TOWARD AN INTEGRATED SMART SUSTAINABLE URBANISM FRAMEWORK IN THE HISTORIC CENTRE OF BAGHDAD. (OLD RUSAFA AS A CASE STUDY)

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TOWARD AN INTEGRATED SMART SUSTAINABLE URBANISM FRAMEWORK IN THE HISTORIC CENTRE OF BAGHDAD. (OLD RUSAFA AS A CASE STUDY)

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ABSTRACT

According to Batty "Despite a century of effort, our understanding of how cities evolve is still woefully inadequate" (Batty, 2008). The form of the city has been changing as the complexity of its systems has increased. Its varied aspects and methods have included ICT, smart transport systems, and the Intelligent Community Forum (ICF) for example. In the pursuit of smart sustainable urban form in heritage cities such as Baghdad, the research will analyse the concept of 'smart sustainable city', taking into account urban conservation, use, and reuse of historic places, buildings and cultural environments.

The capital, Baghdad, is the largest city in Iraq. The population of Baghdad as of 2017 is approximately 8,000,000, making it the second largest city in the Arab world after Cairo, Egypt. There are four historic areas of the modern city of Baghdad: Rusafa, Karkh, Adhamiya and Kadhimiya. The area of Old Rusafa represents the main historic centre of Baghdad. Its unique urban fabric defines this area and is surrounded by modern urban pattern and by modern roads, which replaced its walls.

Generally speaking, in most of the traditional areas in Baghdad city and especially the area of Old Rusafa, due to the lack of standard infrastructures, the deteriorating built environment and rundown houses, air pollution and a lack of modern facilities, the younger generation is abandoning these areas (Al-Akkam, 2012a). Nowadays, most residents are low-income families who cannot afford to live in better sectors with higher rent. Such problems have brought into focus the extent to which a smart and sustainable urban design framework can be able to provide appropriate solutions to regenerate the traditional urban fabric regarding urban form, land use, transportation, and create a new vision to deal with the social and economic processes. However, the significant features in the historic part of Baghdad such as narrow alleys, natural shading, the hierarchy between public and private space, mixed-use, human scale pattern, high density/low rise living, a walkable and zero carbon environment are providing an extraordinary base to implement smart and sustainable standards. Unfortunately, there is a tremendous amount of evidence of a decline in the social function of historic urban fabric and traditional Iraqi houses of Old Rusafa (Al-Akkam, 2013b). Thus, this research will illustrate how ICT and smart

sustainable design might transform the historic urban environment in the traditional area of Rusafa to be both smart and sustainable.

This research first offers a review of the process of urban transformation in the context of city change through utilising urban morphology to explain how Baghdad transformed from a geometric city to an organic form and then from a traditional city to the modern metropolis. Then it will assess the physical and social conditions of the old area of Rusafa as a case study by using quantitative and qualitative methods, which are both essential for evaluating the situation in the traditional urban fabric. The research then will present the criteria for smart and sustainable urban design processes, as its primary contribution, to propose a method to fill a gap related to the use of 'Smart and Sustainable City' in a historic environment and furthermore, to determine the positive and negative aspects (opportunities and constraints) to the historic centre of Baghdad. In the final stage, this research will produce a smart and sustainable urban design framework for Old Rusafa and will introduce some guidance for future development to highlight opportunities and control constraints. The results lead us to state that, the different demands of such an area (Old Rusafa) present unique challenges for which sustainability and digital techniques potentially provide new methods of regeneration. It also helps to find the positive and negative aspects that can serve as a platform to resolve the conflicting values of traditional urban form and modern design models.

The findings of this research provide insights into the cases that urban designers, policy-makers, technology companies and governments should consider in devising regeneration solutions and endeavours dealing with historic cities, aiming to integrate traditional principles with contemporary needs and provide a new vision for rethinking the way cities are designed, built, and managed. The primary implications will be summarised in two outcomes, the implementation of smart and sustainable urban design in a historic environment and the degree of amenability of the historic centre (Old Rusafa) for smart and sustainable regeneration.

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Al-Saffar, Mazin. 2017. “Assessment of the main Components of the Traditional Urban Form in the Historic Centre of Baghdad (Old Rusafa)” ISUF 2017 XXIV international conference: City and territory in the globalisation age.

Al-Saffar, Mazin. 2016. 'Toward an Integrated Sustainable Urban Design Framework in the Historic Center of Baghdad.' The International Journal of Environmental Sustainability, USA,13(1) pp. 31-52.

Al-Saffar, Mazin. 2011. "Simulation in City Planning." Journal of Association of Arab Universities for Studies and Engineering Research 18 (2):1-18.

Al-Saffar, Mazin. 2010. "Globalization and its impact on the urban system." The Iraqi Journal of Architecture 6 (19-20-21): 277-292.

Al-Saffar, Mazin. 2009. "Methods to Employ Information Technology in Urban Regeneration of Contemporary Iraqi Cities." Fifth Scientific Conference on Higher Institute of Urban and Regional Planning, Baghdad, Iraq.

Al-Saffar, Mazin. 2007. "Futuristic Vision for the Effect of Technology and Information on Al-Karrada District in Baghdad.” Master Thesis, Higher Institute of Urban & Regional Planning, University of Baghdad, Baghdad, Iraq.

Presentations

Al-Saffar, Mazin. 2017. “Toward an Integrated Smart and Sustainable Urbanism Framework in the Historic Centre of Baghdad: Old Rusafa as a Case Study” PGR Workshop with Fabrizio Gallanti, Manchester School of Architecture, 2 May 2017.

Al-Saffar, Mazin. 2016. “Urban Development and Transformation in Baghdad City from The First AD to 2016” The Master Plans of Baghdad: Notes on GISBased Spatial History, Manchester School of Architecture, December 2016.

Al-Saffar, Mazin. 2016. “Cities as Complex Systems” Strategic Network: Data and Cities as Complex Adaptive Systems (DACAS), DACAS Workshop 01 –, 01 - 03 February 2016.

Al-Saffar, Mazin. 2015 & 2016. “Urban Transformation in Baghdad City Form", PGR Workshop with Eamonn Canniffe, Manchester School of Architecture, December 2015.

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CHAPTER 1: INTRODUCTION

1 Introduction

Over the last five decades, many types of research and projects have been made through UNESCO, ICOMOS, and other organisations to conserve historic places in different cities of the world. Iraq has participated in the efforts of UNESCO for the preservation of its culture heritage, by proposing a number of sites for inscription to the World Heritage Committee (Hatra, Ashur, Samarra, traditional Iraqi houses and the Iraqi Museum) as having outstanding universal value and some of the most important archaeological collections in the world. 20,000 sites were estimated by Iraqi heritage experts to require protection before they deteriorate. So far, about 700 archaeological sites have been discovered in Baghdad alone (GHF, 2012).

In this context, this research will explore how ICT and smart sustainable design might transform the historic urban environment. The different demands of such areas present unique challenges for which, sustainability and digital techniques potentially provide new methods of regeneration.

In order to create contemporary cities with a sustainable urban form, we must understand the processes of sustainable urban design. In the view of the UN Sustainable Cities Programme (SCP), sustainable urbanisation is a process involving a set of successive and overlapping activities, with stakeholder involvement at different stages (UNCHS, 1992). Sustainable cities must tackle all the dimensions of sustainability such as the social, economic and environmental aspects.

Despite the apparent lack of connection among urban conservation, sustainability, and smart cities, it is clear that ICT has great potential for promoting a transition in the contemporary city. For heritage cities, it is a matter of having a better understanding of what types of ICT and smart sustainable design could provide the best advantages for society and the urban environment.

1.1 Research Aims and Questions

1.1.1 The main objective of this research:

1. The first aim of this research is to produce a smart sustainable urbanism framework and design proposal that provides conceptual solutions to shape the future of the historic centre of Baghdad, which may apply to other historic cities.
2. The second aim of this research is to provide a deeper view and better understanding of what smart sustainable cities indicators could implement in an urban core of the Iraqi traditional urban areas as a base to resolve the conflicting values of the traditional urban form and modern design models.
3. The third aim of this research is to fill a gap related to the use of 'Smart and Sustainable City' methods in a historic environment by conducting a specific case study of a physical part of an existing city (Old Rusafa) in order to add enough knowledge to the field to inform further study and potential implementation.

1.1.2 The questions addressed in this research:

Q1. Is the traditional urban area of Old Rusafa in Baghdad city amenable to smart sustainable cities processes? This question can be addressed by:

A. Appraisal of the situation of the historic centre to find which sustainability and digital techniques potentially provide new methods for regenerating the broken urban structure of the old city.
B. Reviewing the literature and identifying the heritage features of the traditional urban fabric in Old Rusafa that improve amenability to create a smart and sustainable urban area.
C. Identifying urban heritage context and urban conservation in historic cities and assessing the role of historic preservation of Baghdad.

Q2. What are new alternative methods (smart sustainable principles) which could integrate traditional principles with contemporary needs and provide a new vision for reconstructing the historic areas in Baghdad? This question can be addressed by:

A. Identifying the criteria for smart sustainable cities, which are most relevant to urban design and urban forms on the traditional urban fabric scale.
B. Assessing the criteria for smart sustainable citiy concepts in the historic centre of Baghdad.

Q3. How can smart sustainable methods affect and develop the traditional urban fabric? This question can be addressed by:

A. Producing smart sustainable urbanism strategies that seek an efficient quality of life for the old city stakeholders with the lowest environmental footprint, renewable energy and rehabilitation the traditional urban fabric with its historical buildings.
B. Suggesting guidelines for the future development that shape urban form, urban fabric and advance urban components of the traditional city.

1.2 Determination of Problems in the historic part of Baghdad City

The historic areas in Baghdad are suffering from problems such as a low standard of infrastructure, poor environment, an absence of contemporary facilities, a lack of available conservation work, traffic congestion, functional disorder, deteriorating physical conditions of the Baghdadi traditional houses and uncontrolled land use (figure 1.1). Al-Akkam illustrated some of these main problems in the historic part of old Rusafa (Al-Akkam, 2012b).

1.2.1 Growth and Boundaries:

There is no clear vision for future growth and no plan to determine and organise the relationship between the real boundaries of the city centre with the other secondary centres. This has led to the interruption of the continuity and communication between these different centers.

1.2.2 Land use:

There are considerable differences in land uses (industrial, residential, commercial) in the traditional quarter, which is reflected in delayed traffic, few pedestrian walkways, an imbalance in standards of land use, noise pollution, visual pollution and low environmental standards. The main elements of land use problems are as follows:

- Residential areas: the residential areas in old Rusafa are in poor condition with lack of modern infrastructures, low environmental standards, and deterioration of the traditional Baghdadi houses as well as an increasing the rate of occupancy.
- Commercial areas: most commercial buildings in the city centre have deteriorated, with an absence of basic standards for services and infrastructure standards such as sewage, clean water, and electricity.
- Industrial areas: various problems are caused by these areas air pollution and crowding for example, and have negative impacts on the primary services such as electricity, water supply, etc.

1.2.3 Transportation:

A clear vision policy on public transportation for old Rusafa is absent, which has led to traffic congestion, vehicular congestion, a lack of traffic control system, noise pollution, and air pollution (figure 1.2).

1.2.4 The Riverfront:

There are many problems at the riverfront in the traditional city such as the absence of openness toward the river, lack of open green areas, inadequacy in the connections between the two sides, and a lack of clear axes of pedestrian movement parallel to the river (figure 1.3).

1.2.5 Visual pollution:

There has been massive visual pollution in many commercial streets in different areas of Baghdad and particularly in historic parts due to the lack of new building regulations, uncontrolled land uses, and the use of new type of materials such as aluminum in the historic context (figure 1.4).

Figure 1.1: Deteriorating Physical Conditions of the Baghdadi Traditional Houses.
Source: Author 2016

Figure 1.2: Transportation Problems in Old Rusafa
Source: Author 2016

Figure 1.3: River Front of Baghdad City Center
Source: Author 2016

Figure 1.4: Visual pollution
Source: Author 2016

1.3 Research Methodology & Literature Review

The research aims to assess the condition of the traditional urban fabric in Old Rusafa to find solutions and create a smart and sustainable urban design framework. Therefore, this research will be based on a combination of theoretical and empirical data to ensure that research questions are answered by using appropriate methodologies. The nature of this study can be called a multi-strategy research, where each method integrates and builds on the strength of the other. The researcher will apply mixed method, which is a combination of quantitative and qualitative processes of analysis (Creswell, 2013:89). The two different broad methodological approaches, qualitative and quantitative, will be used to achieve the objective of the research study. Moreover, the case study method will be used as a research tool. The research will be categorised into five stages of work, in which different methodologies will be adopted in each study.

1.3.1 Stage 1: Critical Review of the Literature (Old Rusafa)

The first stage will consist of a literature review and analyses of the historical background of the process of urban transformation in the context of city change. The case study will focus on an example of the traditional urban fabric found in the historic centre of Baghdad (Old Rusafa). Then, it will illustrate the most important components of urban fabric that represent the structure of the traditional urban fabric. This research also will assess the role of historic preservation of Baghdad urban fabric by using Cohen's tools and methods in his book *Urban Conservation* to save the structure and history of cities and to promote local and place identities. The result of these techniques will lead to identifying the heritage features and components of the traditional urban fabric in Old Rusafa that improve amenability to create smart and sustainable urban area.

1.3.2 Stage 2: Critical Review of the Literature (smart sustainable urban design)

This stage will involve literature surveys of historic and contemporary sources relevant to the smart and sustainable urban design such as *Sustainable Urban Form, Designing Sustainable Cities, Sustainable Urbanism, Urban Ecosystems, Future Forms and Design for Sustainable Cities, The New Science of Cities, Smart Cities, Smart about Cities, Creating Smarter Cities, Internet of Things Infrastructures*. It will examine the principles

of smart sustainable urbanism and will investigate current concepts of how to plan and create a smart and sustainable city. A comparative case study method for existing smart and sustainable city projects will be used as a fundamental source for this research (Masdar City is the first eco-city in the Arab world, but is an entirely new city). Furthermore, it will take the form of a mixed methods approach or archival research supported by some empirical evidence about smart and sustainable design. By using this methodology, we will assess and identify the criteria for smart and sustainable design in Old Rusafa.

1.3.3 Stage 3: Mixed Research Methods for Looking at the Case Study (Old Rusafa)

This research contains two purposes, which are the application of smart sustainable urban design in the traditional urban fabric and the degree of amenability of the historic centre (Old Rusafa) for smart sustainability. Therefore, a mixed method will be applied to the case study. The quantitative method will be used to assess the role of smart sustainable urban design, and the qualitative approach will be employed to evaluate the situation of the historic centre and its responsiveness to smart and sustainable design. The outcome of this stage will contribute to assessing the physical and social conditions of Old Rusafa (the last assessment and survey of the physical and social conditions in Old Rusafa by JCP in 1984) and will examine the criteria of smart and sustainable urban design concepts in the historic centre of Baghdad.

1.3.3.1 Quantitative method

Quantitative research is a method of data collection aimed at gathering information, which can be quantified. When represented as set units, the data may be easily compared and analysed statistically. The units or scales of data must be created appropriately and, when collected, may then be analysed easily. The ease of comparing data in this way enables vital patterns to be seen and provides data for further research (Bryman, 2006). The quantitative method will be used to assess smart sustainable urban design in the case study.

1.3.3.2 Structured interview

A pre-planned structure interview will be used to collect data. The case study will be the old area of Rusafa, and this research will attempt to interview a number of policymakers, professionals, and local residents, consequently, a structured interview is a preferred solution for collecting the data.

1.3.3.3 Analysing and interpreting quantitative data

After collecting the data by a structured interview, the result will be analysed. After that, the result will be shown in graphs and tables, and they will be ready for interpretation and evaluation.

1.3.3.4 Qualitative method

The qualitative research investigates data from direct fieldwork observations (Patton, 2002:4). Qualitative research concentrates on the acquisition of data relating to experiences, feelings, and judgment. Such data are gathered from people directly involved in the environment under investigation, whether subjects or observers (Bryman, 2006). The core of qualitative analysis lies in the related processes of describing phenomena, classifying it, and seeing how the concepts interconnect (Dey, 1993:32). The qualitative method will be used to evaluate the traditional urban area regarding its urban form and components, historical spines, riverfront, Rashid Street and suq (market) areas. Thus, we will collect visual data and drawn surveys to assess the historic district.

1.3.3.5 Observation

Observation is an essential method of finding out about the world around us. Although it is an approach to data collection for research objective, it is more than just looking or listening (Stenhouse, 1975). Observation of the case study area will be used to collect visual data for the case study. Observation will be performed in all parts of the traditional urban area combined with the walking tool and serial vision for collecting data.

1.3.3.6 Walking tool

Sinclair (2003) indicates, "Walking is the best way to explore and exploit the city" (Sinclair, 2003:4). Careri (2002) asserts, "Walking is useful for architecture as a cognitive and design tool, as a means of recognizing a geography in the chaos of the peripheries, and as a means through which to invent new ways to intervene in public metropolitan spaces, to investigate them and make them visible" (Careri, 2002:134). It is a multifaceted activity and a temporal practice, which has an impact on design, for example, urban walking has yet to be fully understood and engaged with" (Matos Wunderlich, 2008). Structured walking will be used as a tool to make observations for the case study (Old Rusafa) to collect the visual data, walking is a really useful tool to collect data because the case study covers the traditional urban area and walking around such an environment and a space is the best way to understand and analyse that locality.

1.3.3.7 Serial vision

The term serial vision was developed by Gordon Cullen to illustrate what a pedestrian experience when moving through space. The pedestrian's view continually changes when moving through a curving pathway, arriving at a courtyard, or turning a corner. This changing view creates a sense of discovery and drama (Cullen, 1961:17). To carry out the case study, it is necessary to identify a method to collect the visual data. This consists of a sequence of photos from all parts of the traditional urban area under consideration. In this research, the serial vision method will be used to collect and analyse data.

1.3.3.8 Mapping, analysing and interpreting the qualitative data

The collecting of visual data will comprise many linear sequences of photos from all parts of the locality studied. The sequential photographs will be from many walkable routes and will be clustered. New approaches and computational tools will be used for analysing collecting data and after that will be mapped for assessment. Maps will be produced for illustrating each element of the traditional urban area. Each map will be interpreted and evaluated. "The original aim of using a variety of data gathering methods (textual and visual) was to enable a form of qualitative triangulation to be deployed in analysing the complex web of audience responses"(Peng and Park, 2013).

1.3.4 Stage 4: Smart and Sustainable Urban Design Framework for Old Rusafa

New systemic approaches and computational methods such as (CAD) or other types of documentation, e.g. sketches and photographs will be used at this stage to evaluate and analyse problems at both historic area and building scale (Lim, 2010:41). “A Digitised Planning System should equip architects, planners, and stakeholders generally to properly weigh up the pros and cons of different options in delivering outcomes. This would be an “Urban BIM”: a system that integrates professional activity and leaves no spatial voids” (Stonor, 2014). This research will apply relevant theories and approaches in urban design and architectural practice. As a result, a smart and sustainable urban design framework will be produced, providing conceptual solutions of the future of Old Rusafa in terms of the environment, land use, transportation, public open space and the historic city centre image.

1.3.5 Stage 5: Conclusion: Opportunities and Constraints

Stage five is the final stage, in which conclusions are drawn about the learning experience gained from the conduct and completion of this research. Potential future related research directions on the subject are indicated. Then, we will identify the opportunities and constraints of the traditional urban fabric and will suggest some guidelines for the future development of Old Rusafa regarding ICT & smart sustainable design and potential application in other cities.

1.4 Contribution to Knowledge

The contribution to knowledge is to propose a method to fill a gap related to the use of the 'Smart and Sustainable City' concept in a historic environment and to determine the positive and negative aspects (opportunities and constraints) in the historic centre of Baghdad. Smart city themes have been applied in Masdar City as one of the world's eco-cities, which is modelled on historical precedent, and with a problematical result. This thesis will seek to apply a smart and sustainable approach to an existing inhabited historic fabric. In addition, the most important contributions made to knowledge in this research are highlighted below:

1. Conducting a problem analysis review of the current situation in Old Rusafa, to find which sustainability and digital techniques potentially provide new methods for developing the broken urban structure of the historic centre.
2. By using advanced computational methodologies for addressing accelerated planetary urbanisation in Old Rusafa, we will promote and develop new ways to explore complex urban territories.
3. Identification of contemporary decision-making approaches and processes including citizen's attitudes and thoughts towards smart and sustainable cities.
4. Development of appropriate recommendations that will aid in an improved approach towards smart and sustainable future in historic areas.
5. Developing an analytical framework for exploring ICT as a mediator between sustainability and traditional urban design on the one hand and the smart city on the other.

1.5 Thesis Structure

This thesis is organized into ten chapters, in which the main goals are achieved.

1.5.1 Chapter 1 Introduction

This introductory Chapter shows a glimpse of the research context and a description of the research objectives and question. It will provide a brief explanation of the research methodology and identify the contents of each of the ten chapters. Finally, Chapter 1 will clarify an outline of the structure of this research.

1.5.2 Chapter 2 City Structure and Urban Transformation in Baghdad City

Chapter 2 will examine how Baghdad city emerged and will try to develop a comprehensive understanding of the history of urban transformation in the context of city change. This chapter will explore the process of urban transformation in Baghdad and explain its different types of urban patterns. Moreover, this section will illustrate the main components of urban form in the historic centre of Baghdad.

1.5.3 Chapter 3 Urban Heritage and Conservation Literature Review

Chapter 3 will seek to build a theoretical background about urban heritage context, conservation, and urban conservation. It will discuss the relevant principles of urban preservation in historic cities and evaluate the role of maintenance of traditional urban fabric. Then this chapter will review the physical and social conditions of Baghdad and examines the contemporary situation of heritage and conservation there. Finally, this section will revitalise urban heritage in Old Rusafa regarding its urban pattern, network and fabric.

1.5.4 Chapter 4 Urban Sustainability Literature Review

Chapter 4 will scrutinize the sustainability concept as a worldwide concern and will debate its definitions, aims, and dimensions. Then it will focus on sustainable urbanism and discuss various aspects that have a direct or indirect impact on the sustainable urban form by analyzing a range of policy and strategies to achieve urban sustainability. It will examine the principles of sustainable urbanism and explore how to evaluate a sustainable city by discussing and giving examples of comparative analysis of a number of cities in using urban sustainability indicators.

1.5.5 Chapter 5 Smart Cities Literature Review

Chapter 5 will explain the term smart city and will show the main components of the smart city concept. It will illustrate some challenges faced in the implementation of smart cities projects and the role of ICT and IoT in addressing them. This chapter will show the main design principles for smart cities and policy approaches. Furthermore, it will seek to examine a different type of literature review of the primary test cases of the smart city concept.

1.5.6 Chapter 6 Smart and Sustainable City Literature Review

Chapter 6 will try to conceptualize and define the aspects and implementation domains that constitute smart sustainable cities. It will investigate the literature review around the subjects of smart sustainable cities and identifies the term smart sustainable city (SSC) in various ways according to different literatures. It will examine the influence of the smart city concept on sustainable behavior, planning, and urban sustainability. This chapter will clarify smart sustainable cities indicators (SSCIs) and their assessment approaches.

1.5.7 Chapter 7 Research Methodology

Chapter 7 will examine the methodology adopted throughout this research that aims to realise the respective results. It will seek to highlight the design method and will present the mixed research methods of qualitative and quantitative methodologies that will be utilised in the case study area. It will show various ways of collecting data including physical field survey and citizens' questionnaire and the methods of analysis including descriptive and spatial analysis.

1.5.8 Chapter 8 the Case Study Area (Old Rusafa) Analysis and Examination

Chapter 8 will examine the case study data and develop a comprehensive understanding of the existing physical condition. It will seek to bring to light particular aspects of the case study (the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa), which has been chosen as the case study area of this thesis. This part also will illustrate the data collecting method and represent the analytical stage of the collecting information. It will clarify the utilising of the methodological approaches and tools that analyse the fieldwork to answer the research questions, using various sources such as maps, photographs and legislative texts.

1.5.9 Chapter 9 the Case Study Data Analysis and Examination

Chapter 9 will display the analysis in line with the structure of the posted survey, and will show the main essential guidance to be utilised in a practical case study that was determined. It will clarify the relatively high awareness of the interviewees to the issues facing Old Rusafa. It will explain the structured interview that includes seven parts, and each one of these elements involves various questions. This chapter will deliver the analysis of factors that represent the historic centre of Baghdad (Old Rusafa). It will show the analysis of accessibility, infrastructures and facilities in the historic centre of Baghdad. Finally, it will investigate the significance of sustainability indicators and smart city characteristics.

1.5.10 Chapter 10 Towards Smart and Sustainable Urbanism Framework in Old Rusafa

Chapter 10 will produce an adequate framework and guidelines for the controlled development for the future of Old Rusafa taking into account the new principles and criteria of the smart sustainable cities concept. It will determine guidelines for the future development of the case study area. This section will show how the implementation of the smart sustainable city concept in the historical environment of the case study area faces a big challenge on how to integrate various advanced technologies and infrastructures to minimise the environmental impacts and the deterioration of the traditional urban context.

1.5.11 Chapter 11 Results, Discussions and Conclusion

Chapter 11 will involve a summary of the significant contributions made to knowledge in this study throughout its chapters, with the consideration of how the research questions and aims are answered and achieved. Each section of this chapter will clarify how each chapter was examined during this study and where within this thesis it is adduced, authenticated, it attains the thesis aims and answers the research questions.

CHAPTER 2: CITY STRUCTURE AND URBAN TRANSFORMATIOM IN BAGHDAD CITY

2 Introduction

During the 21st century, urban transformation of cities has been intensely affected by flows of socio-economic and technological processes. Through the centuries, such as all historical places in Mesopotamia, Baghdad has given an outstanding example of dramatic evolution. The capital city of Iraq, which stands on the river Tigris, faced various transformation processes in the culture and physical environment due to social and political movements (Figure 2.1). The transformation of Baghdad is a very complicated process driven by various factors affecting the homogeneity of the old urban fabric. Reconfiguration and the production of new urban typologies within the heritage fabric were the most significant effects. The outcome was different spatial languages competing with each other. This transformation changed the relations and hierarchies among spaces, which allowed more flexibility and accessibility between private and public space (Figure 2.2).

This section of the thesis will identify the research aim three and question one-part B (page 3) along with the study approaches, which will be used to implement this research and fill the thesis gap. The primary purpose of this chapter is to examine how Baghdad city emerged and to develop a comprehensive understanding of the history of urban transformation in the context of city change. To achieve this aim, this chapter will utilise urban morphology to explain how Baghdad transformed from a geometric city (the Round City AD762 by Caliph Al-Mansur) to an organic form and then from a traditional city to the modern metropolis. It will seek to analyse the process of urban transformation in Baghdad and show different types of urban patterns. Moreover, this chapter will try to illustrate how the new way of transportation represented by the car has affected the historic centre and changed the structural system of Baghdad. Then this chapter shows the main components of urban form in the historic core of Baghdad. The result of this section has led to identifying the heritage features and components of the traditional urban fabric in Old Rusafa that is suitable to create smart and sustainable urban areas.

Figure 2.1: Iraq Map
city Source: https://www.mapsofworld.com/iraq/

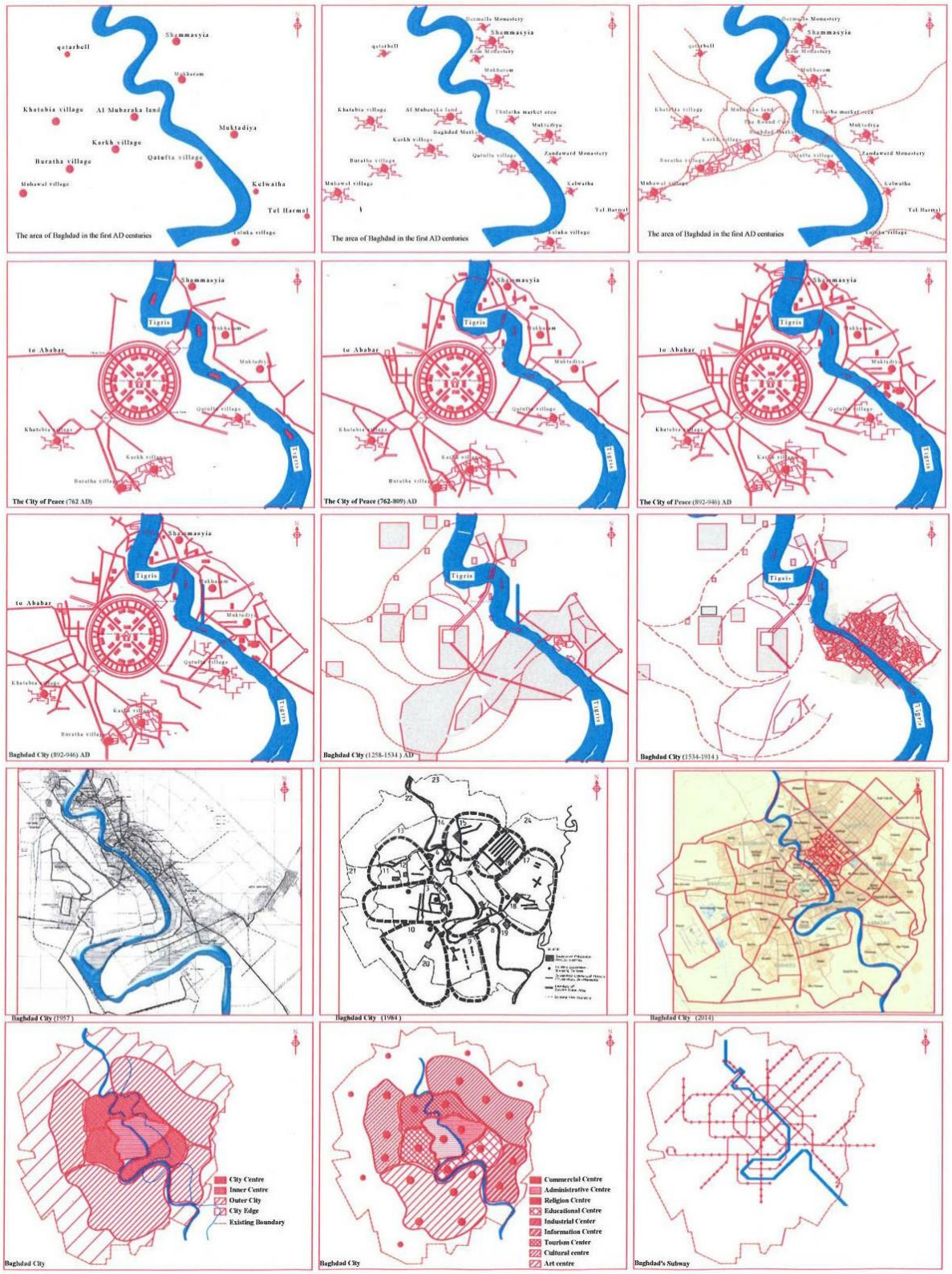


Figure 2.2: The Urban Growth and Transformation in Baghdad City from the First AD to 2016
Source: Author 2016

2.1 Historical Background

A set of factors played a substantial role to determine the locational choices of historic cities such as the availability of natural recourses, trade routes, and political considerations, and in some issues on the religious significance (Bianca, 2000:137). In the first century AD, most Mesopotamian cities grew on the bank of great rivers that are the source of prosperity to the country. Many villages and towns were connected by waterways and canals on both sides of the river Tigris. In the early 7th century, there is mention in the historical writings of a market called Baghdad on the western bank of the river Tigris, due to the transportation of goods and the massive agricultural activity. This shows that Baghdad market was a connecting area between east and west and it was regional market before the coming of sea routes, probably as part of the famous Silk Road on the way for convoys between India, Persia, and Iraq (Figure 2.3) (Al-Silq, 2008).

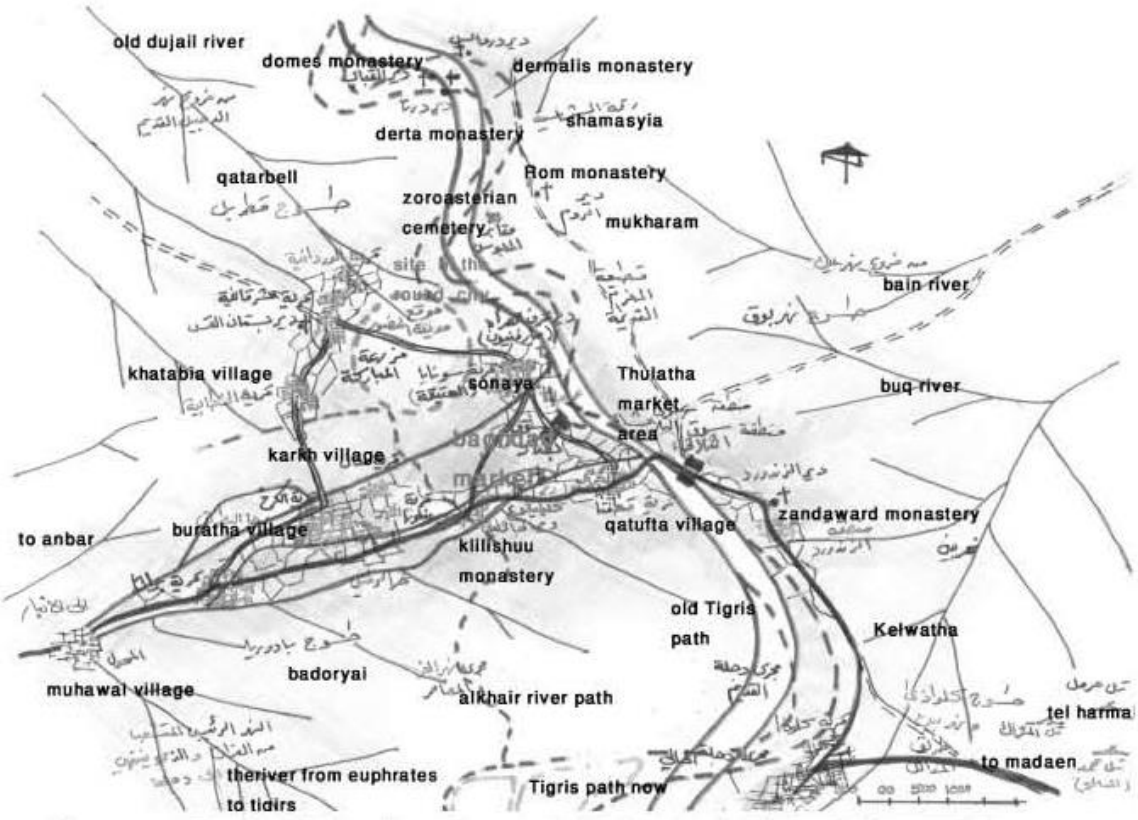


Figure 2.3: The area of Baghdad in the first AD centuries before the building of the round city Source: (Al-Silq, 2008).

2.1.1 The City of Peace (762-809)

Through the centuries, such as all historical places in Mesopotamia, Baghdad has given an outstanding example of dramatic evolution. The city, which stands on the river Tigris, faced various transformation processes in the culture environment due to natural and political reasons (Al-Hasani, 2012). It faced the biggest challenge in its history when it was chosen by Caliph Al-Mansur to be his capital city. Al-Mansur was the second caliph of the Abbasid Empire, and he ruled the Islamic world beginning in 750 AD (Marozzi, 2014:2).

Al-Mansur started searching many areas that deserved to be the place for a great empire ruling almost half of the known world stretching from Morocco to Central Asia. After discussion with his assistants and meeting with a number of citizens, he decided that Baghdad was the most appropriate area. In 762 AD, Al Mubaraka land (meaning the blessed) was chosen to construct the round city (The City of Peace) (figure 2.4 A & B), with a palace and mosque in its centre. The City of Peace took four years for construction (762-766 AD). The city had four equidistant gates (Kufa Gate, Basra Gate, Sham Gate and Khorasan Gate) and two main radial streets surrounded by a deep moat and three walls, 17m high the outer one, 30m high the middle and the most significant with balconies and watchtowers. Then the third inner wall that separated private houses and the governmental buildings. In the main centre, there were the two impressive buildings, the mosque and the Royal Palace of the golden door. The fundamental feature of the palace was a massive 40m dome roofing the central two floors (Al-Silq, 2008).

Figure 2.4 A: Round City in the times of al-Mansur
Source: https://www.pinterest.co.uk/pin/352758583295501453/?lp=true

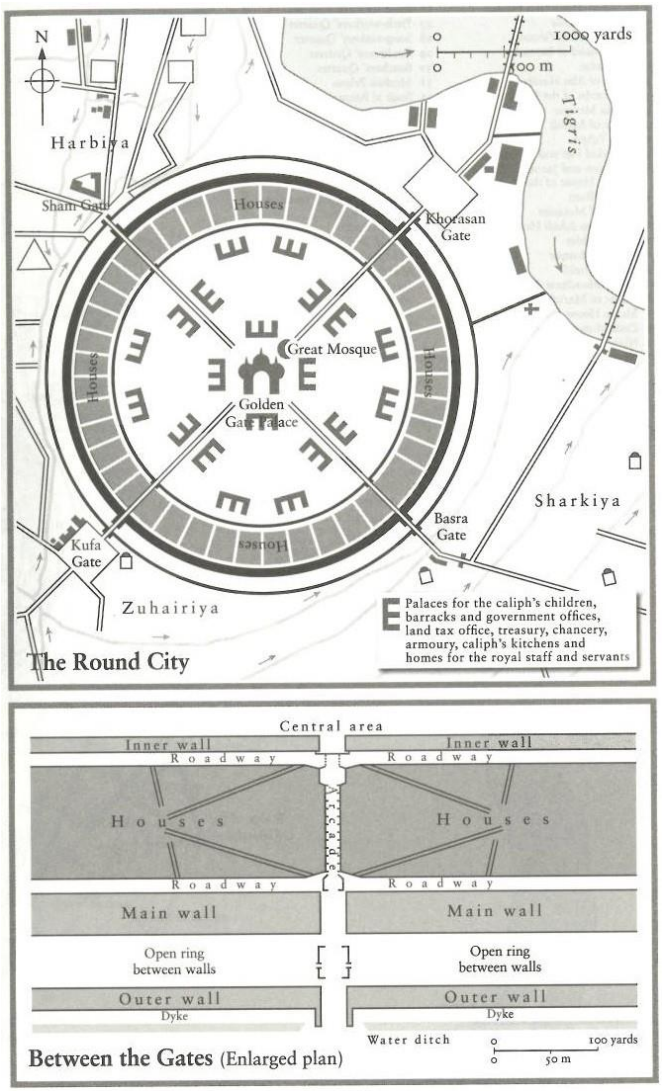


Figure 2.4 B: The City of Peace
Source: (Marozzi, 2014)

The mosque had a square shape, a square minaret, a pulpit, a mihrab, five courtyards and two rows of columns around the courtyard. This mosque was built similar to Masjad-al-Nabi in Medina (Berehinejad et al., 2014). In the following decades, the city started to extend beyond its wall because of limited space and increased population. The outer four gates were joined with roads going to the nearer villages; Karkh village was the most important one, which grew to be an urban area that covered the whole area to the south of the city. The surrounding urban district became much more complex each village grew and had its mosque, market and administrative buildings. The market became an essential part of the city that played a significant role to promote its prosperity. Soon after, a new urban settlement was built by Caliph Al Mehdi, the son of Al Mansur, on the eastern side of the Tigris that will be the basis of the case study of this thesis. Al Rusafa mosque was the first monument built in this new district (the palace was built later). Al Mehdi city was also

surrounded by a moat and wall and was joined to the circular city by a bridge (figure 2.5) (Al-Hasani, 2012). As the city continued to grow, many urban districts and palaces were built such as Al Kuld palace, Issa palace, and Al Qarar palace. The population of Baghdad was around one million; the city became one of the most multicultural places on earth, different nationalities and religions lived there, reaching its peak with the golden age of Harun Al Rasheed. (786-809 AD) (Marozzi, 2014:38).

The name of Baghdad dominated the whole capital due to the cultural facilities and policies at that time, while the name of the city of peace started to disappear progressively. The city consists of two fundamental parts, Karkh on the western bank of The Tiger River and Rusafa on the eastern bank. The architectural type of the city at that time can be found from the illustrations in the historical books, which described the architectural type of Al Hira city that had an open central courtyard surrounded by arcades and within them, the most important large space called the iwan. The domes were the other significant features of the Abbasid age covering the large spaces (Al-Silq, 2008).

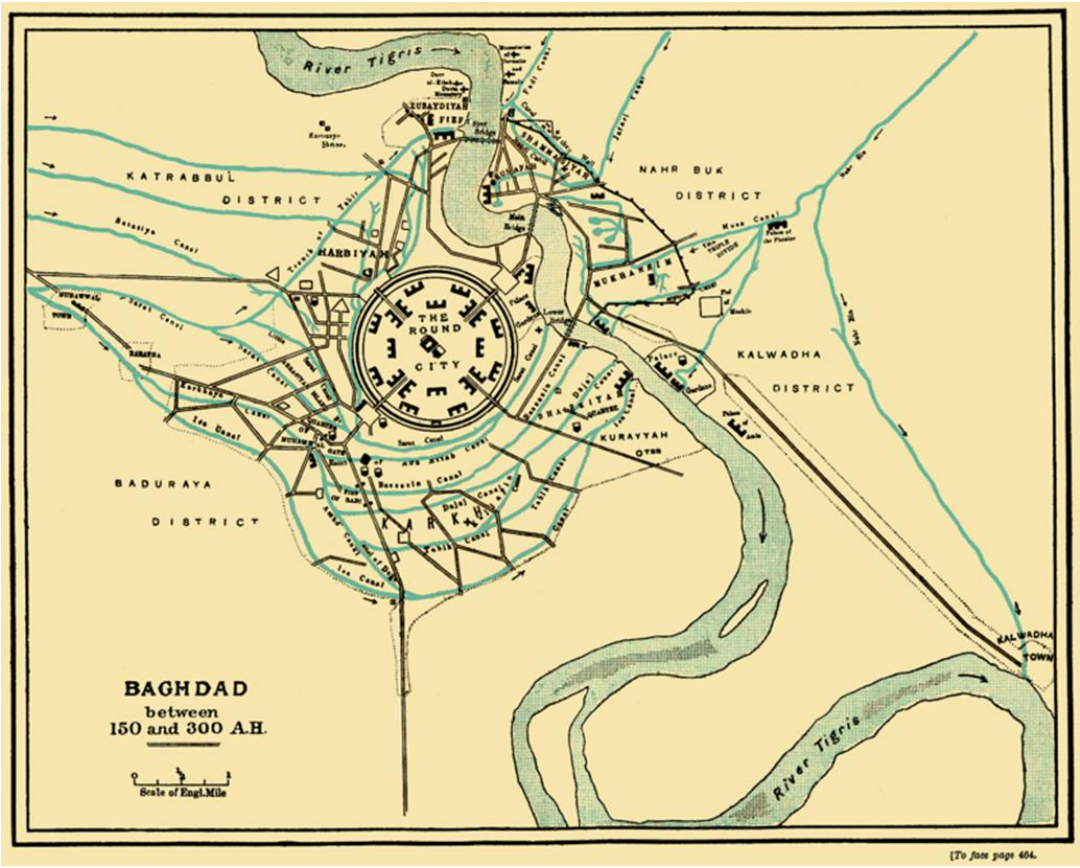


Figure 2.5: The Round City (762-946)
Source: http://www.amusingplanet.com/2016/07/the-round-city-of-baghdad.html

2.1.2 New Urban Center (809-946)

After Al Rasheed's death in 809 AD, the struggle between Al Amin and Al Mamoon to be crown prince reached the point of warfare. Al Mamoon's army attacked the round city, destroying part of its walls, and many palaces, and killed Al Amin. The new Caliph decided to move to the Rusafa area and construct a new royal palace. Later several building and palaces were built around the royal palace, forming a new urban centre on the eastern bank of the Tigris River called Dar Al Khilafa (house of Caliphate) (Al-Silq, 2008). However, after the death of Al Mamoon in 833 AD, the new Caliph Al Mutasim moved the capital of the Abbasid Empire to Samara in 836 AD.

Later Abbasids returned from Samara in 892 AD, and a new city centre in Al Rusafa was constructed with a half-circular wall (Bianca, 2000:249). A market grew around the new urban centre, Thulatha, developed many urban districts, which became the historic core of Baghdad city. These areas had centres containing the two main components the mosque and the market, and a variety of buildings, for instance, schools, libraries, public baths, hospitals and the most significant area composed of compact, houses in narrow alleys. The new public centre grew from three sides and was connected with the other side of the Tigris River by the only bridge. This growth was organic, which depended on the old existing paths and nodes. Paths distribution, the relationships between mass and space, compact fabric, a gradation of urban paths from the public to private and the narrow alleys were the fundamental characteristics of the urban structure of the city (Al-Silq, 2008). The extension of the new urban centre has led to the building of a new wall for more protection from external threats (figure 2.6). These city walls and structure remained until the end of the 19th century.

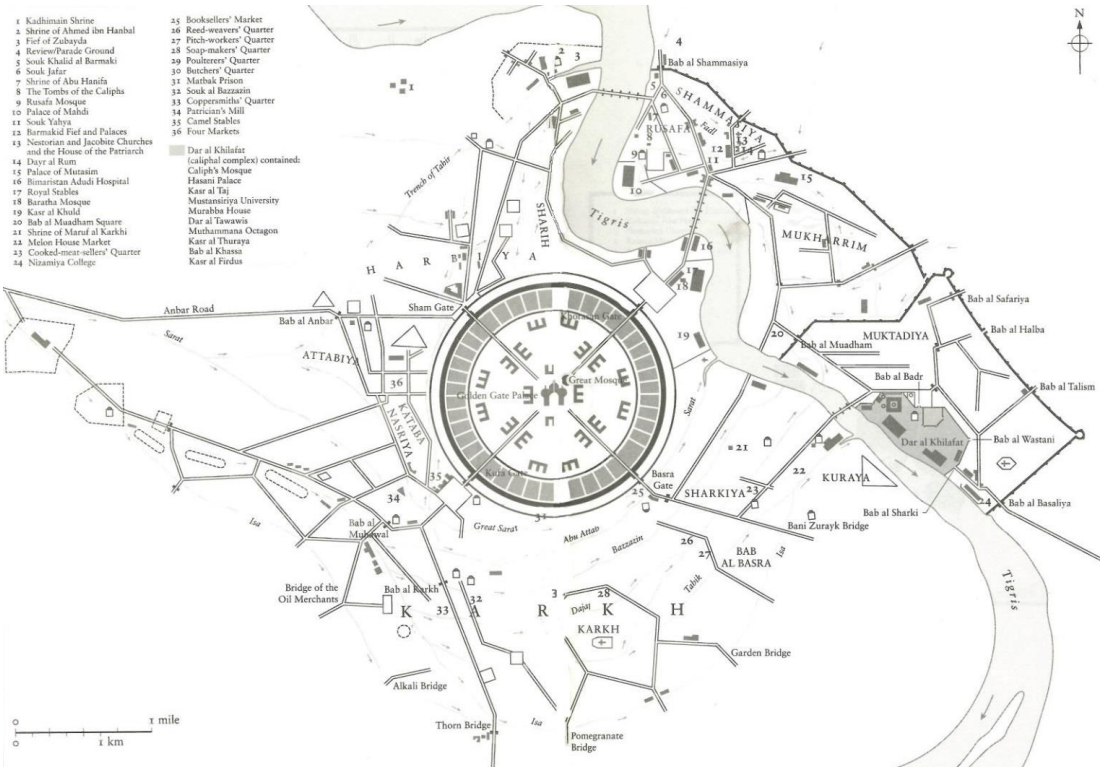


Figure 2.6: Baghdad morphology until the end of Abbasid Empire
Source: (Marozzi, 2014).

