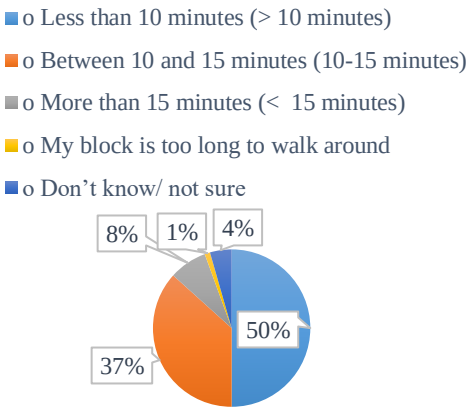




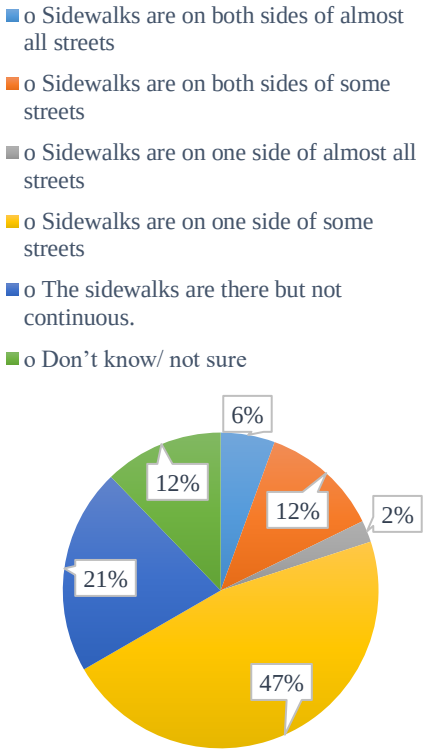
Homes are within walking distance of these services?



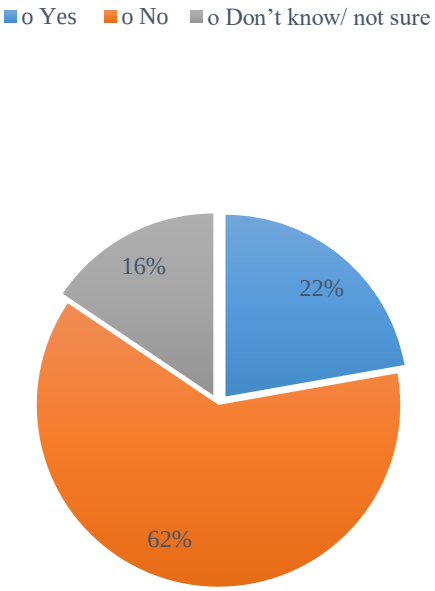
How long it takes to reach your destinations



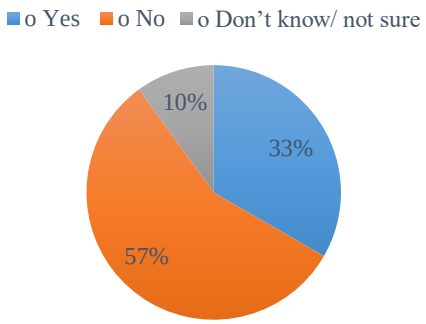
What best describes the sidewalks in your neighborhood



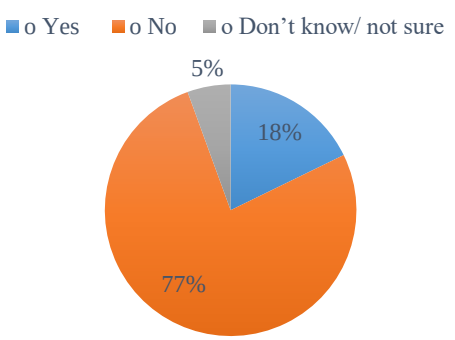
The sidewalks in the neighborhood are well maintained and the pattern of the sidewalk is different than the street?