2.1.3 The Dark Periods

The history of Baghdad witnessed an eventful path of prosperity in times such as the Abbasid Empire when Baghdad had many unique libraries. The House of Wisdom was an attraction point for the most significant thinkers, scientists, mathematicians and linguists of the world. However, Baghdad had also a difficult time of floods, epidemics, fires and foreign control. In 1258 was the darkest period when Mongols occupied and destroyed the round city. The great Khan of the Mongols, Mongke in 1255 put his brother Hulagu Khan in charge of an army whose goals were to destroy the Abbasid Empire. Hulagu's army, estimated at over 150,000 soldiers, entered and occupied the City of Peace on February 10th, 1258 and destroyed mosques, palaces, libraries, and hospitals within one week (figure 2.7). They threw the books from Baghdad's libraries into the Tigris River, which was said to turn black with the ink from the books. More important than everything, The Mongols killed between 200.000 and 1,000,000 people in that week of destruction. They left Baghdad completely depopulated and uninhabitable (Marozzi, 2014:143).

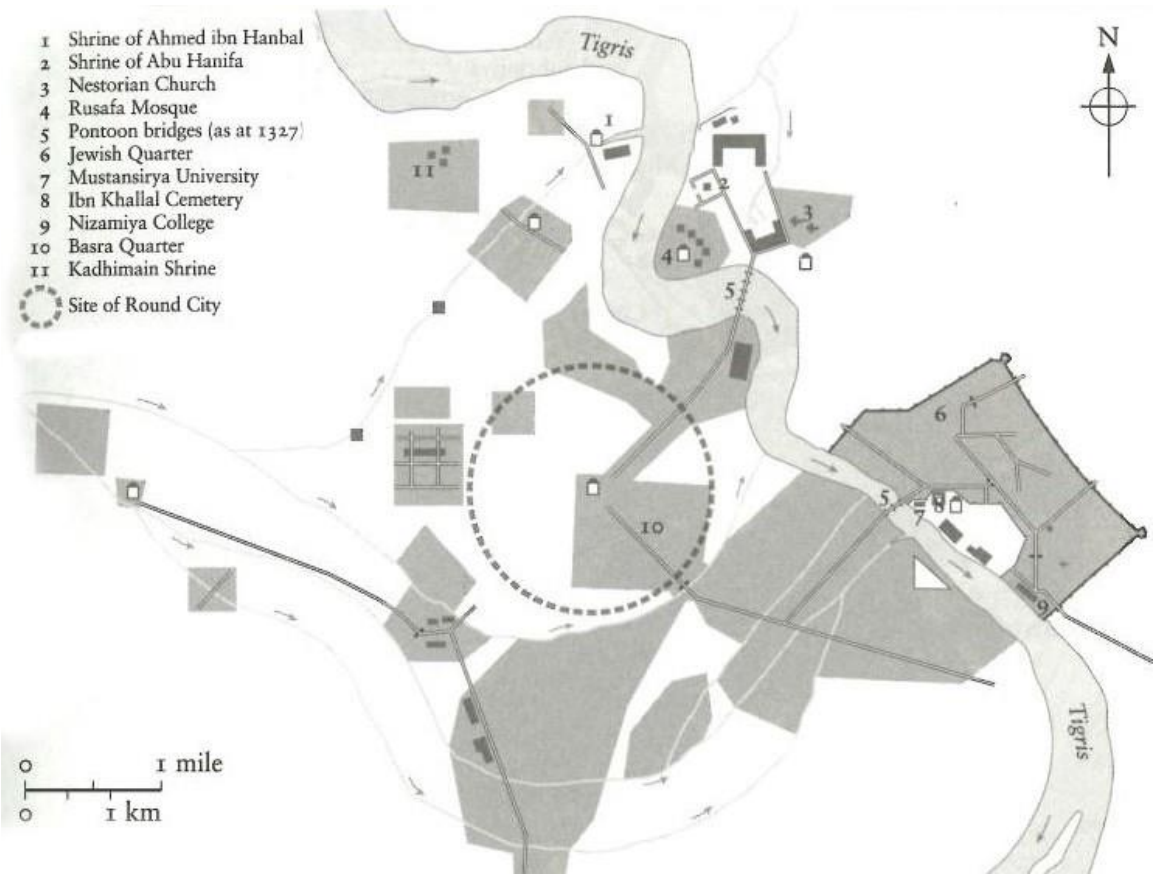


Figure 2.7: Baghdad 1258-1534
Source: (Marozzi, 2014).

Up to the 20th century the city has been occupied many times by different groups, for instance, the Buwaihids (946-1055), Seljuks (1055-1152), Ilkhanid (1258-1338), Jalairids (1338-1411), Ottomans (1638-1917), the British (1917-1932) and the Americans (2003) have all left their marks in varying degrees and reduced Baghdad's status (figure 2.8) (JCP, 1984). Caliph Al Nasir and Caliph Al Mustansir tried in the early 14th century to bring some well-being back to Baghdad. They constructed essential buildings such as Al Mustansiryia School (figure 2.8 A), Al Nasiryia palace (The Abbasid palace), The Tomb of Zumurid Khatun (Al Nasir's mother) and Al Khulafa mosque (figure 2.8 B), which are still the oldest existing features of Baghdad. Al Khulafa mosque was built to be Dar Al Khilafa (House of the Caliphate), its minaret still exists but now beside a new mosque built in 1960 (Al-Silq, 2008)(figure 2.8 C).

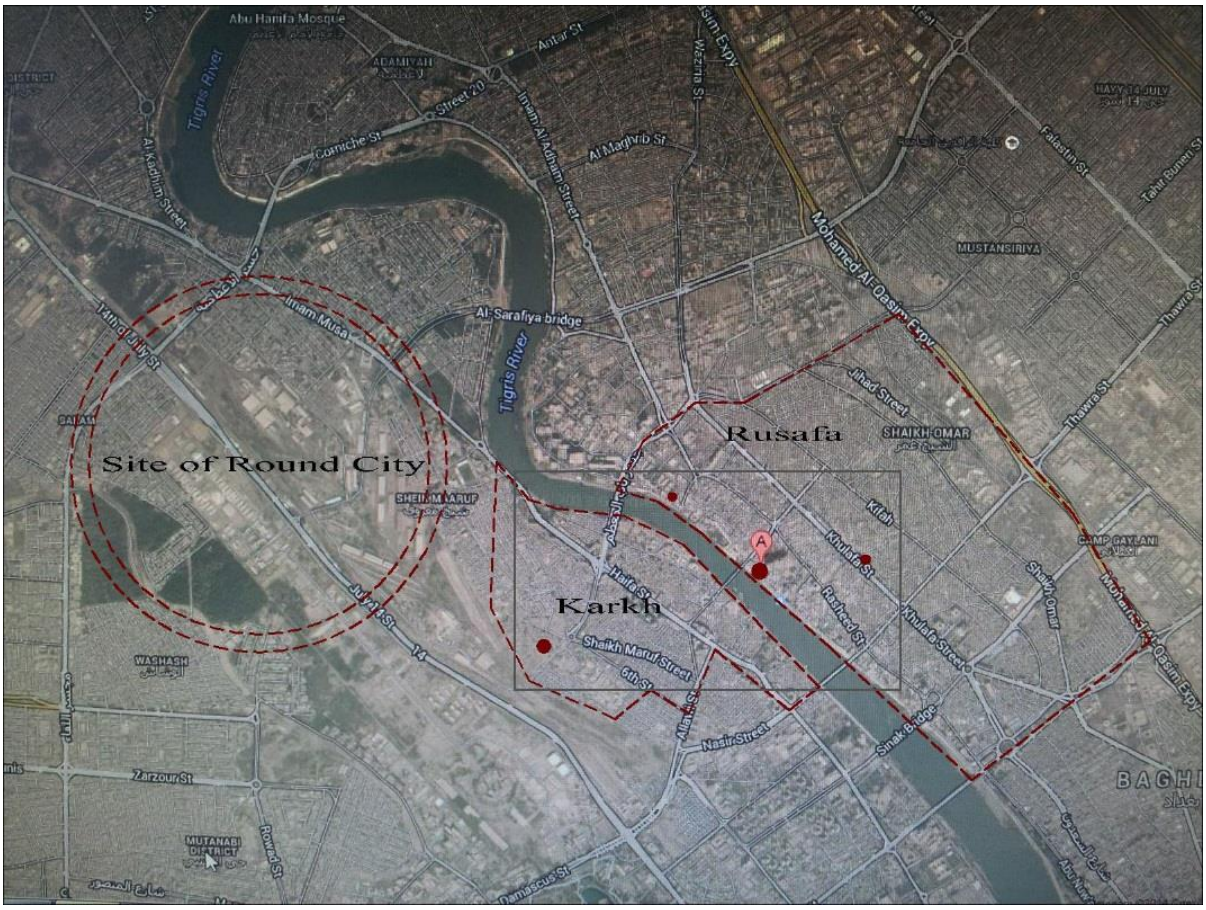


Figure 2.8: Old Core of Baghdad City
Source: Author 2016 according to google

Figure 2.8: Oldest existing features of Baghdad City
Source: Author 2016 according to google

Figure 2.8 A: Al Mustansiryia School
Source: Author 2016 according to the Municipality of Baghdad

Figure 2.8 B: Tomb of Zumurid Khatun
Source: https://archnet.org/sites/1696/media_contents/35530

Figure 2.8 C: Khulafa Mosque
Source: Author 2016

In the 17th century, a map showed Baghdad surrounded by a quadrilateral wall with four gates on the eastern bank of Tigris River while Karkh on the western bank was reduced to a linear area with small neighborhoods (figure 2.9). Another map in the 18th century documented the city with its four gates, Kulwatha Gate or Eastern Gate, Muatham Gate, Wistani Gate and Talsam Gate, also it was indicated that there were 22 Khans, several public baths, and 20 significant mosques (figure 2.10). The urban components were well organised and combined in the 19th century due to the geometrical form of the city. The street pattern of Baghdad was narrow and irregular, the houses were more suitable for the social and climatic characteristics of the city and fully integrated with their urban context. In the late of the 19th century, the Ottoman began to cut the first axis in Baghdad Rasheed Street and attempted to import Westernization into the urban evolution pattern (Al-Hasani, 2012)(figure 2.11).

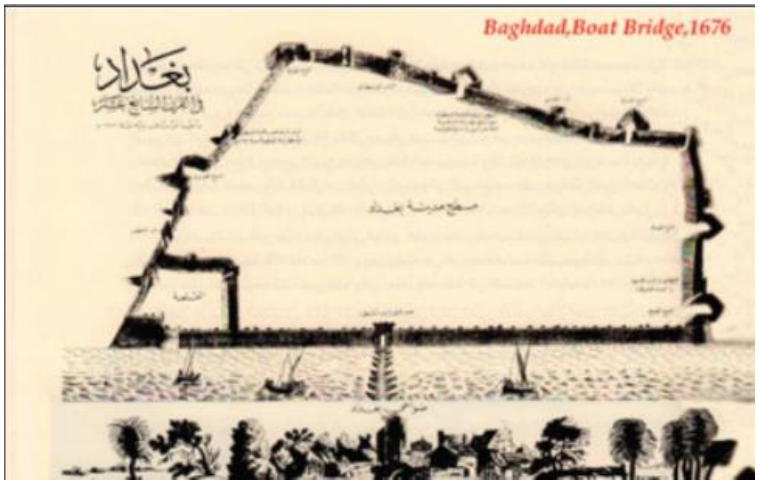


Figure 2.9: Baghdad in 17th Century
Source: (Sousa, 1952).

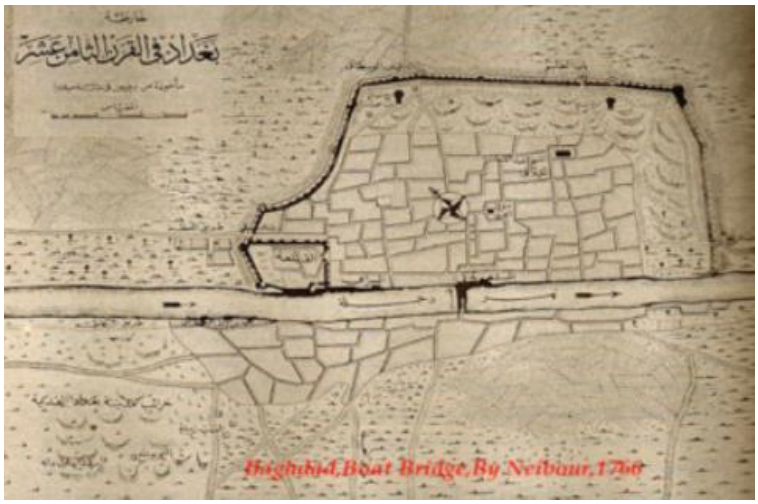


Figure 2.10: Baghdad in 18th Century
Source: (Sousa, 1952).

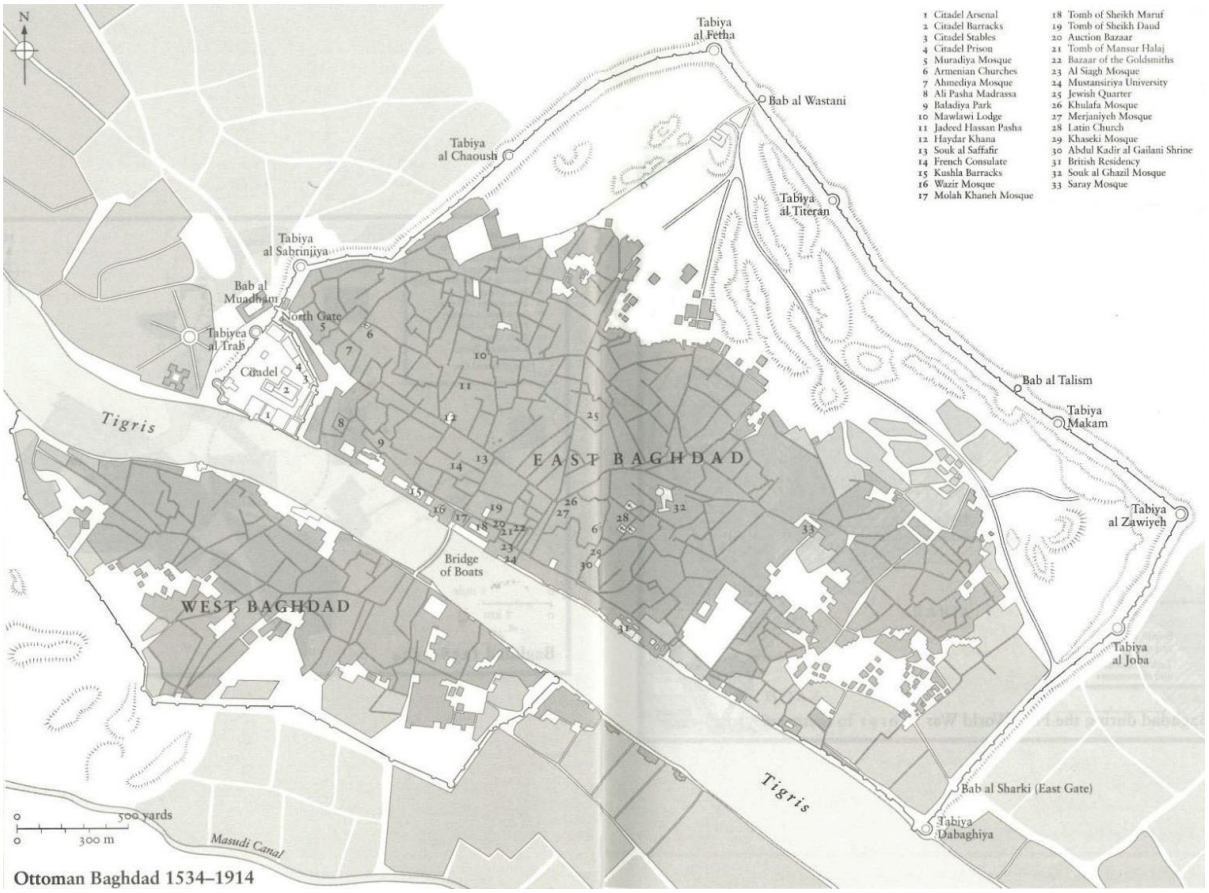


Figure 2.11: Baghdad 1534-1914
Source: (Marozzi, 2014).

2.1.4 Baghdad in 20th century

Another change occurred in 1917 during WWI, when after centuries of Ottoman control the British Army entered Baghdad, and once again it becomes a capital city looking to construct a new contemporary country, but under the British mandate. Baghdad witnessed a further change in the urban components and with the cultural structure at the beginning of the 20th century due to the political, economic and social situation. The opening of Rasheed Street in 1908 and then completed by the British was the first change in the traditional urban fabric (figure 2.12). The street became the most significant feature and the centre of business in Baghdad city for decades. The traditional style of buildings on Rasheed Street had a unique type, which gave the street an outstanding character.

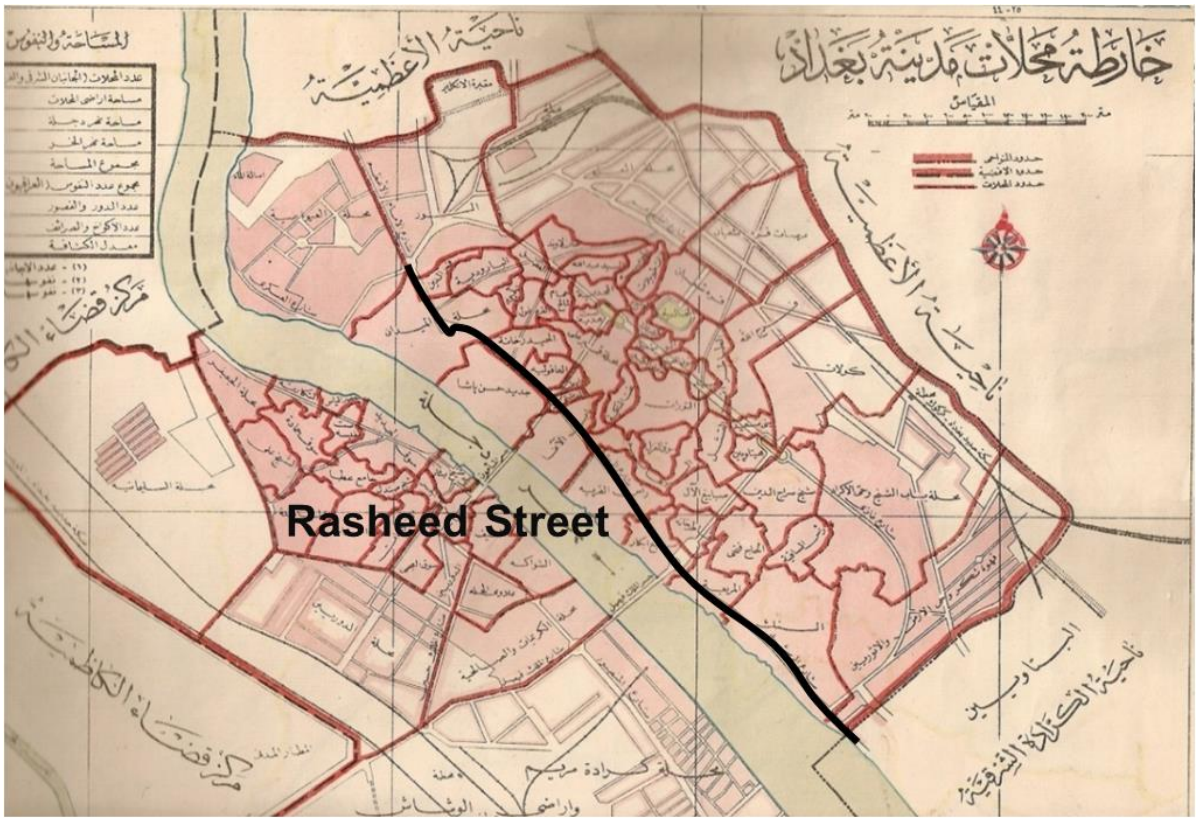


Figure 2.12: Rasheed Street
Source: Author 2016 According to the Municipality of Baghdad

New urban districts emerged outside the historical area in different directions in the 1930s, the new districts (Saadoon to the south, Waziryia to the north and Salihyia and Karadat Maryiam on the western bank of the river), they were designed according to the western methods like gridiron planning and the garden city (Al-Silq, 2008), while the old urban fabric developed in two directions towards the Northwest and the Southeast. At the same time, the urban evolution programs neglected the urban heritage concerning renovation and preservation of the old traditional sites. Again three major roads (Kifah Street, Sheikh Omar Street and Khulafa Street) were penetrated into the historical fabric of Rusafa parallel to the Tigris River between World War One and Two (Al-Hasani, 2012), with a rate of demolition of about 32 hectares or 6% of the whole site of the old city (JCP, 1984) (figure 2.13).

After the massive increase in economic resources in the 1950s, the establishment of the Higher Council for Reconstruction determined the modern planning notion for the city (Al-Hasani, 2012). Furthermore, massive projects in Baghdad were implemented such as electric power stations, oil refineries, large factories, and dams, which were essential

projects to protect the Mesopotamian valley from the risk of floods. These circumstances led to the invitation of many famous architects in the world to design projects and create unique concepts for Baghdad city. They tried in their designs to combine different ideas: Wright by designing the Opera house of Baghdad and the master plan for greater Baghdad, and Gropius in his design of the University of Baghdad created a sophisticated system of masses and spaces inspired from the courtyards in the old city. In addition, the amazing design of Baghdad Gymnasium building by Le Corbusier, The Ministry of Planning by Ponti and the Art Gallery by Aalto were also planned (Al-Silq, 2008).

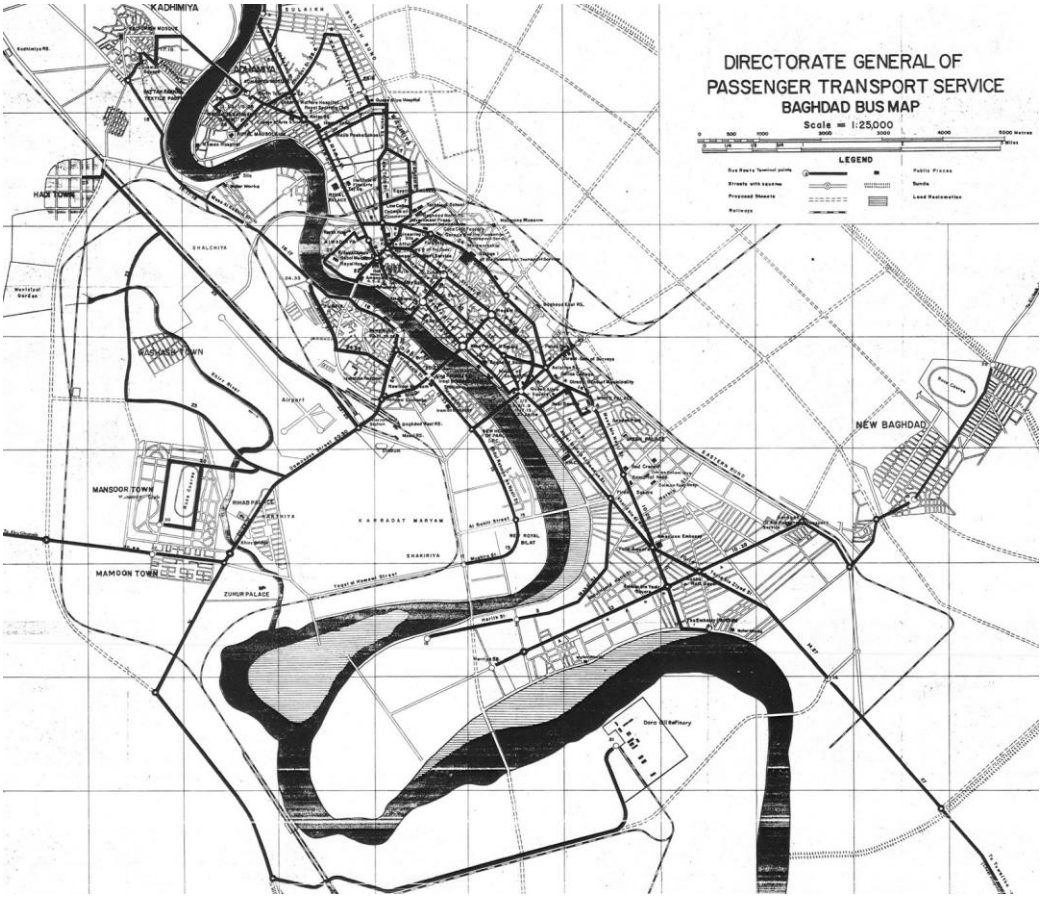


Figure 2.13: Baghdad 1957
Source: (Pyla, 2008)

The Iraqi Government between 1956 and 1984 appointed various international Architects and Planners to prepare a master plan due to the rapid extension in Baghdad city. P.W. Macfarlane was the first one who proposed in 1956 eight sectors each one with a population of about 18000 and a road system joining the historic urban area in Baghdad with new river bridges and the outlined districts (figure 2.14).

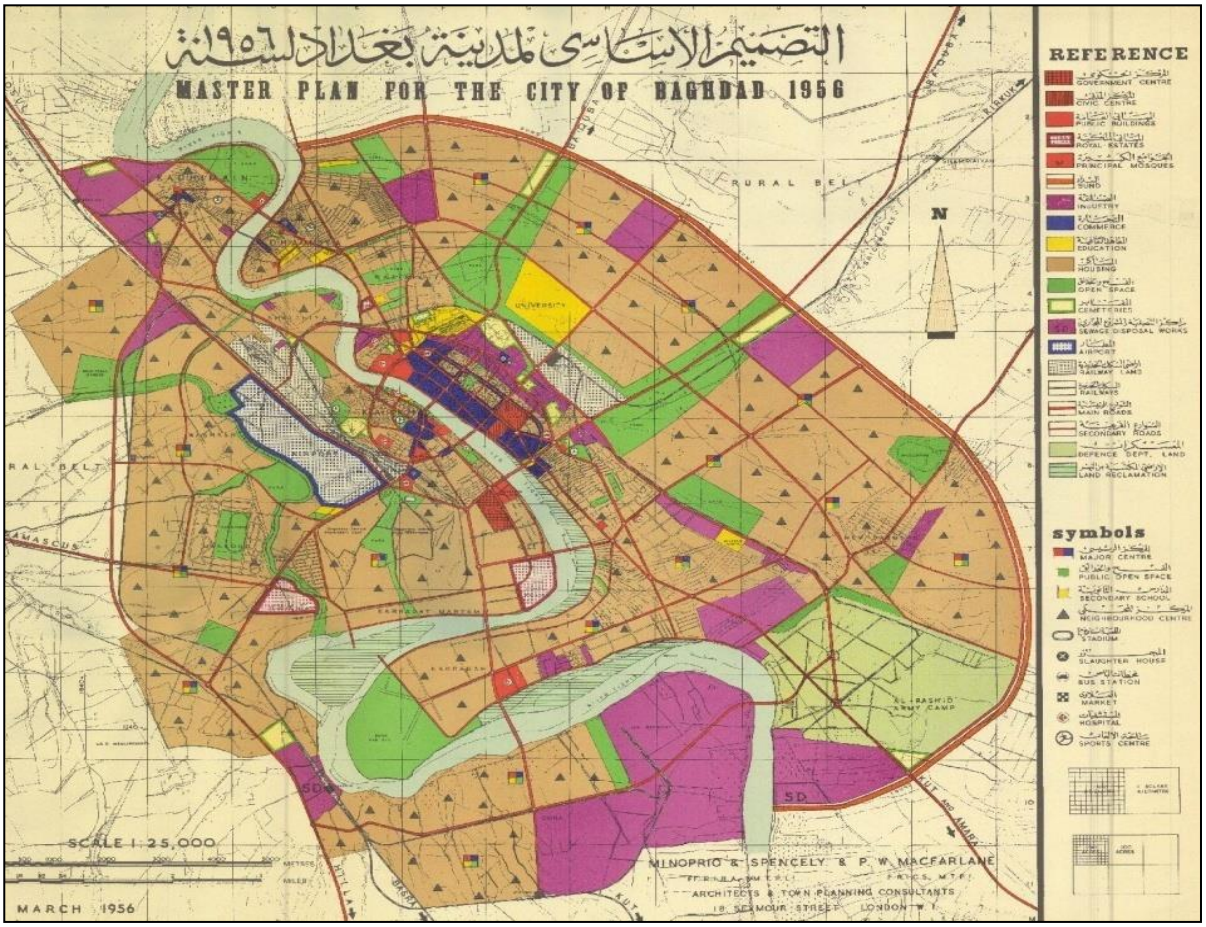


Figure 2.14: The Master Plans for Baghdad, P.W. Macfarlane, 1956
Source: The Municipality of Baghdad

In 1958, modern urban planning of five sectors of Baghdad was submitted by Doxiadis. He suggested a rectangular district along the northwest and the southeast axis of the river. Doxiadis's master plan aimed to achieve a more comprehensive framework for modernization (Pyla, 2008) (figure 2.15). The third master plan by Polservice for Baghdad city in 1970 determined the administrative boundaries and the development strategies until 2000. Polservice recommended preserving as many as possible of the traditional sites and urban fabric of the historic quarters (figure 2.16).

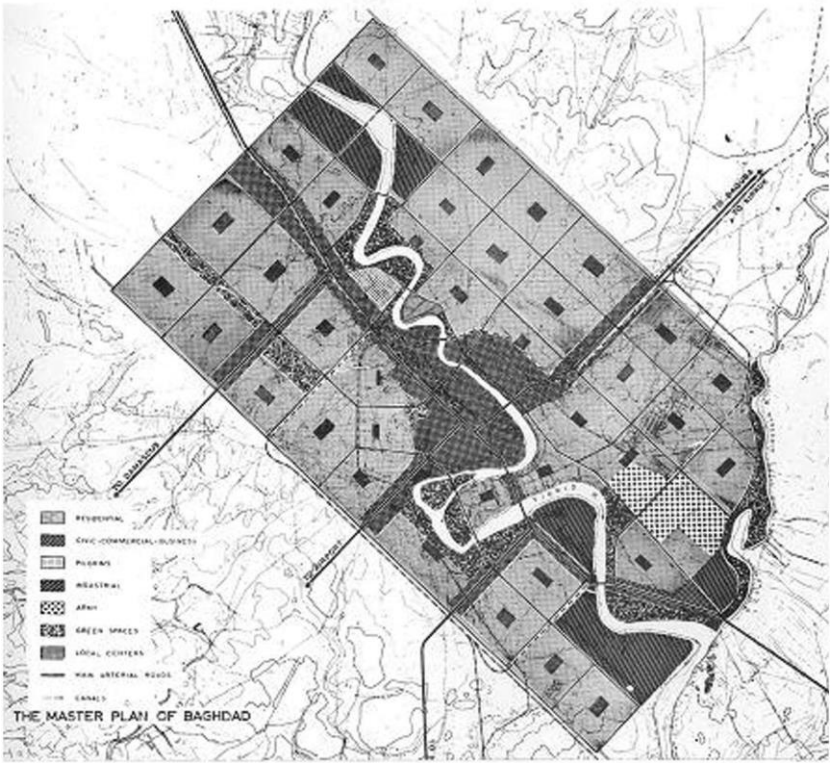


Figure 2.15: The Master Plans for Baghdad, Dioxides, 1958
Source:(Pyla, 2008).

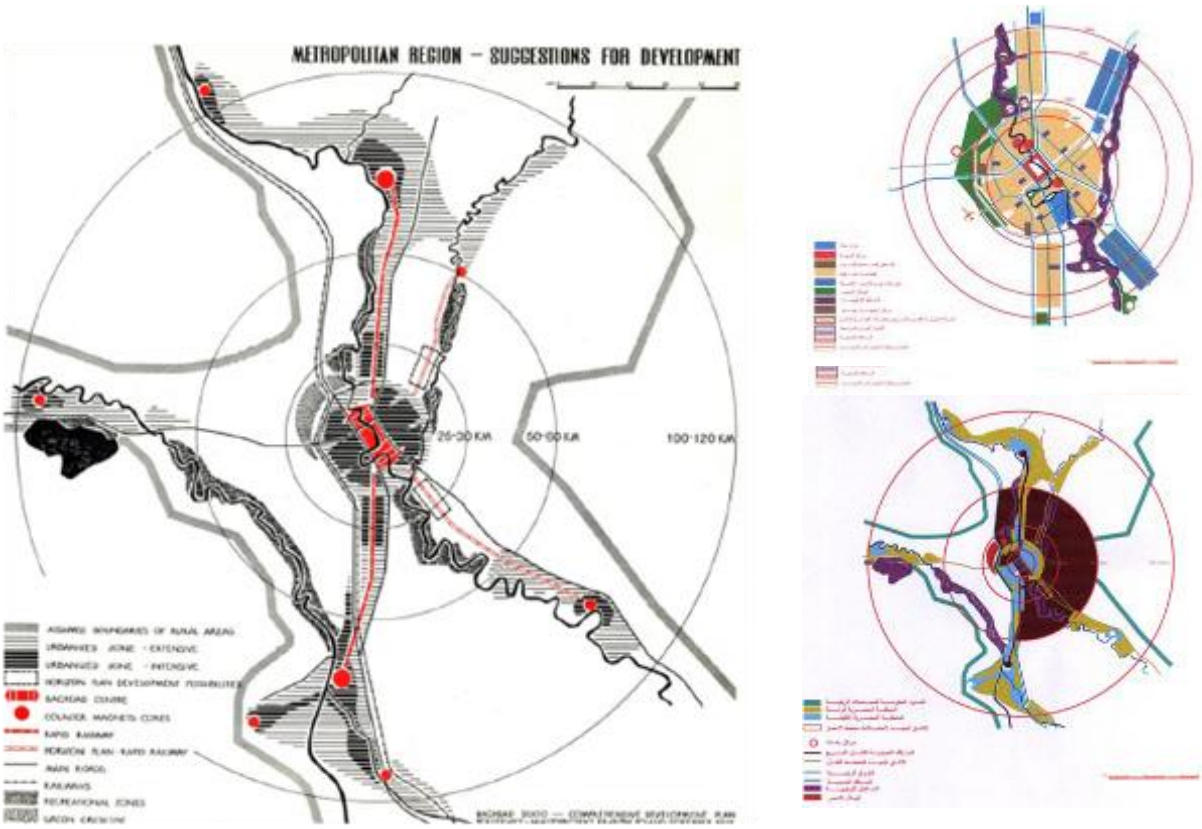


Figure 2.16: Polservice (Poland) Concept of multiple circles of greater Baghdad 2000
Source: (Polsevice, 1973)

The last comprehensive master plan for Baghdad was submitted by JCCF 1987(figure 2.17). One of the significant comprehensive urban conservation master plans for Old Rusafa was submitted by JCP (Japan planners, Architects, and consulting engineering) in 1984. Urban conservation and redevelopment of the traditional core were the main aims of this scheme. This project proposed a buffer zone around the old centre by promoting the advancement of a central business district (CBD). This master plan was only partially implemented due to the political condition from 1990 until now. The proposed conservation scheme designated conservation places and monuments to ensure their protection. It also offered solutions that minimized the damage as much as was possible by the removal of eyesores, development control, incentives for restoration, and by environmental rehabilitation and revitalization. The JCP plan (1984) designated conservation places within Old Rusafa, identified building by building, their typology and architectural interests, and suggests various criteria for intervention, restoration, urban repair, infill or substitution. A methodological approach for such intervention and a corresponding 'manual' for the use of The Municipality of Baghdad was proposed, to permit it to control on-going growth. They assert that conservation and development in the historic core should be implemented in the progressive stage, and can succeed only when other equally necessary legal, administrative and financial tools are provided. The importance of this plan is not envisaged as merely a passive protection of the existing historic centre. In addition to proposing the conservation, restoration or rehabilitation of significant portions of the historic centre, the structure plan and urban design schemes aim for an active development of the historic fabric. This included the retrieval of many fundamental parts which, if realized, would significantly improve the image of Old Rusafa (figure 2.18) (JCP, 1984).

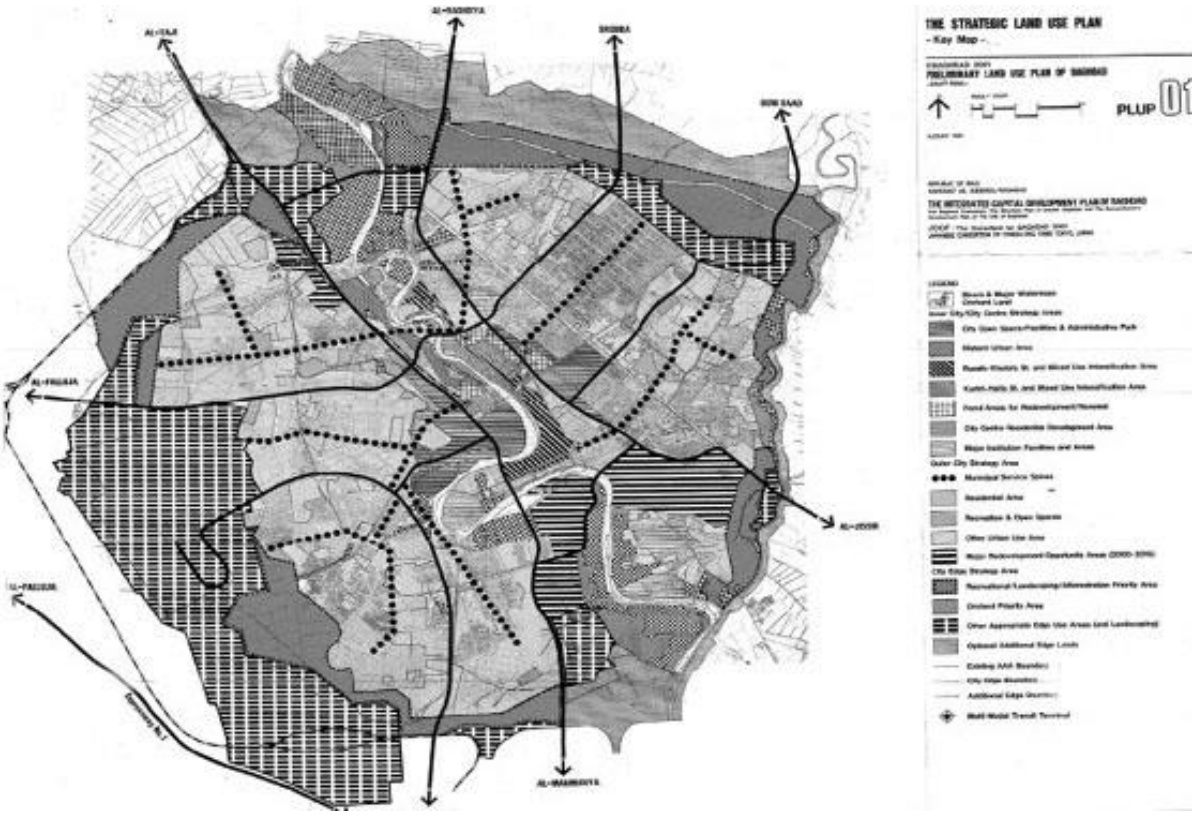


Figure 2.17: Master plan of Integrated capital development plan of Baghdad 2001
Source: (JCCF, 1987).

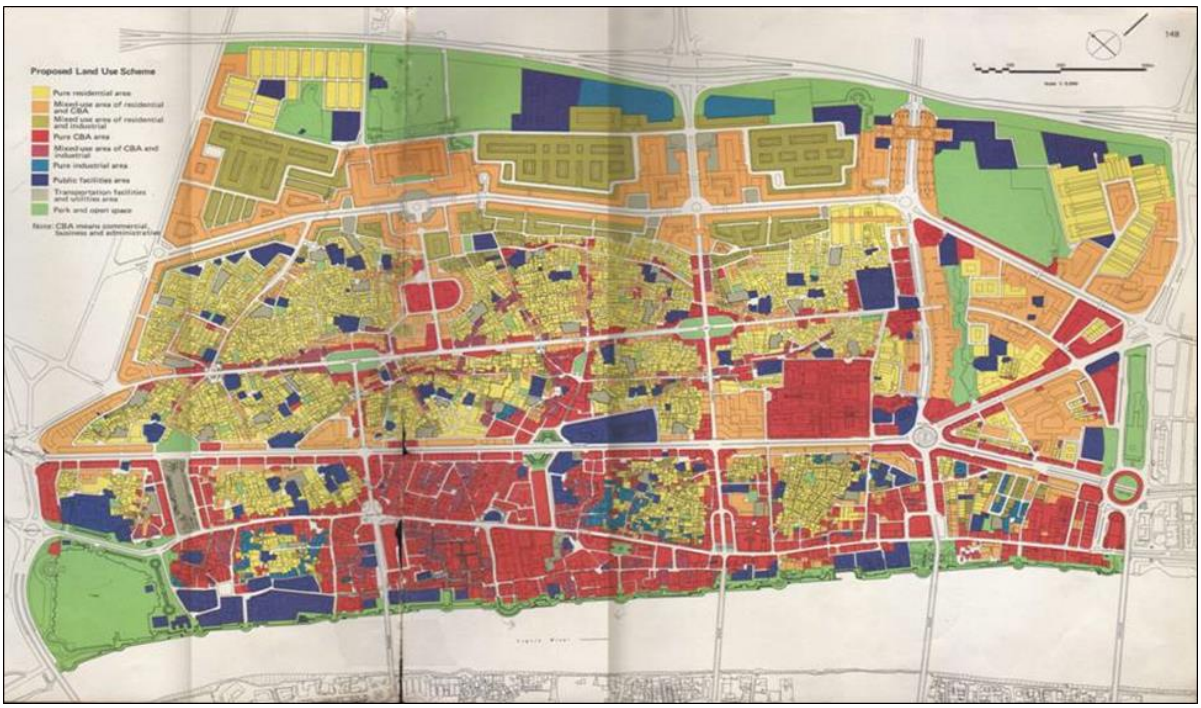


Figure 2.18: Goal Image of Rusafa Historic Center
Source: (JCP, 1984)

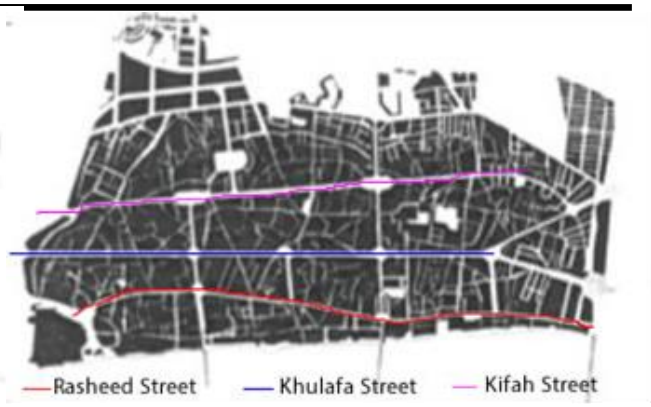
2.2 Assessment of the process of urban transformation in Baghdad city form and function

During the 21st urban transformation of cities has been intensely affected by flows of socio-economic and technological processes. Selim (2017) argues that "improving the experience of built landscapes not only involves refining their urban quality but also ingrains belief in an inclusive change in the outcome. In many situations, the overhaul of districts and neighborhoods holds unique connotations of repairing existing defects in the outdated and creating a reborn reality" (Selim, 2017:14).

The transformation of Baghdad city is a very complicated process driven by various factors affecting the homogeneity of the old urban fabric (figure 2.19). Reconfiguration and the production of new urban typologies within the heritage fabric were the most significant effects. The outcome was different spatial languages competing with each other. In Figure 2.20, I have analyzed the process of urban transformation in Baghdad and showed a different type of urban pattern. The city began with a circular geometric form (The Round City) from 767 to 912 AD and then transformed to more organic pattern until the end of the 19th century. This transformation changed the relations and hierarchies among spaces, which allowed more flexibility and accessibility between private and public space.

Baghdad witnessed another transformation in the 20th century due to the urban growth, political issues and economic evolution. The new geometrical areas with new wide streets have increased the pressure on the historic part of the city physically, economically and socially. Since the last transformation the relation between private and public in the new districts has changed, privacy has started to disappear and converted to publicity, and public spaces are still looking for their identity (Al-Hasani, 2012).

Old Rusafa



Westernization: 1800-1960

Reconstruction Boom: 1970

Urban Change 1983

Figure 2.19: Urban Transformation in Historic Part of Baghdad (Old Rusafa) (JCP, 1984)

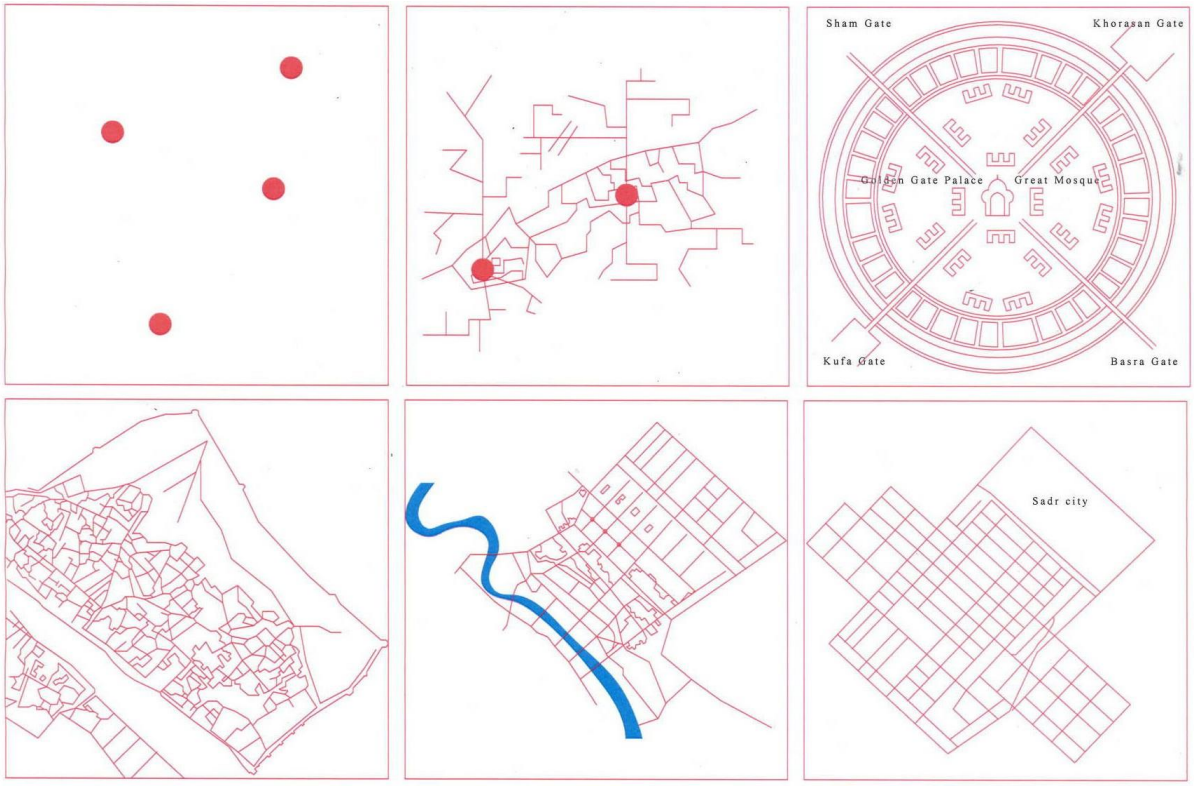


Figure 2.20: Urban Transformation in Baghdad
Source: Author 2016

The analysis and illustration of the urban growth, morphology and the transformation of Baghdad city in Figure 2.2 started from the first century AD when the area of Baghdad was still small cells and then developed to be villages that have organic patterns and connected to each other through natural paths (waterways, canals, and routes). To use ideas from Batty this analysis shows that Baghdad started with stochastic growth from the bottom up based on developing one of these cells to be the main point for attracting other cells such as Karkh village. For example Batty has stated that "the city has grown in some direction instead of others is largely due to a combination of physical and accidental historical factors, it does not imply any differences in the way growth has occurred from one time period to the next" (Batty et al., 2006). Later Baghdad witnessed another type of growth, top-down when one of its settlements was chosen to be the centre of the Abbasid Empire and a comprehensive master plan (the round city plan) was prepared for it. This type of growth represents a different method for thinking at that time, and a new urban form and pattern was produced due to that. This show according to Batty's analysis that systems are resilient and can represent different types of transformations that rely on the processes that generate them.

The limited space and fixed boundaries of the new geometric pattern played a fundamental role to promote the organic form, which had the ability and flexibility to extend and evolve. In addition, we will find that the geometric pattern created new nodes and urban networks that produced new processes for developing urban transformations and led to a growing complex structure in Baghdad city. Each one from these systems had their unique urban components such as mosque, palace, market and administrative buildings and showed strong levels of connectivity that indicate the fact that Baghdad city had reached a level of self-organization in the golden age of Harun Al Rasheed (786-809 AD).

Baghdad had only an organic pattern after the destruction of the round city in 1258 by the Mongols, and that model remained until the 20th century when a new essential change in the political, economic and social situation pushed such systems into another regime. The new way of transportation represented by the car also invaded the traditional fabric and changed the structural system of Baghdad. Due to that, new urban systems and forms emerged outside the historical area in different directions and three major roads were

penetrated into the traditional fabric of Rusafa parallel to the Tigris River. Nowadays Baghdad has therefore a complex system and urban forms.

I have also tried through my analysis in Figure 2.2 to show how such a system can grow and change in different forms affected by technological innovations. These new structures or networks are defined by their functions and connections to each other through various ways such as invisible smart electronic networks, smart transport systems, and smart central control systems. However, it still needs to be discovered who will be responsible for managing these new systems, what type of processes and morphology they will follow to build themselves. Furthermore, how these systems will develop and promote the traditional fabric in Baghdad and became an example for other historic cities, most importantly “what modern information technologies might do to the future city during the next 100 years” (Batty et al., 2006), will be the subject of this thesis.

2.3 Components of Urban Form in the historic centre of Baghdad

The term urban form has been used in the recent literature to describe a city's physical characteristics and features that are related to land-use patterns, transportation systems or sometimes to urban design (Jabareen, 2006). However, urban form is not only related to the physical sides but also might make other contributions to social aspects such as social interaction and sense of society. The UK Government Office for Science defines urban form as "the physical characteristics that make up built-up areas, including the shape, size, density and configuration of settlements. It can be considered at different scales: from regional to urban, neighborhood, 'block' and street". It always develops in response to economic, environmental, social, and technological evolutions (Government Office for Science 2014). Urban form defined by the City Form Group cover five elements that make up a city's urban form: density, land use, transportation, housing or building types, and layout (M. Jenks et al., 2010). Regarding urban form Bianca, asserts that there is an interaction between what individuals build and what they believe, which has led people to structure their environment, while they are also affected by it in their attitudes as an outcome of interacting with it over. "Urban form, architecture, and cultural tradition can be seen as a natural expression of prevailing spiritual values and beliefs which are intimately related to the acknowledged cosmic order of the world" (Bianca, 2000:22). The modern city of Baghdad represents one of the significant historical cities in the Middle East; it contains four main historical areas: Old Rusafa, Karkh, Adhamiya and Kadhimiya. The form of Baghdad has changed as the complexity of its systems has increased. The traditional urban form of the historic core of Baghdad has been influenced by social, cultural, and religious factors. During the last few decades, Old Rusafa has suffered in both its monuments and areas, however, enough urban fabric remains to evoke its past grandeur. Four main urban components identify the traditional urban form in the historic centre of Baghdad (the traditional urban fabric, Baghdadi houses, mosques and traditional souks). This section will assess the importance of the main components of urban form in the historic centre of Baghdad. It will also seek to illustrate how the traditional urban form has played a fundamental role in promoting citizens' social life by creating a sustainable social environment, identity, privacy, safety and equity. Furthermore, this section will debate how the modern method of transportation represented by the car has affected the structural system of the historic core.

2.3.1 The Residential Unit (Traditional Baghdadi Houses)

The urban fabric in Muslim cities is determined by clusters of residential units due to the particular attitude of Islam towards formal civic institutions and its relatively low emphasis on monumental public buildings and their sheer quantitative dominance (Bianca, 2000:72). The residential unit that represents the courtyard house is the most complex of all elements of urban form in the traditional Islamic city structure and especially in Old Rusafa (figure 2.21). The majority of the traditional Baghdadi houses have been built in the nineteenth century and represent the output of a long period of development and characteristics that are the combination of experience and the invention of climatic influences in Muslim lifestyle (Warren and Fethi, 1982:42).

Figure 2.21: The Complexity of Designing Group of Traditional Baghdadi Houses Makes Separation Impossible, Even Shanashils Reached out Virtually to Touch
Source: (Warren and Fethi, 1982:201).

The traditional Baghdadi houses consist of two floors and one courtyard (some of them with two courtyards) (figure 2.22), and they are accessible from one entrance only, which leads visitors through a series of sub-spaces before reaching the central courtyard. Due to the density of population and the limitations in land area in Baghdad, these houses are structured vertically with spaces on different floors in relation to the central courtyard (Al Sayyed, 2012). “The Muslim builds his house in order to live in it with his extended family. The house's structure usually allows for horizontal and vertical expansion to accommodate increasing needs that may arise from the marriage of one of the sons or new births, and as allowed by the topographic nature of the flat or mountainous landscape” (Shokry, 2012). The main element in these houses is a central open courtyard that plays a vital role as the focal point of the family's social interactions (figure 2.23). One of the essential motivations behind the choice of the courtyard as a fundamental part of a traditional Islamic house is the desire for privacy. This particular spatial thinking can be seen in most traditional areas in Baghdad where the courtyard house was used as a significant part of the urban fabric (Bianca, 2000:80). The main source of air, light and a place where visitors could dismount in traditional Baghdadi houses is the courtyard, it was also a place where women would not be seen in this semi-public area (Shokry, 2012) (figure 2.24).

Figure 2.22: Traditional House with Primary and Secondary Courtyards, Cross-Section, Elevation Long Section Above Right
Source: (Warren and Fethi, 1982:161)

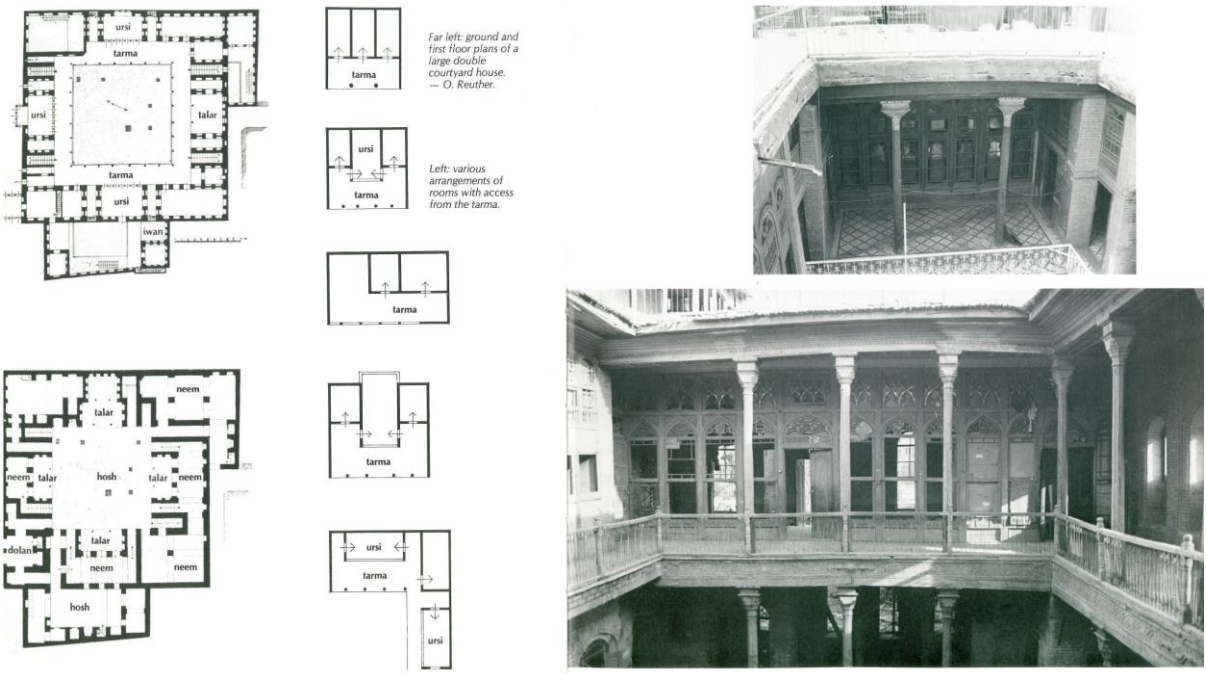


Figure 2.23: A Central Open Courtyard as the Focal Point of the Family's Social Interactions Source: (Warren and Fethi, 1982:69).

Figure 2.24: The Courtyard is the Main Source of Air, Light and a Place Where Visitors Could Dismount, and it was Also a Place Where Women Would Not be Seen in this Semi-Public Area
Source: (Warren and Fethi, 1982:57,137)

The narrow alley together with the hierarchy of the traditional Baghdadi house provides for a series of thresholds of security, particularly visual security between spaces. “In physical terms, security can be seen to be provided by concentric rings of protection, the concentric rings being provided by passive, design or construction elements of the building clusters and surrounding area” (Shokry, 2012). The traditional house emphasises the inviolability of the private domain, the interior of the house does not reveal its secrets and charms to outsiders, and in fact, the exterior of these houses is very deceptive with high walls and balconies (Shanasheel). The significance of the Shanasheel is that it filters light while

increasing ventilation, and allows looking outside without being seen (figure 2.25). This indicates that the interior of the Baghdadi houses was more important than the exterior. “The traditional street of the traditional quarters of Baghdad are distinguished by the elaborate overhanging screened and balconied windows, known as Shanasheel which jetty out from the upper rooms, and by handsomely decorated entrance doorways fronting on the street” (Warren and Fethi, 1982:42).

Figure 2.25: Shanasheel Filters Light, Increasing Ventilation, and Allows Looking Outside without Being Seen
Source: Author 2016

2.3.2 The Mosque

Old Rusafa in Baghdad is considered as a model of Muslim cities, in which the location of a mosque and its relationship with the other urban components has been considered the main principle of urban design. A mosque is an axis of connections, a centre for activities and as an essential component for citizens living in urban areas (Gazi et al., 2012) (figure 2.26). The place of the mosque in Baghdad has played a fundamental role in the arrangement of the city’s evolution. It reflected the concept of the Islamic nation which confirms the promotion of unity and social relations. This point has led to keeping the balance in a determination of land use patterns and attention to equity, as in traditional Islamic city all citizen has the right to use the religious and public spaces equally. “In the early times, the mosque was the exclusive public facility representing the complete range of social and civic affairs in the city; it later experienced a certain reduction of its scope and a greater concentration on social and religious affairs, at the expense of its political function” (Bianca, 2000:110). The land use method within Old Rusafa located the mosque

first as a center and then the market and residential neighborhoods surrounding this centre. In Islamic cities, people considered the distribution of balanced and convenient access as principles in site selection for mosques (Gazi et al., 2012). Mosques in traditional Islamic cities were placed in a suitable and standard distance from each other (Mortada, 2003:85,89).

The form of traditional Muslim cities is based on a religious sense of life and respect for family privacy. This type of privacy in these cities and especially in Old Rusafa have led to making these areas ecological through permanent boundaries of neighbourhoods and homes, dead-end streets and a communal life of all people in a neighbourhood. Gazi argues that Islam, because of its value system, has determined behavioural patterns with the role of the community and humanitarian organisations such as mosques in settlement morphology. In addition, he believes that Mosques are the spiritual identity of Muslims and a place of support which started from the beginning of Islam until now and it is the most significant part of the urban environment (Gazi et al., 2012). Therefore, one of the main aims of traditional urban design in Old Rusafa was utilising various ways of preserving heritage in the urban environment by creating harmonious atmosphere in the city. The role of mosques in Old Rusafa creates active urban areas regarding the economic, social and cultural environment, maintaining the hierarchy and the identity of these historic cities.

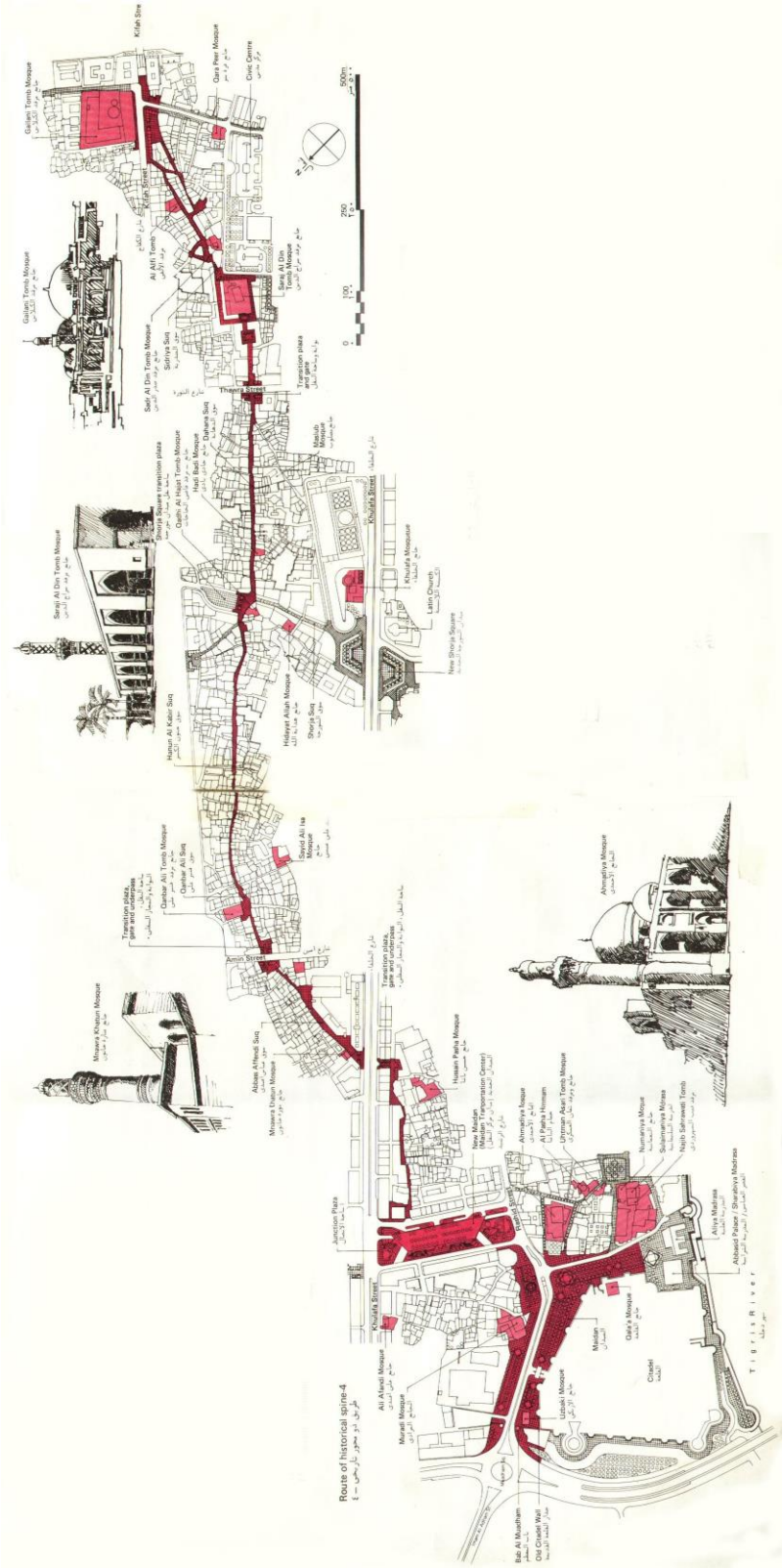


Figure 2.26: A Mosque is an Axis of Connections, a Center for Activities and as an Essential Component for Citizens Living in Urban Areas. We can see many mosques in the fourth historical spine of Old Rusafa between Gailani and Maidan such as Gailani Tomb Mosque, Mnawra Khatun Mosque, Ahmadiya Mosque and Khualfa Mosque (JCP, 1984).

2.3.3 The Traditional Suq

Commerce was another significant and dynamic element of the Muslim urban system, which always occupied an outstanding position in the traditional city centre in conjunction with mosques and related social welfare buildings. One of the hallmarks of traditional Muslim cities was the interaction between religious and commercial activities (Bianca, 2000:123,124). Suqs are the main source of prosperity that provided the economic activity in Old Rusafa. They are also one of the main public functions in the urban components of Old Rusafa. The suq beyond its commercial purpose is a place for social meeting and exchanging all types of news (Bianca, 2000:126).

Urban areas of Baghdad in 1955 indicated that the commercial distribution for both markets and small shops occupied the strip areas on the two banks of the River Tigris (Alobaydi et al., 2015) (figure 2.27). Many historic suqs were demolished in Old Rusafa during the period 1973-1976 such as Mustansiriya (Suq al_Haraj) which was built in 1673 by Hussain Silandar Pasha. This suq was rebuilt in 1818 by Daud Pasha and demolished in 1974 when Mustansiriya School was cleared of its surrounding fabric. The origin of Suq al_Haraj may well go back to the Abbasid period when it was called the 'Tuesday Market' or Thilatha Suq. It consisted of small shops on both side, the suq dimension being about 130 meters in length and 5 meters in width, it was roofed by a series of domes supported by pointed arches and pendentives. The second one was Haidarkhana Suq which was built in 1700 and demolished in 1917 when Rashid Street penetrated the traditional fabric of old Rusafa. This suq, located in Haidarkhana mahalla of Rusafa and adjacent to the Mosque of the same name, was a vaulted suq. Qaplaniya Suq was the third suq, which was built in 1818 by Daud Pasha. This suq was a small suq of outstanding architectural interest located near Qaplaniya Mosque, and it specialised in the sale of rugs and carpets. Its dimension was about 80 meters in length and 4 meters in width and was particularly popular with foreign tourists. Qaplaniya Suq was demolished in the 1974-1976 period (Fethi, 1977).

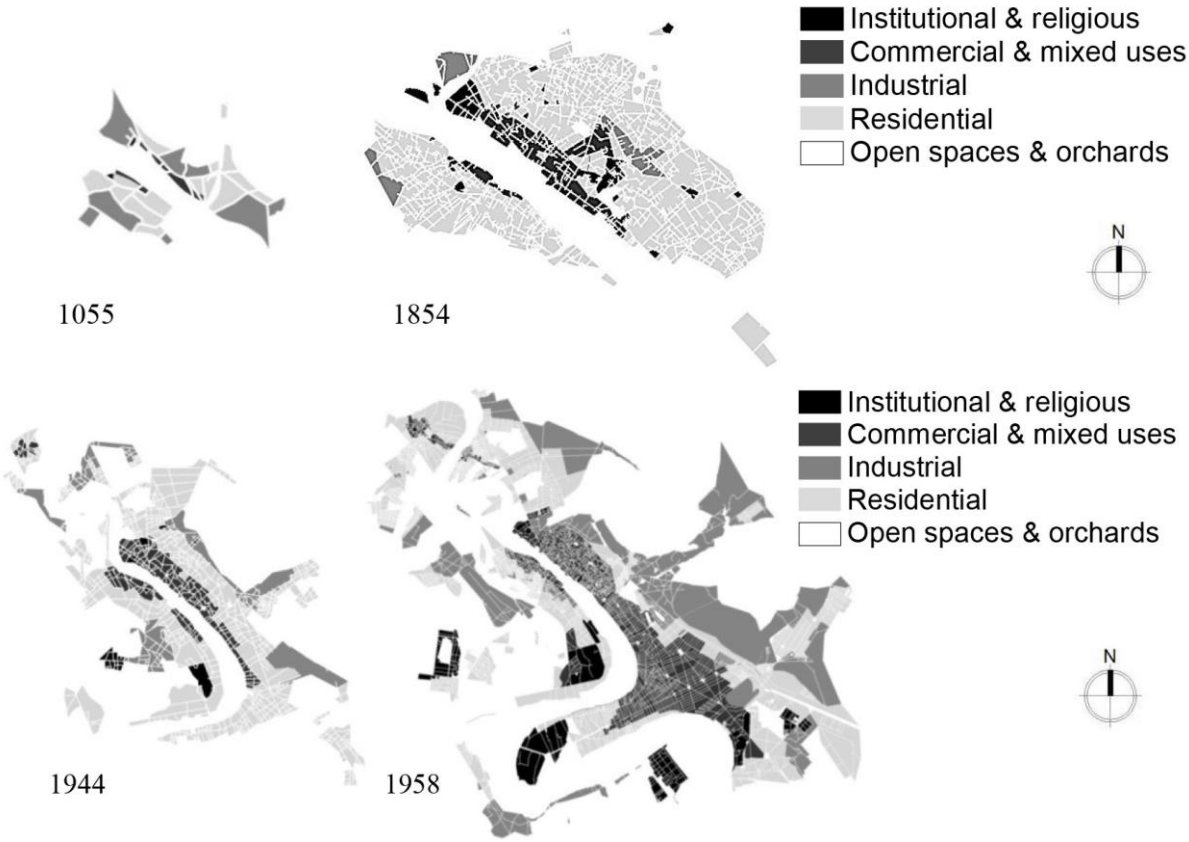


Figure 2.27: Concentrated Commercial and Continuous Residential Patterns of Land Uses of Baghdad in between 1055-1958
Source: (Alobaydi et al., 2015).

The main suq and oldest one which is still existing are Al-Shorja Suq. It was first called Al-Rayahin Suq then al-Attarin Suq. This suq was established at the beginning of Abbasid period about 750 AD, and it is the main part that represents the commercial activity of the historic area of Old Rusafa. Al-Shorja Suq and its shops, stores and squares have preserved its traditional characteristic. It is "a large maze like a narrow street with arcades of shops and stalls hiding large warehouses and craftsmen's workshops behind; some built on lifted wooden platforms" (Kirtikar, 2011:41)(figure 2.28).

The linear arrangement of long shopping alleys that could easily be divided into unique interconnected parts created the ubiquitous suq structures of the Islamic city. Each section was protected by gates which closed at night, so that accessibility to the central suq area could be interrupted at any time, just like the same way as in the residential unit. The duplicated individual suq sections by parallel units placed "back to back" or enlarged into more comprehensive systems by conjunction with perpendicular parts have led to more complex souk units in the city centre. The suq was combined with the central spines connecting the city gates and the heart of the city centre, complemented by a number of parallel alleys and cross-links in the central area. These parallel alleys were divided into various specialised sections, allowing visitors to review different goods in one single location. Customers could explore through walking from the periphery to the city centre a cross section of locally available products. The transport of these people and goods from one part to another gives clear proof of this commercial network and constitute a significant activity in the streetscape of traditional Muslim cities (Bianca, 2000:128,135).

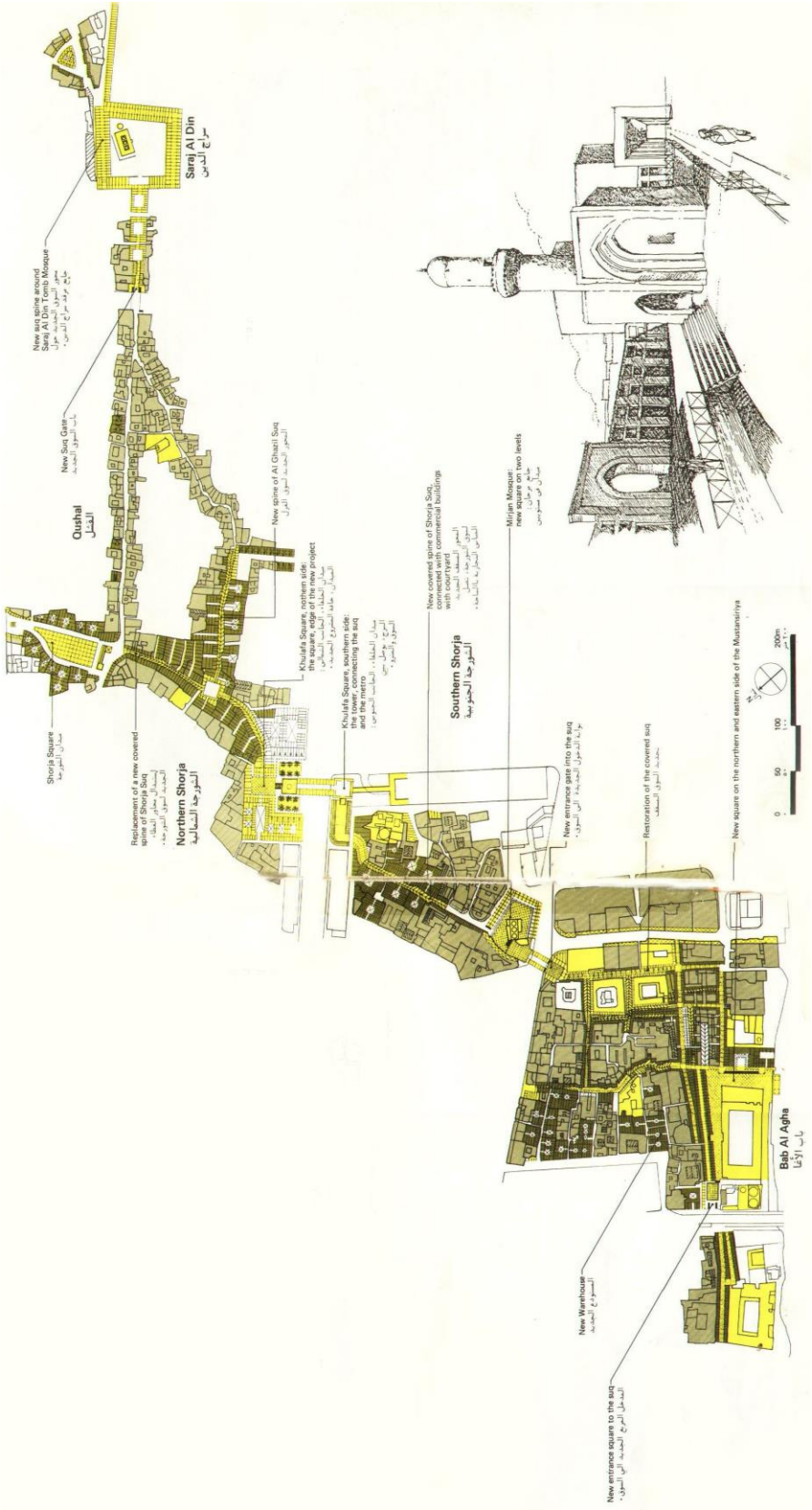


Figure 2.28: The Main Suqs of Old Rusafa are Concentrated in Bab Alagha Area Near Al Mustansiriya School and Extend Northeast through the Shorja Suq which is Part of the Central Business District (JCP, 1984).

2.3.4 The traditional urban fabric

The unique urban fabric is the main element that represents the characteristics of Old Rusafa. It contains traditional courtyard Baghdadi houses and narrow alleys, as well as the presence of social and cultural places and historical buildings such as Al-Mustansirya School, Abbasid Palace, Baghdadi Museum, Old Defence Ministry, Saray Square, Marjan Khan, Al Qishla, the Museum of Pioneers and Artists (Albayati et al., 2015). The traditional urban fabric is composed of small residential units interconnected onto another residential cluster, it becomes a system of hierarchical parts of different sized units producing a complex pattern of unity and homogeneity (Kiet, 2010) (figure 2.29).

Bianca described the main land-use pattern of the historic Muslim city as focusing on the "multifunctional core structure enveloping or at least partially surrounding the central mosque by different layers of interconnected suqs. As a rule, these are interspersed with a number of hammams, madrasas, and caravanserais which constitute the support system for the mosque and the retail shops" (Bianca, 2000:143). He also illustrated the feeling and movement through this highly articulated complex, the visitor experiences a distinct sense of spatial continuity transcending the limits of individual buildings and connecting the various realms of public life. At the same time, he receives clear physical guidance concerning the differentiation between different sectors (Bianca, 2000:146). The unity of urban fabric depends on the ability to display various requirements in a consistent language of affiliated forms, based on the diversity of organic patterns at varied hierarchic planes. Thus, Bianca mentions, "The integration of individual components is sustained by multiple structural analogies and by ascending correspondences within the deep structure of the city. Thus, the urban fabric gains access to the symbolic since small elements can reflect the structure of the whole in the same way that the human microcosm can mirror the universe. It is this hidden vertical reference system which gives depth and unity to the urban fabric, instils spatial quality to its individual components, and grounds man in his environment by inscribing his temporal urban existence within a timeless order" (Bianca, 2000:157).

Figure 2.29: A: Baghdad 2015 and B: Neighborhood in Old Rusafa
Source: Google maps, 2015

2.4 Conclusion

This research has endeavoured to realise the spatial features, structure and identity of Baghdad through examining the process of its urban transformation and growth, and by analysing its physical structures at different stages and periods. Ahmadi et al., (2012) assert, "New cities form rapidly and usually follow many unconnected concepts that confuse urban spaces, while historical cities were formed gradually according to accepted patterns and rules. Many non-local agents influence the form of new cities, while the form of traditional urban spaces depends on the morphology of the site, the historical background and the culture of the local people" (Ahmadi et al., 2012). Thus, urban designers, policy-makers, architects and governments should consider devising regeneration solutions and endeavours dealing with historic cities, aiming to integrate traditional principles with contemporary needs and provide a new vision for rethinking the way cities are designed, built, and managed. Moreover, we should seek to find new methods of regeneration that might help to find the positive and negative aspects that can serve as a platform to resolve the conflicting values of traditional urban form and contemporary design models.

Urban form, as Bianca, asserts, is an interaction between what individuals build and what they believe, which has led people to structure their environment, while they are also affected by it in their attitudes as an outcome of interacting with it over time. "Urban form, architecture, and cultural tradition can be seen as a natural expression of prevailing spiritual values and beliefs which are intimately related to the acknowledged cosmic order of the world" (Bianca, 2000:22). The complex urban structure and form in Old Rusafa have provided an example of how to create privacy and a healthy environment for its people, especially within the district society. This chapter has illustrated an understanding and an assessment of the main components and existing physical condition of the historic centre of Baghdad. It also has clarified that the narrow alley together with the hierarchy of the traditional Baghdadi house provides for a series of thresholds of security, mainly visual security between spaces. Old Rusafa includes some significant buildings, mosques, traditional suqs and private houses that emphasise the urban fabric identity and its urban form. Therefore, for a future vision, a considerable effort is required in the traditional

centre to regenerate urban heritage form under the light of the new principles of contemporary design models.

We will evaluate in the next chapter the pertinent principles of urban conservation in historic cities, and we will assess the role of historic preservation of Baghdad urban fabric by using Cohen's tools and methods from his book *Urban Conservation* to save the structure and heritage of cities and to promote local and place identities.

CHAPTER 3: URBAN HERITAGE AND CONSERVATION

3 Introduction

This chapter aims to build a theoretical background about urban heritage context, conservation, and urban conservation. It investigates the relevant principles of urban preservation in historic cities and assesses the role of historic preservation of Baghdad urban fabric by using Cohen's tools and methods from his book *Urban Conservation* to preserve the structure and history of cities and to promote local and place identities. Then this section reviews the physical and social conditions of Baghdad and examines the contemporary situation of heritage and conservation there. The final aspect of this chapter proposes how to revitalise urban heritage in Old Rusafa regarding its urban pattern, network and fabric. This section will seek to address the study aim three and question one-part B and C (page 2).

Baghdad, one of the leading cultural centres in the Middle East has been a centre of political and economic operations since it was chosen by Caliph Al-Mansur to be his capital city for the Abbasid Empire in 762 CE. Up to the 21st century, the city has been occupied many times by different groups such as the Ottomans (1638-1917), the British (1917-1932) and the Americans (2003) who have all left their marks in varying degrees. The historic quarter of Old Rusafa is one of the areas of the city where historic buildings going back to the early 13th century have resisted the power of transformation, such as Al Mustansiryia School, the Abbasid palace, and Al Khulafa Mosque. This chapter will address how the traditional compact urban fabric in Old Rusafa has witnessed irreparable damage because of wars, a weak definition of demands and an ambiguous formulation of what to preserve. These are some of the reasons that the majority of urban conservation plans prepared by different groups for the city centre have not been successful. This part will address revitalising urban heritage in Old Rusafa as an example of preserving the urban system and its components in historic cities. It will also argue the significance of maintaining these historic places and how to promote socio-economic and sustainability aspects. Finally, preserving traditional areas will require implementing efficient and sustainable urban development strategies that drive urban evolution and encourage revitalisation of the historic centre.

3.1 Urban Heritage context

Urban heritage involves a vast set of noticeable and unnoticeable aspects, which include archaeological sites, ancient monuments, individual buildings or groups, streets and ways connecting those groups, and places surrounded by buildings (Daher, 1996). Due to these aspects, we cannot narrow down the urban heritage to monuments of historical interest or individual buildings. Urban heritage exists in the physical features of buildings, public spaces, and urban morphology. Thus, a better understanding of urban heritage will depend on understanding both heritage context, and the categories of heritage values derived from modernity. Let us define what heritage is:

Heritage was defined by ICOMOS as “the combined creations and products of nature and of man, in their entirety that make up the environment in which we live in space and time. Heritage is a reality, a possession of the community, and a rich inheritance that may be passed on, which invites our recognition and our participation” (ICOMOS, 1982).

Heritage Canada Foundation has defined the term heritage area as “A synonym for a designated historic district or conservation area, which denotes a neighbourhood unified by a similar use, architectural style and/or historical development” (HCF, 1983). Urban conservation offers a sustainable solution to the social and economic problems and also will promote the historic environment, create new opportunities bringing new life to run-down areas (EH, 2004).

Everard and Pickard, (1997) mention that “the built heritage provides us with a sense of place and personal identity, and a source of pride, which is of greater importance than its real estate value. They suggest that “the 'psychological and aesthetic value' of the conserved environment is so important that knowledge of peoples' conscious or subconscious commitment to buildings from the past should play a crucial part in the development of conservation policy and practice”. They add that heritage has a wide range of values: aesthetic value; value for architectural, environmental, and functional diversity; value for cultural memory or heritage; resource value; as well as an economic and commercial value. Furthermore, Everard and Pickard said, “There may be "multi-faceted outcomes of conserving the cultural built heritage' regarding the dynamic benefits to

society" which means that "the cultural heritage as an economic, tourist, scientific, educational and sustainable asset which needs to be protected by the commitment of the whole community through partnership of public and private sectors" (Everard and Pickard, 1997).

Since policymakers and urban authorities have turned to 'culture' as an instrument for urban regeneration, the importance of historic environments has become increasingly evident as part of urban regenerative initiatives (Pendlebury, 2002). At the same time, "conservation initiatives try to enhance strategies which not only ensure the continuing contribution of heritage to the present and the future through the thoughtful and intelligent management of change responsive to the historic environment and collective needs, but also the preservation of fundamental elements of social environments. Such strategies will lead to more equitable and sustainable solutions to the problems currently faced by the historic quarters" (Akkar Ercan, 2011).

Girard, (2013) argues, "city/heritage capital has been recognized as the starting point to increase economic prosperity, environmental quality and social conviviality, since conservation of cultural heritage has been regarded as a productive activity. City history, memory and identity have been conserved in a creative way, combining conservation with innovations, past and present, present and future, within a circular process". He adds, "Cultural heritage is a key component of the city system: it should be viewed as a dynamic adaptive subsystem that evolves over time (with changes) under the pressure of many different forces (due to economic growth, market pressures, decline, and regeneration processes), while still maintaining its identity, integrity and continuity". He suggests, "cultural heritage conservation and management should be characterized by a dynamic perspective, characterized by synergies, circular processes and creativity" (Girard, 2013).

To sum up, the previous studies have illustrated a partial vision for dealing with the assets of urban heritage and their relationship with environmental, social and economic issues, especially in an age of contemporary transformations. Therefore, an evaluation of urban heritage conservation under the light of the new principles of smart and sustainable design is required to regenerate urban form and fabric.

3.2 Conservation in the Urban Context

3.2.1 Conservation

Substantial changes in the urbanised world have led to the formation of architectural and urban conservation. Cultural signs of the communities are represented by the city and its architectural elements. Conservation was defined "in preserving and maintaining the frame and concrete architectural structure; however, the growth of awareness alongside attention to other aspects caused different aspects to be effective in recognizing and evaluating the values" (Ebrahimi, 2015). In addition, it "is the action was taken to prevent decay and manage change dynamically. It embraces all acts that prolong the life of our cultural and natural heritage" (Ardakani and Oloonabadi, 2011). Conservation policies and measures have changed due to the alteration in the principles of urban conservation. Peerapun has stated according to ICOMOS that coherent strategies of socio-economic development and urban planning at every scale should be an integral aspect of the conservation of historic urban areas. He has added that one of the essential element for the success of conservation programs is public participation (Peerapun, 2012). Conservation aims to be a part of broad procedures for promoting the existing physical built environment and affects all citizens of a community. Glendinning argues that architectural conservation is something that embraces different forms and subjects such as urban design, housing, environmental issues and renewal (Glendinning, 2013:1).

The past century has been one of unprecedented change regarding the impact on the urban environment. Globalization, rapid uncontrolled development, demographic changes, and economic pressures are the main factors driving change in the urban environment, which directly influences the preservation of historic urban environments. The issue of conservation of historic urban areas was seen in a new light in the late 1980s, partly due to the growing concern for the environment and situations of poverty in many countries, in part because of the significant natural political changes, disasters, and armed conflicts (Assi, 2002). Many challenges emerge in the conservation of built heritage, but the main one is the original uses can be changed while preserving the importance of the area and its buildings (Hiu and Hon, 2012).

3.2.2 Urban Conservation

Puren and Jordaan (2014) mention that the number of urban citizens will rise to more than 60% of the world population by 2030. Such growing will lead to increased development pressure in urban areas to provide housing, infrastructure, facilities, and increasing living standards for residents. As a result, historical cities and built heritage resources are especially at risk in responding to modern commercial forces. The loss of value is irreversible if these areas and resources are destroyed. Puren and Jordaan said that "Conservation of heritage resources is often linked with sustainable development and increased economic investment. They argue that "preservation costs of built heritage resources are high, as this must be done using skilled labour and scarce or costly building materials. Integrating built heritage into the existing urban fabric and future development of cities in such a way that its contemporary use can support its continued existence may be a step in the direction of a more sustainable approach to urban conservation compared to previous preservationist approaches and more appropriate for developing countries". Puren and Jordaan, suggest that "a shift in how urban conservation is viewed in the sense that it should move from preserving heritage resources as isolated objects towards a more integrated view where heritage resources are proactively integrated into the contemporary uses and future development of cities to ensure the continued existence of these assets. In addition, they emphasise that "the proactive role of urban planning in combining the past with contemporary use and possible levels of integrating urban conservation and urban development. They also write, "A balanced approach to integration is suggested that implies integrating built heritage into the current urban milieu so as to fulfil current needs (e.g. social, cultural and economic needs), without actually destroying or indelibly altering it in a negative manner" (Puren and Jordaan, 2014).

Improving the quality of urban areas in recent years has become a response to the challenges displayed by citizen's mobility, which require the physical renewal of declining inner urban spaces in a flexible way. Cities show endless examples of neglect that manifests high rates of decline in their urban fabric. These areas are widely connected with historical layers of urban change during which they have, over time, advanced declined and sometimes been renovated. The narrow alleys found in Cairo, London, Rome and Athens represent vibrant models of this. Various actions to conserve these fortunes were

framed in combinations of policies that have seen positive results in the recent years. During the 19th century the infrastructure of land uses, buildings and streets suffered from different issues typically linked with urbanisation, for instance, poverty, migration, overpopulation, unemployment and segregation (Selim, 2017:14,15).

The term "urban conservation" was utilized by The United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Global Heritage Fund to refer to protecting heritage buildings and cities. Albrecht has stated that "urban conservation" was used by others more broadly to include environmental factors as well as socio-physical and socio-cultural issues. Moreover, he defined urban conservation as "protecting and managing the valuable ecological spaces and species in and around cities, as well as the ecosystem services that they provide" (Albrecht, 2013).

Urban conservation, as Cohen (1999) points out, is a cultural necessity "due to the increasing tendency of city dwellers to move back into historical centres, urban conservation is becoming an ever more urgent issue" (N. Cohen, 1999:9). He argues that people interests in dwelling in historic city centres not only due to socioeconomic factors but also to different activities and the various cultural and urban strata (N. Cohen, 1999:13). Pendlebury and Strange asserted that the power in shaping the planning of the contemporary city is the practice of conservation of the historic environment (Pendlebury and Strange, 2011). Su has stated that over the last three decades urban conservation has become a substantial element to promote urban competitiveness in the global economy (Su, 2010). Thus, "conservation, on an urban scale, is concerned with the urban fabric as a whole and not with architecture alone. The successful conservation project will make use of quantitative analyses and will be aided by comparative and economic studies" (N. Cohen, 1999:13).

Girard, (2013) asserted, "Conserving "places" in a productive perspective has been interpreted as a valorisation process, creating an added value (regarding use values, social values, symbolic values, market values) through circularisation and synergies. In the new "circular" heritage economy, import capability (attractiveness for tourists, visitors, talents, capitals) and export capability (handicraft products, arts, local identity products, knowledge products) are integrated into wealth-creating processes. Re-use, restoration and

regeneration of materials stimulate circular processes. Cultural heritage is often considered as the incubator of new creative activities, which are usually found in cultural districts". He assrts, "conservation of cultural heritage can play a key role in promoting a circularisation of city processes, and thus in enhancing the cities' resilience and creativity". He debates, "The success of integrated conservation (in terms of resilience, creativity and sustainability) can be measured by the density of circular processes and synergies that have been activated in a specific area/territory" (table 3.1). He concludes, "The conservation-recreation interface of urban cultural heritage contributes to resilience and prosperity, insofar as it stimulates cultural identity and the sense of place. In turn, enhancing the urban cultural landscape through planning/design promotes the general milieu that stimulates urban creativity" (Girard, 2013).

The fundamental features of cities demand tangible conservation of its urban fabric to create an appropriate characteristic. One of The primary purposes of urban preservation is to promote the historical physical environment and ensure its continuity as an attractive place to live. In fact, urban conservation has become a policy of redevelopment places and socio-economic advancement in various cities in the world such as Johannesburg in South Africa, Penang in Malaysia, Singapore, and Hong Kong (Su, 2010). Therefore, urban conservation will require comprehensive spatial analyses and investigations devoted to the evaluation of historic urban areas (Koramaz and Gulersoy, 2011).

		Quantitative/Qualitative Impacts		
		Economic	**Ecologic**	**Social**
Integrated conservation contribution to the city	**Creativity**	Heritage conservation has been interpreted as *recreation* of places, by *innovative* activities/ processes. They have guaranteed the financial investments payback and stimulated new investments in *circular* perspective, attracting *creative* entrepreneurs and increasing local productivity	The introduction of *green technology* in heritage conservation: • has reduced the ecological load • has stimulated new economic processes based on circular loops	• *Innovative* management models able to link build cultural heritage to people/inhabitants, …promoting community through circular relationships • Interactive creativity processes through strong participation
	Resilience	A local economy based on *short loops* between production and consumption on the use of local resources, can become more resilient to facing globalized economy stresses. Valorization of local diversities increases resilience	Reuse, recycling, restoration and regeneration of natural materials contribute to: • co-evolution of urban and ecological systems • city mitigation and adaptation plans • circularization of processes	• Through valorization of the quality of the physical environment the *places* attractiveness is increased, and the competitiveness, with positive outcomes for jobs, wealth production and distribution, reducing poverty and reinforcing social bonds with circular relationships
	Sustainability	Regeneration of historic districts has valorized resources of places (history and geography) characterized by specific identity and has attracted people and investment, and stimulating local entrepreneurship has increased the capacity to export new quality goods services, in a *circular/synergistic* process	Reduction of natural resources and fossil energy to satisfy human need has contributed to: • the health of the ecosystem and to human health • quality of life • urban synergies based on circularization/relationships/connections	• Places regeneration can be considered as the entrance point towards self-organization of the district • Common resources management stimulates the *self-management* potential of local communities towards a self-sustainable model that is characterized by itself by circular relational dense relationships

Table 3.1: The Role of Cultural Heritage-Integrated Conservation, Towards Circularization and Synergies
Source: (Girard, 2013)

3.2.3 Urban Conservation and Islamic Society

Jokilehto, (1999) states that "the modern sense of historicity is one of the basic factors leading to the development of the modern conservation movement". Maintenance and repair of community properties are one of the traditional systems that had been used by Islamic society, and this was established within a kind of endowment called *waqf*, this system was because of the relation of Islamic philosophy to equity. The *waqf* system depends on voluntary contributions to administer properties such as public and social services, mosques, caravanserais, and schools. This system has continued until modern ages in many Islamic countries such as Iraq, Morocco, and Egypt and guaranteed repair of traditional buildings and prevented the division of larger properties between several

inheritors, and has led to the ground for common social responsibility (Jokilehto, 1999:12,13).

In recent years, governments, practitioners, experts, academics, and international organisations have considered urban heritage as urban areas rather than single monuments. They moved toward utilising citizen participation to preserve, manage and control urban conservation plans. The traditional urban fabric in historic cities of developing countries suffers from similar cases. Firstly, they are currently facing a fast population growth, poor infrastructure, and demolition of urban heritage. Secondly and most importantly, they ignore the significance of citizen participation and opinion as an essential element to resolve problems that might appear in the decision- making and policy-making process. The bottom-up approach has become a crucial factor in cultural heritage issues creating new opportunities for citizens' participation in the decision-making process of urban conservation. Sarvarzadeh and Abidin point out that citizen participation can improve the practice of urban preservation and assist policymakers in identifying opportunities and challenges (Sarvarzadeh and Abidin, 2012).

The sustainable future of heritage properties is facing two significant issues among stakeholders, the shortage of knowledge and lack of interest. Stakeholders were expected to have diverse knowledge and experience, and interest in, cultural heritage resources. However, Alsalloum points out that governments and professionals considered citizen's participation in forming and responding to the social needs of societies. He discovered that 61 document confirmed the significance of promoting the awareness of local communities to involve them in different conservation procedures (table 3.2). ICOMOS, the Council of Europe and UNESCO, published the majority of these documents and emphasised the need to involve both experts, and citizens in all steps of managing tradition properties were underlined. "The conservation of the architectural heritage, however, should not merely be a matter for experts. The support of public opinion is essential. The population, on the basis of full and objective information, should take a real part in every stage of the work, from the drawing up of inventories to the preparation of decisions" (Alsalloum, 2011).

Returning to traditional social values and enhancing the concept of identity is a tendency nowadays in Old Rusafa. The historic centre is represented by the critical role of culture,

religion, and the most significant element social structure. The physical and social situation are depressed in this traditional area but it is still the source of cultural inspiration for citizens, and people still prefer to go back and live in the traditional neighbourhoods where they grew up. This area has community representatives who could participate and promote conservation processes more than the official administrative body in such areas (Al-Akkam, 2013a). Pieri argued that the issues in Baghdad city make it more difficult to formulate a plan of urban modernity that is consistent, specific and unanimously accepted. She mentioned, "The best solutions must be pragmatic. It is important to create a preliminary dialogue between the city's residents and urban planning experts". Pieri added "in the case of Baghdad, a city in which there were so many urban and architectural additions throughout the twentieth century, preserving a "continuity" does not only imply the formal level, but also the practical appropriation of the urban space. Baghdad's renaissance should not depend on arbitrary external criteria deciding what is beautiful or ugly, good or bad, but on a cautious analysis of the physical needs and the mental representations of its inhabitants, balancing between objective, subjective and even symbolic data" (Pieri, 2014). Girard, (2013) points out, "The consequences of the interpretation of cultural heritage as a subsystem of a city's complex dynamic and adaptive system is that cultural heritage should evolve with society, reflecting its changes, adapting itself to the new needs of inhabitants, in a circular way" (Girard, 2013).