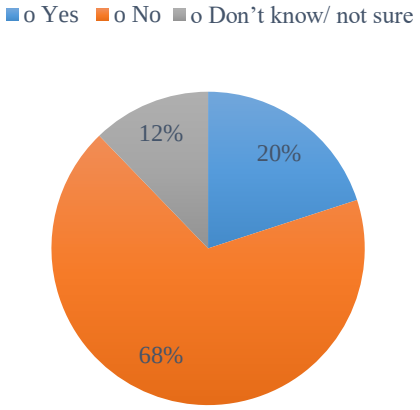
There are Street signs at all intersections



There are barries to saparate the sidewalk from the street?



There are enough pedestrian crossing



Cross streets without problems

- o Safe
- o The speed is limited
- o The road is defind
- o With problems: (you can choose more than one)
  - · Road was too wide
  - · Traffic singals made time interval long.
  - · Obstical to see clearly (Parked car, plants or trees blocks the view)
  - · The speed of the street was very high
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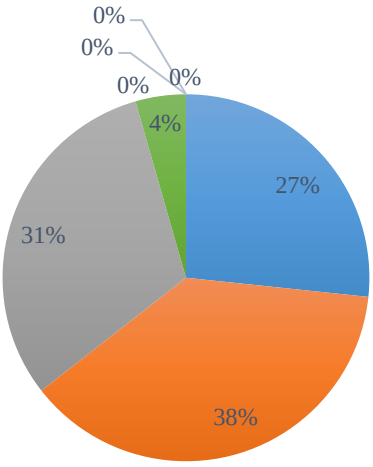
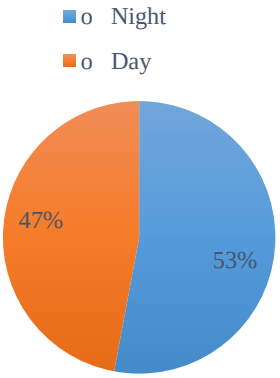
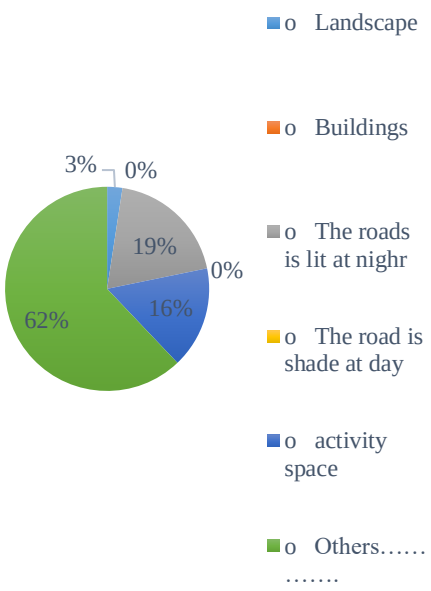


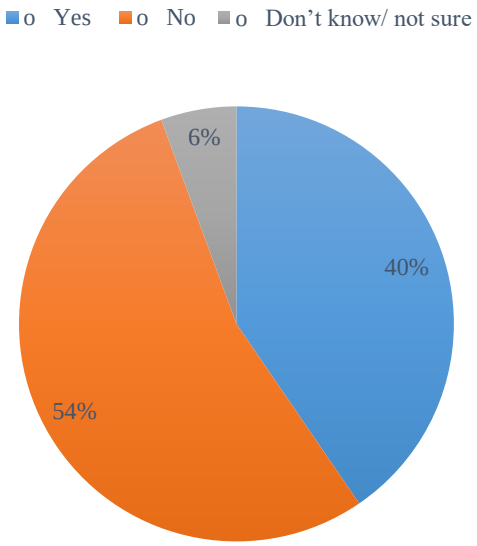
You can walk on the street during these time.