Organizations	Number of documents	Years
UNESCO	13	1966, 1976, 1999, 2001, 2002, 2003, 2005, 2006, 2008
ICOMOS	17	1967, 1968, 1974, 1975, 1983, 1987, 1996, 1998, 1999, 2005, 2008
Council of Europe	17	1975, 1985, 1986, 1987, 1989, 1990, 1991, 1995, 1996, 1997, 1998, 2000, 2003, 2005, 2006
OWHC	4	1993, 1997, 1999, 2003
ICCROM	1	1998
CIAV & ICOMOS	1	1999
EUCTP	1	2003
INTBAU	1	2007
Europa Nostra	4	2006, 2008, 2009
ICATHM	1	1931
International Symposium	1	1975
Total	**61**	**From 1931 to 2009**

Table 3.2: 61 Documents Showing The Significance of Involving Local Societies In Different Conservation Procedures
Source: (Alsalloum, 2011).

3.2.4 Urban Conservation and Economics

Economics is the most crucial element that might enhance and encourage governments to plan a new strategy for developing the traditional cores in historic cities. The majority of historic centres in Iraq are concentrations of local industries that are the primary source of traditional and cultural goods and services, not only for local residents but also for visitors and the whole population in the country. Conservation of historic areas can motivate these traditional industries, generating incomes and employment for local citizens and businesses. This will lead to increasing the rate of internal and external tourism that might be one of the fundamental elements of significant revenue; tourists are usually attracted by the traditional areas that represent cultural identity. This will form a new and essential commercial space for the traditional products of the city. If these historic centres are ignored or demolished, we will lose these advantages (Throsby, 2014).

Yung and Chan argued, "Conservation of historic buildings and places contributes to a higher degree of creativity and economic development as well as a better quality of life and the social well-being of different groups. However, a key issue in heritage conservation is the use of the heritage and its vital interface with both culture and identity" (Hiu and Hon, 2012). Cohen points out that the urban economic dimension is an essential element in conservation. "One element that should be included is an appraisal table. In preservation, all financial issues and figures used are relative, varying according to the specific instance at hand. Without a financial benchmark (land and building values), the data is unmanageable, and recommendations on a large scale cannot be made. This background material will be reworked, highlighting the potential components of preservation. This preliminary survey illustrates the size and the scope of the problem. Only after this step is complete, will the concept of conservation be clear. With a clear understanding of the issues, it will be possible to move to the next phase" (N. Cohen, 1999:59). Old Rusafa has strong economic bases and contains many significant commercial markets such as Shorja Suq which has a national role. This area is considered as the main business centre of Baghdad and showed the characteristic division of trade, goods, and crafts (figure 3.1).

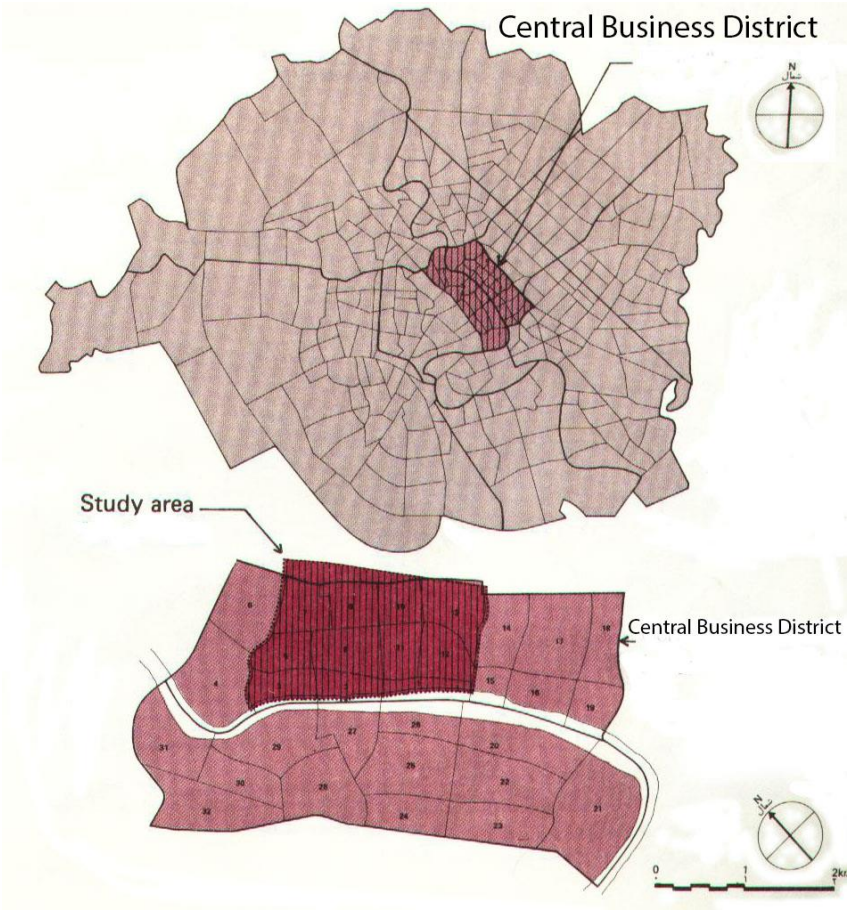


Figure 3.1: Old Rusafa as Part of The Central Business District in Baghdad (CBD)
Source: (JCP, 1984).

These markets or suqs are located in a particular place that is usually connected with its adjacent specialised suq. Sarai Suq, for example, is close to Mutanabi Street, the first one specialises in books and stationery, and the second specialises in print works, libraries and book storage (figure 3.2 A&B). A second example is Sarafin Suq, which is occupied by moneylenders and exchange, this suq is just located near a new street of the banks. Furniture, car repair, metalworking, and textiles are the significant industries in Old Rusafa. Various challenges and problems have faced the national economy such as war, no access to adequate private investment and lack of official promotion of widespread interest in urban conservation. In addition, the land around the commercial centre has witnessed an increase in its price, and the costs of materials and high standards of craftsmanship that are needed to preserve this area are prohibitive (Al-Akkam, 2013a).

Figure 3.2 A: Sarai Suq Figure 3.2 B: Mutanabi Street.
Figure 3.2 A & B: Sarai Suq Specializes in Books and Stationery, Mutanabi Street Specializes in Print Works, Libraries and Book Storage.
Source: Author 2016

3.2.5 Urban Conservation and Sustainability

In the last few years, these has been much research on the urban conservation of traditional areas. The consequences of this literature have endeavoured to find a connection between urban maintenance and the ability of cities to transform to sustainable future. Shwartz et al. (2014) Clarify that "Researchers, advocates, and policymakers have proposed urban conservation as an emerging, integrative discipline that can contribute to sustainable cities by delivering co-benefits to human and non-human components of biodiversity" (Shwartz et al., 2014).

The beginning of arranged international initiatives to combine both sustainability and conservation was in 1972 by United Nations (UN) and UNESCO. These actions did not emphasise the words sustainability and maintenance at that time; the emphasis was on environment and protection. Rodwell states that UNESCO adopted conservation and the UN adopted sustainability (Rodwell, 2008:64). He mentions, "In the broader, ecological sense, conservation and sustainability share the same generative basis as the mainstream of modern town planning, namely, the forces unleashed by the Industrial Revolution and the associated serious environmental consequences of the loss of equilibrium between the

human and natural worlds" (Rodwell, 2008:47). Auclair and Fairclough point out that "heritage is a central thread of sustainability, not only as an issue of preservation but of creation, adaptation, and resilience to change. Indeed, it is widely claimed, but not always accepted, that preserving historic buildings is inherently sustainable because it retains embodied energies and minimises the consumption of new energy and raw materials" (Auclair and Fairclough, 2015:6).

The urban environment has been faced with an unprecedented change in the last century. Many elements are leading change in the urban environment such as demographic changes, globalisation, uncontrolled development as well as economics, which directly affected the conservation of historic urban environments (Paul, 2010). Therefore, conservation will offer sustainable solutions to many problems that afflict our historic cities such as the social and economic problems. "It stands in the vanguard of social and economic policy, capable of reversing decay by injecting new life into a familiar area" (Al-Akkam, 2013a).

The essential objective for integrative urban conservation and regeneration planning is sustainable development, which should be expanded to contain diverse aspects of development (figure 3.3) (Peerapun, 2012). A sustainable city, as Rodwell identifies, is "one in which its people and businesses continuously endeavour to improve their natural, built and cultural environments at the neighbourhood and regional levels, while working in ways which always support the goal of global sustainable development". This illustrates the need to enhance a balanced relationship between a city and its region and the world's limited resources. He has added, one of the essential topics in today's corroboration of the sustainable city is that it is an achievable goal only on condition that we saw the city as an effective and complex ecosystem and control it as such (Rodwell, 2008:111).

Hiu and Hon state that "Built heritage is extremely difficult to survive in a city if they are not conserved in a sustainable way". To move to this stage, it demands the involvement of the environmental, social and economic issues in urban conservation to promote the quality of life for all citizens and to create a better place to live and work. Social equity, inclusiveness, and social action are consistent with the concerns of built heritage conservation as part of sustainable development (Hiu and Hon, 2012). Sustainable city planning is an essential issue in historic cities that seek to create livable places for public,

green areas and the perfect physical environment that is required for a better social life (Sinemillioglu et al., 2010). Heritage and sustainability in the 21st century share the broadest common base when both are considered, first as being ongoing processes rather than immediate end-products, and second as being people-centred (culturally as well as socially) rather than object-oriented (Auclair and Fairclough, 2015:20).

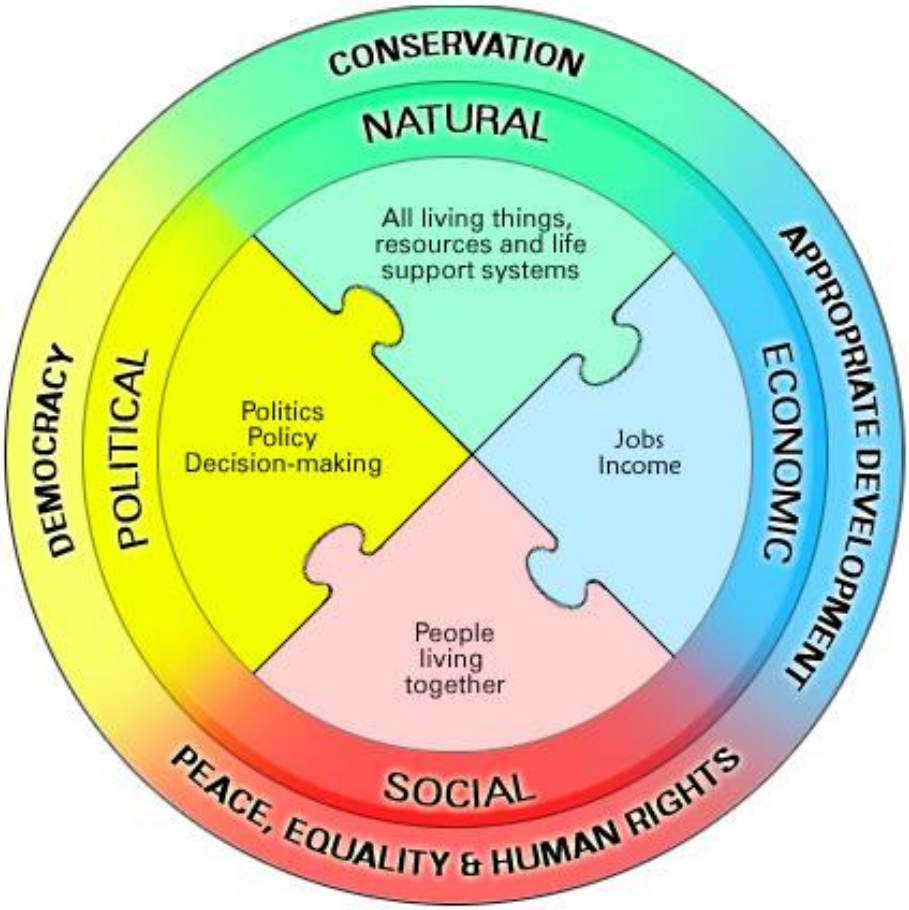


Figure 3.3: Four Dimensions of Sustainable Development (UNESCO, 2010). "The concept of sustainable development is widely accepted and expanded to include various dimensions of development. An interesting model developed by UNESCO (2005) comprises three stacked circles. The middle circle indicates the four dimensions of development – natural, economic, social, and political aspects. The inner circle indicates four major issues associated with the four aspects. The outer layer indicates four means of development – conservation, appropriate development, peace in combination with equity and human rights, and democracy" (Peerapun, 2012).

3.3 Urban Heritage Conservation in historic cities

In the Arab world, many countries have witnessed a dramatic, rapid urban evolution after gaining independence in the 1950s and 1960s. Boussaa (2017) argues, “The Islamic urban centres, which formed the central parts of these cities, witnessed continuous pressures of redevelopment and destruction. A large number of these centres with rich urban and architectural values were often demolished and replaced by high-rise buildings”. He adds, “Following the period of development and rapid urbanisation, people started to realise that their cities have lost their identity and character in the mainstream of the globalisation trends. The historic centres and urban cores, which escaped complete demolition, have survived as isolated pockets in the middle of hybrid environments”. He debates that “these historic centres used to keep the city alive and participated in its economic growth. Today, it is rarely the case; many of these old cores have been marginalised and left to face their fate of neglect and disrepair. With land values rising, the owners of these historic centres were pressurised by land developers to tear them off for massive redevelopment projects, which would bring more financial revenues”. Moreover, he states, “the viability of a historic centre depends on how its position, function and values can be sustained within the emerging global environments, particularly concerning modern districts. Central cores were attractive because they provided a diversity of services within a small area, and within easy reach by pedestrians” (Boussaa, 2017).

In the last five decades, various projects, research, and proposals have been produced to preserve historic cities in the world and especially in the Arab world. Cultural heritage has contributed to promoting the economic, social and cultural life of cities in the developing countries. We can find the heritage in the historic core of alleys and traditional buildings that have resisted the power of modernism. The significance of preserving these iconic historic buildings and areas is to obtain economic, social and cultural goals. The population growth and urban expansion in countries of the Third World present a serious threat to their urban heritage. Hence, policymakers, architects, and urban designers require creating a new approach that connects the architectural and cultural functions of heritage in the urban spaces. In several historic cities in developing countries, the long-term methods of urban evolution have by passed centres where alleys, patterns, urban fabric, social and heritage activities have been kept unchanged for many centuries. Throsby points out,

"creative activity in the past has generated the urban heritage we utilise today, and creativity is required in integrating the management of that heritage with the production of contemporary culture for the benefit of future generations" (Throsby, 2014).

Bianca argued that the Industrial Age has affected the dynamics of the socio-economic issues and has helped them to find their physical term in the substantial transformation of historic cities, while changes in the architectural fabric through former centuries, had usually happened as part of a natural evolutionary process (Bianca, 2000:174). Shin asserts that due to the increase of local entrepreneurialism, cities have employed different strategies to compete for increasingly footloose capital and citizens. Conservation of historic areas has played a fundamental role in promoting economic development in cities. Consequently, historic urban centre and plenty of significant monument and architectural heritage can be found and have gained renewed interests in the last decades for their socio-economic value (Shin, 2010).

Bianca points out that the process of the physical growth in most historic Muslim cities over the past eight decades was determined by the colonial powers in setting out their new modern area. Bianca debated the possible range of urban interventions which were defined by two extremes. "One consisted in superimposing the new city on the old historic fabric by cutting out large new roads and sites for major public buildings – an approach which entailed the progressive demolition of historic urban structures by the expanding new facilities. The other one consisted of setting up completely new colonial cities on virgin land, without seeking any interface with pre-existing urban structures" (Bianca, 2000:177).

Historic cities have transformed into paths of cultural activity by using appropriate urban conservation, which is not only preserving some significant building but is a compressive approach to protecting and conserving the whole historical urban structure. The diversity of urban layers in the historic cities are created by a web of buildings and streets from various durations of time. Geometry and systematic building are the elements that have led to the formation of the urban wave. The idea in designing spaces, house, mosques, and public building in Old Rusafa, is similar carpet weaving, "thus, the reinforcing the commonly used term urban fabric especially as used with respect to planning" (figure 3.4) (N. Cohen, 1999:9,11). Cohen described Babylon city as an example of the historical

conception of ancient cities, and in the 19th century was represented as romantic, symmetrical and very regular, nearly utopic. He mentioned that this concept had helped conventional European landscape and design attitudes. Similarly, with the round city, its concept despite the lack of physical remains has a mythical status which helped form the urban structure of Old Rusafa. “Study of the past must be more factual if it is to contribute to the new understanding of the urban structure” (figure 3.5 A&B) (N. Cohen, 1999:9).

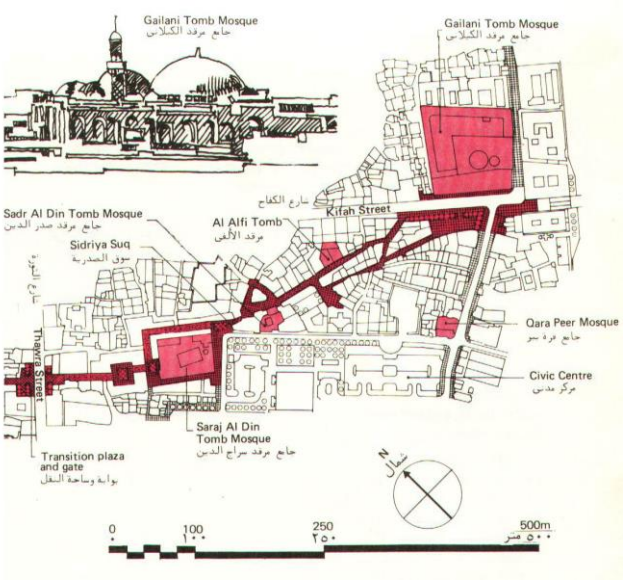


Figure 3.4: House, Mosques, and Public Building that Form Urban Fabric in Old Rusafa
Source: (JCP, 1984).

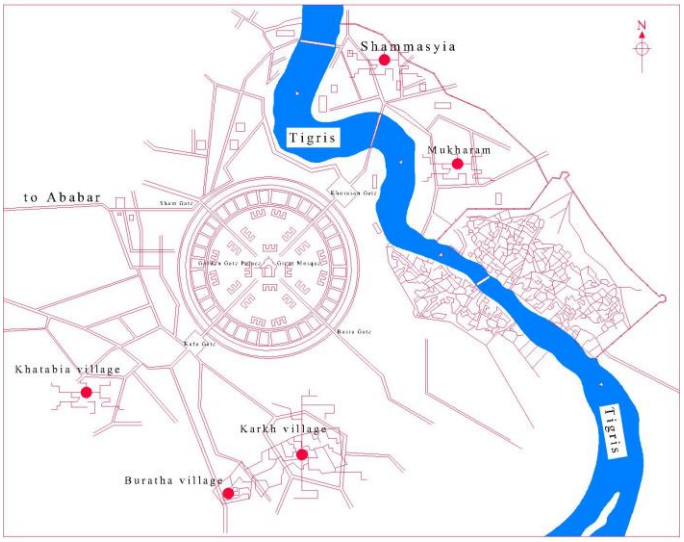


Figure 3.5 A: The Round City Helped Form Urban Structure of Old Rusafa
Source: Author 2016

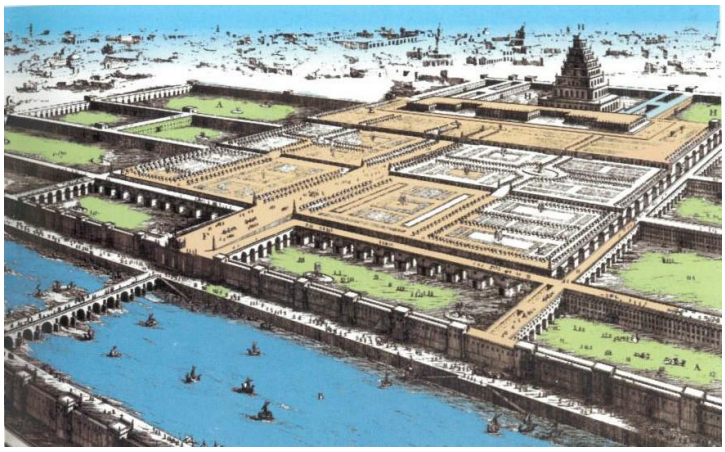


Figure 3.5 B: Babylon City as an example of Ancient Cities that Helped Form Conservational in European Landscape and Design Attitudes.
Source: (N. Cohen, 1999:9)

3.3.1 Urban Conservation and Planning in Old Rusafa

The Municipality of Baghdad lacks a clear vision and regulations regarding urban conservation, and this usually creates many obstacles when they want to prepare a plan for conserving traditional areas. The traditional urban fabric in Old Rusafa has witnessed an irreparable damage as a result of the weak definition of demands and an ambiguous formulation of what to preserve. This is one of the reasons that the majority of urban conservation plans prepared by different groups for the city centre have been not successful.

Cohen asserts how crucial it is to integrate between urban planning and conservation as a symbiosis, neither quite complete without the other, as by this integration one can promote the traditional areas with an improved life and preserve existing urban structure. In this aspect, he says, “Plans that do not integrate a solid legal foundation for reinforcing urban patterns with a clear vision of the future simply postpone problems of urban continuity. This is the reason for shifting the focus from individual buildings to a more general, contextual, collective and cultural outlook”. Furthermore, he showed how satellite would allow us to examine the range of urban sprawl and provide us with a clear vision for the way we look. By using this type of analysis in Old Rusafa, it will enable us to evaluate and understand the urban context that might guide urban designers as to how to integrate the new urban system into the old fabric. This type of anatomy according to Cohen will “take the place of maps and show truthfully the way we behave in our organisation of urban life” (figure 3.6) (N. Cohen, 1999:15).

To protect the historic part of Baghdad, the Municipality of Baghdad presented a study to develop Old Rusafa that showed many problems with the historic centre, such as the demolition of buildings and deterioration of the historic urban fabric. As a result, many initiatives were started by the Union of Architectural Heritage in 2010 to rescue Baghdad’s architectural heritage. This fact is confirmed by Al-Akkam, who says, “Unfortunately, however, all these projects focused on physical aesthetics and appearance and proposed either to demolish significant parts of the historic areas or to imitate the urban development of Western countries. These studies did not deal with the local community and tried to use the term “sustainability” as a label for propaganda and no more. These studies were vague

and did not follow a clear urban policy, or take into consideration public participation" (Al-Akkam, 2013a) (figure 3.7).

Figure 3.6: Old Rusafa from the space
Source: Author 2016 According to the Municipality of Baghdad

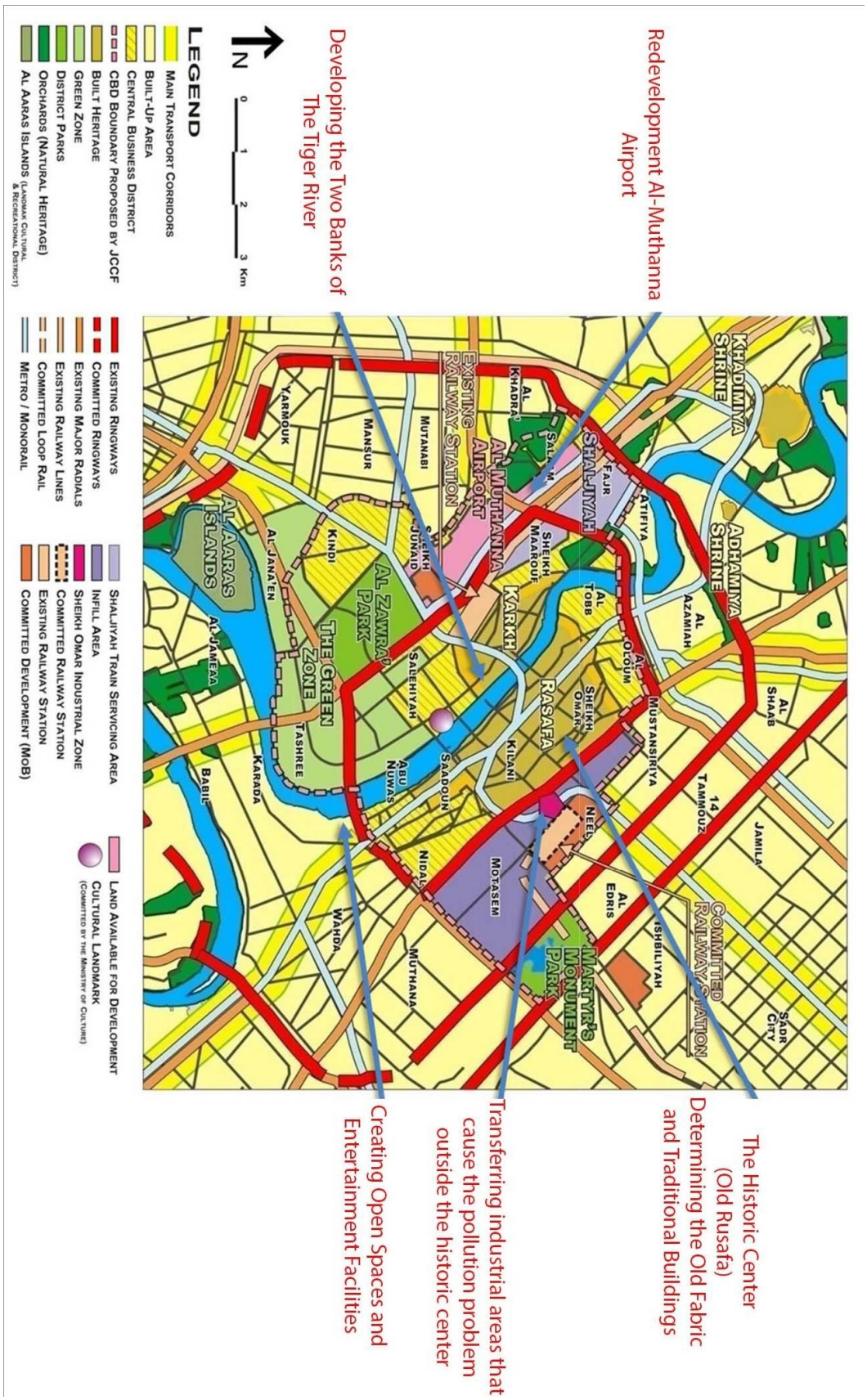


Figure 3.7: Short Term Development Strategy for the Central Business
Source: Author 2016 According to the Municipality of Baghdad

3.3.2 Revitalising Urban Heritage in Old Rusafa in Terms of its Urban Pattern, Urban Web and Urban Fabric.

During the last few decades, Rusafa has suffered damage both to its monuments and in broader areas, however, enough fabric remains to evoke its past grandeur. "The State of Iraq Cities Report (SICR) 2006-2007 reported that the structures of historic areas have been modified, with many buildings evolving toward commercial and government use. The city has many seriously deteriorated structures without infrastructure, leading to poor internal sanitation, drainage problems and effluences" (Al-Akkam, 2013a). The architectural heritage in Rusafa is mainly composed of dense traditional courtyard housing. The comprehensive surveys by JCP in 1984 showed that the historic area contained 3900 houses which mostly belong to the late 19th and early 20th centuries, 63 mosques, five tombs, six madrassas, 11 khans, six hammams, four churches, nine suqs, and 3gates. Of the listed 132 monuments in the old area of Rusafa, only 21 monuments belong to the Abbasid Empire (762-1258), while the majority are from the Ottoman Period (figure 3.8) (1638-1917).

Figure 3.8: The area of old Rusafa: Listed Fabrics to Be Conserved
Source: (JCP, 1984)

The beginning of the modernisation in Old Rusafa started in 1869 when the Ottoman demolished the old city walls that were built during the Seljuk rule (1052-1152 AD) and constructed the first residential extensions. The layout of the old city did not change much between the Seljuk period and the end of the 19th century. Many problems have led to the deterioration of the structures of the historic centre that were constructed of brick and timber and had to be rebuilt periodically, due to frequent flood damage and fire. One of the main problems was the opening of four essential roads (Al-Rasheed Street, Khulafa Street Kifah Street and Sheikh Omar Street) between 1914 and 1956 which linked the Northwest and the Southeast ends that dissected the continuous urban fabric into isolated fragments (figure 3.9). The second problem was the rehabilitation of the disrupted urban form on both sides of these new roads that were given over to wholesale redevelopment, vast areas of old urban fabric were demolished, and the rest of the traditional urban fabric was ignored. The method of transforming the city centre from the traditional to the modern was another problem, which was affected not only physically, but also socially, by the departure of the original people of Old Rusafa into new modern areas. A new community from rural areas in search of employment and a better life filled the social vacuum in the old city by renting the traditional houses, usually one family per room. Furthermore, property owners were not interested anymore in preserving their properties. These circumstances have led to an acceleration of the physical deterioration. Bianca argued that the traditional urban fabric required a new scheme to solve the broken structure of the urban system, before producing a comprehensive plan for the historic centre that might propose a total redevelopment including the conservation of a few isolated historical buildings. He also suggested relinking the current components of the urban system to integrate the remains of the traditional urban fabric and precious urban characteristics (Bianca, 2000:250-256). Therefore, to create an efficient urban conservation in Old Rusafa, we should consider and improve all socio-economic issues, and produce a holistic approach to revitalizing urban components of the urban system in the city centre of Baghdad.

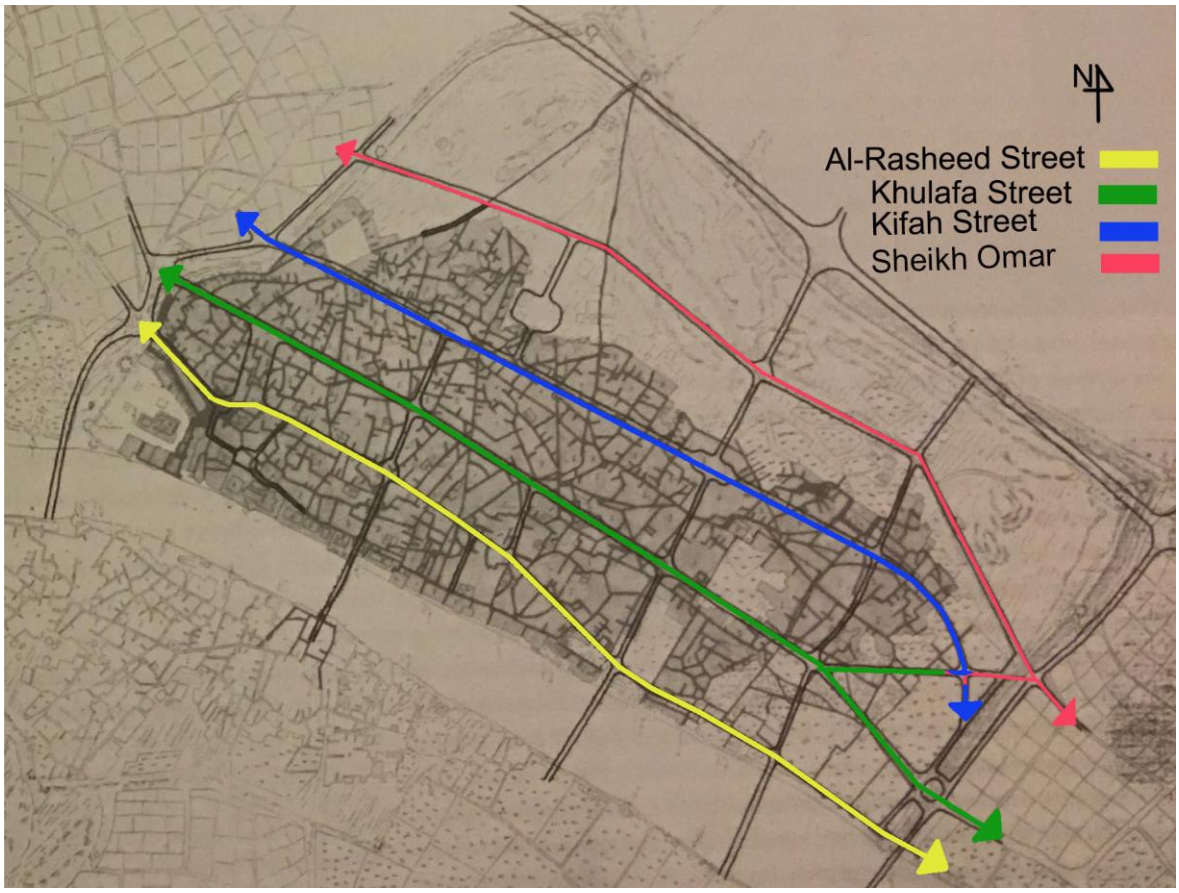


Figure 3.9: Old Rusafa from 1854, Overlapped with the New Urban System
Source: Author 2018 According to (Bianca, 2000:251)

3.3.2.1 Urban Pattern

Population growth is the main reason for current urban development in various urban areas worldwide resulting in a reduced quality of urban patterns and the quality of life of the urban resident. In other words, the lack of quality of urban patterns will result in a reduction in the quality of life of the urban resident. Hence, enormous efforts are made to evolve new procedures for improving the socio-economic and environmental condition that might transform current urban patterns toward a higher quality. Wissen Hayek et al., says, "Urban areas are highly interlinked systems with human agencies and urban patterns, both affecting socio-economic and ecological processes at various spatial scales" (Wissen Hayek et al., 2015).

Cohen points out that the best urban pattern should have the basis for sustainable life, and to encourage the present towards self-preservation, without ignoring the new one, should

implement a few general conditions. First one must consider the idea of the whole with the size and the character of the city. This method will clarify the structure and allow us to make decisions more quickly and control the nonessential mistakes. In this case, the new pattern will have the ability to accommodate itself in a well-identified framework with the past. The second one should determine the fundamental elements that constitute urban patterns including building style and spaces that define human actions in such area. Lastly, the main components in the urban fabric should have the capability to affect local elements to improve relationships and overcome that is usually detrimental (N. Cohen, 1999:19).

In the past decades, Baghdad city has experienced hugely significant changes in its appearance and urban patterns. Many new buildings and modern road facilities were built in the historic city centre. The new type of urban area and modernism movements have affected the identity of the existing traditional urban fabric, which has led to the creation of a new urban pattern within the old one (Figure 3.10). Al-Hasani argued that the conflict between various patterns could be solved by defining the area between them and develop it in a better way to use it between diverse users and functions. He also debated, “The self-organised urban form was interrupted by a planned and planted one. The result was two different space languages competing against each other. Those new added urban elements have created an interrupted urban pattern, which was so far from having continuity, coherence, and integrity with the surroundings. The quality, use and nature of the urban space in Baghdad is based on different spatial concepts, urban patterns and building typologies” (Al-Hasani, 2012). However, the historic urban area has a highly mixed land use pattern and still contains many essential features from the past, represents not only the concentrated residential area but also the commercial, political, and cultural centre of Baghdad city.

Figure 3.10: The New Urban Pattern within the Old Fabric (Old Rusafa)
Source: Author 2016 and (JCP, 1984)

3.3.2.2 Urban Web

Cities are built on and consist of various webs that have similarity in its structure and are integrated; however, some of these webs are entirely different. Webs that form the city might contain multiple sections that allow us to compare them regarding its age, dimensions and types of formation, and furthermore, periods of its historical growth and importance (figure 3.11). Cohen argues that some of these webs may be the outcome of a primary grid that, through time, has evolved subdivisions and changed. He emphasises that urban webs are fundamental elements to clarify the physical characteristics of the particular area. Cohen also asserts that conservation should be determined by webs that are made up of diverse components. He added that identification of the space such as nodes, squares and the links connecting them within the urban web would also define the kind of conservation. Cohen indicates, "The urban web is a most general view of a settlement, but does not delve into the physical details. Through it, one can see the general properties, characteristics of urban axes and its diverse components, enabling the discovery of similarities between various cities" (N. Cohen, 1999:43,71,133).

Figure 3.11: Old Rusafa Contain Multiple Sections That allow us to Compare between Them in Terms of its Age, Dimensions, Types of Formation, and periods of its historical importance
Source: Author 2016

Urban webs consist of all components that form cities such as paths, roads, highways, open spaces, squares and green areas (figure 3.12). Salingaros has illustrated that "the urban web is a complex organising structure that exists primarily in the space between buildings. Each building encloses and shelters one or more human activity node. External nodes range from being exposed, to having various degrees of partial enclosure". The procedures that create urban webs could be summed up regarding the node, connection, and hierarchy. Nodes of human action (such as a park, store, home, work, restaurant, church etc.) are the basis of urban webs, and the interconnections of these nodes make up the web. Human action nodes and their connective processes are promoted by the city's elements both natural and architectural. Salingaros confirmed, "The web determines the spacing and plan of buildings, not vice versa. Nodes that are too far apart cannot be connected by a pedestrian path". He debates that the connections between nodes of the urban web have a complex method of organisation. These connections provide better accesses, various paths and get easily to any point. Moreover, the self-organisation of urban webs will produce an ordered hierarchy of connections on several various stages of scale. Salingaros emphasises this fact; he says "The organisation process follows a strict order: starting from the smallest scales (footpaths), and progressing up to the higher scales (roads of increasing capacity). If any connective level is missing, the web is pathological. A hierarchy can rarely be established all at once" (Salingaros, 1998).

Baghdad city contains a massive number of public and civic areas that have a traditional style. Urban webs in Old Rusafa could be classified into two main typologies based on the existing arrangement of urban components and the relationship between traditional and modern urban patterns. Traditional neighbourhoods are connected to each other through alleys and different type of open spaces like in many Islamic cities. The hierarchy in these areas still preserved a flexible transition character between the main urban components. Further, it has regulated a relationship which begins from the traditional Baghdadi house. The traditional type that represents the identity of the walled Islamic city and modern type have created new hybrid urban areas that have not the same kind of connection. Public areas and facilities inside traditional private areas represent these new hybrid urban spaces. The character of the historic centre has changed and has modified the new hierarchy of areas inside Old Rusafa. Al-Hasani asserts that "More transformation of private spaces into public ones has occurred. This type of space character was configured as a result of the

partial invasion of the modern urban pattern inside the historic one. After new building typologies and streets have interrupted the old traditional one, different topologies with variation in shape, nature, and use were established" (Al-Hasani, 2012).

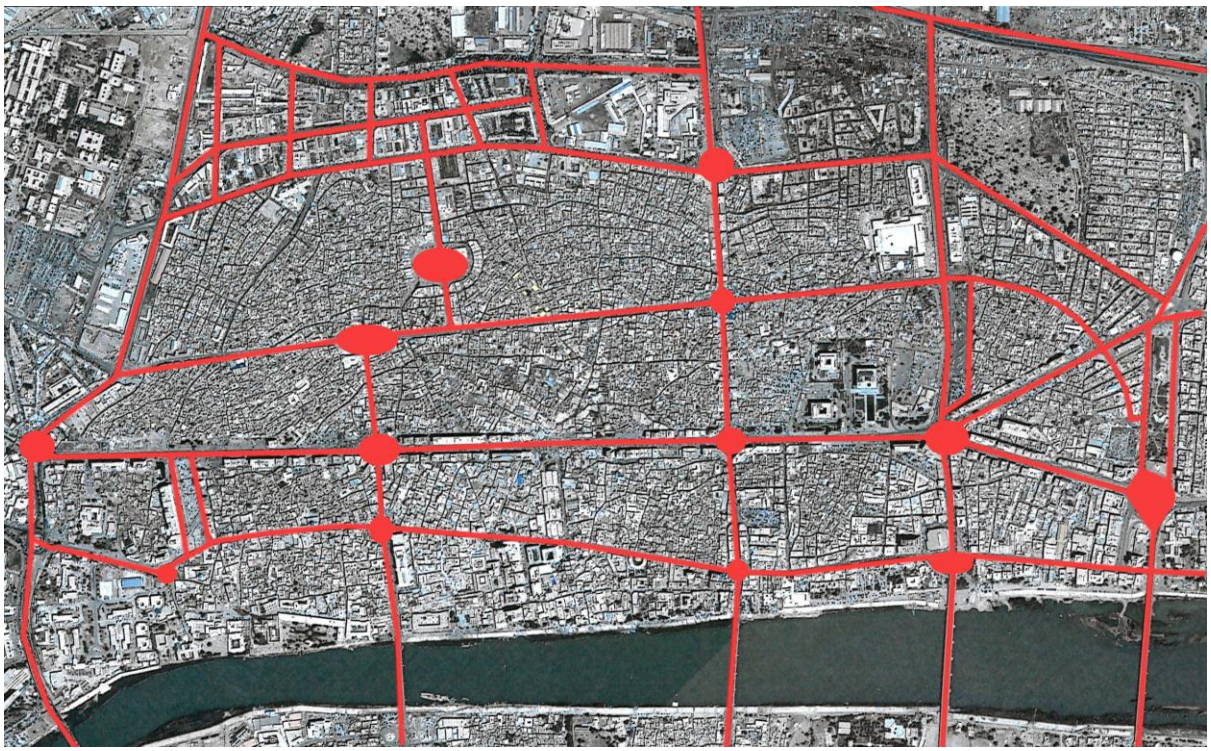


Figure 3.12: Urban webs in Old Rusaffa are consisted by all components that form cities such as paths, roads, highways, open spaces, and squires
Source: Author 2016

3.3.2.3 Urban Fabric

Old Rusafa is the historic centre of Baghdad city, and due to that, its fabric has been under pressure from modern development and has suffered tremendous losses in its traditional form. However, there is still an opportunity to preserve the rest of the unique fabric by promoting these areas with new facilities and fixing the broken structure. The historic center has witnessed some conservation by the Municipality of Baghdad in its fundamental buildings and street such as the Al-Mustansyria school, the Baghdadi Museum, Khan Marjan, Al-Rashid Street, the historic castle which is used as the Ministry of Defence, and many tombs, mosques, houses, cafes and squares (figure 3.13). Al-Akkam argued that we could not obtain the main aim of conservation without administration of the integration procedure between urban morphology and contemporary requirements (Al-Akkam, 2013a).

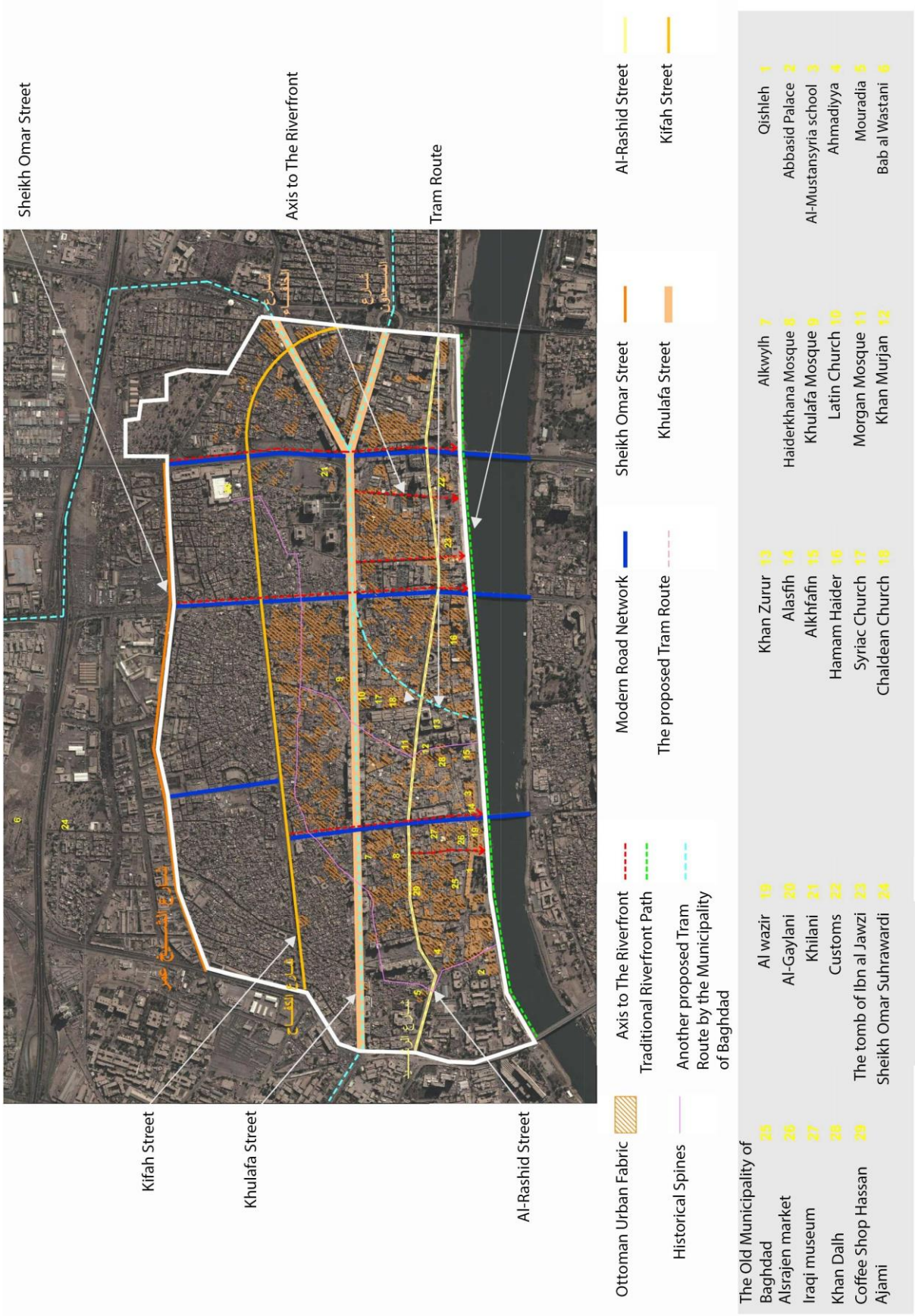


Figure 3.13: Urban Conservation Strategy in Old Rusaffa
Source: Author 2016 According to the Municipality of Baghdad

3.4 CONCLUSION

This chapter debates the literature review around the subjects of conservation in the urban context, urban maintenance and socio-economic and sustainability aspects. It has asserted that conserving historic centres are significant in protecting citiy identity, character and contributing to their economic development. The argument of this research concentrates on urban conservation and planning in Old Rusafa and indicates that the traditional urban fabric in Old Rusafa has witnessed irreparable damage because of the weak definition of demands and an ambiguous formulation of what to preserve. It has also indicated that the Municipality of Baghdad is suffering from lack of clear vision and regulations regarding urban conservation and this usually creates many obstacles when they want to prepare a plan for conserving traditional areas. As a result, the majority of urban conservation plans prepared by different groups for the city centre have been unsuccessful. Therefore, to create an effective urban conservation in Old Rusafa, we should enhance socio-economic, environmental aspects, and produce a comprehensive method to revitalising urban components of the urban system in the city centre of Baghdad.

CHAPTER 4: URBAN SUSTAINABILITY

4 Introduction

In the early 1970s, the notion of "sustainability" in its modern meaning emerged in response to a spectacular development in understanding that modern evolution practices were leading to worldwide environmental and social crises. Human societies have usually been concerned about environmental issues. For a thousand years, citizens have had to evolve their societies and livelihoods within the context of pre-existing ecosystems that have changed by the development of early civilizations. Wheeler has shown that "current sustainability debates are the modern version of age-old concerns about how to maintain human societies within the context of natural ecosystems" (Wheeler, 2013:25).

The United Nations Conference on Environment and Development through their Agenda 21 noticed that about 70% of the procedures required to implement sustainability needed to be accomplished locally (UNCHS, 1992). The fundamental questions remain as to what sustainability means and should deal with: is it about people, economy, city, culture, environment, politics, government etc.? In my point of view, sustainability is about all of these things and more.

Consequently, this chapter investigates the sustainability concept as a worldwide concern for the last decades, through debates on its definitions, aims, and dimensions. Then it concentrates on sustainable urbanism and explores various aspects that have a direct or indirect impact on the sustainable urban form by analysing a range of policy and strategies to achieve urban sustainability. It examines the principles of sustainable urbanism and investigates how to assess a sustainable city by discussing and giving examples of comparative analysis of some cities in using urban sustainability indicators. The primary aim of this section is defining sustainability, urban sustainability dimensions and their assessment that will cover the research gap and address the thesis aim two and question two-part A (page 3).

4.1 Sustainability

The concept of sustainability has become an essential concept in national and international discussions, which have attempted to identify the role of cities regarding modern concerns about the requirement to obtain environmental sustainability (World Commission on Environment and et al., 1987). Newman (1999) pointed out that "The sustainable cities movement seems united in its perception that the state of the environment demands action and that cities are an appropriate forum in which to act". He suggests that "all sustainability initiatives should be centred on strategies for designing, redesigning and building sustainable cities. From a global perspective, he suggests that cities shape the world and that we will never begin to implement the sustainability process unless we can relate it to cities" (Newman, 1999). Sustainability has been defined in various ways, with different criteria and emphases (Table 4.1).

	Definitions of Sustainability	Source
1	Sustainability has been defined as a global process of development that minimizes the effect on environmental sinks using processes that simultaneously promote the economy and the quality of life.	(World Commission on Environment and et al., 1987)
2	Sustainability as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.	(Cooper et al., 2009:8)
3	In practice, sustainability in the context of risk management could mean placing greater emphasis on integrating the profitable results of risk management with the standards of sustainable development of a given territory through a holistic perspective. It includes initiatives, which allow management activities to contribute to the minimization of risk losses, alleviation of poverty, enhancement of social equity as well as quality of life of people, growth of community engagement and involvement, maintain and improvement of natural resource base as a whole over long periods of time.	(Edjossan-Sossou et al., 2014)
4	Sustainability is dynamic methods rather than a constant approach, and it as a Meeting the needs of people now without devastating the life-supporting ecosystems for future generations.	(L. Huang et al., 2015)
5	Sustainability is a manifesto for destructive human activities: leave the world better than you found it, take no more than you need, try not to harm life or the environment, make amends if you do.	(T. Yigitcanlar et al., 2015)

6	Sustainability can be defined as the capacity to endure. It derived from Latin word where it means to hold. Sustainable referred as a management tool. It has predicted to be one of the best yardsticks to determine the well-being of a development.	(Ibrahim et al., 2015)
7		
	Sustainability is about improving the quality of life and maintaining our basics; it is not only about the integration of ecological, social, and economical issues. It is also about ensuring that the future generations will have an access to a quality of life at least equivalent to our current one.	(Naguib et al., 2016)

Table 4.1: Comparative Definitions of Sustainability
Source: Author 2016

Palacio (2015) argued that "Cities are complex systems and defining the urban qualities that foster sustainable societies can be an intricate task". He declares that modern cities are at the same time the place of economic production, social well-being, and environmental quality. He indicates that these three elements have been highlighted as key components of sustainability in the 'Action agenda for sustainable development' of the United Nations (Palacio, 2015). Jenks & Dempsey also confirm that a high quality of life for the whole society within a new socio-economic framework is the primary objective to achieve urban sustainability and reduce the impact of the city on the local and global environment. Therefore, our cities must tackle all the dimensions of sustainability such as the social, the environmental, and the economic (figure 4.1). The relationship between these three elements needs more research as one cannot exist without the others. Urban life, activities, and culture depend on their wider environment. Thus, the fundamental factor to achieve sustainable cities is to produce new active generations able to participate to make decisions and change the political structures. Jenks & Dempsey add that the strategies for the future form of cities that should be adopted in a global economy and information age are still being debated (M. Jenks and Dempsey, 2005:24,28).

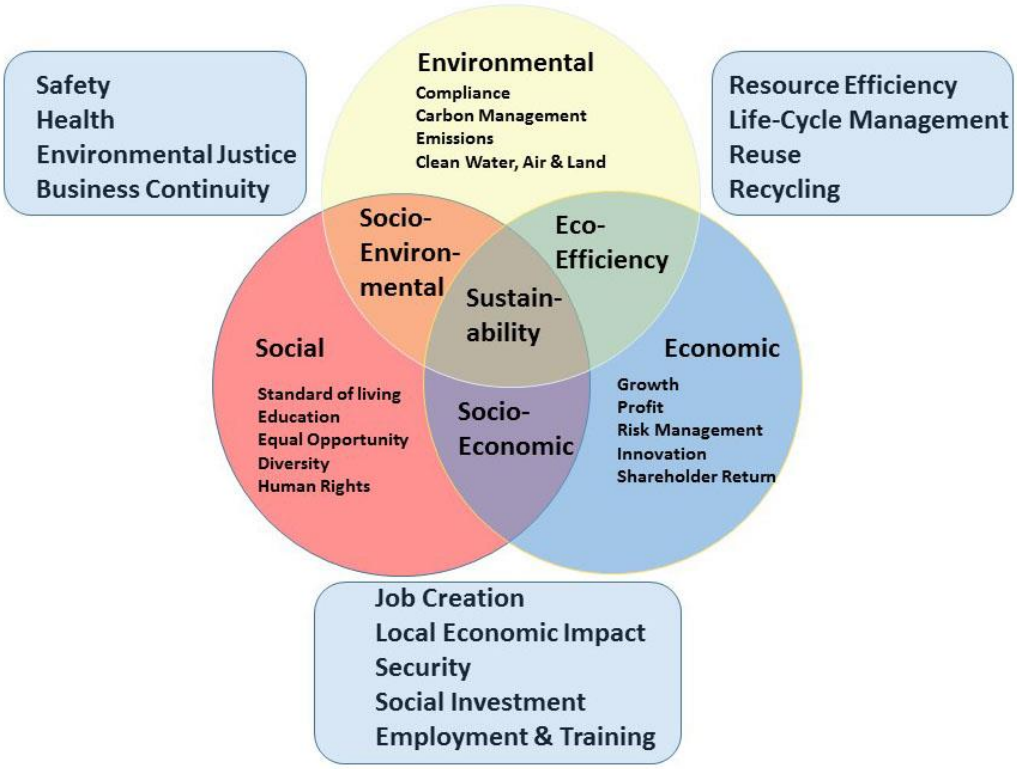


Figure 4.1: The Main Dimensions of Sustainability: Environmental, Social and Economic
Source: Author 2016

The term 'sustainability' has its momentum and has dominated modern design thinking. Sustainability has many definitions in connection to cities and has no fixed boundaries. Its relationship to economic growth and practices make 'sustainability' hard to identify solutions holistically. Sustainability has embraced the technological means for dealing with environmental and socio-economic issues in cities (Jones and Jones, 2007). Grierson indicates that sustainability "involves a move from a current condition of unsustainable activity towards a process of improvement and increased quality". He confirms that "the term is used to indicate a change of attitude towards prioritising ways of life that are in the balance with the current renewable resources of the ecosystem and the biosphere" (Grierson, 2007). Cooper et al. (2009) address that sustainability requires gathering three main quality of life objectives firstly, social progress that addresses the requirement for everyone, the maintenance of stable levels of high economic evolution and finally development and the effective protection of the environment and wise use of natural resources (Cooper et al., 2009:8).

Huang et al., 2015 indicate that sustainability has become the topic of our time since the 1970s over many sets of initiatives by the UN, international institutions, and research

organisations. They also confirm that sustainability consisted of three elements environment, economy, and society (also known as the ‘‘Triple Bottom Line’’). They argue that their interconnection, especially on the degree of substitutability between natural capital and human-made capital, has been at the essence of the argumentation on ‘‘weak sustainability’’ against ‘‘strong sustainability’’. They propose that “Weak sustainability” require unlimited substitutability between human-made capital like urban infrastructure and machines and natural capital such as ecosystems and biodiversity. Strong sustainability, in contrast, presumes that human-made and natural capital are complements. (L. Huang et al., 2015). Yigitcanlar et al., (2015) point out that sustainability suggests preserving the ecosystem and its services and at the same time providing for human needs. They discuss that “sustainability is a manifesto for destructive human activities: leave the world better than you found it, take no more than you need, try not to harm life or the environment, make amends if you do” (T. Yigitcanlar et al., 2015). Naguib et al., (2016) mention that “sustainability is based on the maintenance of sustainability basics and the expected quality of life seeking economic, social, and environmental progress” (figure 4.2) (Naguib et al., 2016).

Ecological	Social	Economic	
Survival sustainability			Global ↕ Local
Protection of life support systems Prevention of species extinction	Capacity to solve serious problems	Subsistence	
Maintaining quality of life			Global ↕ Local
Maintenance of decent environmental quality	Maintenance of decent social quality (eg. vibrant community life)	Maintenance of decent standard of living	
Improving quality of life			Global ↕ Local
Improving environmental quality	Improving social quality	Improving standard of living	

Figure 4.2: Analyzing the Three Dimensions from Global to Local Level
Source: (Naguib et al., 2016)

4.2 Urban Sustainability

The population growth in cities has increased in recent years to exceed the proportion of population growth in rural areas. This demographic change will require new methods, and our current tools will not be sufficient. The approaches we use require intelligent ways to face the fast growth in cities. In the next 50 years, we will need to build cities for 3 billion human beings, double what we have today. This will also confirm the necessity to implement urban sustainability in cities that have not yet been built. Reutersward (2009) debate that the new sustainable cities will participate significantly to promote the urban environment and create livable, efficient cities. Consequently, urban designers need to rethink land use and the horizontal division of functions and design productive and active cities. To achieve that, we also need to consider urban morphology and how it will participate in the city's long-term economic growth. Reutersward (2009) shows that the sustainability of a city has typically focused on technical solutions for a more efficient urban life and sustainability effects occurring within the city's administrative boundaries. He suggests that in the future, to improve urban sustainability cities will require creative strategies, flexibility and have the ability to move from sustainability to regeneration. He also adds cities must be economically productive, can reduce poverty and must deal with the issue of equity. Cities even will need to reduce the impact on the environment and face rising sea level, landslides, drought, and extreme weather events. Reutersward (2009) indicates that education will be an essential component of sustainable urban development. Further, everybody must have the right to obtain the right knowledge to elevate them out of extreme poverty and stagnation. All these elements will demand to utilize intelligent methods and modern thinking to administer this massive change, creating new systems of gain (zero carbon, zero waste, green transportation, sustainable food, equity, happiness, health and culture) and implement green infrastructure in terms of green space, parks, gardens, civic space, water, waste, transportation and energy (figure 4.3) (Reutersward, 2009).

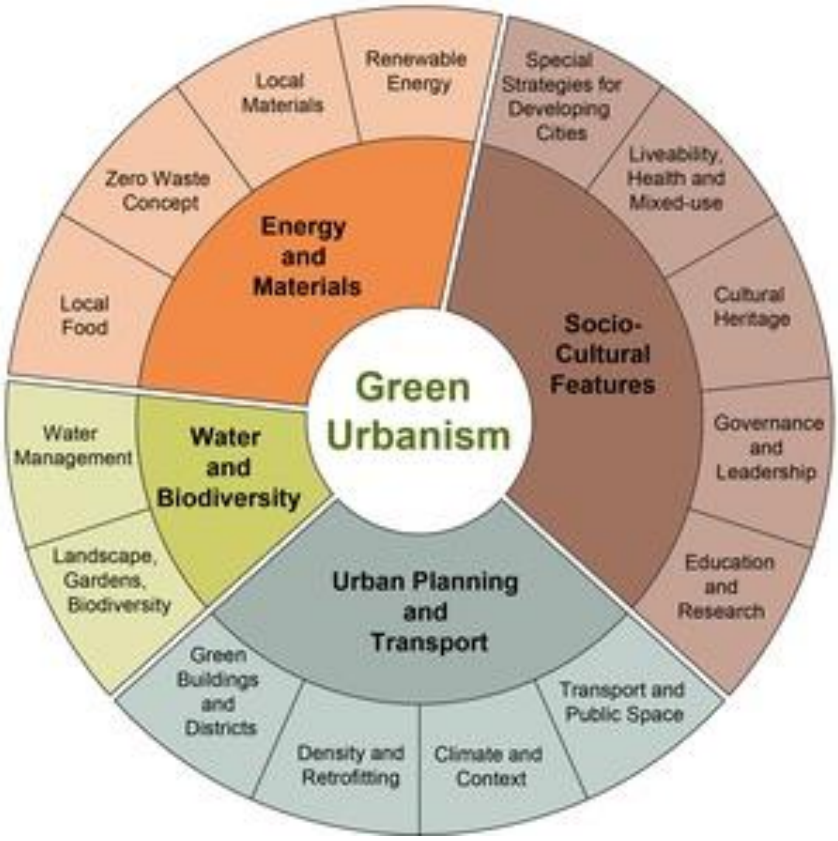


Figure 4.3: The Green Urbanism as a means to measure sustainable design.
Source: http://www.eco-business.com/opinion/transforming-city-sustainable-design/

Jenks and Dempsey propose that "crucial to the development of a sustainable city is the commitment and will of the population". Unfortunately, there is an emphasis on people as consumers rather than as citizens, and therefore sustainable cities need the active involvement of the people; they need active citizens. Jenks and Dempsey argue that the city has to meet the business requirements of the new economic paradigm by employing the right people; increasing interaction and communication; promoting accessibility, openness and convenience; achieving flexibility of operation, functional, financial and physical; and maintaining and improving value through image differentiation (M. Jenks and Dempsey, 2005:24,26). Willis adds the following argument towards achieving any of these principles: "does the political will exist to overcome the current state of reluctance by some developers to use sustainable technologies?" (Willis, 2005). Williams, Burton, and Jenks also argued that to realise a sustainable city there have to be clear concepts about

what it should look like and how it should function. They also state, "A prerequisite to achieving sustainable urban form is knowing what it is" (Williams et al., 2000:196). Webster and Williams state that "the current position facing those involved in steering urban change is that both the mechanisms for attaining sustainable development and the future form which sustainable development might take remain ill-defined and contested" (Webster et al., 2005:264).

Adinyira & Adjei-Kumi also identify urban sustainability as "a desirable state or set of urban conditions that persist over time. It is often characterised by issues such as intergenerational equity, protection of the natural environment, minimal use of non-renewable resources, economic vitality and diversity, community self-reliance, individual well-being, and satisfaction of basic human needs" (Adinyira et al., 2007). Grierson shows that urban sustainability "requires that we see urban systems like ecosystems, where humans through their actions, have produced changes that have thrown the global ecosystems off balance". He emphasises that the challenge then is "to establish what actions need to be taken to counter the negative effects of human activity and maintain equilibrium within the parameters of sustainability" (Grierson, 2007). Urban sustainability has been defined in different ways, with various criteria and emphases (table 4.2).

	Definitions of Urban Sustainability	Source
1	Urban sustainability is to achieve a high quality of life for the whole community within a socio-economic framework that minimizes the impact of the city on the local and global environment.	(M. Jenks and Dempsey, 2005:24)
2	Urban sustainability is used as a desirable state of urban conditions that persists over time. The concept is often characterized by issues such as the proper use of resources to guarantee a generational equity, protection of the natural environment, minimal use of non-renewable resources, economic vitality and diversity, community self-reliance, individual well-being, and satisfaction of basic human	(L.-Y. Shen et al., 2011)

	needs.	
3	Urban sustainability is defined as the challenge to solve both the problems experienced within cities and the problems caused by cities, recognizing that cities themselves provide many potential solutions.	L.-Y. Shen et al., (2011) According to the European Commission (2006) (L.-Y. Shen et al., 2011)
4	Sustainable urbanization refers to the well-balanced relationship between the social, economic and environmental agents in society, so as to accomplish sustainable urban development.	L.-Y. Shen et al., (2011) According to Drakakis-Smith, (2000) (L.-Y. Shen et al., 2011)
5	Sustainable urbanization is a dynamic process that combines environmental, social, economic and political institutional sustainability. It brings together urban and rural areas, encompassing the full range of human settlements from village to town to city to metropolis, with links at the national and global levels.	L.-Y. Shen et al., (2011) According to UN Habitat, (2004) (L.-Y. Shen et al., 2011)
6	Urban sustainability is an adaptive process of facilitating and maintaining a virtual cycle between ecosystem services and human well-being through concerted ecological, economic, and social actions in response to changes within and beyond the urban landscape.	Huang et al., (2015) According to Wu (2014) (L. Huang et al., 2015)
7	Urban sustainability is the process of developing a built environment that meets people's needs whilst avoiding unacceptable social or environmental impacts.	Huang et al., (2015) According to Hamilton et al. (2002) (L. Huang et al., 2015)
8	Sustainable development of human settlements combines economic development, social development and environmental protection, with full respect for all human rights and fundamental freedoms, including the right to development, and offers a means of achieving a world of greater stability and peace, built on ethical and spiritual vision. Democracy, respect for human rights, transparent, representative and accountable government and administration in all sectors of society, as well as effective participation by civil society, are indispensable foundations for the realization of sustainable development	Huang et al., (2015) According to United Nations Human Settlements Programme (UN-Habitat) (1996) (L. Huang et al., 2015)
9	Sustainable urban development may be defined as a process of synergetic integration and co-evolution among	Huang et al., (2015) According to Camagni (1998) (L. Huang et

	the great subsystems making up a city (economic, social, physical and environmental), which guarantees the local population a non-decreasing level of wellbeing in the long term, without compromising the possibilities of development of surrounding areas and contributing by this towards reducing the harmful effects of development on the biosphere	al., 2015)
10	Sustainable urbanization can be defined as urbanization practice that complies with sustainable development principles that combines environmental, social, and economic sustainability.	(L. Shen et al., 2016)
11	Sustainable urban development refers to a city which its people businesses continuously endeavor to improve their environments while maintaining the sustainability of ecological systems that supports the growth. Sustainable urban development must aim to produce a city that is user-friendly and resourceful, in terms not only its form and energy-efficiency, but also its function, as a place for living	(Mersal, 2016)

Table 4.2: Definitions of Urban Sustainability
Source: Author 2016

'Designing Sustainable Cities' by Cooper, Evans and Boyko offered a good argument of how to find a practical solution to achieve sustainable urban design, as well as attempting to address sustainability issues in relation to the design and planning. In addition, this book examined social, environmental and economic factors and their relationship to the decision-making processes. Designing Sustainable Cities offers a better explanation of the dimensions of sustainability (Cooper et al., 2009).

Shen et al., (2011) said that the terms "urban sustainability, sustainable city and sustainable community" refer to the desirable state, while "sustainable urbanisation and sustainable urban development" refer to the process towards the desired state. While the principle of sustainable urbanisation refers equal concern to environmental, governance, social and economic sustainability, social sustainability is more difficult to define due to its diverse, wide and subjective characteristics. Shen et al., (2011) argue that fast urbanisation is often

at the cost of the damage to valuable ecosystems and areas for satisfying the urban requirement. Shen et al., (2011) discuss that governments and international organisations at different levels look for the optimum urban sustainability value. They add that practices toward a sustainable urbanisation play a fundamental role in obtaining global sustainability goals. They show that considerable efforts in promoting the mission of sustainable urbanisation practice have been committed by international institutions and currently these missions are vastly examined through various disciplines (L.-Y. Shen et al., 2011).

Huang et al., (2015) indicate that during recent decades, urban sustainability and sustainable development have become increasingly prominent on political agendas and scientific research. They mention that efficiently managing urban flows, maintaining cultural and social diversity, minimising the consumption of space and natural resources, ensuring equal access to resources and services protecting the health of the urban population are urban sustainability objectives. They debate that the sustainability of urban places is fundamental to the sustainability of nations, regions, and the world as a whole. They have shown some definitions of urban sustainability in different ways, with various criteria and emphases. The majority of the explanations displayed by Huang et al., (2015) are derivations from those of sustainability, concentrating on the advancement of long-term human wellbeing by balancing the three dimensions of sustainability, reducing resource consumption and environmental damage, increasing resource use efficiency, and ensuring equity and democracy (L. Huang et al., 2015).

Alfonso Piña & Pardo Martínez (2016) argue that the city is recognised as an important generator of evolution and poverty reduction due to the concentration of national economic activity, commerce, public service provision, and transportation. They add that the infrastructure of countries has been improved by associating between the city and the rural area. They also mention that the city is related to higher levels of learning and education, better health, easier access to social services, and promote opportunities for cultural and political participation. However, the city has negative aspects, such as traffic congestion, air pollution, and higher demand for resources that led to unsustainable production and consumption patterns (figure 4.4) (Alfonso Piña and Pardo Martínez, 2016).

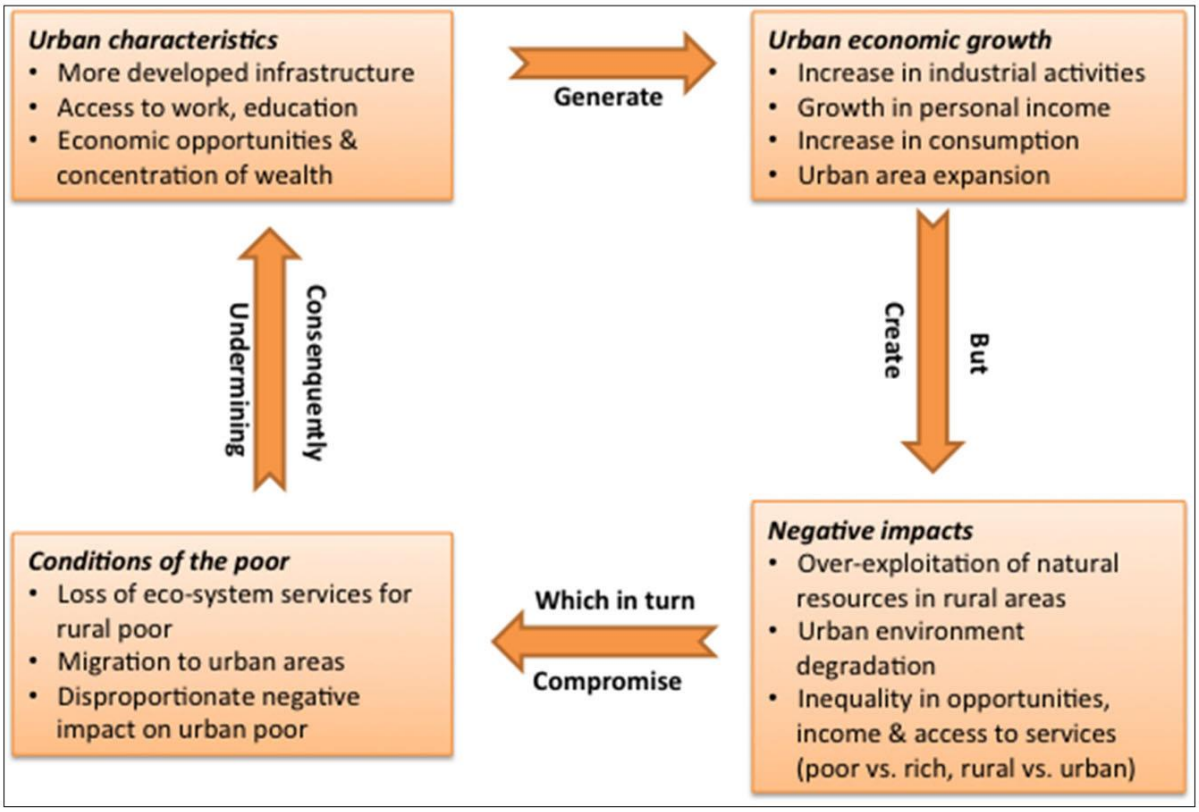


Figure 4.4: The Urbanization Cycle and Environmental Impacts
Source: (Alfonso Piña and Pardo Martínez, 2016)

"Cities and urban design are intimately linked to sustainability goals" (Larco, 2016). The connection between sustainability and urbanism according to Larco, (2016) is well established and is primarily based on the effect of urban form on transport, equity concerns and pollution, water quality and recharge rates, and habitat. Larco, (2016) mentions that the term 'sustainable urbanism' is sometimes used interchangeably and involves topics of sustainability associated with the whole process of city management and development, while sustainable urban design sits somewhere within that (Larco, 2016). The intersection of both concepts, urbanisation and sustainability characterise urban sustainability. Two levels can define sustainable urbanisation; the first is sustainable urban development and the second is the sustainable city. Tan et al., (2016) argue that a sustainable city is utilised to describe the current conditions of cities, for instance, eco-environmental proper use of resources, protection, individual welfare, and satisfaction of basic human needs. They also confirm that the sustainable city represents an economic space within which the social, economic and ecological contradictions are being managed and strategically addressed (Tan et al., 2016).

Shiwei et al., (2016) emphasise that sustainable urbanisation should pursue six basic principles: conservation, comfort, coordination, compactness, completeness, and collaboration. They asserted that sustainable urbanisation is a dynamic and multidimensional approach covering social-economic, environmental and political-institutional sustainability. They contended that a sustainable urbanisation is an urbanisation approach that achieves the norms of sustainable development. They conclude that the ability of a region's evolution in a sustainable urbanisation way in future is sustainable urbanisation potential. They indicate that it is essential to evaluate the sustainable urbanisation potential of an area to reach sustainable urbanisation, and the results will be beneficial for policymakers to develop scientific measurements (Shiwei et al., 2016).

4.3 Sustainable Urban Form

Williams, Burton and Jenks in their book 'Achieving Sustainable Urban Form' showed that the physical form of urban areas has contributed to the enormous problems of cities. Therefore, the search for sustainable urban form today requires a reorientation of the search for a number of sustainable urban forms which respond to a variety of existing settlement patterns and contexts. They asserted that to understand a sustainable city; there has to be a clear concept of what it should look like and how it might function (Williams et al., 2000:1,7). Urban form is one of these concepts, as it conceptualises the overall spatial patterns of cities and in turn their physical pattern (Lynch, 1984). In this regard, significant arguments have been put forward to measure the implications of urban form on a number of sustainability dimensions and this has given rise to the term 'sustainable urban form' in recent literature. Romanos and Auffrey discussed that various urban forms could have very different degrees of sustainability and there is not a single model of sustainable urban form that is applicable in all cases. They defined a sustainable urban form "is one that can adapt well to the requirements of growth and change without destroying natural resources and traditional culture in the process" (Romanos and Auffrey, 2002:253).

Jenks and Jones discuss that the form of the sustainable city has been identified by a massive amount of research that illustrated which urban forms might most influence

sustainability. They mentioned that the sustainability of cities and urban forms have concentrated on increasing the density of development, implementing a mix of uses and realising socioeconomic variety. Jenks and Jones presented their arguments about the physical dimensions of urban form and how they might contain their shape, land uses, size and allocation of open space. Furthermore, it may include a combination of plenty of features, comprising a city's transportation system and urban design characteristics (Mike Jenks and Jones, 2010).

The strategies for the future form of cities that should be adopted in a global economy and information age are still being debated (M. Jenks and Dempsey, 2005:24). Jenks and Dempsey indicate that the density of development is one of the enduring themes behind the search for more sustainable urban forms. They point out that the higher density is seen as a fundamental part of achieving sustainable development. (M. Jenks and Dempsey, 2005:288,300,307,432). Jabareen (2016) states that "the form of the contemporary city has been perceived as a source of environmental problems". He confirms that the main objectives of sustainable urban forms are reducing energy use, decreasing waste and pollution, minimising automobile use, conserving open space and sensitive ecosystems, and livable and community-oriented human environments. The concept of sustainable urban form to be achieved will require a high density and adequate diversity, compact with mixed land use, and its design is based on sustainable transportation, greening, and passive solar energy. This will demand that local governments, planning consultants, landscape architects, and urban designers utilise a variety of planning and design approaches and policies (Jabareen, 2006).

The most acknowledged issue in the world environmental agenda is the physical urban form and its relation to the efficiency of the city. Charehjoo and Siong (2013) argue that sustainability of the city is multifaceted, and sustainable urban form is a substantial element towards realising a sustainable development and that quality of life is one of its vital components (Charehjoo and Siong, 2013). Therefore, one cannot consider urban forms 'sustainable' in the full meaning if they are not appropriate to people as places to live, work and interact. They also discuss that to achieve sustainable urban form nowadays, especially in relation to planning policy and land functionality, the most effective solution must be performed utilising a compact city model which consists of a city shape with high

density and mixed land use. They conclude that it is essential to understand the physical development pattern to navigate it towards sustainable urban development (Charehjoo and Siong, 2013).

4.4 Sustainable City Dimensions

Ibrahim et al., 2015 state that the dimensions of the sustainable city are a complex issue to understand. They point out that "care needs to be exercised over the context within which the cities exist, their cultural background and regional and national differences. There will be significant differences in different parts of the world of the interpretation of the sustainable city; however, there are common underlying and enduring themes, which appear to inform both the debate and claims for urban forms that promote sustainability" (Ibrahim et al., 2015).

Cities are active complex open systems with associated social, economic and environmental systems. Consequently, sustainable development in cities cannot be obtained without integrating sustainable development indicators that address social, economic and environmental dimensions, moreover, as every city is different these indicators must be different. Michael et al., (2014) stressed by associating the social, economic, and environmental sustainability dimensions' negative synergies can be hindered and positive synergies are fostered and real development is encouraged. Nevertheless, they indicate that the main challenge to practitioners and researchers is how to combine the three dimensions into a significant and dynamic framework for research and action. They add, as the concept of sustainability is multidimensional, thus, social, economic, and environmental aims can evolve synergies to a certain degree. However, as they compete with each other they are not always mutually supportive (Michael et al., 2014). Cities as Palacio, (2015) has also confirmed are systems of the complex and fine diversity of environments and users that support each other mutually, both socially and economically. The dominant tradition in urban design and planning has failed in obtaining the variety that sustains urban vitality (Palacio, 2015)

4.4.1 Social Dimensions

At the beginning of the 21st century, the social dimension became widely utilised in urban planning research and practice. Nevertheless, aspects of social sustainability and knowledge of spatial distributions of social values are required. Despite the lack of consensus, the majority of the issues connected with social sustainability are related to well-being, human capital, and social capital. Various definitions of social sustainability have been discussed, proposed, and reviewed during the last decade. Johansson et al., 2016 explain that the standard for social sustainability often includes many factors that are favoured by a local community or group of citizens. Therefore, it is a substantial component for assessing social sustainability analysing people's perceptions of their circumstances and environments together with investigating social changes to determine whether it is decreasing or increasing. They identify diverse aspects of social sustainability associated with urban environments, income distribution, sense of community, the attractiveness of the public realm, housing, social inclusion and local networks, and urban design. They add that there are also regarded to be significant aspects of social sustainability to consider in urban studies like resource distribution, equality, and access to public services for instance (Johansson et al., 2016).

"The concept of sustainability is the need of the current society to be satisfied without compromising the needs of future generations" (Michael et al., 2014). The social dimension deals with society well-being, how to attend to human requirements and to raise the opportunities for advancement equally for all community. It involves ideas of sharing, cultural identity, equity and empowerment, accessibility, participation, and institutional stability which endeavour to maintain environment through economic growth and the reduction of poverty. Michael et al., (2014) mention that the social dimension is reflecting the shared principles and values of the society that bring advantages to citizens and is grouped by facilitating co-operation and decreasing opportunistic behaviours. They assert that an essential thing is that social indicators are comprehensive and tend to be very subjective (Michael et al., 2014).

Naguib et al., (2016) found that involvement of societies and citizens in sustainability plans are significant to cope with the lack of ability and resources that can prevent the way

to gain the objectives and aspirations of development. They elaborated that local efforts had to be promoted by the governments and officials. Naguib et al., (2016) mention that "The need for urban sustainability aims to develop the ability to perceive the community as a whole and demonstrate the concept of the community as a system through their vision, evaluation and participation in order to meet the need of all its actors and inhabitants as well as the sustainability of its environment" (figure 4.5) (Naguib et al., 2016).

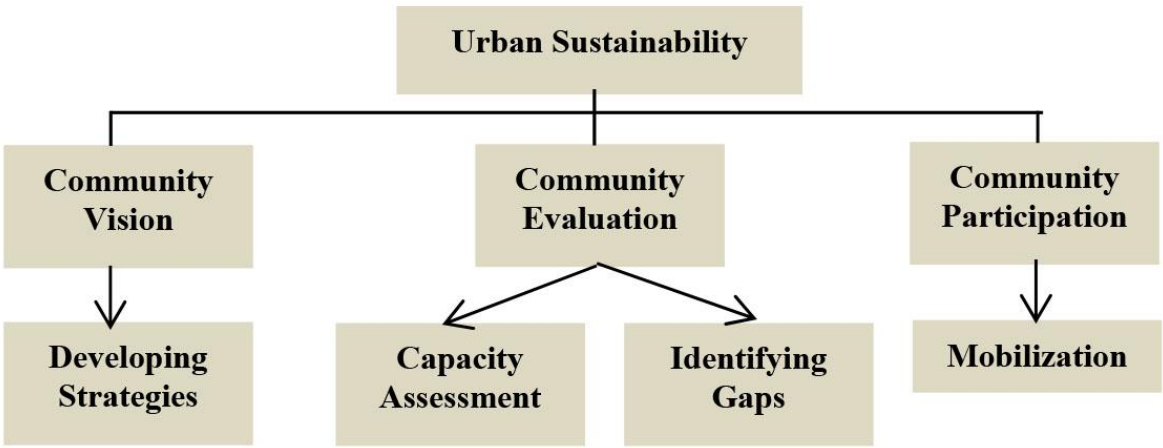


Figure 4.5: Urban Sustainability Requirements
Source: (Naguib et al., 2016)

Social sustainability according to Shen et al., (2011) is seen as one of the essential dimensions for assessing urban sustainability (L.-Y. Shen et al., 2011). The societal perspective as Palacio, (2015) mentions usually addresses the city as the space of social development and social process, including ideas for instance equity, well-being, and quality of life (Palacio, 2015). The main elements of social sustainability as described by Ročak et al., (2016) are trust, sense of place, quality of life cultural identity, involvement and resources, and empowerment. According to these components, they indicate that social conditions with social policy regions in social sustainability are integrated and frequently overlooked due to the ambiguity and assessment problems. The needs, challenges, and opportunities of urban societies have appeared to address activities in civil society, and are framed regarding the sustainability of a community that emphasises livability and quality of life. They mention that the argumentations on social sustainability pay particular attention to discovering conditions for future scenarios. They state, "Social sustainability is not only about societal qualities in the present but about also creating social structures that can guarantee these qualities for the coming generation" (Ročak et al., 2016).

Mersal, (2016) states that today the social foundation of urban design is the issue of sustainable development. He displays a better framework to achieve sustainable communities in urban design. He mentions that cities require redesigning many of their functions and technologies with ecological principles to build a sustainable society for future generations. The main finding of Mersal, (2016) is that sustainable communities are not obtained by chance, we must work to achieve them, and the report introduces the main elements of sustainable communities as displayed in (figure 4.6) (Mersal, 2016).

Figure 4.6: Sustainable Community
Source: (Mersal, 2016)

Mersal, (2016) also indicates that stakeholder participation is a significant strategy in obtaining urban environmental management, which needs the efforts of a wide range of organisations, institutions and citizens in recent years. He indicates that "sustainable development must incorporate an inescapable commitment to social equity and there must be genuine stakeholder participation at all stages of development" as shown in (figure 4.7) (Mersal, 2016).

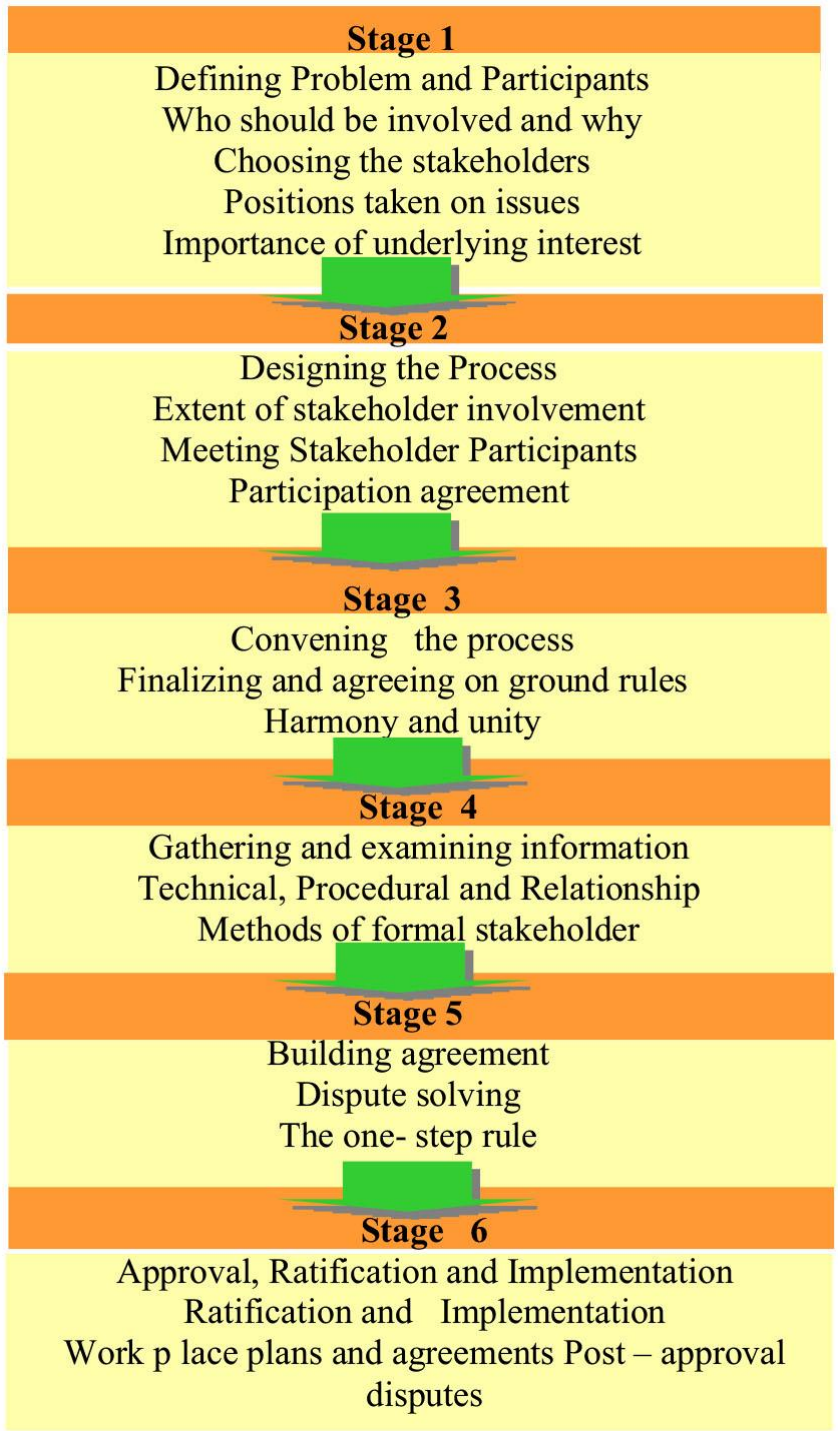


Figure 4.7: Stages in Stakeholder Participation
Source: (Mersal, 2016)

4.4.2 Economical Dimensions

The economic dimension according to Michael et al., (2014), "refers to the development, growth, and productivity, which has guided conventional development science in the past in which economic growth will trickle down to the poor through a market allocation of resources, sustained levels of growth and consumption, and assumption that natural resources are unlimited. It implies a system of production that satisfies present consumption levels without compromising future needs". (Michael et al., 2014). Stossel et al., (2015) point out that following the strong sustainability method promoted by ecological economists, a sustainable city should meet good environmental quality within its boundaries, the city operates within the limits of domestic and global ecosystems (i.e., its resource consumption is sustainable), and the city does not harm the environmental quality and climate elsewhere outside its boundaries (Stossel et al., 2015).

Larco, (2016) point out that the term 'economic sustainability' has been utilised to indicate to the creation of economic value, raise in economic activities and substantial cost savings. He states that the main beneficiaries or aims of sustainable economics can also vary considerably, with studies, reports, and research concentrating on some subset of businesses, consumers, residents, municipalities and community as a whole (Larco, 2016). In the economic perspective as Palacio, (2015) states "cities are regarded as spaces for socio-economic prosperity and innovation; competitiveness has been considered as a central concept in creating the urban qualities that can attract economic and human capital" (Palacio, 2015).

The new Sustainable Development Agenda by UN-Habitat (2016) seeks to make cities and human settlements inclusive, safe, resilient and sustainable by supporting positive economic, social and environmental links between urban, peri urban and rural areas and by strengthening national and regional development planning (UN-Habitat, 2016). Economic productivity, as Science for Environment Policy (2015) mention, depends on healthcare, security, food, water, happy citizens, who need easy access to education, transport, clean air and electricity. They indicate that to achieve sustainable cities we should build efficient waste disposal systems, green areas, green buildings, smart public transport and most

important must attract employers producing green products from local resources for regional markets (Science for Environment Policy, 2015).

4.4.3 Environmental Dimensions

The environmental dimension of sustainability according to Michael et al., (2014) involve the ecosystem prosperity, which is a condition in which the ecosystem preserves quality and variety. They mention its capability to promote all life, and its potential to adapt to change to provide future choices (Michael et al., 2014). Palacio, (2015) states that "the environmental dimension of the city in the frame of sustainable development has been focused mainly on the question of the demands and the impacts of the city and society on ecosystems in terms of the ecological footprint, or environmental quality and public health" (Palacio, 2015). Science for Environment Policy, 2015 state that "it is also important that cities reduce natural resource consumption (including water and materials like stone and gravel) and waste production footprints, and that they improve land-use efficiencies (especially the reuse of grey field and brown field land) so that negative environmental impacts are minimised" (Science for Environment Policy, 2015).

Mori and Yamashita, (2015) stressed that the limits of the negative impacts of the city on the local and global environment should be identified in the environmental dimension. They indicate that based on these limits the sustainability of cities should be assessed on the relevant fixed criteria. They argue that the fundamental thing is that the global limitations have to be appropriately specified and examined in the assessment of city performance with leakage effects of the city encompassed (Mori and Yamashita, 2015). Mersal, (2016) argues that urban problems required new measures, and it will have to be more sensitive to ecology and community, efficiently integrated, more open to citizen involvement than what now prevails, more respectful to uncertainties, and more efficiently integrated. He points out that evaluating the effects of urban environmental problems in terms of health effects, ecology values, productivity, amenity, and other key indicators is the main challenge of environmental planning (figure 4.8). Mersal, (2016) asserted that "sustainable urban development must aim to produce a city that is user-friendly and resourceful, in terms not only of its form and energy-efficiency but also its function, as a place for living" (Mersal, 2016).

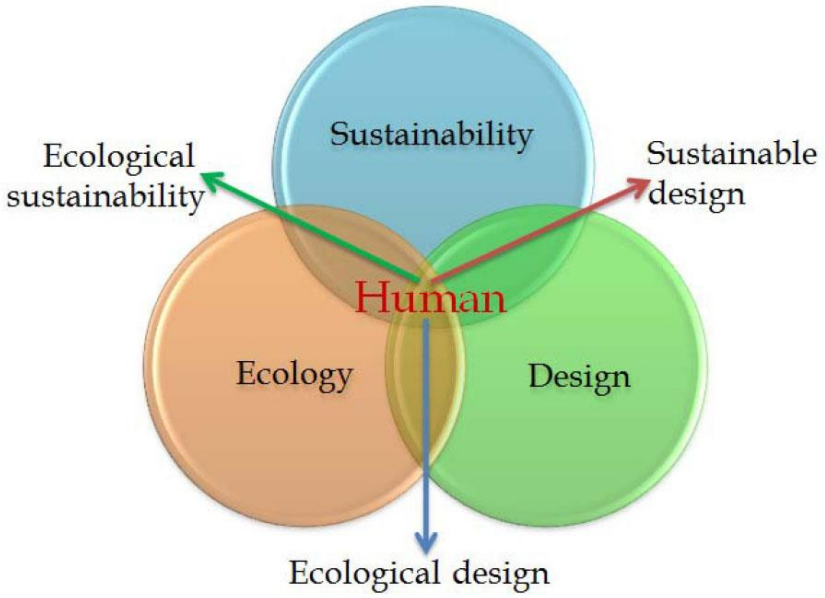


Figure 4.8: The relationship between ecology, Sustainability and design
Source: (Mersal, 2016)

4.4.4 Governmental Dimensions

UN-Habitat, (2016) confirm that urban governance delivers sustainable development when it is environment-friendly, participatory, accountable, transparent, effective and efficient, equitable and inclusive, abiding by the rule of law. They point out that the quality of human settlements and urban governance affect the quality of life of billions of individuals. They reveal that in their Habitat agenda, adopted in 1996, acknowledged the role of local authorities and the significance of involvement as essential to implementing the universal goals of adequate shelter for all and safer, healthier, more liveable, sustainable and productive human settlements. UN-Habitat, (2016) also display that governance composed of the traditions and institutions by which authority in a country is exercised. They manifest that this will include the process whereby governments are selected, monitored and replaced, the capacity of the government effectively to frame and implement sound policies, and citizen and government compliance with the institutions that govern economic and social interactions among them (UN-Habitat, 2016).

4.5 Urban Sustainability Assessment

The city has become the core of social and economic operations, and the main form of human habitat. It follows that humanity's sustainability and the prosperity of urbanites are strongly associated with the way the city functions. Diverse sets of urban sustainability indicators and indices have been developed in recent years. These sets of indicators identify components of urban activity that are not environmentally sustainable and provide data about the state of the environment. Utilisation of these assessments has the potential to raise the awareness of the public and decision-makers of important areas for policy and action required for promoting sustainability, and through participation create a better understanding of complex city–environment interactions. Urban sustainability assessment is divided by Stossel et al., (2015) into two major types. A set of indicators that can be utilised to measure environmental properties (such as the concentrations of some air pollutants can be used to measure local air quality, and the emissions of GHGs) can highlight a studied entity's contribution to climate change processes are the first one. Indices are the second type, in which several indicators are synthesised into a single metric, different air pollutants aggregated into a single index value for example (Stossel et al., 2015).

The assessment of sustainability in the urban context is fundamental for urban decision makers such as urban designers, planners, architects, and engineers. Walton et al., (2005) confirm through their work that there are many criteria and tools to assess the sustainability of urban development in cities such as scale, life cycle, location, context and all stakeholder values. (Walton et al., 2005). Shen et al., (2011) point out that urban sustainability indicators are significant for assisting in target setting, performance reviews and facilitating communication among the policy makers, professionals and community (L.-Y. Shen et al., 2011).

Hiremath et al., (2013) indicate that one of the essential planning concepts from its beginnings in economics and ecological thinking is sustainability, and has widely been applied to assessing urban development. They mention that over a period different methods, techniques and instruments have emerged for urban sustainability assessment that helps determine how cities can become more sustainable. They assert that indicators-based

approaches are one of these methods and participate in the building of sustainable self-regulated systems that combine development and environment protection. Therefore, these methods will provide a solid basis for decision-making at all stages and are being increasingly utilised (Hiremath et al., 2013).

Urban sustainability can be assessed and measured by a large diversity of ways. Srivastava (2016) discuss "Assessment methods may be structural frameworks for issues inherent in city-scale sustainability or assessments tools that provide qualitative and quantitative checklists to measure urban sustainability. The structural frameworks may be used to test the thoroughness of tools, identify gaps and provide the structure to create new assessment tools". He states that "the goal of indicator-based assessment structures of urban sustainability is to provide an easy to communicate and a measurable checklist of all relevant sectors as cities formulate an urban sustainability plan" (Srivastava, 2016).

Urban sustainability assessment identified by Yigitcanlar et al., (2015) as "a process by which the implications of an initiative on sustainable urban dimensions are evaluated, where the initiative can be a proposed or existing policy, plan, programme, project, a piece of legislation, or a current practice or activity". They summarise that "sustainability assessment aims to steer societies in a more sustainable direction by providing tools that can be used either to predict impacts of various initiatives on the SUD of society or to measure progress towards a more sustainable state" (T. Yigitcanlar et al., 2015).