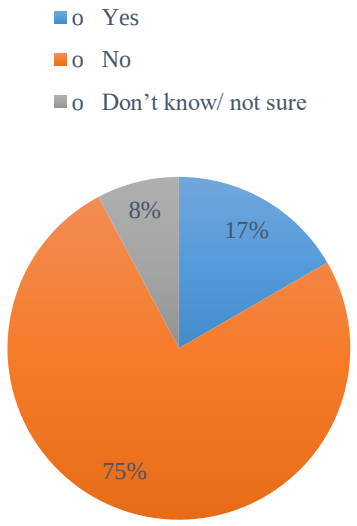
Walking is interesting due to ?



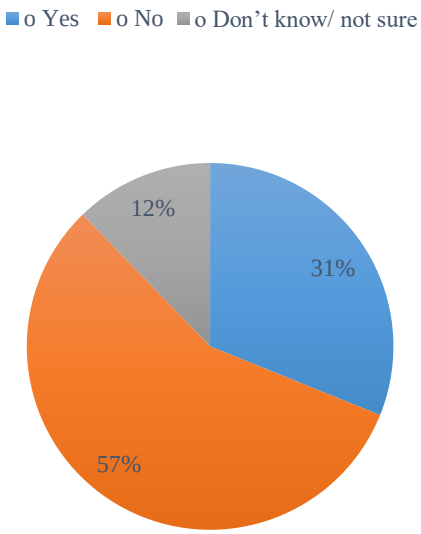
There are areas that are well furnish to rest along the walk path

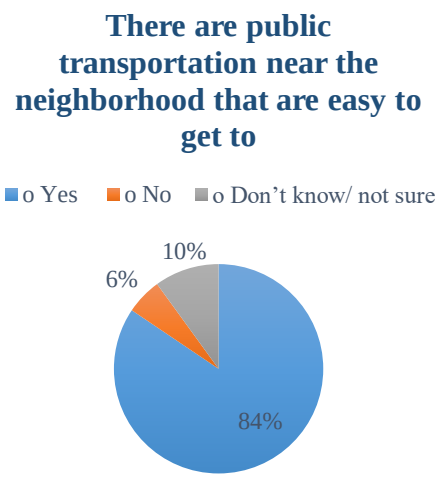


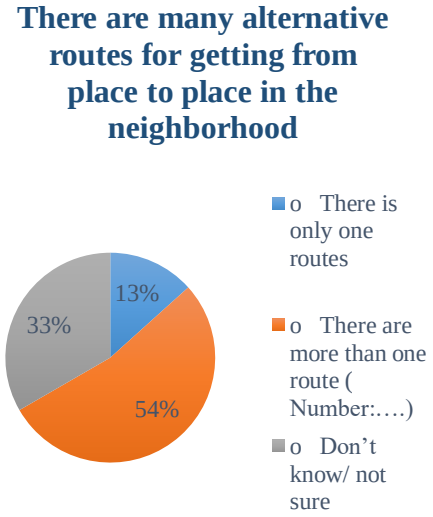
There are an open space/ parks adjacent to walking paths?