Measuring urban sustainability as Grafakos et al., (2016) state is a continuing challenge for the city. They indicate that over the past two decades, a range of indicator and index systems has been advanced to assess an extensive variety of cases ranging from carbon emissions to ecological footprint and material flows. They address that the indicators and indices in use across the various cities and regions worldwide vary according to their particular requirements and aims of the local context. They classify city-level sustainability measurement methodologies into sustainability indicators (e.g., carbon, water and energy footprint), sustainability measurements (e.g., life cycle measurement, strategic environmental measurement, and environmental impact measurement) and integrated sustainability indexes (e.g., Green City Index, Urban Sustainability Index) (Grafakos et al., 2016).

4.6 Urban Sustainability Indicators (USIs)

This research will seek to determine the most relevant criteria to the historic centre of Baghdad by defining a set of urban sustainability criteria that can be assessed in the traditional fabric such as socioeconomic development, and environmental management. This will be used as a framework for investigating urban sustainability in Old Rusafa.

Science for Environment Policy, (2015) indicate that "urban sustainability indicators are tools that allow city planners, city managers and policymakers to gauge the socio-economic and environmental impact of, for example, current urban designs, infrastructures, policies, waste disposal systems, pollution and access to services by citizens. They allow for the diagnosis of problems and pressures, and thus the identification of areas that would profit from being addressed through good governance and science-based responses. They also allow cities to monitor the success and impact of sustainability interventions" (Science for Environment Policy, 2015).

Urban indicators can provide quantitative and qualitative information that help to determine urban development priorities (Kasparek and Dimashki, 2009). USIs are very important to assist local and national policymakers to develop their action towards sustainability. "They serve several purposes: 1. Systematic monitoring of urban environmental changes 2. Early warning of urban environmental problems 3. Target setting 4. Performance reviews, and 5. Public information and communication" (Alberti, 1996). Ibrahim et al., (2015) point out that sustainability city indicators can be seen as an asset that gives a synopsis of data about the subject of the problem.(Ibrahim et al., 2015)

In the last decade, Grafakos et al., (2016) confirm that there is a huge variety of rating sustainability measurement tools that have been advanced and that have been utilized in different cities at various levels, such as green buildings, infrastructure projects and neighbourhoods. They asserted that the main goal of this type of sustainability assessment tool is to measure the overall sustainability performance of the project under consideration (e.g., building), integrating multiple sustainability norm (energy, environmental, water, etc.), to assess and to compare it with other similar projects (i.e., buildings) (Grafakos et al., 2016).

There are different tools and methods utilized internationally to monitor sustainability:

•LEED: Green Buildings Council's Leadership in Energy and Environmental Design (USGBC, 2014)
•Green Building Challenge (Canada, 1998-2007)
•NABERS: National Australian Building Environmental Rating System (NABERS, 2014)
•Green Guide to specifications: in the UK
•Estidama: meaning "sustainability", by (Abu Dhabi Urban Planning Council, 2014)
•BREEAM: Building Research Establishment Environmental Assessment Methods (BREEAM, 2014)
•CASBEE: Comprehensive Assessment System for Building Environmental Efficiency
•IUSIL: International Urban Sustainability Indicators List (L.-Y. Shen et al., 2011)

A new comprehensive list of SIs have been created by Shen et al. (2011) through gathering all the indicators from frameworks created by the United Nations (2007), the European Foundation (1998), Research and Development (2000), the UN Habitat (2004), the World Bank (2008), and the European Commission on 39 Energy and Environment and Sustainable Envelopment (2004). The result of this compilation is the International Urban Sustainability Indicators List (IUSIL), which included 115 indicators divided into 37 categories. These categories fell within four parts of sustainability: environmental, economic, social, and governmental. Three main aims of IUSIL, firstly, promote the exchange of knowledge for future practices, secondly, provide a reference for the selection of indicators, and thirdly, help further evaluate the selection of indicators. Shen et al., (2011) said that national and local governments across the world have advanced indicators to measure the urban sustainability performance according to their local or national priorities since early 1990's. They reveal that there are different lists of urban sustainability indicators, despite there being no single set of indicators that suits equally all cities or communities. It is, therefore, the utilisation of common indicators that is fundamental for controlling and comparing the process of sustainable urbanisation so that this does not remain as an abstract concept. They clarify that "Comparable indicators are important because they allow cities to have a common grid to share and apply successful tools and measures" (L.-Y. Shen et al., 2011).

Shen et al., (2011) mention there are drivers to document the range to which cities are or are not becoming sustainable by using indicators, and to discover the practical challenges that are being encountered in the process. However, they show that the process of selection indicators should not be about combining the information for all indicators, but rather selectively analysing the ones which are essential in essence and more likely to produce the most accurate information about the status of practice. They assert that indicators must be verifiable, reproducible, clear, simple, scientifically sound, and smart (Table 4). They proposed that urban sustainability indicators should provide at least explanatory tools to translate the concepts of sustainable development into practical terms, pilot tools to assist in making policy choices that promote sustainable development, and finally, performance assessment tools to decide how active efforts have been (L.-Y. Shen et al., 2011).

International Urban Sustainability Indicators List (IUSIL)			
Category		**Indicator**	
Environmental			
En1	Geographically balanced settlement	En1-1	Population growth
		En1-2	Planned settlements
En2	Freshwater	En2-1	Proportion of total water resources used
		En2-2	Water use intensity by economic activity
		En2-3	Presence of faecal coliforms in freshwater
		En2-4	Biochemical oxygen demand in water bodies
En3	Wastewater	En3-1	Percentage of city population served by wastewater collection
		En3-2	Percentage of wastewater receiving no/primary/secondary/tertiary treatment
En4	Quality of ambient air and atmosphere	En4-1	Number of times the limit values for selected air pollutants are exceeded
		En4-2	Existence and level of implementation of air quality management plan
		En4-3	Emissions of greenhouse gases
		En4-4	Consumption of ozone depleting substances
En5	Noise pollution	En5-1	Share of population exposed to long-term high level of environmental noise
		En5-2	Noise levels in selected areas
En6	Sustainable land use	En6-1	Artificial surfaces as a percentage of the total

			municipal area.
		En6-2	Extent of derelict and contaminated land
		En6-3	Number of inhabitants per Km2
		En6-4	Quota of new edification taking place on virgin area and quota taking place on derelict and contaminated land in % per year.
		En6-5	Restoration of urban land
			a) Renovation, conversion of derelict buildings
			b) Redevelopment of derelict land for new urban uses
			c) Cleansing of contaminated land
		En6-6	Protected areas as a percentage of total municipal area
		En6-7	Land affected by desertification
		En6-8	Area under organic farming
		En6-9	Proportion of land area covered by forests
En7	Waste generation and management	En7-1	Percentage of city population with regular solid waste collection
		En7-2	Percentage of solid waste disposed to sanitary landfill/incinerated and burned openly/disposed to open dump/recycled/other
		En7-3	Total solid waste generation per capita
		En7-4	Generation of hazardous waste
		En7-5	Waste treatment and disposal
		En7-6	Management of radioactive waste
En8	Effective and environmentally sound transportation systems	En8-1	Travel time
		En8-2	Transport modes
		En8-3	Energy intensity of transport
En9	Mechanisms to prepare and implement environmental plans	En9-1	Local environmental plans
		En9-2	Latest approval date of Master Plan
En10	Biodiversity	En10-1	Proportion of terrestrial area protected
		En10-2	Management effectiveness of protected areas
		En10-3	Area of selected key ecosystems
		En10-4	Fragmentation of habitats
		En10-5	Change in threat status of species
		En10-6	Abundance of selected key species
		En10-7	Abundance of invasive alien species

Economic			
Ec1	Consumption and production patterns	Ec1-1	Material consumption
		Ec1-2	Material intensity of the economy
		Ec1-3	Domestic material consumption
		Ec1-4	Annual energy consumption, total and by main user category
		Ec1-5	Share of renewable energy sources in total energy use
		Ec1-6	Intensity of energy use, total and by economic activity
Ec2	Economic development	Ec2-1	Macroeconomic performance
			a) Gross domestic product (GDP) per capita
			b) Gross saving
			c) Investment share in GDP
			d) Adjusted net savings as percentage of gross national income (GNI)
			e) Inflation rate
		Ec2-2	Employment
			a) Employment-population ratio
			b) Vulnerable employment
			c) Labor productivity and unit labor costs
			d) Share of women in wage employment in the non-agricultural sector
		Ec2-3	Information and communication technologies
			a) Internet users per 100 population
			b) Fixed telephone lines per 100 population
			c) Mobile cellular telephone subscribers per 100 population
		Ec2-4	Research and development
			a) Gross domestic expenditure on Research and Development as a percent of GDP
		Ec2-5	Tourism
			a) Tourism contribution to GDP
Ec3	Finance	Ec3-1	Debt service ratio
		Ec3-2	Tax collected as percentage of tax billed
		Ec3-3	Own-source revenue as a percent of total revenues
		Ec3-4	Capital spending as percentage of total

			expenditures
Ec4	Water	Ec4-1	Price of water
		Ec4-2	Domestic water consumption per capita
Ec5	Strengthen small and microenterprises	Ec5-1	Informal employment
Social			
So1	Energy Access	So1-1	Percentage of city population with authorized electrical service
		So1-2	Total electrical use per capita
		So1-3	Number and duration of electrical interruptions per year per customer
So2	Water Access	So2-1	Percentage of city population with potable water supply service
		So2-2	Number of interruptions in water service
So3	Education	So3-1	Percentage of children completing primary and secondary education
		So3-2	Percentage of school aged children enrolled in
			schools (by gender)
		So3-3	Student/teacher ratio
So4	Health	So4-1	Mortality
			a) Under-five
			b) Mortality rate
			c) Life expectancy at birth
			d) Healthy life expectancy at birth
		So4-2	Health care delivery
			a) Percent of population with access to primary health care facilities
			b) Contraceptive prevalence rate
			c) Immunization against infectious childhood diseases
		So4-3	Nutritional status
			a) Nutritional status of children
		So4-4	Health status and risks
			a) Morbidity of major diseases such as HIV/AIDS, malaria, tuberculosis
			b) Prevalence of tobacco use
			c) Suicide rate
So5	Safety	So5-1	Number of homicides per 100,000 population
		So5-2	Number of sworn police officers per 100,000

			population
		So5-3	Violent crime rate per 100,000 population
So6	Fire & Emergency Response	So6-1	Number of firefighters per 100,000 population
		So6-2	Number of fire related deaths per 100,000 population
		So6-3	Response time for fire department from initial call
So7	Poverty	So7-1	Income poverty
			a) Proportion of population living below national poverty line
			b) Proportion of population below $1 a day
		So7-2	Income inequality
			a) Ratio of share in national income of highest to lowest quintile
So8	Transportation	So8-1	Km of transportation system per 100,000 population
		So8-2	Annual number of public transit trips per capita
		So8-3	Commercial Air Connectivity
		So8-4	Average travel speed on primary thoroughfares during peak hours
		So8-5	Transportation fatalities per 100,000 population
		So8-6	Number of daily trips and time taken per capita by type of trip and by mode of transport
		So8-7	Total average daily distance covered per capita by type of trip and by mode of transport
		So8-8	Mode of transportation used by children to travel between home and school
So9	Natural hazards	So9-1	Percentage of population living in hazard prone areas
		So9-2	Human and economic loss due to natural disasters
		So9-3	Disaster prevention and mitigation instruments
So10	Adequate housing	So10-1	Durable structures
		So10-2	Overcrowding
		So10-3	Right to adequate housing
		So10-4	Housing price and rent-to-income
So11	Shelter	So11-1	Percentage of city population living in slums
		So11-2	Area size of informal settlements as a percent

			of city area and population
So12	Security of tenure	So12-1	Secure tenure
		So12-2	Authorized housing
		So12-3	Evictions
So13	Access to credit	So13-1	Housing finance
So14	Access to land	So14-1	Land price -to-income
So15	Promote social integration and support disadvantaged groups	So15-1	Poor households
So16	Culture	So16-1	Number of cultural establishments per 100,000 population
		So16-2	City expenditures on culture as a percentage of overall city budget
So17	Recreation	So17-1	Square meters of public recreation facility space per capita
		So17-2	City expenditures on public recreation as a percentage of overall city budget
So18	Availability of local public green areas and local services	So18-1	Citizens' access to nearby public green areas and basic services
Governance			
Go1	Participation and civic engagement	Go1-1	Citizens participation
		Go1-2	Voters participation
		Go1-3	Civic associations
Go2	Transparent, accountable and efficient governance	Go2-1	Transparency and accountability
Go3	Government	Go3-1	Corruption
		Go3-2	Percentage of population having paid bribes
Go4	Sustainable management of the authorities and businesses	Go4-1	Share of public and private organizations adopting and using environmental and social management procedures

Table 4.3: International Urban Sustainability Indicators List (IUSIL)
Source: Source: Author according to (L.-Y. Shen et al., 2011)

As far as urban sustainability is concerned, Hiremath et al., (2013) show indicators will play a dynamic role in revealing in what fields a city is doing better than in others and according to its specific objectives (Hiremath et al., 2013). Sustainability indicators as Edjossan-Sossou et al., 2014 write have to achieve some significant requirements. First of

all, easy to understand by every actor of risk assessment even if he is not an expert, secondly, based on accessible information so that the data will be available when it is required, thirdly, relevant by revealing what is essential to be known, and most importantly should be reliable so that the data they provided will be trusted (Edjossan-Sossou et al., 2014).

Three main types of sustainability indicators are identified by Yigitcanlar et al., (2015), the first one is individual indicator sets, which contain vast lists of indicators covering a full extent of cases to promote the integration of environmental concerns into policies. Secondly, thematic indicators, which comprise a few set of indicators to assess sustainable development policy for each of the cases. Lastly, systemic indicators, which utilise one indicator to identify a complex issue. Yigitcanlar et al., (2015) point out that the selection of appropriate indicators will firstly depend on policy relevance and utility for users, secondly, analytical soundness and the thirdly point is measurability. They emphasise that indicators must be scientifically sound, sensitive to change, technically robust, measurable and capable of being regularly updated, easily understood. Moreover, Yigitcanlar et al., (2015) add that sustainability indicators are significant aspects of assisting sustainable urban development by providing some benefits. For example, understanding sustainability by analysing the current state of sustainability and identifying relevant cases of urban development. Promoting decisions by identifying activities required and providing information necessary for determining aims. Solving conflict and building consensus by establishing a common language and illustrating a discussion and identify differing. Lastly and most importantly, empowering and involving stakeholders for participation, communication, initiation of discussions and awareness raising (T. Yigitcanlar et al., 2015).

Urban sustainability indicators (USIs) can play a fundamental role in enhancing the science and practice of sustaining urban systems. In the literature of sustainability indicators, Huang et al., (2015) indicate that a distinction is usually made among the terms of indicators, indices, data, and which together shape an indicator pyramid or a conceptual hierarchy (Figure 4.9). They point out that the essential components of an indicator are data, and an indicator set or a composite index comprised of multiple indicators (L. Huang et al., 2015).

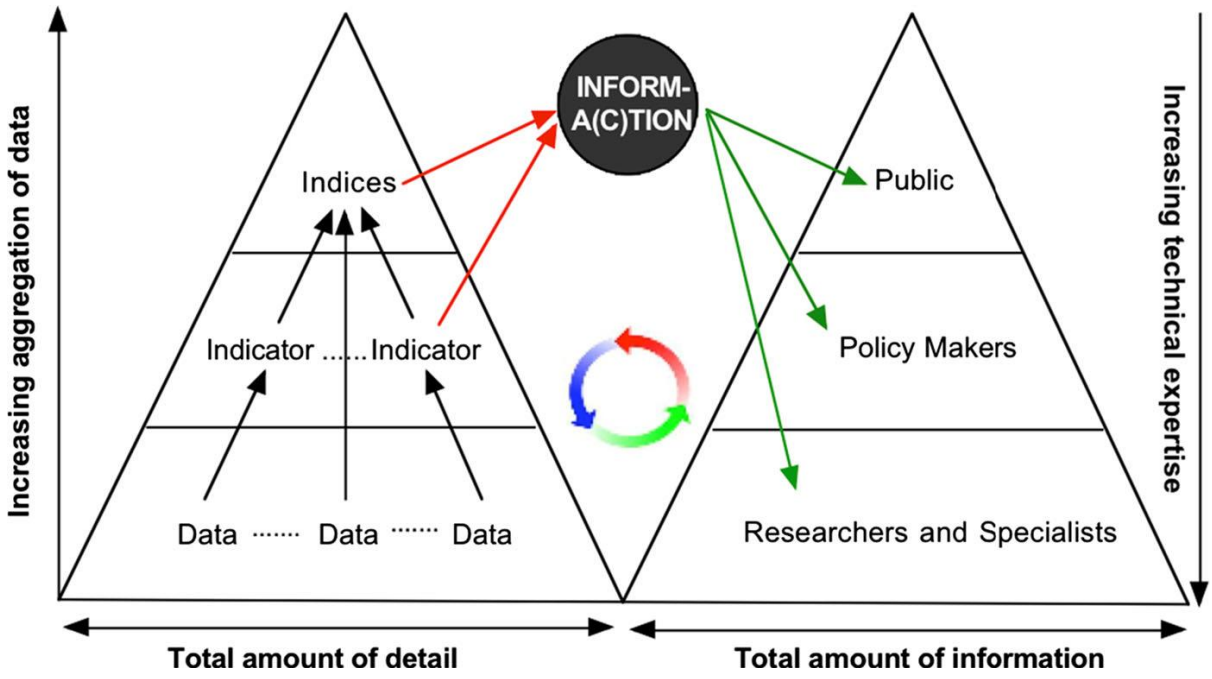


Figure 4.9: The Indicator Pyramid, Illustrating the Relationship Among Data, Indicators, and Indices, as well as Their Primary User Groups.
Source: (L. Huang et al., 2015)

Sustainable cities refer to the maximisation of the social and economic advantages under the determination of environmental burdens and within the acceptable boundaries of social inequity and economic. According to the concept, Mori and Yamashita (2015) argue that the indicators in the triple bottom line will be divided into two sets for the assessment of sustainability: maximisation and constraint indicators. Maximisation indicators assess the benefits that the city produces in social and economic aspects. Constraint indicators assess the sustainability of cities according to relevant criteria regarding socio-economic distributional justice and sustainable environment (Mori and Yamashita, 2015). Moreover, Michael et al., (2014) assert that the aims of sustainable development in the socio-economic and environmental aspects might be obtained efficiently by acting on the local level. They state that indicators are utilised for a diversity of purposes that extend from public awareness programmes to decision-making. From policy perspectives, the development of the indicators is required and assist in concretisation to moulding the policy objectives. They mention that urban indicators to be meaningful in the urban context should be minimal (Michael et al., 2014).

Michael et al., (2014) debate that SIs tend to be explicit and quantitative, while most people and institutions' use of sustainability indicators tend to be more implicit and qualitative in practice. They clarify that in various political and research contexts both qualitative and quantitative indicator types can serve well. SIs, however, are more characterised by other indicators by their need to assess the efficiency of a system to adapt to change and continue to function over a long time span. They have seen SIs as significant tools in the achievement of sustainable development, and it is more representative of the requirement of local users by concentrating on the primary cases that affect the pursuit of sustainability within that local area. They add that without local societies, governments and individuals rising to meet the significant challenge of sustainability sustainable development cannot be implemented. They explain that the most commonly accepted method for measuring sustainable development is indicators as they bring various meaning to different levels. The indicators at the local level are utilised in the decision-making procedures of urban development for application by local authorities. At the regional level, the indicators are utilised to compare data for regional development programmes and the project management through the participation of different institutions and service agencies. Lastly, the indicators at the international level are utilised to finance regional development projects with global resources and for the development of the cities and societies of the third world (Michael et al., 2014).

4.7 Comparative Analysis of A number of Cities using Urban Sustainability Indicators

Nowadays, providing citizens with a good quality of life and best infrastructures in their cities is the most prominent challenge facing governments around the world. Therefore, many cities have improved sustainable urban development plans for managing their urbanisation process towards a desired status of urban sustainability. The main aspects of communicating the status of the practice are urban sustainability indicators, which assist in determining how effective the strategies and policies enforced have been in the realisation of sustainability objectives. Shen et al., (2011) have displayed and examined various city sustainable development plans where sustainability indicators are embraced for controlling the performance of the implementation of the plans, where the implementation of urban sustainability indicators can be appreciated and compared (L.-Y. Shen et al., 2011).

The nine cities were chosen by Shen et al., (2011) from both developing and developed countries and regions in the world, cities are Melbourne, Hong Kong, Mexico City, Taipei, Singapore, Iskandar, Barcelona, Chandigarh and Pune. In their sustainable urban development plans, the generalities of each city have presented the aim to show and identify the purposes, goals, boundaries and milestones, which can assist to produce a big picture of each of these cities. A template is used, which includes headings of “vision”, “action by”, “participants”, “term”, “date of launch”, “date of update”, “monitoring”, “focus areas”, “remarks”, as revealed in (table 4.4) in order to gather comparable valid information for comparison between cities. International Urban Sustainability Indicators List (IUSIL) are used to help in conducting a comparative analysis of these cities. Air pollutants indicators, which can be expressed by toxicity, quantity emitted or CO2 content for instance, due to that IUSIL must be clear and distinct indicators to avoid repetitions and a better classification (L.-Y. Shen et al., 2011).

Comparable attributes	Melbourne	Hong Kong	Iskandar
Name	City plan 2010	The HK2030 Study	Iskandar development region's comprehensive development plan
Vision	Towards a thriving and sustainable city	Asia's world city	A world class sustainable and environmentally friendly metropolis
Action by	Melbourne City Council	Hong Kong Government	Government of Malaysia
Participants	Government, academics and NGOs	Government, Professional Institutions, Academia and consultations to public	Government, Professional Institutions and Academia
Term Launched	10 years	30 years	–
Updated	2000	2000	2007
Monitoring	2005	2007	–
	2005 & 2007	Every year	–
Focus areas	• A connected and accessible city • An innovative and vital business city • An inclusive and engaging city • An environmentally responsible city	Economy, health and hygiene, natural resources, society and social infrastructure, biodiversity, leisure an cultural vibrancy, environmental quality and mobility • Provide a quality living environment • Enhance economic competitiveness • Strength links with Mainland China	• International rim positioning • Establishing hard and soft infrastructure enablers • Investment in catalyst projects • Establishing a strong institutional framework and the creation of a strong regulatory authority • Ensuring socio-economic equity and buy-in from the local population
Remarks	• Integrated planning framework • Triple bottom line: Economic prosperity Social equity Environmental quality	• Sustainable Development for the 21st Century in HK (SUSDEV 21) • Sustainability assessment system • Computer Aided Sustainability Evaluation Tool (CASET)	• Attract domestic and foreign investment • Five dimensions: Regulatory, social, physical, infrastructure and commercialization

Comparable attributes	Barcelona	Mexico City	Taipei
Name	Sustainable Barcelona	Plan Verde (Green Plan)	Framework for Measuring Taipei's Urban Sustainability
Vision	Barcelona towards urban sustainability	The greenest city in Latin America	Making Taipei a city with sustainability characteristics
Action by	Sustainable Barcelona Civic Forum	Government of Mexico City	Academics
Participants	NGOs, private and civil associations, and local authority	Government, Professional Institutions and Academia	Academia, Professional Institutions and NGOs
Term Launched	–	15 years	–
Updated	1995	2007	1998
Monitoring	–	–	–
	–	Every year	–
Focus areas	The efficient use of resources, avoid endangering people's health, biodiversity, diversified economy, service access, preserve the mixture of functions, gender equality employment, social work, establishment	Land conservation, Public space, Water, Mobility, Air, Waste, Energy	Ecological sustainability, water resources utilization, economy efficiency, resource self-sufficiency, environmental loading, living comfort, transport efficiency, environmental management, social welfare and public safety, education
Remarks	Barcelona City Council adopted the indicators in 1997	• Communication Instrument • 3rd largest metropolitan population in the world • Experts said in 2000: "Total collapse of Mexico City by 2010"	• Signals lights (green, yellow and red) • Never implemented

Comparable attributes	Singapore	Chandigarh	Pune
Name	Green Plan	City Development Plan of Chandigarh	City Development Plan of Pune
Vision	A model green city	The greenest city of India	An economically vibrant and sustainable city
Action by	Government of Singapore	Government of Chandigarh	Government of Pune
Participants	Government, Academia, Professional Institutions and NGOs, Public consultations	Government, Academia, Professional Institutions, NGOs, Public consultations	Government, Academia, Professional Institutions, NGO's, Public consultations
Term Launched	10 years	30 years	10 years
Updated	1992 & 2002	2006	2006
Monitoring	1999 & 2002	–	–
	Every 5 years	Every year	Every year
Focus areas	Air and climate change, water, waste management, nature, public health, international environmental relations, reduce the ambient particulate matter, improve carbon intensity, reduce per capita water consumption, generate awareness of water resources	Governance, poverty alleviation, economic development, environment, roads, water, solid waste management, transportation, city institutions, municipal finance	Water supply, sewerage, storm water, drainage, solid waste management, transportation and roads, slums and basic services, land use, river conservation, economic development, cultural heritage, urban governance
Remarks	• International awards for water management • Partner the 3P (public, private and people)	• Jawaharlal Nehru National Urban Renewal Mission (JNNURM) – 2005 • Mandatory consultations	• Jawaharlal Nehru National Urban Renewal Mission (JNNURM) – 2005 • Mandatory consultations

Table 4.4: Comparable Attributes of Nine Cities
Source: Source: (L.-Y. Shen et al., 2011)

USIs identified in each of the nine cities selected are subjected to a compliance analysis for each of the 37 categories included in IUSIL. The compliance analysis consists in determining which indicators from IUSIL have been involved in the individual cities, the results of the investigation are presented in (table 4.5), and the data in the table are also highlighted in various figures (i.e. Figs. 4.10e4.15) to facilitate the comparison analysis. A hundred percent represents full compliance with IUSIL in Figures 4.10-4.13, and the bars indicate the ratio of the included and similar indicators in each city to the total indicators included in IUSIL in each dimension accordingly. A hundred percent represents the totality of indicators in each city in Figures 4.13, and the bars indicate the proportional compliance of each aspect. The totality of categories included in IUSIL is represented in Figures 4.15, and the bars indicate the number of categories addressed by each city (L.-Y. Shen et al., 2011).

Category		Cities C1	C2	C3	C4	C5	C6	C7	C8	C9
Environmental										
En1	Geographically balanced settlement	✓	○	–	✓	○	✓	–	○	✓
En2	Freshwater	–	–	○	✓	○	✓	✓	✓	✓
En3	Wastewater	–	–	○	✓	✓	✓	✓	✓	✓
En4	Quality of ambient air and atmosphere	✓	✓	–	✓	✓	–	✓	✓	–
En5	Noise pollution	✓	✓	–	✓	✓	–	–	✓	–
En6	Sustainable land use	–	✓	○	○	✓	○	–	✓	○
En7	Waste generation and management	–	–	✓	✓	✓	✓	✓	✓	✓
En8	Effective and environmentally sound transportation systems	✓	–	–	✓	✓	–	–	–	–
En9	Mechanisms to prepare and implement environmental plans	✓	–	✓	–	✓	–	✓	–	–
En10	Biodiversity	✓	✓	✓	○	✓	–	✓	–	–
Economic										
Ec1	Consumption and production patterns	–	✓	○	✓	○	○	○	–	–
Ec2	Economic development	○	✓	✓	–	–	○	–	✓	✓
Ec3	Finance	–	–	–	–	–	–	–	✓	✓
Ec4	Water	✓	✓	–	✓	–	–	–	–	–
Ec5	Strengthen small and microenterprises	–	–	○	–	–	–	–	–	–
Social										
So1	Energy Access	–	–	✓	–	○	–	○	–	–
So2	Water Access	–	–	✓	✓	✓	✓	✓	✓	✓
So3	Education	○	○	–	✓	–	–	–	–	–
So4	Health	–	✓	–	✓	–	–	○	–	○
So5	Safety	–	–	–	✓	–	○	–	–	–
So6	Fire & Emergency Response	–	–	–	–	–	–	–	○	–
So7	Poverty	–	–	✓	○	–	–	–	✓	✓
So8	Transportation	✓	✓	✓	✓	✓	✓	–	–	✓
So9	Natural hazards	–	–	–	–	–	–	–	–	–
So10	Adequate housing	–	✓	✓	✓	–	○	–	–	✓
So11	Shelter	○	–	✓	–	–	○	–	○	✓
So12	Security of tenure	–	–	–	–	–	–	–	–	–
So13	Access to credit	–	–	–	–	–	–	–	–	–
So14	Access to land	–	–	✓	–	–	–	–	–	–
So15	Promote social integration and support disadvantaged groups	–	✓	✓	–	✓	–	–	✓	–
So16	Culture	✓	✓	○	○	–	–	–	✓	✓
So17	Recreation	–	✓	–	–	✓	–	–	–	○
So18	Availability of local public green areas and local services	✓	✓	○	○	✓	○	–	✓	○
Governance										
Go1	Participation and civic engagement	✓	✓	✓	–	–	✓	–	–	✓
Go2	Transparent, accountable and efficient governance	–	–	–	–	–	–	–	✓	○
Go3	Government	–	–	–	–	–	–	–	–	–
Go4	Sustainable management of the authorities and businesses	–	–	–	–	–	–	–	–	○

Keys: ✓ Included, ○ Similar, – Not included; C1 – Melbourne, C2 – Hong Kong, C3 – Iskandar, C4 – Barcelona, C5 – Mexico City, C6 – Taipei, C7 – Singapore, C8 – Chandigarh, C9 – Pune.

Table 4.5: Compliance of Cities with IUSIL.
Source: Source: (L.-Y. Shen et al., 2011)

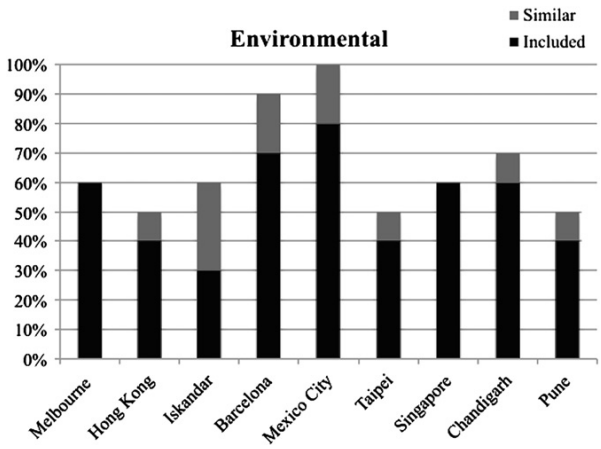


Figure 4.10: Environmental Dimension
Source: Source: (L.-Y. Shen et al., 2011)

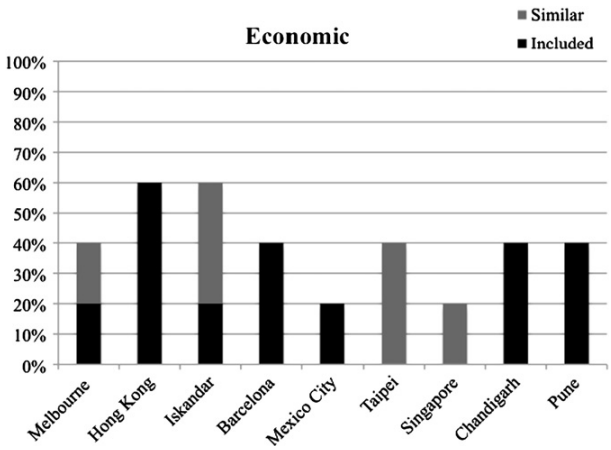


Figure 4.11: Economic Dimension
Source: Source: (L.-Y. Shen et al., 2011)

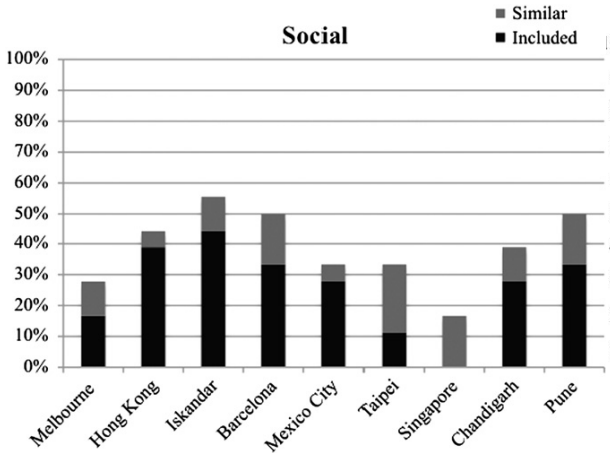


Figure 4.12: Social Dimension
Source: Source: (L.-Y. Shen et al., 2011)

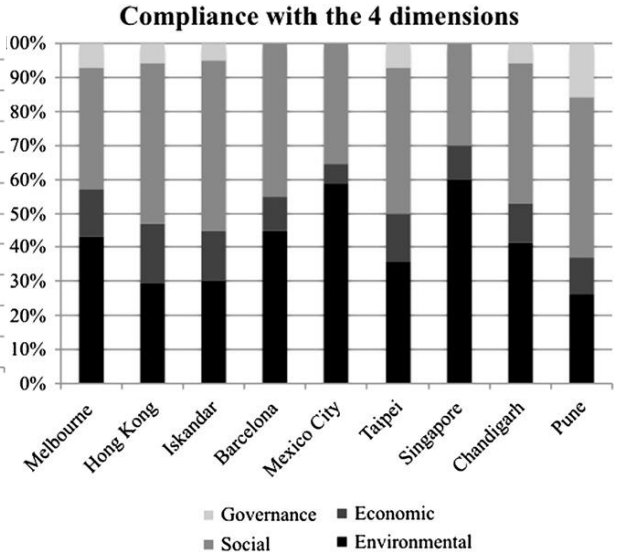


Figure 4.13: Compliance with the 4 Dimensions
Source: Source: (L.-Y. Shen et al., 2011)

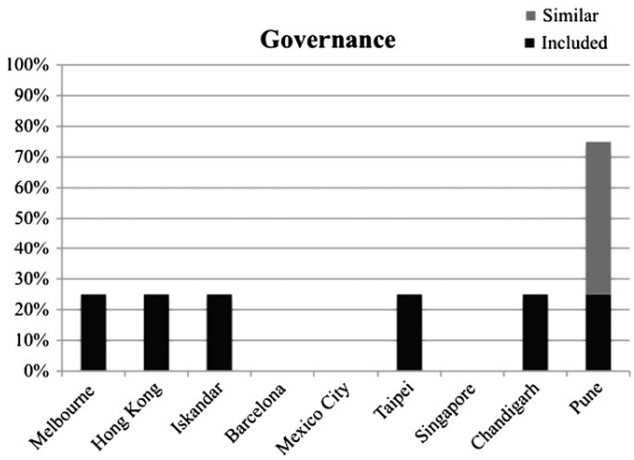


Figure 4.14: Governance Dimension
Source: Source: (L.-Y. Shen et al., 2011)

Figure 4.15: General Compliance
Source: Source: (L.-Y. Shen et al., 2011)

Several stories of the evolution of sustainable urbanisation plans are shown by various cities, the selection of urban sustainability indicators and their implementation. Under different circumstances, in a different time, and for varied purposes but by large these plans were developed after achieving sustainable urbanisation. The differences between cities also show the difficulties in implementing a combination of common urbanisation indicators.

The comparison between the nine cities can lead to the following general comments (L.-Y. Shen et al., 2011):

- The use of indicators is an important tool and has been widely adopted for assessing urban sustainability performance.
- Different indicators have been applied in various ways, the goal is the same, for achieving urban sustainability.
- A short list of indicators at the beginning of the application is recommended, and during later revisions, more indicators can be added or eliminated according to the emerging needs and gained experience in individual cases.
- Because of the differences between cities, the selection of indicators should be done with the clear understanding of the needs where these are going to be applied.
- The integration of short-term and long-term sustainable urban development plans should be encouraged and their continuity should be assured.
- Involvement of different sectors in the definition of objectives and strategies may represent an important step for obtaining the recognition and support when adding efforts to accomplish them.
- It is important to emphasize that any attempt proposing a set of objectives and strategies to be applied indistinctly in all communities can be arguable.
- Sharing experiences generated from different cities can eliminate the barriers that lead to the maturity of sustainable urbanization as a common city. This can be done through the use of a common comparative basis to differentiate the strategies and evaluate the results obtained from their implementation
- The continuous comparison of more cities can lead to the development of standard processes, which can be used to guide the development of particular plans, selection of indicators, objectives and strategies for implementing the sustainable urbanization practice in other communities.

4.8 Sustainable Cities Challenges

Managing the heavy dependence on ecosystem services is the main challenge for today's cities, which results in the depletion of natural resources and biodiversity and the efforts to mitigate and adapt to climate change while prioritising public health and quality of life. Science for Environment Policy state that "a sustainable city can only be one for which the inflow of material and energy resources, and the disposal of wastes, do not exceed the capacity of the city's surrounding environment. In other words, for achieving environmental sustainability urban consumption must match or be below what the natural environment — such as forests, soil and oceans — can provide, and the resulting pollutants must not overwhelm the environment's ability to provide resources to humans and other members of the ecosystem" (Science for Environment Policy, 2015).

Huang et al., (2015) argue that cities cannot possibly be sustainable by continuously increasing their material and energy consumption at the expense of its environment. The mention that the challenge of sustainable cities or urban region must preserve a level of local and regional biodiversity and ecosystem functioning to provide the most of the fundamental ecosystem services required for human well-being (L. Huang et al., 2015). The method of designing a sustainable city is a complex and multidisciplinary decision-making process, which is concerned with the management of a huge amount of data within the built and natural environment. The type of these data usually contain rich information about population, the economy, society and the environment within the various fields at the local and national levels and this data can be used in urban sustainability analysis. Sustainability and quality of life will be the main elements to evaluate this information that comes from different sources such as National Statistics, local councils, commercial survey companies and government departments (Cooper et al., 2009:243).

Nowadays, cities are facing several essential challenges regarding improving sustainable urbanism and development. One of these challenges is how to solve problems of unsustainable geographical expansion patterns and ineffective urban design and planning methods that have increased the number of slums areas, unsuitable delivery of essential services and inefficient resource use and poverty. Another challenge is that cities continue to be the primary contributor to the total greenhouse gas emissions that have led to the

global climate change. Therefore, if we want to achieve sustainable cities, we will need new visions of multilayered understanding of what a city might become. We will also need to depend on a wide-ranging selection of initiatives. Some of these initiatives will be top-down and demand powerful leadership and large-scale investment programs and other initiatives will be bottom-up and depend on shifts in actions. For example, the integration between individuals, businesses, and organisations regarding making sustainable choices will enable us to be more aware of the processes of sustainable urban development. This will be supported by technology, a suitable design of the physical environment, information and feedback. The critical thing for cities to face their future challenges is to move towards a sustainable future over both the moral and physical organisation of the city (Williams, 2010).

The multi-dimensional challenges to sustainable planning as UN-Habitat, (2016) debate are daunting. They indicate that there are several cities which have advanced promising models of environmental activity, to repair and maintain ecological balance, changing consumption and production patterns, developing ecological efficiency and striving for social equity. They assert that the city must fulfil universal access to essential services like waste management, energy, food water, sanitation, and mobility, which are fundamental to socioeconomic welfare, public health and the urban environment. UN-Habitat, (2016) display some essential differences between developed countries and developing countries in urban opportunities and challenges as it shown in (table 4.6). Moreover, they indicate that cities typically face four main types of environmental challenges, including three types of threat to, and one from, the natural milieu (UN-Habitat, 2016):

1- Effective equal access to resources and urban public services contributes to poverty alleviation.
2- Managing environmental hazards requires a risk-based approach, fully taking in the uncertainties inherent to environmental information and climate change.
3- The effects of urban expansion on land conditions make it impossible to consider any town or city in isolation, highlighting the need to recognize the variety of specific spatial connections and impacts (such as biodiversity loss and deforestation).
4 - A low-carbon world calls for changes to resource consumption and an effective if gradual shift to more sustainable societies.

Urban Opportunities and Challenges		
	Developed countries	**Developing countries**
1	Older stock of urban infrastructure and building, with associated decline and depreciation, with financial and environmental consequences. New York City for example has more than 1,000 miles of water pipe, which is more than 100 years old, while the Underground in London has similarly passed its centennial anniversary.	Low levels of infrastructure provision and little improvement, particularly in sanitation and road connectivity among cities.
2	More developed public and political institutions and local capacities, with higher levels of trained staff and municipal revenues, reflected in the share of local revenue as a portion of total public revenue.	Weak urban governance and poor provision of public goods. Weak municipal finance, with low revenue base.
3	More defined urban spatial structure including residential segregation by income, spatial sprawl with higher demand for transport and mobility, such as in suburban Paris.	Ineffective housing policies, and particularly poor urban planning, with resulting high shares of urban residents living in slums.
4	Greater installed economic interests and productive capacities, reflecting historical legacy of industrial revolution, with higher levels of accumulation and capital formation. The downside of this legacy is associated with vulnerability to changes in global economy, deindustrialization, and higher unemployment, examples such as Detroit or Spain.	High levels of urban poverty, growing levels of intra-urban inequality, and marginalization of various groups including women.
5	Established modes of urban finance and resource mobilization with higher accountability levels.	Poor provision of green and public spaces, including streets networks.
6	Important levels of human capital investment, particularly at higher levels of education.	De-densification of urban areas resulting in urban sprawl and increasing demand for transport.
7	Populations who are increasing their average and median ages, leading to the need for new kinds of social policies to meet their particular requirements in health care, transportation, or leisure, to mention a few.	Low levels of human capital and declining environmental quality
8	New forms of marginalization, particularly with the lack of economic opportunities for increasing shares of youth and immigrants within their urban populations.	Slow growth of formal sector employment, with high levels of informality and unemployment, particularly among youth
9	Slowing down of rates of demographic growth due to lower birth rates, which in turn often reflect reduced economic growth.	Continued rapid urban demographic growth.
10	large waves of immigration to Western Europe from Africa, the middle east, and eastern Europe, as well as continued high immigration to the Us from Latin America.	Weak ability to prepare for and withstand disasters. Weak management of potentially productive rural urban linkages.

Table 4.6: Urban Opportunities and Challenges
Source: Author 2016 according to (UN-Habitat, 2016)

4.9 Sustainable Cities of the Future

The World Bank and International financial institutions (IFIs) are active participants in future cities forming future urban development over their lending policies. IFIs indicate through using the term sustainability frequently in relation to their future cities investments not only low-carbon ambitions but also imply cities that are well administered, well designed and efficient. United Nations estimates 70% of the world population will live in global cities by 2050 (figure 4.16). Therefore, cities are experiencing the greatest urban transition the world has ever seen, accounting for 80% of global carbon dioxide emissions, consuming over two-thirds of the world's energy, and producing 1.3 billion tons of waste per year. Leaders, governments, architects, urban designers, developers, planners and business leaders need to make decisions and find solutions for how billions of urbanites will live in the future (Normisur International, 2014). Nevertheless, the crucial questions are how these cities are designed and managed? How they affect our environment? Will they promote our local, national and international economies? How can cities lead economic growth, while sustaining natural resources, reducing greenhouse gas emissions and developing the quality of life?

Our assessment of the past and our expectations for the future will determine strategic decisions about urban infrastructure and development management. Mersal, (2016) argue, "How we think about the future has important consequences for how we define the problems to be addressed and how we search for solutions. Traditional approaches to planning and management typically rely on predictions of probable futures extrapolated from past trends. Planners and managers need to rely on a much broader and diverse knowledge of the past to build a view of the long now" (figure 4.17) (Mersal, 2016).

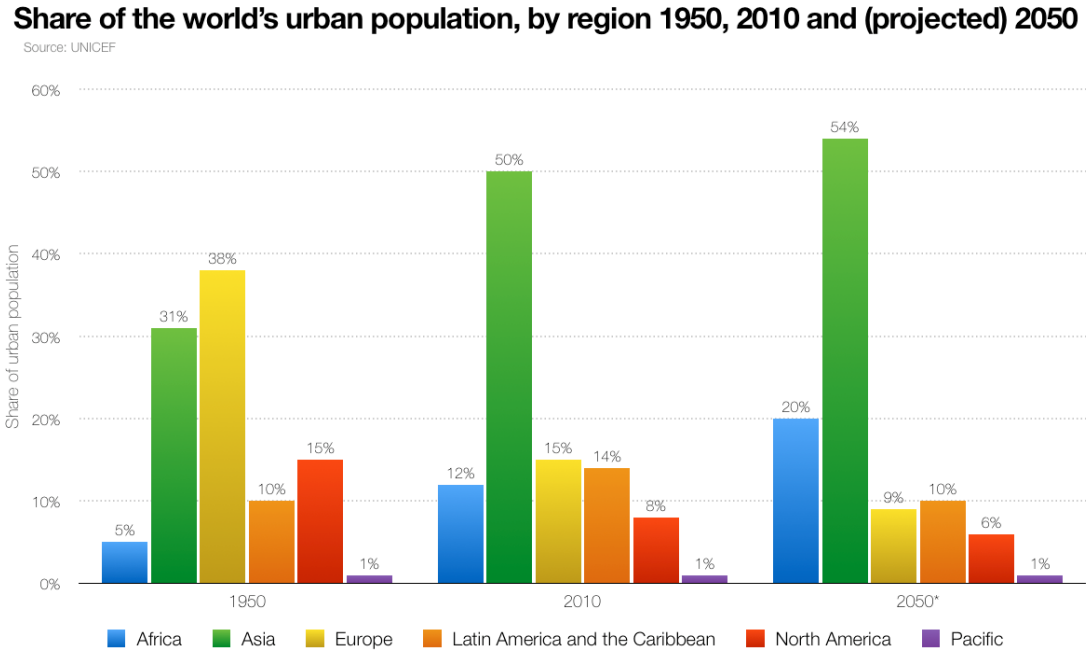


Figure 4.16: The world population projections by UN.
Source: http://blog.megafounder.com/blog/smart-cities-sustainable-future/

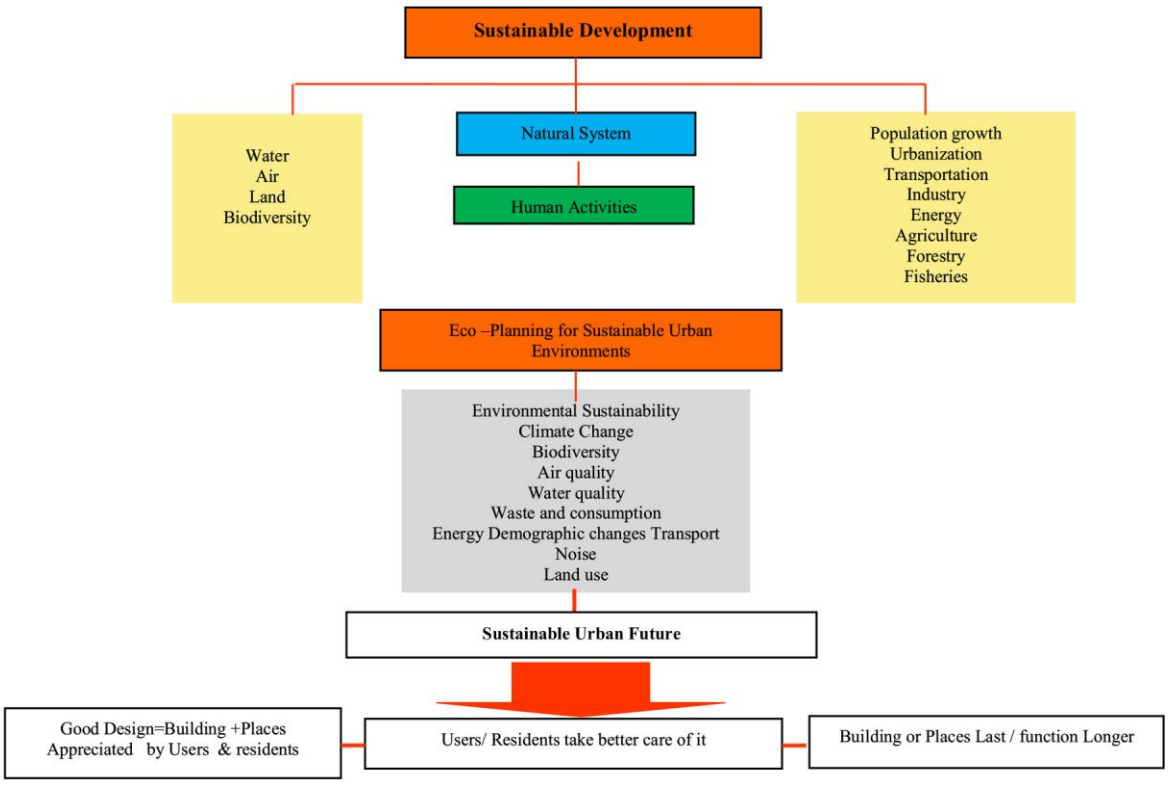


Figure 4.17: Sustainability Urban Future
Source: (Mersal, 2016).

The substantial thing is to realise what we need for our future cities, and put in place systems now that serve those future requirements in a sustainable and integrated way. "Despite initial attempts to consolidate future cities lexicon into a globally agreed set of terms, there is still no established and authoritative set of meanings. Smart cities, for example, are still associated with either sensor and household data, integrated citywide systems management, or the social and economic knowledge of citizens. Liveable cities may refer to cultural and diversity assets, environmental quality, or even daily convenience. Sustainable cities may signal low-carbon energy usage, green space, and transport, or neighbourhood participation" (figure 4.18&4.19) (Clark et al., 2014). In other words, the main ideas of future cities are still not yet determined. The decisions made by corporations are driven by competitive dynamics while those made by governments and decision-makers often represent aesthetic and political decisions rather than a clear understanding of distinct meanings.

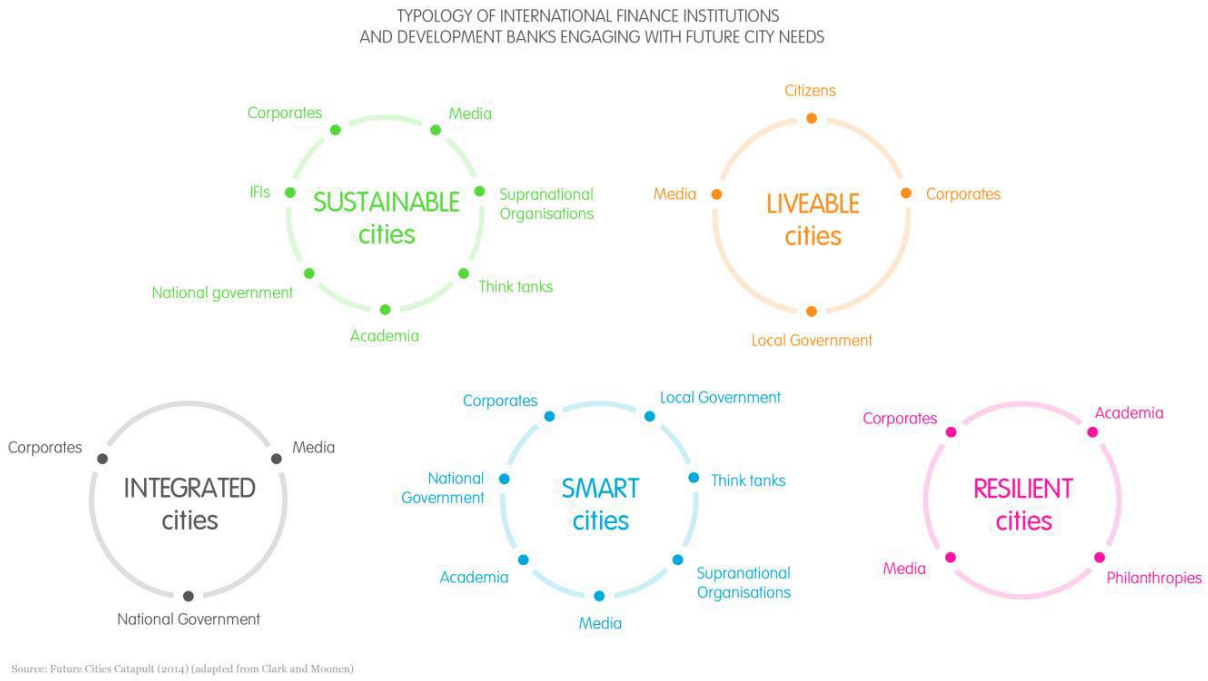


Figure 4.18: Most common phrases of "Future cities"
Source: (Clark et al., 2014)

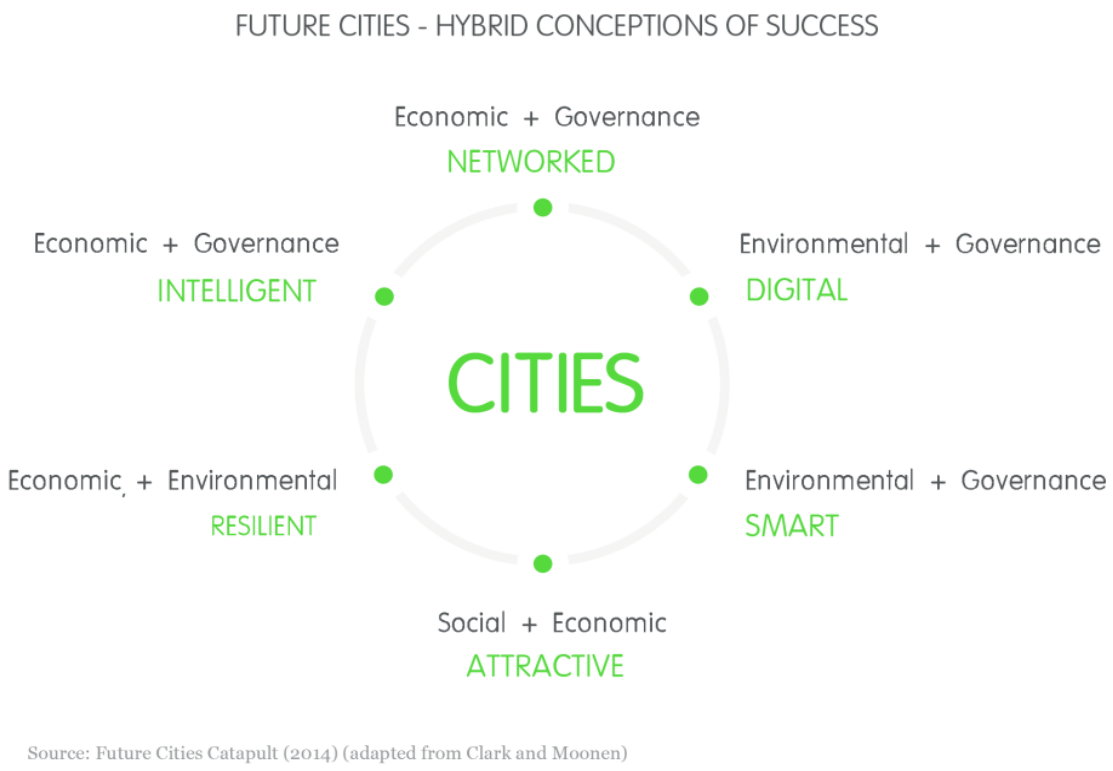


Figure 4.19: Future cities – hybrid conceptions of success
Source: Source: (Clark et al., 2014)

Cities as Palacio, (2015) asserted are complex systems and determining the urban features that enhance sustainable societies can be an intricate task. The contemporary city is at the same time the place of economic production, social (human) well-being, and environmental quality (Palacio, 2015). Mori & Yamashita, (2015) point out that the minimum demands for achieving sustainability are to fulfil all the constraints and to maximize economic and social benefits to promote quality of life as far as is sustainable regarding environmental limitations and socio-economic equity (Mori and Yamashita, 2015). The sustainable city has been defined in different ways, with various criteria and emphases (table 4.7).

	Definitions of Sustainable City	Source
1	Five goals that make sustainable city: minimizing the consumption of space and natural resources; rationalizing and efficiently managing urban flows; protecting the health of the urban population; ensuring equal access to resources and services; maintaining cultural and social diversity.	Huang et al., (2015) According to European Environment Agency (Stanners and Bourdeau 1995) (L. Huang et al., 2015)
2	The sustainable city can be seen as a city that can provide the basic needs of city inhabitants such as infrastructure, civic amenities, health and medical care, housing, education, transportation, employment, good governance and ensure the populations needs are met benefiting all sectors of society. sustainable city is vital in controlling the development of a town based on the quantity and quality of infrastructure and facilities are sufficient to avoid other problems, for example lack of housing in urban areas that will cause squatter settlements.	(Ibrahim et al., 2015)
3	The sustainable city is the city that maximizes socio-economic benefits measured by economic and social indicators under relevant constraints measured by environmental sustainability indicators and socio-economic indicators of distributional equity.	(Mori and Yamashita, 2015)
4	A sustainable city is a city where achievements in social, economic, and physical development are made to last and where there is a lasting supply of the natural resources on which its development depends. Furthermore, a sustainable city maintains lasting security from environmental hazards that may threaten development achievements by allowing only for acceptable risk.	Huang et al., (2015) According to the United Nations Centre for Human Settlements (Habitat) (1997) (L. Huang et al., 2015)
5	A sustainable city is one which succeeds in balancing economic, environmental and socio-cultural progress through processes of active citizen participation.	Huang et al., (2015) According to Mega and Pedersen (1998) (L. Huang et al., 2015)
6	A city moving toward sustainability improves public health and well-being, lowers its environmental impacts, increasingly recycles its materials, and uses energy with growing efficiency.	Huang et al., (2015) According to World watch Institute (2007) (L. Huang et al., 2015)
7	A sustainable city is one that can provide and ensure sustainable welfare for its residents with the capacity of maintaining and improving its ecosystem services.	Huang et al., (2015) According to Zhao (2011) (L. Huang et al., 2015)
8	A sustainable city is one in which the community has agreed on a set of sustainability principles and has further agreed to pursue their attainment. These principles should provide the citizenry with a good quality of life, in a livable city, with affordable education, healthcare, housing, and transportation.	Huang et al., (2015) According to Munier (2007) (L. Huang et al., 2015)
9	A sustainable city is a city constructed or landscaped in such a way as to minimize environmental degradation, with facilities (such as transport, waste management, etc.) which are designed so as to limit their impact on the natural environment, while providing the infrastructure needed for its inhabitants.	(Lee et al., 2016)

Table 4.7: Definitions of Sustainable City
Source: Author 2016

4.10 Towards Sustainable Urbanism in the historic part of Baghdad

At the district scale, narrow organic alleys, with a homogeneous arrangement of housing plots, characterise the traditional urban fabric of Baghdad. There are four historic areas in the modern city of Baghdad: Rusafa, Karkh, Adhamiya, and Kadhimiya. All these areas are well defined by their unique urban fabric and surrounded by modern urban pattern and by modern roads, which replaced their walls. Narrow alleys, natural shading, high density/low rise living, public spaces, mixed-use, human scale, privacy, walkable and natural environment are the most significant features in the historic part of Baghdad (figure 4.20). These qualities provide an extraordinary base to implement smart and sustainable standards. The characteristics of the old urban fabric represent the main principles of environmental sustainability and show us how individuals in the past built a sustainable environment to face the harsh climate. They achieved by their design equity, clean environment, efficient use of resources, safety, low use of energy and low rate of pollution. Smart sustainable urban design should be able to provide appropriate solutions to regenerate the traditional fabric regarding urban form, land use, local environment, transportation, and create a new vision to deal with the social and economic processes. Consequently, our challenge is to find a comprehensive theory that can serve as a platform to resolve the conflicting values of traditional urban form and modern design models, sourcing new sustainable technologies, the improving efficiencies of current technologies and the integration of the infrastructure systems.

Various proposals have emerged in recent years for the construction of the eco-cities and smart cities such as Barcelona smart city and Masdar City as an eco-city development in the United Arab Emirates. In contrast to the historical area in Baghdad city, which has evolved and transformed through complex processes (since its founding in 762 AD), Masdar City is planned as a model of urban environmental sustainability based on a master plan designed by the British firm Foster & Partners in 2007 (figure 4.21). The reinvention of the traditional Arabic city is the main concept of Masdar City where the person, not the car is the essential element. According to Masdar City's official website Masdar City will house around 1,500 clean-tech companies, with 40,000 residents and 50,000 commuters and will cover an area about six square kilometres. It will provide a high quality of life by bringing together all of the functional aspects of a modern city and reducing the

environmental impact through achieving zero waste, clean-tech cluster, powered by 100% renewable energy, being carbon neutral and fossil fuel free zone. Masdar City will be a base for the establishment of clean and sustainable technologies and will provide a platform for promoting technologies such as photovoltaics (PV) for producing energy and personal rapid transit (PRT transportation).

Despite being planned as one of the world's eco-cities, however, some fundamental obstacles and questions are facing Masdar City to ensure the success of such an attempt. One of these questions who and why would people choose to live and work in this city? Are those residents able to afford the cost of living in Masdar City? 20% of Abu Dhabi's population are nationals, and the rest are workers who come from all over the world to work in UAE. The income for these labourers is less than a third of national families, showing there are a significant gap and inequality between the emirate's residents. Because of this gap and the lack of planning for affordable housing, only rich people will be able to live in Masdar and the rest as commuters who will come just for work. The second concern is how Masdar city will be useful in decreasing the UAE's greenhouse gas emissions as a whole. The United Arab Emirates have the biggest per capita ecological footprint and the second highest per capita greenhouse gas emissions in the world (Stilwell and Lindabury, 2008). Another significant concern is there are several firms, which have expressed interest in opening offices in Masdar City, which is driven by profit from the short-term construction of the city, with no clear vision of maintaining a long-term presence. Therefore, any global financial crisis besides the stringent labour laws in the UAE will affect the long-term success of Masdar City (Reiche, 2011). These flaws of the Masdar Initiative can be avoided in other initiatives and even if Masdar city as a whole is not a useful model for the existing city it will be useful to model parts of the Masdar Initiative, such as the PRT system or the widespread deployment of solar and zero waste technologies for other cities like Baghdad. These technologies are in the process of development, and if Masdar city shows that they will work and are cost-effective, these technologies can then be implemented on a larger scale throughout the world (Stilwell and Lindabury, 2008).

Figure 4.20: Urban Pattern in the Historic Part of Baghdad
Source: Author According to the Mayoralty of Baghdad 2016

Figure 4.21: Masdar City – Growth Plans for a Sustainable Neighborhood
Source: (Wagle, 2014).

4.10.1 Sustainability in Traditional urban fabric

The organic urban fabric in Old Rusafa was the first step for sustainable thinking. This was materialized in urban design and its components features such as compact urban fabric, unique design houses, narrow alleys, natural shading, privacy, mixed-use, human scale, walkable and natural environment (figure 4.22). The complex urban structure in the historic part of Baghdad provides a great example of how to avoid the hot and dry weather during summer, sand storms and to minimise the thermal load on the buildings envelopes especially houses (figure 4.23). The main aim in these areas is to reduce the internal daytime temperature and to produce shaded exterior living space. The compact city of narrow alleys and traditional Baghdadi houses are oriented in a defensive posture against the wind-borne dust, and the direction of the sun must be determined for all hours of the day at all seasons also the direction of the prevailing winds, especially during the hot season (Al-Zubaidi, 2007). Traditional compact urban fabric with attached traditional houses provided protection, privacy, a suitable and healthy environment for residents, especially within the neighbourhood community. Privacy, comfortable environment and safety in traditional areas were preserved in many planning, and design solutions as the main neighbour rights and these are the first stage to live in a sustainable urban area. The main features of the traditional urban fabric did not begin in the Abbasid period but date back to the historic city of Ur in Mesopotamia 2000 BC (figure 4.24) (Al-Silq, 2008).

Figure 4.22: A Narrow Alley with Natural Shading in the Historic Part of Baghdad
Source: Author 2016

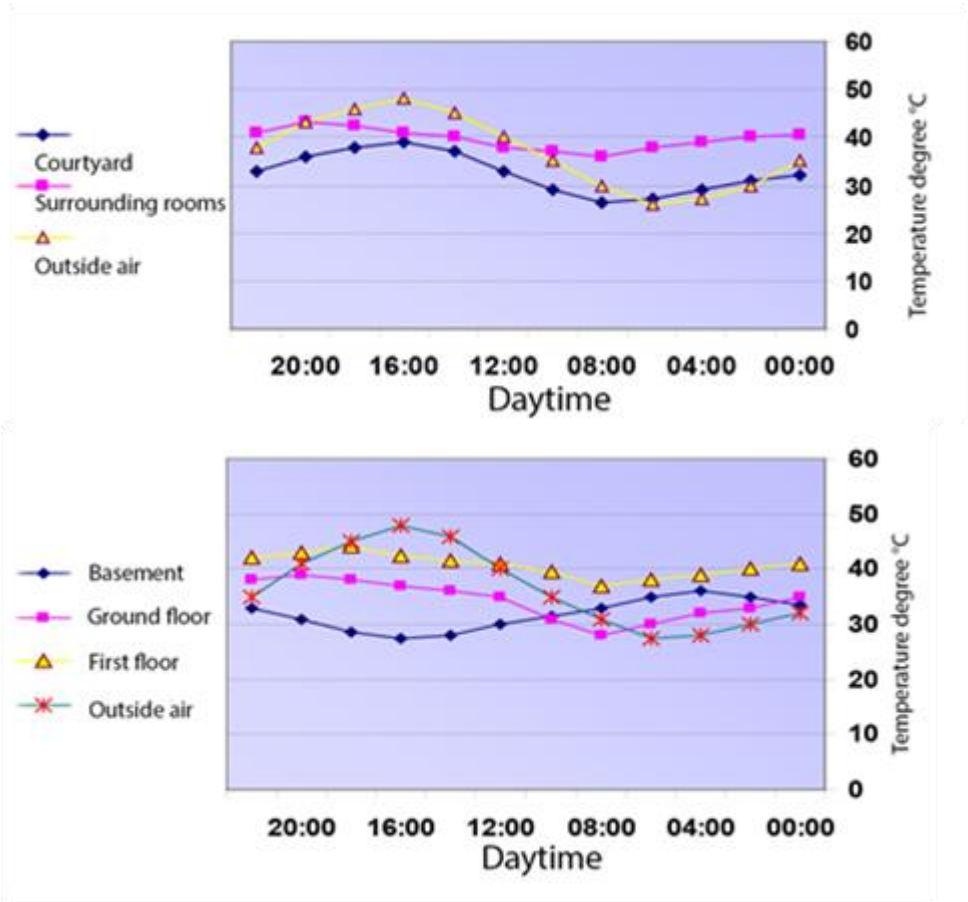


Figure 4.23: Temperature Degree in Traditional Baghdadi House
Source: (Al-Zubaidi and Shahin, 2008).

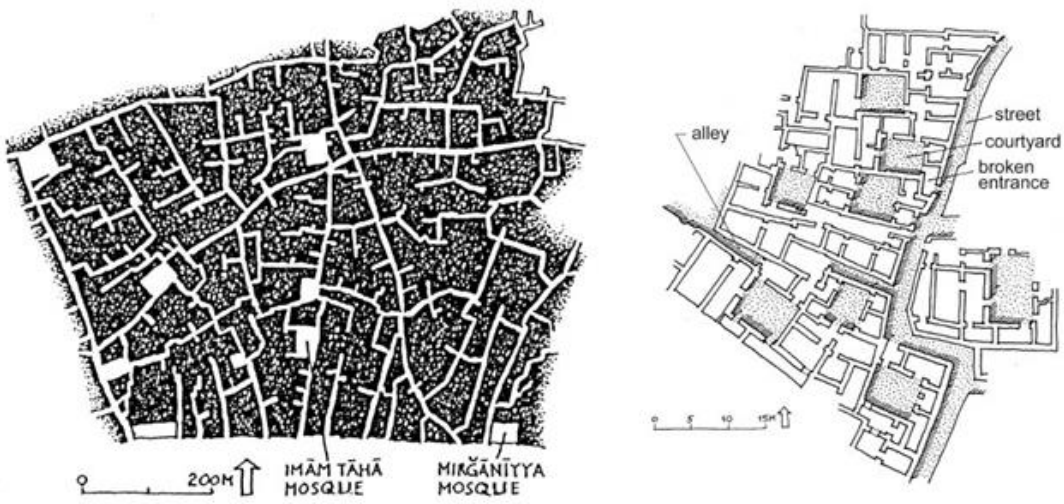


Figure 4.24: Central part of Baghdad with neighbourhood squares, Neighborhood in Ur, 2000 BC
Source: (Ragette, 2003).

4.10.2 Sustainability in Traditional societies

Traditional societies in Old Rusafa have explored the concept of urban sustainability in the way of their living, and they cleverly consider climate as an essential element and become a part of their cultural environment in creating urban form. They have used materials available in their surrounding environment and achieved a sustainable urban form that can cope with climatic conditions and at the same time reduce the impact on the environment. These principles would cover a wide variety of issues including environmental, urbanism and energy-saving features. Klinker emphasises that the traditional policies could be the base or the link to more environment-respected (Kennedy, 2004:7). The essence of sustainability in the traditional urban fabric of Old Rusafa is not because of the type of buildings, but it is a way of life. The connection between the three dimensions of sustainability (environment, society, and economy) and the principles of the traditional urban form (stable temperatures and natural ventilation with zero environmental impact) in the historic area of Baghdad have created a new way of thinking and acting responsibly towards the surrounding environment and cultural values. Bianca believes that there is an interaction between what people build and what they believe, mentioning that man structures his environment and is influenced by it in his attitudes as a result of interaction with it over time (Bianca, 2000:22).

4.10.3 Sustainability in Traditional Baghdadi Houses

A dense grouping of courtyard houses with narrow alleys has let to create urban sustainability in the traditional fabric. The main strategies in Baghdadi houses are privacy, protection, equity and efficient use of resources. These strategies affected the urban pattern, spatial relations, and the house layout. The Baghdadi houses derive light and air from their internal open spaces and allow individualised control of the built environment in these traditional areas (Figure 4.25 A) (Ragette, 2003:50). Courtyards play a fundamental role in controlling the internal and external environment, a thermal regulator that prevents direct sunlight in the daytime, this will allow the cool air to rise and leak out of the surrounding rooms. During this time, the courtyard now begins to act as a chimney, when the outside temperatures are highest. Afternoon convection currents are set up, and the courtyard floor and the internal environment of the house get warmer. The narrow alley

and courtyard are protected by shadows of adjacent structures during the late afternoon. In the sunsets, the courtyard will start to radiate rapidly to the clear night sky, and the air temperature will fall rapidly. Then, the cool night air descends into the courtyard and fills the surrounding rooms and completing the cycle (Figure 4.25 B) (Al-Zubaidi, 2007). Therefore, these processes and strategies have proved that urban sustainability can be achieved by using traditional principles and methods to reduce the impact on the environment.

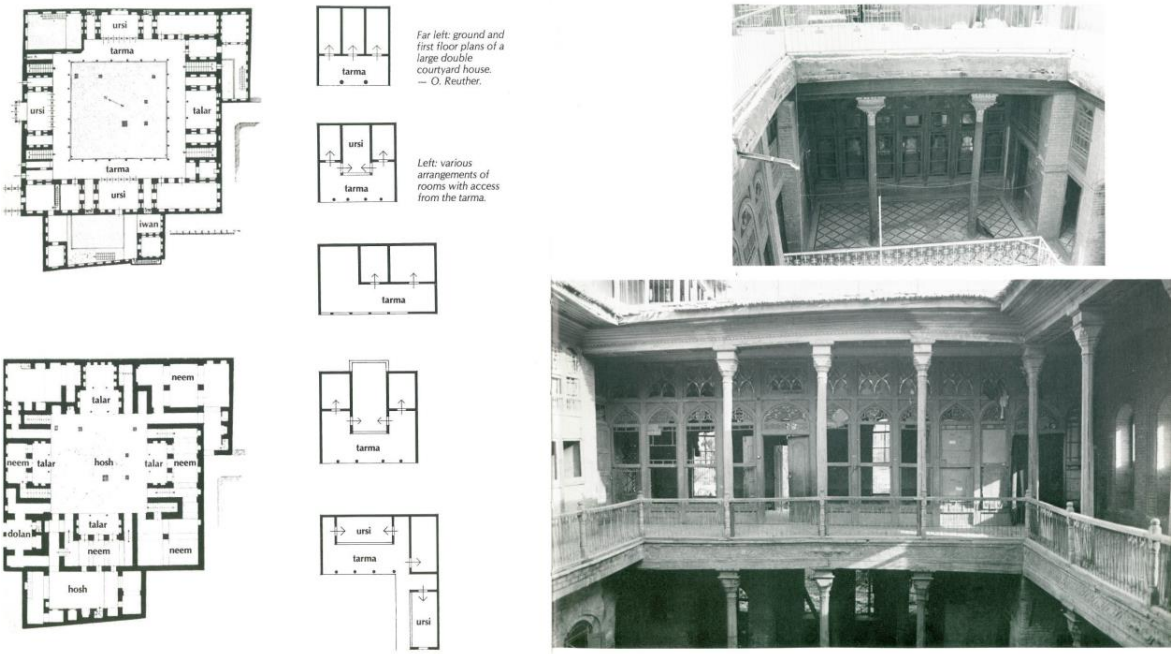


Figure 4.25 A: Central Open Courtyard as the Focal Point of the Family's Social Interactions (A Traditional house in Baghdad)
Source: (Warren and Fethi, 1982:69).

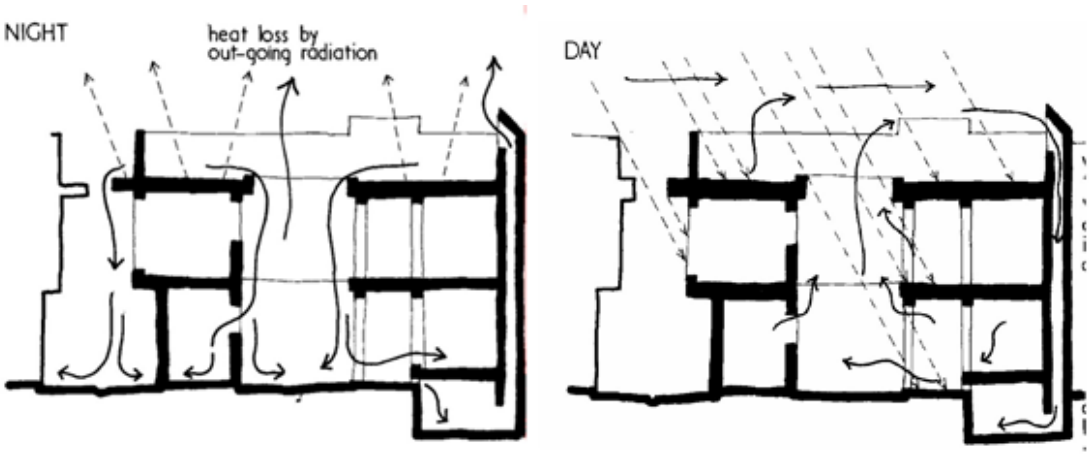


Figure 4.25 B: Thermal Performance of the Courtyard in a Traditional House
Source: (Al-Zubaidi, 2007).

4.10.4 Sustainability in Using Materials, Natural Ventilation and Basement as Thermal Mass Effect Cooling Strategy

Traditional houses and building materials, such as brick, tree trunks, clay, and wood are natural, and they are low in embodied energy and toxicity. These traditional materials are local and appropriate to climatic conditions and can naturally make the comfortable internal environment and obtain the potential of urban sustainability. Traditional houses materials are low embodied energy, recyclable, reusable, energy efficient and environmentally sustainable. Furthermore, they were perfect thermal insulators when utilised as thick walls with minimum external openings (Al-Zubaidi, 2007).

Natural ventilation in the traditional urban fabric in old Rusafa was one of the main cooling strategies was used to provide a suitable internal climate through evaporative cooling. Narrow alley and traditional Baghdadi houses are oriented concerning dominant wind. Wind towers (badgirs) is the primary natural ventilation features and play a fundamental role in basement “sirdab” and courtyard as a complementary natural ventilation system for traditional Baghdadi houses (figure 4.26). The basement as a thermal mass had been used in traditional houses of Old Rusafa for a long time to cope with the hot and dry environment. These houses contain subterranean air tunnels or streams connected to the basement by a vertical shaft to cool the internal spaces (Fathy et al., 1986:89). These strategies have utilised natural resources to achieve urban sustainability in the traditional urban fabric.

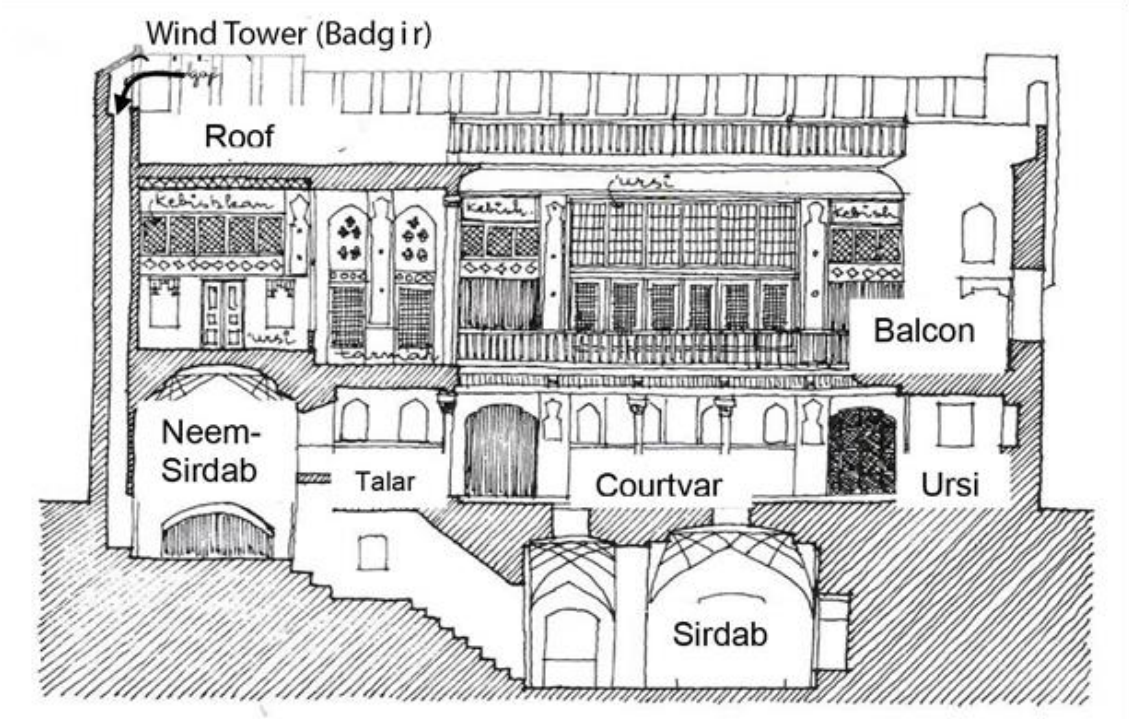


Figure 4.26: Cooling Strategy: Basement and Wind Tower (Badgir) - Traditional House in Baghdad
Source: (Al-Zubaidi, 2007).

4.11 Discussion and Conclusion

The expansion of urban development and changes in cities are the main drivers of global environmental change and are unavoidable aspects of socio-economic development in different cities (Kuo and Tsou, 2015). The capability of a region's development through sustainable urbanisation in the future is the objective and the potential of urban sustainability. It is crucial to evaluate the urban sustainability potential of a region to reach sustainable urbanisation, and the results will be beneficial for policymakers to advance scientific assessments (Shiwei et al., 2016). Several ways and approaches have been identified by scholars to steer the practice of sustainable urbanisation. The majority of cities in the world have developed vastly and have witnessed growing environmental problems in recent decades, and that has produced a broad discussion on urban sustainability and development. Sustainable development demands resource, socioeconomic, and environmental balance, it also must consider each city's situation and features to improve urban planning and development. To move toward sustainability, the city must use resources adequately, decrease environmental impacts, improve social

conditions, and guarantee economic growth and development (Alfonso Piña and Pardo Martínez, 2016).

Interactions of the complex and multi-spatial scale of the city with their local, regional and global environments demand that urban sustainability can be assessed in a way that reflects and accounts for this complexity. The dynamic of any assessment tool relies on information availability that evolves worldwide, due to the gap between the information available today and what is required to assess urban sustainability will reduce, and the number of cities that can be involved in comparative analyses will increase (Stossel et al., 2015).

It is very important to propose a framework that provides the foundations to produce a comprehensive measurement tool that accounts for the central essence of cases that are common to all cities where sustainability is concerned such as urban sustainability, sustainable urban form, equity, quality of life, and efficient use of the resource. This framework accounts for the various optional norms that are pertinent to urban sustainability in every city but might take different forms because of location and regional resources. This will allow the city to determine relevant cases in their own context and assess unique local situations that will have a big influence on long-term sustainability (Srivastava, 2016).

Three other are methods explicitly included in policy by King, (2016) by using urban performance data to drive public policy, firstly, improving technical capacity, secondly, empowering views through enhanced reliability of facts and thirdly, changing the terms of normative discourse on topics in urban policy. We have seen a massive growth over the last recent years in understanding the utility of sustainable development as a paradigm for all sectors of society. Governments, businesses and communities have considered the values embodied in sustainable development as suitable to meet their requirements. Sustainable urban indicators are also being improved to assess the condition of growth and determine gaps in development services. Nevertheless, these indicators have been presented by some local governments as background studies secondary to the sustainability plans being improved. Hence, they fail to utilise the full benefit of employing SUIs and to exploit for themselves the wealth of benefits from more programs that are robust and can

be actualised. King, (2016) highlights a misconception as to how SUIs should be utilised and what the functions they might play. Understanding of various functions of SUIs aside from solely performance metrics should help to correct that gap (King, 2016).

Indicators play a significant role as far as urban sustainability is concerned in showing in what fields cities are doing better than in others and according to their specific objectives. Sustainable urban indicators should participate in making the city's sustainable development more visible and transparent, provide decision-making with relevant information, stimulate communication, help construct and harmonise data banks, aid in comparison, evaluation and prediction, and promote citizen empowerment and participation. Sustainable urban indicators must be evolved utilising indicator values from cities that might be categorised as a sustainable megacity based on its performance against different indicators. Hiremath et al., (2013) emphasise that any study in SUIs should concentrate on the specific goals (Hiremath et al., 2013):

1- Developing sustainable urban indicator variables spanning all the relevant sectors of a typical megacity.

2- Developing a benchmark sustainable indicator-base for a selected megacity.

3- By adopting the same methodology and the same indicators develop the database for the city.

4- Comparing and evaluating the indicator data and benchmarking indicator database using a “gap analysis” approach.

5- Suggesting appropriate policy measures and implementation strategies to bridge the identified gaps to attain the goal of sustainable urban system.

6- The household, industrial, commercial and transport activities should be examined in the context of resource utilization and benefit sharing. This will participate to the design of policies, tools, and methods fundamental for planning in order to achieve the aim of sustainable development and social cohesion of metropolitan regions (Hiremath et al., 2013).

L.-Y. Shen et al., (2011) point out that because of the differences between cities, the selection of indicators should be done with the clear understanding of the requirements where these are going to be applied. They indicate that it is significant to confirm that any endeavour proposing a set of goals and plans to be utilized indistinctly in all communities can be arguable. On the other hand, to eliminate the barriers that lead to the maturity of urban sustainability as a common practice will require sharing experiences generated from different cities. This might be achieved by using a common comparative basis to differentiate the plans and assess the outcomes attained from their implementation. (L.-Y. Shen et al., 2011).

The centre of the whole of Baghdad is Rusafa, and due to that, its historic fabric has been under pressure from modern growth and has lost so much from its structure. The search for sustainable urban form today requires a reorientation of the search for a number of sustainable urban forms which respond to a variety of existing settlement patterns and contexts. The finding of this research provides insights into the cases that urban designers, policy-makers, technology companies and governments should consider in devising regeneration solutions and endeavours dealing with historic cities, aiming to integrate traditional principles with contemporary needs and provide a new vision for rethinking the way cities are designed, built, and managed. The primary implications are summarised in two outcomes, the implementation of the sustainable urban design in a historic environment and the degree of amenability of the historic centre (Old Rusafa) for sustainable regeneration.

Traditional urban fabric in Old Rusafa had achieved urban sustainability by implementing natural environment through compact urban planning, narrow alleys and their orientation, shading passageways and attached buildings. Furthermore, urban sustainability in Old Rusafa had been achieved by utilising natural materials that can reuse it again, using renewable energy and natural ventilation. The natural environment of the Tigris River, where Old Rusafa is located, includes some significant buildings, mosques, traditional suqs and private houses that emphasise the urban fabric identity and its urban sustainability. For a future vision, a considerable effort is required to regenerate urban heritage conservation principles under the light of the new policies of sustainable urban design. Finally, governments, planners, architects, urban designers, companies and professionals should

improve urban design strategies, qualities codes, and building regulations towards urban sustainability, heritage values, and cultural environments. Encouraging people to participate in decision-making and increasing public awareness about urban sustainability.

4.12 Chapter Summary

This chapter contains the literature review around the subjects of sustainability, urban sustainability, sustainable urban form, and sustainable cities. It provides a review of the origins of these subjects, along with different definitions of each that are commonly cited in the literature. It concentrates specifically on urban sustainability and the evolution of cities, along with a review of common challenges and barriers. This chapter has investigated and analysed the some of the existing environmental sustainability assessment methods and formulated in IUSIL that will be used for assessing environmental sustainability performance for chosen traditional urban fabric in Old Rusafa that will be an empirical study for this research. Formulating IUSIL is the first step in advancing sustainability environmental measurement method appropriate to Baghdad city, which is one of this research aims. The argument of this chapter also concentrates on the comparative analysis of a number of cities in using urban sustainability indicators. This assessment and comparative of various cities provide an objective base to develop a set of assessment method appropriate to Baghdad city and especially to Old Rusafa.

CHAPTER 5: SMART CITIES

5 Introduction

This chapter explains the term smart city and describes the main components of the smart city concept. It elaborates on some challenges encountered in the implementation of smart cities projects and the role of ICT and IoT in addressing them. This chapter provides some fundamental design principles for smart cities and policy approaches and concludes the chapter with a summary of the findings and suggestions. It will examine the literature review of key texts of the smart city concept in different places. By exploring the smart city concept what is meant both analytically and philosophically will advance and support this thesis to create an appropriate smart sustainable framework for Old Rusafa. This chapter will respond to the study aim two and question two section A (page 3).

The move towards a smart city is currently a trend for major cities in the world. Half of the world's population is currently residing in cities, and it is expected that this number will rise to 70 % by 2050. The city as a centre of human civilisation cannot be separated from problems related to excess capacity and a matter of convenience. More and more people are moving from rural to urban areas which increasingly poses new problems in the city (Purnomo et al., 2016). The origin of the concept of smart cities as Höjer and Wangel, (2014) mention can be traced back to at least the smart growth movement of the late 1990s, and namely from what they call the “cybernetically planned cities” of the 1960s, and in proposals for networked or computable cities in urban development plans from the 1980s onwards (Höjer and Wangel, 2014). Marsal-Llacuna et al., (2015) assert that the idea of smart cities is only becoming widely known after 2009, and even today it is still a somewhat ‘fuzzy’ concept. They point out that the smart city concept has developed out of livable, creative, digital and knowledge cities, drawing heavily on the idea of the sustainable city and having in common a large technological component (Marsal-Llacuna et al., 2015). Li et al., (2016) debate that due to challenges facing contemporary cities of losing their previous features, the concept of the smart city has become remarkable as a significant policy to reshape our behaviour towards the built environment (Li et al., 2016). Battista et al., (2014) emphasise that the smart city concept might be an applicable solution and play an important role to determine technologies and innovations that allow us to promote socio-economic and environmental development (Battista et al., 2014).

5.1 Smart Cities

In the 1970s, the concept of smart cities has emerged, "when urban contexts adopted a digital configuration that focused on technologies and non-material structures embedded in the physical space of the city" (Bifulco et al., 2016). M. Batty et al., (2012) also confirm that during the last decade the concept of smart cities has also emerged as a fusion of notions about how ICT might promote the functions of cities, improving their efficiency, advance their competitiveness, and producing a new way to realize and analyse problems of poverty, social deprivation, and poor environment. Smart cities are usually pictured as combinations of tools across many levels that are connected over multiple networks that produce continuous information regarding the movements of individuals and materials in terms of the flow of decisions about the physical and social form of the city. Nevertheless, cities can only be smart if there are networks that can combine and analyse this information to advance the efficiency, sustainability and welfare in cities (Batty et al., 2012).

The United Nations, (2016) mention that it is essential to analyse different definitions of the term smart cities to reveal and emphasise various aspects. Governments and stakeholders require working together as UN advance a common understanding of what smart city means in their specific national and city-level contexts. They argue that achieving smart city technologies often need a reliable, efficient, secure, affordable broadband network, an effective ecosystem for the Internet of Things (IoT) and the capacity to make use of the big data generated. They also point out that the concept of smart cities provides diverse opportunities for different cities. In developing countries as the UN shows, the immediate need for cities is to provide appropriate smart urban infrastructure applications to meet the increasing pace of urbanisation and to provide a way for such cities to implement leapfrogging in technology (United Nations, 2016).

Höjer and Wangel, (2014) see that smart city concept combines six elements, smart economy, smart mobility, smart environment, smart people, smart living, and smart governance. They assert that the concept of smart cities is largely today developed by the business sector, and it is a catchword that draws massive interest from companies engaged in ICTs and infrastructure. They choose to highlight a few of them and characterise their

different interests as, for example, if IBM's ambition is to be their choreographer, superintendent and oracle rolled into one, Siemens and Cisco aim to be the electrician and the plumber for smart cities (Höjer and Wangel, 2014).

The idea of the smart city is relatively new, and due to that, smart cities come in many alternatives, sizes and models. Each city has its unique history, features and future dynamic. A complex mix of advanced technologies, ICT, socio-economic aspects, governance arrangements, and politics are the main element that shapes the evolution of the smart cities concept, following very diverse methods depending on each city's specific decisions, aims, funding and domain (Manville et al., 2014). The smart city concept has been defined in many ways; some of them concentrate on ICTs and their infrastructure as advanced technologies that enable citizens to communicate in smart methods, while other definitions focus on socio-economic and environmental aspects that seek to improve the quality of life, urban well-being, e-government, citizens' participation, and advance the sustainability in cities (Smedley, 2013).

Smart cities are represented through firms that are improving global ICT from infrastructure such as networks to software as services. For example, IBM, CISCO, Microsoft, Oracle and SAP are beginning to spread their outputs as they see markets in cities adopting the next wave of output development in the globally distributed world that now exists. However, the most important thing is that smart cities must care about their social conditions of their citizenry not only deal with their economy. Jara et al., (2015) argues that the key aspects to motivate the deployment of the concept of the smart city are efficiently using resources, increasing the quality of services, determining the new requirements, providing data to people in current time and producing a sustainable way of socio-economic development. They point out that to advance the efficiency of the city's infrastructure, public services and cultural places the smart city concept will require utilising the new sophisticated technologies (Jara et al., 2015).

'Smart Cities' by Anthony M. Townsend and *'The New Science of Cities'* by Michael Batty are two books that explore what interactive technology can do for cities of the future. The results range from authoritarian models to ideal, open-sourced democracies. There are two equally powerful visions of what a smart city is and what it should be; however, these

two approaches ideologically are opposed. The first approach is one in which a network of sensors, transport arteries, motion-sensitive street lighting and smart grids feed into a central operating centre. In the future, the type of city-scale performance will be able to achieve the possibility of building automation. Furthermore, the smart city life will be defined by efficient, adaptive systems that can respond in real time to city requirements and change situations at the very small and large scale simultaneously (Townsend, 2013:29). This will provide a new way and vision to reconstruct historical centres by providing smart infrastructures such as sensors for monitoring sewage, water and electricity, and there is even an app that people can download to alert them about an earthquake, fires or any disaster. Townsend in his book *Smart Cities* illustrates the smart infrastructure that local authorities are investing in, as digital facilities can be the way to upgrade our built legacy. However, smart cities might also increase places that have the kind of violence inflicted by poverty and gaps between rich and poor people (Townsend, 2013:12).

The second approach is the city networked from the bottom up. Batty mentioned that cities are more similar to biological than mechanical systems and the increase of the sciences of complexity has changed the direction of the system theory from the top down to bottom up. Networks and their dynamics enhance the relationships between the system elements regarding their interactions. Batty believe that the key insights for understanding the city are in understanding the structure of these coupled networks. The different processes that bring individuals together to produce and exchange goods, ideas and information in cities define a multitude of networks that enable people to deliver materials and data to promote such efforts. These massive data require implementation standards for their integration, for achieving quality standards and for determining the accuracy and error in such data (Batty, 2012).

In the following table I have compiled the results from various sources such as books, journal papers, conference papers and international institution meeting to understand and clarify the term “smart cities” that would promote this research to find accurate principles and methods that could be implemented in the historic centre of Baghdad (table 5.1).