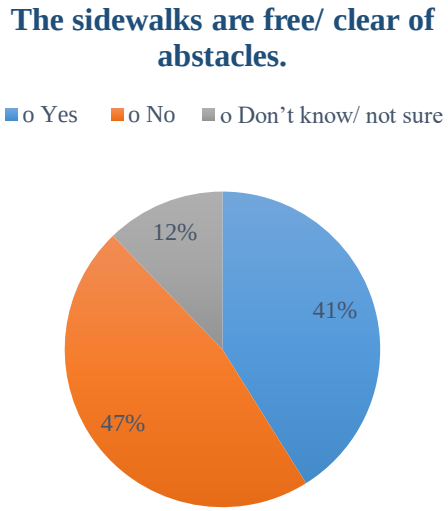


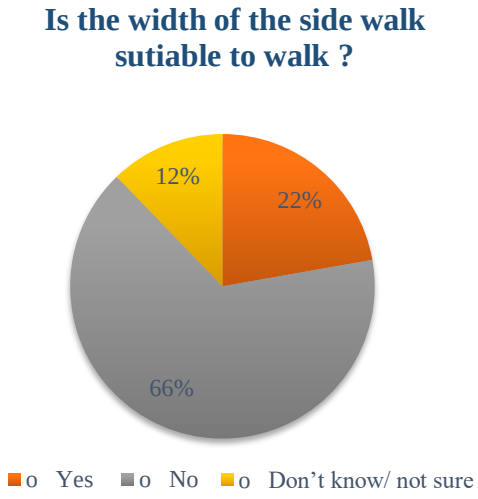
The neighborhood is connected with key destinations by sidewalks.

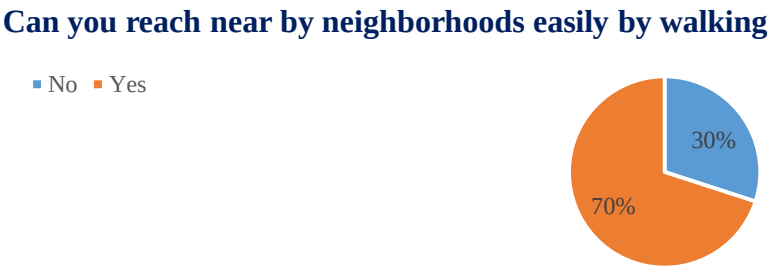



There are public transportation near the neighborhood that are easy to get to
o Yes
o No
o Don't know/ not sure
10%
6%
84%


There are many alternative routes for getting from place to place in the neighborhood
13%
33%
54%
o There is only one routes
o There are more than one route (Number:….)
o Don't know/ not sure


The sidewalks are free/ clear of abstacles.
o Yes
o No
o Don't know/ not sure
12%
41%
47%


Is the width of the side walk sutiable to walk ?
12%
22%
66%
o Yes
o No
o Don't know/ not sure


Can you reach near by neighborhoods easily by walking
No
Yes
30%
70%

Appendix D

Interviewing people in Al Khawaneej first – Pilot study

place	Day- Date	Time	Number of persons interviewers
Al Khawaneej First	Thursday 5/7/2018	7 am – 10 pm 3pm – 9 pm	Two persons
	Saturday 7/7/2018	7 am – 11 pm	One person
	Sunday 8/7/2018	6 pm – 9 pm	Two persons
	Thursday 12/7/2018	3pm – 9pm	Three persons
	Monday 16/7/2018	7 am – 11 pm 3 pm – 9 pm	Three persons
	Tuesday 17/7/2018	6 pm – 11 pm	Four persons
	Thursday 19/7/2018	6 pm – 11 pm	Three persons
	Friday 20/7/2018	7 am – 11 pm 6 pm – 9 pm	Two persons
	Thursady 26/7/2018	7 am – 11 pm 6 pm – 9 pm	Two persons

Appendix E

Community facilities standards list for low, medium and high density areas

GOVERNMENT OF DUBAI	**Organization Unit:**	**PLANNING DEPARTMENT-PLANNING RESEARCH SECTION**	DUBAI MUNICIPALITY
	Form sheet title:	COMMUNITY FACILITIES STANDARDS LIST : اسم النموذج	
	Doc Ref.	**DM-PD-P1-Wi2** : رقم النموذج	

1- SUMMERY OF COMMUNITY FACILITIES STANDARDS FOR LOW DENSITY AREAS (< 70 persons/Ha)

Planning Level	Type of Facility	Pop. Served	Min. Site Area (m²)	Min. Site Area per Person (m²)	Max. Dist. To Facility (m²)	Building Height	Total Coverage Area
Neighborhood Level	Local Mosque	2000	1800	0.9	500	Ground	40%
	Retail Facilities*	2000	400	0.2	400	Ground	-
	Post Shelter	2000	35	-	400	Ground	-
	Local Plaza	2000	1500	0.75	400	NA	-
	Tot Lot**	2000	1500	0.75	400	Ground	-
	Neighborhood Park	2000	4000	2	400	NA	-
Community Level	Juma Masjid	6000	4500	0.75	1000	G+Mez.	40%
	Com. Shopping Center*	6000	6000	1	800	G+Mez.	50%
	Children Nursery*	6000	600	0.1	800	Ground	40%
	Kindergarten	6000	3000	0.5	800	Ground	40%
	Primary School	6000	8000	1.3	800	G+1	40%
	Pvt. General Clinic*	6000	650	0.11	Varies	G+1	55%
	Pvt. Specialty Clinic*	6000	650	0.11	Varies	G+1	55%
	Private Polyclinic*	6000	650	0.11	Varies	G+1	55%
	Playground**	6000	3500	0.6	800	Ground	-
	Community Park	6000	12000	2	800	NA	-
District Level	Intermediate Sch.	10000	9000	0.9	1500	G+2	40%
	Secondary Sch.	20000	12000	0.6	2500	G+3	40%
	Pvt. Daycare Centre*	12000	1200	0.08	Varies	G+1	55%
	Post Office*	20000	2000	0.1	1800	G+1	50%
	Health C. Centre	30000	7500	0.25	2000	G+1	50%
	District Park	20000	20000	1	2000	NA	-
Sector Level	Civil Defense Centre	50000	4000	0.08	4500	G+1	50%
	Eid Prayer Area	70000	14000	0.2	Varies	Ground	-
	Public Library	70000	6000	0.09	5000	G+1	50%
	Police Station	70000	5000	0.07	5000	G+1	50%
	Elderly Rest House	50000	2500	0.05	Varies	Ground	40%
	DM office	50000	1500	0.03	4000	G+1	50%
	DM Centre	150000	4500	0.03	Varies	G+1	50%
	Private Hospital	35000	5000	0.14	Varies	G+2	50%
	Gov. Ref. Hospital	80000	12000	0.15	Varies	G+2	50%
	Sector Park	70000	500000	7	5000	G for park, G+1 for facilities	-

تاريخ الإصدار : 2010/7/18 رقم الإصدار :1

* These Facilities can be provided within a mixed-use buildings ** Optional - Area of each Facility includes parking spaces

2- SUMMERY OF COMMUNITY FACILITIES STANDARDS FOR MEDIUM DENSITY AREAS (70-220 persons/ha)

Planning Level	Type of Facility	Pop. Served	Min. Site Area (m^2)	Min. Site Area per Person (m^2)	Max. Dist. To Facility (m^2)	Building Height	Total Coverage Area
Neighborhood Level	Local Mosque	3000	1500	0.5	500	G+1	50%
	Retail Facilities*	3000	500	0.16	350	G+Mez.	-
	Post Shelter	3000	35	-	-	Ground	-
	Local Plaza	3000	1200	0.4	350	NA	-
	Tot Lot**	3000	1200	0.4	350	Ground	-
	Neighborhood Park	3000	3500	1.2	350	NA	-
Community Level	Juma Masjid	9000	4000	0.45	1000	G+1	45%
	Com. Shopping Center*	9000	5500	0.6	650	G+1	60%
	Children Nursery*	9000	700	0.08	650	Ground	40%
	Kindergarten	9000	2700	0.3	650	Ground	40%
	Primary School	9000	7500	0.8	Varies	G+1	40%
	Pvt. General Clinic*	9000	450	0.05	Varies	G+2	60%
	Pvt. Specialty Clinic*	9000	450	0.05	Varies	G+2	60%
	Private Polyclinic*	9000	550	0.06	Varies	G+2	60%
	Playground**	9000	3000	0.3	650	Ground	-
	Community Park	9000	9000	1	650	NA	-
District Level	Intermediate Sch.	15000	8500	0.55	Varies	G+2	40%
	Secondary Sch.	25000	10000	0.4	Varies	G+3	40%
	Pvt. Daycare Centre*	18000	800	0.04	Varies	G+2	60%
	Post Office*	25000	1800	0.07	1400	G+2	60%
	Health C. Centre	30000	6500	0.22	2500	G+1	65%
	District Park	25000	15000	0.6	2000	NA	-
Sector Level	Civil Defense Centre	70000	3500	0.05	3000	G+1	60%
	Eid Prayer Area	120000	18000	0.15	Varies	Ground	-
	Public Library	100000	4500	0.045	4000	G+2	60%
	Police Station	100000	4500	0.045	4000	G+1	60%
	Elderly Rest House	70000	2000	0.04	Varies	Ground	50%
	DM office	70000	1300	0.02	4000	G+2	65%
	DM Centre	200000	4000	0.02	Varies	G+2	60%
	Private Hospital	35000	2500	0.07	Varies	G+4	60%
	Gov. Ref. Hospital	90000	9000	0.1	Varies	G+4	60%
	Sector Park	100000	300000	3	3500	G for park, G+1 for facilities	-

*These Facilities can be provided within a mixed-use buildings ** Optional - Area of each Facility includes parking spaces

3- SUMMERY OF COMMUNITY FACILITIES STANDARDS FOR HIGH DENSITY AREAS (>220 person/Ha)

Planning Level	Type of Facility	Pop. Served	Min. Site Area (m^2)	Min. Site Area per Person (m^2)	Max. Dist. To Facility (m^2)	Building Height	Total Coverage Area
Neighborhood Level	Local Mosque	4000	1200	0.3	500	G+1	65%
	Retail Facilities*	4000	550	0.14	300	G+Mez.	-
	Post Shelter	4000	35	-	-	Ground	-
	Local Plaza	4000	1000	0.25	300	NA	-
	Tot Lot**	4000	1000	0.25	300	Ground	-
	Neighborhood Park	4000	3000	0.75	300	NA	-
Community Level	Juma Masjid	12000	2800	0.23	1000	G+1	65%
	Com. Shopping Center*	12000	5400	0.45	500	G+1	65%
	Children Nursery*	12000	700	0.06	500	Ground	40%
	Kindergarten	12000	3000	0.25	500	Ground	40%
	Primary School	12000	7800	0.65	Varies	G+1	40%
	Pvt. General Clinic*	12000	500	0.04	Varies	G+2	65%
	Pvt. Specialty Clinic*	12000	500	0.04	Varies	G+2	65%
	Private Polyclinic*	12000	500	0.04	Varies	G+2	65%
	Playground**	12000	2500	0.2	500	Ground	-
	Community Park	12000	8500	0.7	600	NA	-
District Level	Intermediate Sch.	20000	8500	0.42	Varies	G+2	40%
	Secondary Sch.	30000	10000	0.4	Varies	G+3	40%
	Pvt. Daycare Centre*	20000	800	0.04	Varies	G+2	65%
	Post Office*	30000	1800	0.06	1000	G+2	65%
	Health C. Centre	30000	6500	0.22	2000	G+1	65%
	District Park	30000	12000	0.4	1500	NA	-
Sector Level	Civil Defense Centre	100000	3500	0.035	2000	G+1	65%
	Public Library	120000	4000	0.035	3000	G+2	65%
	Police Station	100000	4000	0.035	3500	G+1	65%
	DM office	100000	1000	0.01	2500	G+2	65%
	DM Centre	250000	4000	0.015	Varies	G+3	65%
	Private Hospital	35000	1800	0.05	Varies	G+7	65%
	Gov. Ref. Hospital	100000	5000	0.05	Varies	G+7	65%
	Sector Park	120000	150000	1.25	3000	G for park, G+1 for facilities	-

*These Facilities can be provided within a mixed-use buildings ** Optional - Area of each Facility includes parking spaces