	Definitions of Smart City	Source
1	A city combining ICT and Web 2.0 technology with other organizational, design and planning efforts to dematerialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability.	(Chourabi et al., 2012)
2	A city that monitors and integrates conditions of all of its critical infrastructures including roads, bridges, tunnels, rails, subways, airports, sea-ports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens.	(Kondepudi, 2015)
3	A smart city means how the urban infrastructure is evolved through the Information and Communication Technologies. The goal of promoting the use of innovative technologies from the Information and Communication Technologies area is to satisfy the challenges of the cities in terms of sustainability (e.g., water, gas and energy), to the social demand for real time information(e.g., parking, public transport and weather) and to the emergence of the Future Internet-related technologies.	(Jara et al., 2015)
4	A smart city is first and foremost a city – one that pushes the quality of resource management and service provision to the limit possible at the time.	(Whyte et al., 2014)
5	A smart city is understood as a certain intellectual ability that addresses several innovative socio-technical and socio-economic aspects of growth. These aspects lead to smart city conceptions such as “green” referring to urban infrastructure for environment protection and reduction of CO2 emission, “interconnected” related to revolution of broadband economy, “intelligent” declaring the capacity to produce added value information from the processing of city’s real-time data from sensors and activators, whereas the terms “innovating”, “knowledge” cities interchangeably refer to the city’s ability to raise innovation based on knowledgeable and creative human capital.	Albino et al., 2015 according to Zygiaris (2013) (Albino et al., 2015)
6	(Smart) cities as territories with high capacity for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management.	Albino et al., 2015 according to Komninos (2011) (Albino et al., 2015)
7	Smart cities are the result of knowledge-intensive and creative strategies aiming at enhancing the socio-economic, ecological, logistic and competitive performance of cities. Such smart cities are based on a promising mix of human capital (e.g.	Albino et al., 2015 according to Kourtit and Nijkamp (2012) (Albino et al., 2015)

	skilled labour force), infrastructural capital (e.g. high-tech communication facilities), social capital (e.g. intense and open network linkages) and entrepreneurial capital (e.g. creative and risk-taking business activities).	
8	Smart city [refers to] a local entity - a district, city, region or small country -which takes a holistic approach to employ[ing] information technologies with real-time analysis that encourages sustainable economic development.	Albino et al., 2015 according to IDA (2012) (Albino et al., 2015)
9	The application of information and communications technology (ICT) with their effects on human capital/education, social and relational capital, and environmental issues is often indicated by the notion of smart city.	Albino et al., 2015 according to Lombardi et al. (2012) (Albino et al., 2015)
10	Creative or smart city experiments [...] aimed at nurturing a creative economy through investment in quality of life which in turn attracts knowledge workers to live and work in smart cities. The nexus of competitive advantage has [...] shifted to those regions that can generate, retain, and attract the best talent.	Albino et al., 2015 according to Thite (2011) (Albino et al., 2015)
11	The use of Smart Computing technologies to make the critical infrastructure components and services of a city—which include city administration, education, healthcare, public safety, real estate, transportation, and utilities—more intelligent, interconnected, and efficient.	Albino et al., 2015 according to Washburn et al. (2010) (Albino et al., 2015)
12	Smart cities are cities that have a high quality of life; those that pursue sustainable economic development through investments in human and social capital, and traditional and modern communications infrastructure (transport and information communication technology); and manage natural resources through participatory policies. Smart cities should also be sustainable, converging economic, social, and environmental goals.	(Albino et al., 2015)
13	A smart city can be achieved when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.	Höjer & Wangel, (2014) according to Allwinkle et al. (2011) (Höjer and Wangel, 2014)
14	Smart cities are characterized by a pervasive use of Information and Communication Technologies (ICT), which, in various urban domains, help cities make better use of their resources.	(Höjer and Wangel, 2014)
15	A “Smart City” is intended as an urban environment which, supported by pervasive ICT systems, is able to offer advanced and innovative services to citizens in order to improve the overall quality of their life.	Höjer & Wangel, (2014) according to Caragliu et al. (2009) (Höjer and Wangel, 2014)
16	Smart Cities combine diverse technologies to reduce their environmental impact and offer citizens better lives. This is	Manville et al., (2014) according to Smart Cities

	not, however, simply a technical challenge. Organisational change in governments – and indeed society at large – is just as essential. Making a city smart is therefore a very multi-disciplinary challenge, bringing together city officials, innovative suppliers, national and EU policymakers, academics and civil society.	and Communities (2013) (Manville et al., 2014)
17	A Smart City is a place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses.	Höjer & Wangel, (2014) according to European parliament (2014) (Höjer and Wangel, 2014)
18	Effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens.	(Höjer and Wangel, 2014)
19	A smart sustainable city is an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects.	(United Nations, 2016)
20	Smart cities as places where information technology is combined with infrastructure, architecture, everyday objects, and even our bodies to address social, economic, and environmental problems.	(Townsend, 2013)
21	A Smart city is the high integration of industry, city and residents, which has height prosperity of city information and introduces big data as the core to operate city. Smart city is the advanced stage of urban informatization, whose development is not only focus on the degree of digitization and informationization, but also likely to pay more attention to information prosperity. Smart city is a new thinking of urban management in the information age, which could integrate the government "the visible hand" and the market "invisible hand" to create a business-friendly, management orderly and living comfortable environment.	(Guo et al., 2016)
22	A Smart city is a city that uses information and communications technologies to make its critical infrastructure, its components and public services more interactive, efficient and visible to citizens.	Branchi et al., (2014) according to Sáinz et al. (2013) (Branchi et al., 2014)
23	A Smart city is a digital platform on which a complex ecosystem of multiple agents (including administrations, companies and citizens) is developed, equipped with sensors and capable of offering, through the processing of all the information acquired by the sensor network, the best services possible at every moment.	Branchi et al., (2014) according to Giffinger et al. (2007) (Branchi et al., 2014)
24	A Smart city is a city in which Information and Communication Technologies play a role in one or more sector.	Branchi et al., (2014) according to Pérez et al. (2012) (Branchi et al.,

		2014)
25	A Smart city is investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.	Branchi et al., (2014) according to Caragliu et al. (2009) (Branchi et al., 2014)
26	A Smart city is a space for coexistence among people who, based on the available technologies, can thrive and develop, while taking into account economic, social and environmental sustainability.	(Branchi et al., 2014)
27	A Smart City is quintessentially enabled by the use of technologies (especially ICT) to improve competitiveness and ensure a more sustainable future by symbiotic linkage of networks of people, businesses, technologies, infrastructures, consumption, energy and spaces.	(Manville et al., 2014)
28	A Smart City is a city seeking to address public issues via ICT based solutions on the basis of a multi-stakeholder, municipally based partnership. These solutions are developed and refined through Smart City initiatives, either as discrete projects or (more usually) as a network of overlapping activities.	(Manville et al., 2014)
29	A smart city is related to a coordinated set of interventions with the aim to improve the quality of life and urban services. To achieve this concept of a city, an extensive use of ICT (information communication technologies) and a design full of intelligence and ability is necessary; hence the "smart".	(Battista et al., 2014)
30	A smart city is a humane city that has multiple opportunities to exploit its human potential and lead a creative life.	(Nam and Pardo, 2011)
31	A smart city is a future, better state of an existing city, where the use and exploitation of both tangible (e.g. transport infrastructures, energy distribution networks, and natural resources) and intangible assets (e.g. human capital, intellectual capital of companies and organizational capital in public administration bodies) are optimized.	(Popescul and Radu, 2016)
32	A smart city is a city which takes advantage of ICT in order to ensure its growth and attractiveness.	(Granier and Kudo, 2016)
33	We believe a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructures fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.	Bifulco et al., (2016) according to Caragliu et al., (2011) (Bifulco et al., 2016)
34	The more recent interest in smart cities can be attributed to the strong concern for sustainability, and to the rise of new Internet technologies, such as mobile devices (e.g. smart phones), the semantic web, cloud computing, and the Internet of Things (IoT) promoting real world user interfaces.	Bifulco et al., (2016) according to Schaffers et al., (2011) (Bifulco et al., 2016)
35	A city well performing in a forward looking way in these six	Bifulco et al., (2016)

	characteristics, namely: smart economy, smart people, smart governance, smart mobility, smart environment, and smart living.	according to Giffinger et al., (2007) (Bifulco et al., 2016)
36	A smart city is a holistic approach to helping entire communities go online to connect to local government, schools, businesses, citizens, health and social services in order to create specific services to address local objectives and to help advance collective skills and capacities.	Scuotto et al., (2016) according to Roy (2001, p. 7) (Scuotto et al., 2016)
37	A smart city as a city that makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources.	Scuotto et al., (2016) according to IBM, (2009) (Scuotto et al., 2016)
38	Smart cities represent a conceptual urban development model on the basis of the utilization of human, collective, and technological capital for the development of urban agglomerations.	Angelidou, (2015) according to Angelidou, 2014 (Angelidou, 2015)
39	A smart city is an ultra-modern urban area that addresses the needs of businesses, institutions, and especially citizens. A city is "smart" if it provides better efficiency for urban planning through a variety of technologies.	(Khatoun and Zeadally, 2016)
40	A smart city is a broad concept that involves ICT design and development, the delivery of integrated ICT services, and the engagement of a wide range of users in adopting, applying, and continually adding value to a city's economic, social, and ecological dimensions.	(To et al., 2016)
41	Smart cities as cities that use ICT to sense, analyse, and integrate key information in core systems for urban and public management.	To et al., (2016) according to IBM (To et al., 2016)
42	A smart city as an urban area where smart solutions are implemented to support sustainable urban development.	To et al., (2016) according to Edith Haslinger and her colleagues (To et al., 2016)
43	Cities [should be seen as] systems of systems, and that there are emerging opportunities to introduce digital nervous systems, intelligent responsiveness, and optimization at every level of system integration.	Manville et al., (2014) according to MIT (2013) (Manville et al., 2014)
44	Smart cities is a future notion that will permit their citizens governments, businesses, urban designers, planners, architects and professionals to contribute their opinion through complex system or "systems" in terms of making decisions, sharing big data, promoting urban environment, implementing equity, promoting efficient energy resources, constructing intelligent infrastructures and administrating complex information through utilizing ICT.	Author (2016)

Table 5.1: Comparative Definitions of Smart City
Source: Author 2016

Anthopoulos et al., (2015) indicate that recently the concept of the smart city has not only been determined to ICT but also is concentrated on developing the quality of life in urban areas. They argue that the concept of smart cities has been advanced and has produced different methods to determine its aims, challenges and features. They mention that different institutions have approached the concept of smart cities with various models such as IBM, The International Telecommunications Union, United Nations Habitat, International Standards Organization (ISO) (table 5.2) (Anthopoulos et al., 2015).

	Model	Description
IBM [10]	Nine Pillar Models Smarter City Equation	Planning and Management Services Infrastructure Services Human Services Instrumentation (*the transformation of urban phenomena into data*) + Interconnection (*of data*) + Intelligence (*brought by software*)
ITU [13]	Smart Sustainable City Key Performance Indicators	Environmental Sustainability, Productivity, Quality of Life, Equity and Social Inclusion, Infrastructure development
UN Habitat [14]	Dimensions of City Prosperity	Productivity and the Prosperity of Cities, Urban Infrastructure: Bedrock of Prosperity, Quality of Life and Urban Prosperity, Equity and the Prosperity of Cities, Environmental Sustainability and the Prosperity of Cities
Anthopoulos [7]	Smart city dimensions	Resource, Transportation, Urban infrastructure, Living, Government, Economy, Coherency
ISO [15]	ISO 37120 Sustainable development of Communities Indicators for city services and quality of life	Economy, Education, Energy, Environment, Finance, Fire and Emergency Response, Governance, Health, Recreation, Safety, Shelter, Solid Waste, Telecommunication and Innovation, Transportation, Urban Planning, Waste water, water and sanitation
Neirotti et al. [1]	Smart City domains	Natural resources and energy, Transport and mobility, Buildings, Living, Government, Economy and people
Lee et al. [5]	Framework for smart city analysis	Urban Openness, Service Innovation, Partnerships Formation, Urban Proactiveness, Smart city infrastructure integration, Smart city governance

Table 5.2: Smart City Modelling Approaches
Source: (Anthopoulos et al., 2015)

Neirotti et al., (2014) argue that the smart city concept should have the ability to promote the utilisation of tangible property such as the transport infrastructure, power networks, and natural resources, and intangible property like the intellectual capital of firms, human capital, and organisational capital in public management organisations. They mention that there are two elements which determine the way we define the smart city concept, firstly, the method of the city to lead itself to realise development aims, secondly, the aspects that are more significant for a more intelligent use of urban resources (Neirotti et al., 2014).

Khatoun & Zeadally, (2016) have displayed various projects of implementing the smart city concept in different cities from North America, Europe, and Asia. Each one of these projects has different goals of implementing the smart city concept, Yokohama Smart City Project in Japan, for example, has one of its aims to achieve low-carbon city, whereas Kitakyushu Smart Community Project also in Japan its goal is the involvement of people and firms in the energy-distribution process. Moreover, these projects have considered different characteristics some of them have concentrated in the smart environment and smart living others on smart mobility, smart environment, smart living and smart people. These projects have also shown that integration between various institutions to implement the concept of the smart city (table 5.3) (Khatoun and Zeadally, 2016).

Project/location	Funding	Duration	Goals	Smart city characteristics	Partners
Yokohama Smart City Project,[a] Japan	Ministry of Economy, Trade and Industry (METI)	2010–2015	Low-carbon city, hierarchical energy management systems (EMS), sensitive photovoltaic (PV) generation	Smart environment, smart living	Tokyo Institute of Technology, Toshiba, Mitsubishi, Hitachi
Smart Mobility & Energy Life in Toyota City,[b] Japan	METI	2010–2015	PV generation, intelligent transportation systems, hierarchical EMS, 61.2% renewable energy, 4,000 next-generation vehicles	Smart mobility, smart environment	Nagoya University, Toyota City, Fujitsu, Hitachi, Toyota Motor Corporation, Chubu Electric Power Co.
Keihanna Eco City Next-Generation Energy and Social Systems project,[c] Japan	METI	2010–2015	Develop community EMS to minimize CO_2 emissions, vehicle-to-infrastructure, and to-vehicle	Smart environment	Kyoto, Kizugawa, Kyotanabe, Fuji Electric, Kyoto Center for Climate Actions, Mitsubishi
Kitakyushu Smart Community Project,[d] Japan	METI	2010–2015	Participation by citizens and companies in the energy-distribution process, PV generation, establishing charging infrastructure, and next-generation traffic systems (bicycles and public transport)	Smart mobility, smart environment	Toyota Motor Corporation, IBM Japan, Japan Telecom Information Service Corporation, Mitsubishi Heavy Industries
CITYKEYS,[e] European Union	H2020 project, European Union	2015–2017	Develop and validate key performance indicators and data-collection procedures for smart cities, sharing best practices on user privacy and other legislative issues among cities	Smart mobility, smart environment, smart living, smart people	Research organizations: VTT (Finland), AIT (Austria), TNO (The Netherlands); and five partner cities: Rotterdam, Tampere, Vienna, Zagreb, Zaragoza
LIVE Singapore project,[f] Singapore	National Research Foundation of Singapore	2011–2016	Develop open platform for collecting, elaborating, and distributing real-time data reflecting urban activities: tracking vehicular traffic and estimated temperature rise, energy consumption, and taxi operations	Smart living, smart people	MIT's SENSEable City Lab, Future Urban Mobility research initiative, Changi Airport Group, ComfortDelGro, NEA, PSA, SP Services, SingTel
SmartSantander,[g] Europe	European Union	2010–2013	Deploy 20,000 sensors in Belgrade, Guildford, Lübeck, and Santander, exploiting multiple technologies to collect information on parking spaces, public transport, and automatic management of light; currently uses 2,000 IEEE 802.15.4 devices	Smart living, smart environment	Telefonica I+D (Spain) Universität zu Lübeck (Germany), Ericsson (Serbia), Alcatel-Lucent (Italy), Alexandra Instituttet A/S (Denmark)
Open Cities project,[h] Europe	European Union	2011–2013	Explore how to implement open and user-driven innovation methodologies in the public sector in European cities. including Amsterdam, Barcelona, Berlin, Bologna, Helsinki, Paris, and Rome	Smart governance	Fraunhofer Institute FOKUS (Germany), ATOS (Spain), ESADE Business School (Spain), Berlin Government Senate Department for Economics, Technology and Women's Issues (Germany), Institut Telecom (France), NESTA (U.K.)
Vehicle2Grid,[i] The Netherlands	Top consortium on Knowledge and Innovation Switch2SmartGrids	2014–2017	Deliver European Open Data repository	Smart mobility, smart environment	Cofely, Alliander, ABB, Mitsubishi Motors Corporation, Amsterdam Smart City, Amsterdam University of Applied Sciences
City Science Initiative,[j] MIT/U.S.	Corporate sponsorship, industrial funding, National Science Foundation, Defense Advanced Research Projects Agency, National Institutes of Health	—	Use batteries in electric cars to store locally produced energy	Smart mobility, smart environment	27 scientific research teams[k]
"Green Vision"[l] initiative, San Jose, CA	State and federal funding	2007–2022	Gain scientific understanding of cities: urban analytics, governance, mobility networks, electronic and social networks, and energy networks Create clean tech jobs, reducing energy use by 50%, generating 100% energy from renewable sources, reusing water, installing zero-emission lighting, and having 100% public vehicles run on alternative fuels	Smart mobility, smart environment	Universities, private companies, regional agencies

Table 5.3: Smart City Projects Around the World.
Source: (Khatoun and Zeadally, 2016)

5.2 Dimensions of a Smart City

In the following literature there are different systems and dimensions as Albino et al., (2015) point out such as mobility, public security, utilities, and city' infrastructure have been integrated to form the concept of smart cities. They indicate that experts that agree with this integration of the smart city concept see that all of these systems must work and be managed together. They stress that the Centre of Regional Science at the Vienna University of Technology has determined six key dimensions; smart people, smart living, smart environment, smart economy, smart mobility, and smart governance. They assert that these dimensions will promote the smart city concept that seeks to advance the quality of life for its people (Albino et al., 2015).

The emerging prototype for a smart city as Cassandras, (2016) says "is one of an urban environment with a new generation of innovative services for transportation, energy distribution, healthcare, environmental monitoring, business, commerce, emergency response, and social activities" (Cassandras, 2016). Smart City also refers to "a city well performing in a forward-looking way in these six characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens" (Purnomo et al., 2016). These six characteristics are shown in (figure 5.1). According to (Purnomo et al., 2016):

- Smart Economy refers to the overall competitiveness of a city through innovative spirit, productivity and flexibility of labour market.
- Smart People setting up the human capital and social interaction between people via affinity for life - long learning, participation in public life, creativity and flexibility.
- Smart Government encourages participation of citizens in governance through participation in decision making and transparent governance.
- Smart Mobility, prepares transportation and infrastructure to support local ICT accessibility, ICT infrastructure, sustainable, innovative and safe transportation systems.
- Smart Environment maintains natural resources through the attractiveness of natural condition, environmental protection and sustainable resource management.
- Smart Living improves the Quality of Life by providing cultural facilities, good health conditions, good housing quality and social cohesion.

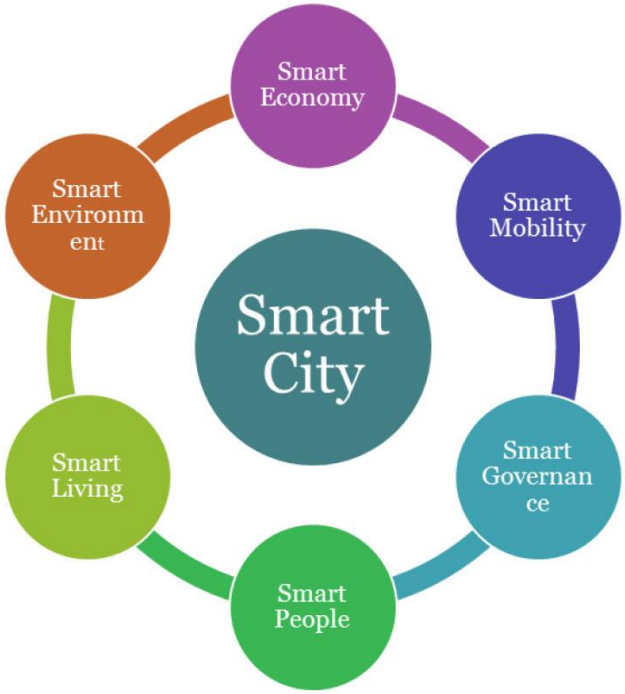


Figure 5.1: Six Characteristics of the Smart City Model
Source: (Purnomo et al., 2016)

Manville et al., (2014) say, "The most successful Smart City strategies might be expected to adopt a multi-dimensional approach to maximise such synergy and minimise negative spill-over effects, as might happen, for example, if a Smart Economy strategy were prioritised which was detrimental to the environment. For this reason, we might expect to see more than one characteristic present in the most successful Smart Cities" (Manville et al., 2014). They describe the six characteristics of the smart city concept in more detail in (table 5.4).

Characteristic	Description
Smart Governance	By Smart Governance we mean joined up within-city and across-city governance, including services and interactions which link and, where relevant, integrate public, private, civil and European Community organisations so the city can function efficiently and effectively as one organism. The main enabling tool to achieve this is ICT (infrastructures, hardware and software), enabled by smart processes and interoperability and fuelled by data. International, national and hinterland links are also important (beyond the city), given that a Smart City could be described as quintessentially a globally networked hub. This entails public, private and civil partnerships and collaboration with different stakeholders working together in pursuing smart objectives at city level. Smart objectives include transparency and open data by using ICT and e-government in participatory decision-making and co-created e-services, for example apps. Smart Governance, as a transversal factor, can also orchestrate and integrate some or all of the other smart characteristics.
Smart Economy	By Smart Economy we mean e-business and e-commerce, increased productivity, ICT-enabled and advanced manufacturing and delivery of services, ICT-enabled innovation, as well as new products, new services and business models. It also establishes smart clusters and eco-systems (e.g. digital business and entrepreneurship). Smart Economy also entails local and global inter-connectedness and international embeddedness with physical and virtual flows of goods, services and knowledge.
Smart Mobility	By Smart Mobility we mean ICT supported and integrated transport and logistics systems. For example, sustainable, safe and interconnected transportation systems can encompass trams, buses, trains, metros, cars, cycles and pedestrians in situations using one or more modes of transport. Smart Mobility prioritises clean and often non-motorised options. Relevant and real-time information can be accessed by the public in order to save time and improve commuting efficiency, save costs and reduce CO_2 emissions, as well as to network transport managers to improve services and provide feedback to citizens. Mobility system users might also provide their own real-time data or contribute to long-term planning.
Smart Environment	By smart environment we include smart energy including renewables, ICT-enabled energy grids, metering, pollution control and monitoring, renovation of buildings and amenities, green buildings, green urban planning, as well as resource use efficiency, re-use and resource substitution which serves the above goals. Urban services such as street lighting, waste management, drainage systems, and water resource systems that are monitored to evaluate the system, reduce pollution and improve water quality are also good examples.
Smart People	By Smart People we mean e-skills, working in ICT-enabled working, having access to education and training, human resources and capacity management, within an inclusive society that improves creativity and fosters innovation. As a characteristic, it can also enable people and communities to themselves input, use, manipulate and personalise data, for example through appropriate data analytic tools and dashboards, to make decisions and create products and services.
Smart Living	By Smart Living we mean ICT-enabled life styles, behaviour and consumption. Smart Living is also healthy and safe living in a culturally vibrant city with diverse cultural facilities, and incorporates good quality housing and accommodation. Smart Living is also linked to high levels of social cohesion and social capital.

Table 5.4: The Smart City characteristics.
Source: (Manville et al., 2014).

Smart infrastructure is an essential element as the United Nations, (2016) confirm, it provides the basis for all of the main characteristics related to a smart city, including smart people, smart mobility, smart economy, smart living, smart governance and smart environment. UN points out that the essential characteristic that underlies most of these elements is that they are associated and that they generate information, which may be utilised intelligently to ensure the optimal use of resources and promote performance. I have clarified in Figure 5.2 the seventh main aspects of smart infrastructure based on the UN (2016) (United Nations, 2016).

Figure 5.2: Smart Infrastructure
Source: Author 2016 Based on (United Nations, 2016)

Smart infrastructure contain as the UN, (2016) display the following elements (United Nations, 2016):

- **Smart buildings:** this aspect merges the various physical systems present in a smart way to ensure that all the systems work together dynamically. Smart building management systems can promote building energy efficiency, reduce waste and ensure an optimum use of water, with operational effectiveness and occupant satisfaction.
- **Smart mobility:** another essential aspect is smart mobility, which is a method that decreases congestion and fosters faster, greener and cheaper transportation choices. The majority of smart mobility systems utilise information gathered from a diversity of aspects about mobility patterns to assist the optimization of traffic situations in a holistic method.
- **Smart energy:** smart energy management systems utilise renewable energy sources, sensors, advanced meters, monitor and optimise energy distribution and usage, digital controls and analytic tools to automate. These systems improve grid operations and utilisation by balancing the needs of the various stakeholders engaged (consumers, producers and providers).
- **Smart water:** an intelligent water management system utilises digital technology to save water, decrease costs and increase the reliability and transparency of water distribution. The city is seeking to solve water scarcity problems with innovative technologies and the better management of water. The main elements of a good water distribution system are advanced metering and flow management.
- **Smart waste management:** Smart waste management systems minimise waste and classify the type of waste at the source, and improve approaches for the proper handling of waste. These systems might be utilised to transform waste into a resource and produce closed-loop economies. Furthermore, Waste management contains the monitoring, collection, transport, processing, recycling and disposal of waste (United Nations, 2016).
- **Smart health:** smart health-care management converts health-related data into clinical and business insights, which include digital health records, home health services and remote diagnoses, treatment and patient monitoring systems. The health and prosperity of urban citizens are of particular concern about the urban

sustainability and their supporting ecosystems. The smart city can advance the capability to utilise technology such as big data to improve predictions or identify hotspots of population health (such as epidemics or health impacts during extreme weather events).

- **Smart digital layers:** this aspect helps to raise understanding and the monitoring of processes and improve the use of limited resources in cities. The capability to capture and share data in a timely method is one of the main value propositions of ICT in smart cities. The city can potentially take action before a problem begins to escalate if the data is produced in real time and is accurate.

These seven smart aspects are significant to determine the smart infrastructure framework for the traditional centre of Baghdad, which would improve the physical urban environment and create new systems and modern digital layers that can solve the current problems of Old Rusafa's infrastructure (this will be discussed in chapter ten). United Nations, (2016) also indicate that there is one way to consider digital infrastructure is in the form of various supporting digital layers, as follows (United Nations, 2016):

(A) Urban: The layer where physical and digital infrastructures meet. Examples include smart buildings, smart mobility, smart grids (for utilities such as water, electricity and gas) and smart waste management systems.

(B) Sensor: This layer contains smart devices that assess and control various parameters of cities and their environment.

(C) Connectivity: This layer includes the transport of data and information from the sensor level to storage and data aggregators for further analysis.

(D) Data analytics: This layer involves the analysis of data gathered by diverse smart infrastructure systems, to help predict some events (such as traffic congestion).

(E) Automation: The digital enabling interface layer that enables automation and scalability for a large number of devices across multiple domains and verticals.

5.2.1 Smart People Dimension

Branchi et al., (2014) state that "The history of a city cannot be detached from that of its citizens. They are the ones who have determined the city's location, spatial configuration, growth and development" (Branchi et al., 2014). This indicates that citizens are an essential element when we want to debate the concept of the smart city. They argue that when we want to discuss mobility, for example, we must not give the priority to the car travel or public transport, but rather on how citizens should travel from one point to another in an effective fast way, conveniently, and with lowest social and environmental effect. They also assert that there are several initiatives that have been indicated the importance of citizens in recent years (Branchi et al., 2014).

A significant dimension of the smart city concept is the smart people concept, which contains different aspects such as education, affinity to lifelong learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism or open-mindedness, and participation in public life. Nam and Pardo, (2011) state, "The Smart Communities movement took shape over the 1990s as a strategy to broaden the base of users involved in IT. They define a smart community as "a community broadly ranging from a small neighbourhood to a nation-wide community of common or shared interest, whose members, organizations and governing institutions are working in partnership to use IT to transform their circumstances in significant ways" (Nam and Pardo, 2011). Popescul & Radu, (2016) point out that the key purpose to implement the smart cities concept is to promote the quality of life and to serve their people; moreover, it is about the interconnection between citizens and devices that surround them. They state, "Citizens have to self-report various data about themselves to the smart cities' managers – contact data, financial data, medical data, and emergency situations' data etc. The data collection, processing and transmission are not usually explained directly to the citizens, and they have to blindly trust the way in which data are used" (Popescul and Radu, 2016).

Lombardi et al., (2012) point out that one of the main aims of implementing the smart city concept is to educate a city's citizens. They state that smart cities should have smart citizens in terms of their educational level (Lombardi et al., 2012). The smart people dimension, has been defined by Bifulco et al., (2016) "through the quality of social interactions in cities,

openness towards different cultures, the development of human capital, the education of people, and the role of ICT in the improvement of participation and the reduction of the digital divide" (Bifulco et al., 2016). The concept of smart cities is that citizens are permanently connected with others and with their machines. This hyper-connection as Marsal-Llacuna et al., (2015) show relates to the common image of people connecting through sensors in connection with their smartphones with their fridge, heating, washing, machine, lights, etc... They indicate that Internet of Things (IoT) in technical terms is the connecting network between digital devices and sensors. Smartphones are equipped with sensors so that people and other mechanisms can run them at a distance (Marsal-Llacuna et al., 2015).

Granier and Kudo, (2016) have also discussed the importance of smart people in making decisions through their smart attitude in e-governance. They assert that the smart citizen's concept indicates the utilization of ICTs by the city and local government in interacting with their people and analysing, managing, and optimizing bid data in real time. They also suggest that governments should allow people participating in making decisions besides producing new services to their communities (Granier and Kudo, 2016). They argue, "Smart community corresponds to smart cities whose governance resembles the latter ideal-type model. In this case, public participation is considered as an end in itself. By contrast, smart cities, which mainly aim at improving public services provision and quality of life correspond to the former, in which public participation is more akin to a means. However, these are ideal-type models and actual smart city projects are obviously imbued with both rationalities, although with a different balance" (Granier and Kudo, 2016). The use of the advanced technology like computers and smartphones by citizens in the smart city initiative, as Gabrys (2014) says, will promote interactions between people and urban environment in the city (Gabrys, 2014).

Manville et al., (2014) assert that the smart city concept is not only formed by elements but also consists of citizens. They argue that people involvement is a significant dimension of the success of the smart city concept. They clarify the two methods of participation a top-down or a bottom-up; the top-down method improves the degree of management, whereas the bottom-up method permits citizens to be involved directly in making decisions. They

say that one of the smart city concept aims is to transform cities into areas with a good quality of life (figure 5.3) (Manville et al., 2014).

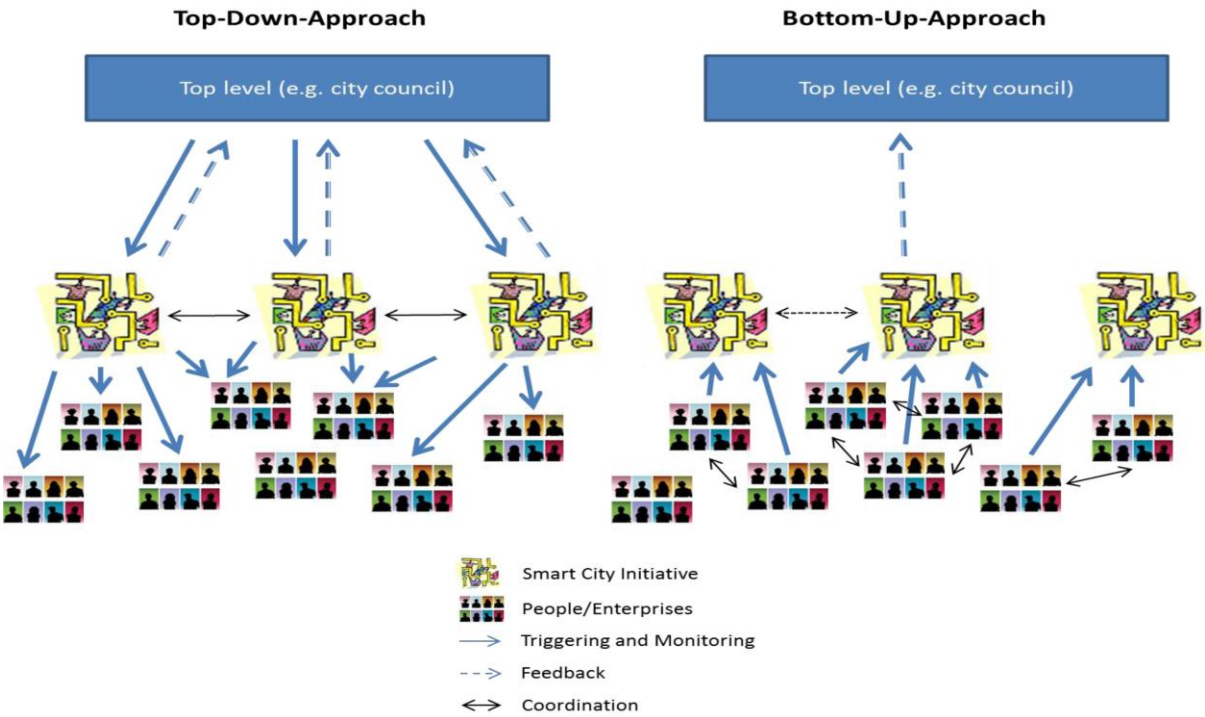


Figure 5.3: Top-down and bottom-up approaches to encouraging the participation of citizens and stakeholders in Smart Cities
Source: (Manville et al., 2014).

5.2.2 Smart Governance Dimension

Lombardi et al., (2012) mention that the smart city concept deals with the relationship between governments and their people. They indicate that smart cities should have smart governance that is using modern methods of communication with their people such as e-governance, e-democracy, and people participation in making decisions (Lombardi et al., 2012). Bifulco et al., (2016) state that "smart governance concerns citizens' participation in urban decision-making processes, the co-creation of new services for an improved quality of life, and the implementation of different instruments for collaboration, service integration, and data exchange" (Bifulco et al., 2016). Manville et al., (2014) point out that the smart governance dimension will seek to create an open service and information platforms for their stakeholders to participate. They say that this will lead to improving

utilities and environmental aspects, job opportunities, business creation, and might also assist to reduce CO2 emission (Manville et al., 2014).

The United Nations, (2016) point out that the concept of the smart city is seeking for new governance models. They argue that balancing both top-down and bottom-up governance methods will create an effective smart city management. On the one hand, it might need strong top-level leadership and top-down execution processes for gathering the data produced by smart sensors located in different smart city infrastructures and taking policy actions, especially through emergencies. On the other hand, bottom-up governance methods have been the determining feature of much of smart cities infrastructure including citizen-driven innovations and co-creation. UN (2016) assert that it is very significant managing a good balance between these two methods. They confirm that implementing such a balance assists city governments utilize the synergy between different participants for instance universities, the private sector, civil community and local and municipal governments. Furthermore, they add that an effective smart city needs breaking down silos across various government departments. UN (2016) show some examples of different innovative and technology applications that produce a platform through which city governments might participate with residents in a regular method (United Nations, 2016).

The essential aspect of achieving smart cities is promoting government and policy for governance. Nam and Pardo, (2011) mention that computing infrastructures are the main technological elements in creating smart cities. They assert that smart cities can produce interoperable, internet-based government services that enable ubiquitous connectivity to convert main government operations, both internally through departments and labourers and externally to people and trades. They argue that the concept of smart government is not only organizing the outcomes of socio-economic systems, but instead, it is associating dynamically with people, societies, and economic in real time to promote development, creation, and advance. They add that smarter government the denotes participation of all sections of societies to create transparently, control resources efficiently, and enable people to engage their opinion in decision-making that influences their cities. At the most fundamental level, smarter government means making operations and services truly citizen-centric (Nam and Pardo, 2011).

Granier and Kudo, (2016) confirm that there are two frameworks of smart governance, associated with "two distinctive waves of technological innovation (technologies for concentrated intelligence and technologies for distributed intelligence)" (Granier and Kudo, 2016). They debate, "In the former, new technologies (big data, etc.) would enable central steering actors to strengthen their intelligence, provide more integrated services, develop better policies and steer other actors in the city more effectively. On the contrary, in the latter, new technologies such as social media and open data would facilitate cooperation between various actors and "takes direct citizen involvement as its starting point" (Granier and Kudo, 2016). Paulin, (2016) debates that the partial use of ICTs in cities by considering cities as public spheres and people as their customers will promote the transition and create a new relationship between governments and their people. He asserts that there is much research and many initiatives to advance the concept of smart government by using ICTs. (Paulin, 2016).

Khatoun and Zeadally, (2016) mention that government-to-citizen, government-to-business, and government-to-government comprise the system of e-government. They state that smart government permits people to achieve their social responsibilities by using a Web portal. They assert the importance of open government data (OGD) in the implementation of the smart city concept, which means that information of big data can be utilised and discussed by policymakers, citizens and different institutions. They indicate that many initiatives have been launched to develop worldwide consideration of OGD by various sectors such as U.S. Open Data Initiative, Organization for Economic Cooperation and Development, and Microsoft Open Data initiative. They see that the smart cities concept is an open data generator (Khatoun and Zeadally, 2016).

5.2.3 Smart Living Dimension

Lombardi et al., (2012) discuss the importance of smart living through the utilisation of sophisticated technologies in the concept of smart cities to improve the quality of life in cities. They assert that to achieve the smart city initiative will require improving ICT and its applications, using modern mobility, employing new technology, utilizing a new method of communication between governments and their citizens, efficient use of natural resources, safety and advancing urban quality (Lombardi et al., 2012). Bifulco et al., (2016) assert that "smart living has been identified with the quality of life, namely, housing, culture, health, tourism, and a specific interest in the search for high levels of social cohesion" (Bifulco et al., 2016).

Nam and Pardo, (2011) recognise creativity, citizens, and knowledge as the main aspects of the smart city concept. Social infrastructures that are related to citizens and their connections are a necessary aspect of the concept of the smart city, which is a combination of different factors such as education, culture, and economics. They mention that "Smart places are getting smarter while other places are getting less smart because such places act as a magnet for creative people and workers. Along with the inflow of smart people, new creative culture driven by them is a drive to urban development". According to the Intelligent Community Forum (ICF) as Nam and Pardo, (2011) display various cities that have been awarded as Smart21 Communities. These cities gain great rank regarding five aspects broadband connectivity, knowledge workforce, digital inclusion, innovation, and marketing and advocacy to be intelligent communities between 2007 and 2011. They show that these cities listed in (table 5.5) are worth to be examined and they said, "Quebec City in Canada was a city highly dependent upon its provincial government because of its weak industrial base until the early 1990s. The city government kicked off a public-private partnership to support the growing multimedia sector and high-tech entrepreneurship. For sustainable urban growth, the City of Riverside in California is improving traffic flow and replacing ageing water, sewer and electric infrastructure by tech-based transformation. Estonia overcame post-Soviet economic ruin, and its capital city Tallinn played as a centre for economic development, harnessing information and communication technologies (ICTs). The city developed a large-scale digital skills training program, extensive e-government, and an award-winning smart ID card" (Nam and Pardo, 2011).

Region	Cities
Asia	Bangalore (India); Chongqing (China); Doha (Qatar); Gangnam District, Seoul (Korea); Hong Kong; HwaSeong-DongTan (Korea); Hyderabad (India); Ichikawa (Japan); Jaipur, Rajasthan (India); Jia Ding (China); Kabul (Afghanistan); Mitaka (Japan); Shanghai (China); Seoul (Korea); Singapore; Suwon (Korea); Taipei (Taiwan); Taoyuan County (Taiwan); Tel Aviv (Israel); Tianjin (China); Yokosuka (Japan)
Africa	Cape Town (South Africa); Nelson Mandela Bay (South Africa)
Europe	Besançon (France); Birmingham (UK); Dundee, Scotland (UK); Eindhoven (Netherlands); Glasgow, Scotland (UK); Hammarby Sjostad (Sweden); Issy-les-Moulineaux (France); Karlskrona (Sweden); Malta (Malta); Manchester (UK); Reykjavik (Iceland); Sopron (Hungary); Stockholm (Sweden); Tallinn (Estonia); Sunderland (UK); Trikala (Greece)
North America	US: Albany (New York); Ashland (Oregon); Arlington County (Virginia); Bettendorf (Iowa); Bristol (Virginia); Chattanooga (Tennessee); Cleveland (Ohio); Corpus Christi (Texas); Dakota County (Minnesota); Danville (Virginia); Dublin (Ohio); Florida High Tech Corridor; LaGrange (Georgia); Northeast Ohio; Loma Linda (California); Riverside (California); San Francisco; Spokane (Washington); Westchester County (New York); Winston-Salem (Carolina) Canada: Burlington (Ontario); Calgary (Alberta); Edmonton (Alberta); Fredericton (New Brunswick); Kenora (Ontario); Moncton (New Brunswick); Ottawa (Ontario); Quebec City (Quebec); Stratford (Ontario); Toronto (Ontario); Vancouver (British Columbia); Waterloo (Ontario); Western Valley (Nova Scotia); Windsor-Essex (Ontario); Winnipeg (Manitoba)
Middle/South America	Barceloneta (Puerto Rico); Curitiba, Paraná (Brazil); Pirai (Brazil); Porto Alegre (Brazil)
Oceania	Ballarat (Australia); Gold Coast City (Australia); Ipswich, Queensland (Australia); State of Victoria (Australia); Whittlesea, Victoria (Australia)

Table 5.5: The List of Smart Cities
Source: (Nam and Pardo, 2011)

One of the fundamental elements in achieving smart living dimension is creating zero-energy building (ZEB) in cities, which participates in addressing challenges such as how to generate renewable energy, and how to find an efficient way of using energy. They point out that the zero-energy building can be measured and defined according to various aspects such as net-zero site energy use, net zero source energy use, net zero energy emissions, net-zero cost, off-grid, and energy-plus. They also determine four main ZEBs aspects as integral elements of the concept of the smart city (environmental design and building practices, renewable energy sources (RES), labelling of technical building systems, intelligent energy management) (figure 5.4) (Kylili and Fokaides, 2015).

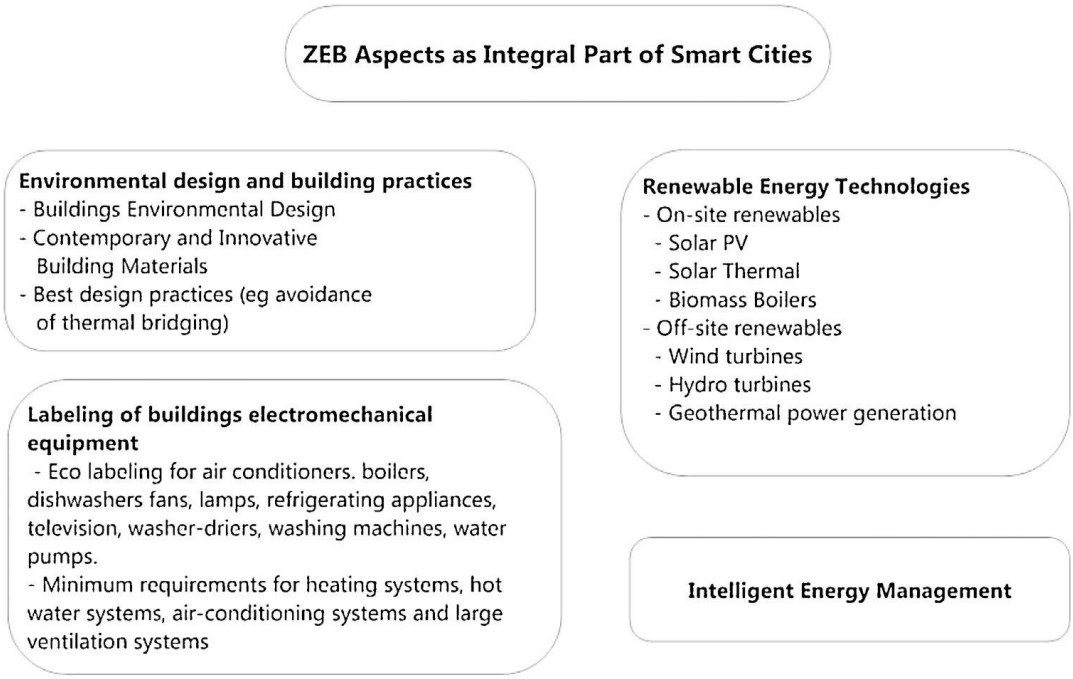


Figure 5.4: Zero Energy Building (ZEB) Aspects as Integral Parts of Smart Cities
Source: (Kylili and Fokaides, 2015)

5.2.4 Smart Environment Dimension

The environmental dimension considered as a key element of smartness that determines well-being increases the availability of green areas in cities and leads towards a sustainable environment. This aspect can produce different sorts of socio-economic advantages. Neirotti et al., (2014) argues that increasing smart city initiatives in cities with their goals developing the sustainable environment will create more advanced infrastructures than polluted cities with limited green spaces. They assert that these cities can face less cost for the further growth than polluted cities that are trying to embrace the smart city concept in mobility, infrastructures and even urban design might be higher (Neirotti et al., 2014). Pouryazdan and Kantarci, (2016) mention that one of the key goals of the concept of smart cities is to advance the quality of life for their citizens by integrating ICTs infrastructures into socio-physical infrastructures in various urban environments. They assert that this integration will offer people different services that are associated with ICTs (Pouryazdan and Kantarci, 2016). Bifulco et al., (2016) point out that “the smart environment has been studied in connection with pollution reduction, natural resource management, and the protection and conservation of natural habitats through the efficient use of resources as well as the re-use or substitution of natural resources to reach sustainability goals” (Bifulco et al., 2016).

5.2.5 Smart Mobility Dimension

Albino et al., (2015) point out that the dimension of smart mobility indicates the use of ICTs in contemporary transport to advance traffic in urban places (Albino et al., 2015). Bifulco et al., (2016) state that "smart mobility focuses both on sustainable and intermodal transport systems offering safe and secure conditions through the use of ICT, and on local, national, and international accessibility" (Bifulco et al., 2016). Smart mobility systems as United Nations, (2016) mention contain mass transit systems as well as individual mobility systems that feature bicycle sharing, ride sharing (or carpooling), vehicle sharing and, more recently, on-demand transportation. Smart transport systems integrate merge the whole array of multimodal transport choices in cities, containing both individual mobility and mass transit, in an efficient method. Modern smart transport systems usually include a network of sensors, automatic vehicle registration plate readers, closed-circuit television systems, navigation facilities, passenger information panels, signalling systems and, most importantly, global positioning system-tracked public transportation, dynamic traffic lights, the capability of integrating live data from most of these sources. This might lead to developments in traffic congestion, environmental performance, accessibility, safety, network management, convenience and public perception. A modern smart transport system is currently operating in Poznan and Poland for example. However, many challenges that emerged in implementing this plan contained a lack of skilled staff, cases related to interoperability and unexpected delays in the construction of hard infrastructure aspects (United Nations, 2016).

5.2.6 Smart Economy Dimension

In connection with the economic dimension as Lombardi et al., (2012) point out smart cities are utilised to characterise cities with smart industry that employs ICTs in their manufacturing procedures. They also state that the smart cities concept is used for commercial complexes or areas containing this domain (Lombardi et al., 2012). A smart city as Nam and Pardo, (2011) state is a learning city, which improves the competitiveness of urban contexts in the global knowledge economy. Learning cities are actively involved in building a skilled information economy workforce" (Nam and Pardo, 2011). The smart economy dimension as Bifulco et al., (2016) show is associated with "economic

competitiveness such as entrepreneurship, innovation, productivity, and flexibility of the labour market, as well as the international expansion of the local economy. The development of a smart city is closely linked to the creation of an urban context that stimulates new industrial activities" (Bifulco et al., 2016). Albino et al., (2015) emphasize that the smart economy dimension is connected with the development of industries that utilize ICTs in manufacturing operations (Albino et al., 2015).

Neirotti et al., (2014) debate that the gross domestic product (GDP) of the city and its development might affect the growth of smart cities initiatives for many reasons associated with the local economic situations and growth ratio. They assert that cities that have an excellent GDP development ratio undergo a remarkable economic development, which affects the financial resources that are available for investments in new projects such as energy, water and waste infrastructures, health and culture, and ICTs infrastructures. They add that citizens who want to advance their prosperity are attracted by the city with a substantial economic growth and play a significant role to promote their human capital (Neirotti et al., 2014).

Popescu, (2015) says that the economic dimension is one of the main characteristics that determine the success of the smart city concept. He shows that this aspect will produce new active generation and promote outputs. He adds that the concept of smart cities endeavours to develop the economic situation in cities by implementing self-governing. He says, "Cities should function as smart collaborative ecosystems, empowered by the highest level of technology development, and may be seen as testing grounds and determinants for social change. The absence of engagement of private associates and feasible business patterns prevents the long-run sustainability and economic value generation of smart city proposals" (Popescu, 2015).

5.3 Smart Cities Indicators (SCIs) and its Assessment

Smart cities require smart city indicators (SCIs) as Marsal-Llacuna et al., (2015) state. They assert that these smart indicators should be gained from physical and non-physical information in real time to manage a city's technological and analytical information accurately, enhance the prosperity, and advance urban sustainability. The new technologies nowadays are producing the most updated information on cities' physical recognition remote sensing imagery. Furthermore, they argue the non-physical urban information that has gained from cities requires to be controlled. They point out that non-physical information indicates to data on the supply and demand of urban infrastructures such as power and water supply, and waste collection. Thus, the non-physical urban information it is much more challenging to manage than physical urban information. Gathering data of the non-physical urban information relies on the cooperation of utility firms and the involvement of the people (Marsal-Llacuna et al., 2015). Two smart cities monitoring initiatives already in operation were found by Marsal-Llacuna et al., (2015), and both initiatives producing indicators from historical statistical data. Academia is the first in the field of monitoring smart cities. They indicate that an index of “smartness” consisting of 74 indicators in six categories has been produced by the Vienna University of Technology, University of Ljubljana and Delft University of Technology to rank European cities. This initiative will be a breakthrough in the emerging area of the monitoring of city smartness if the proposed index did not affect an outcome from a collection of indicators based on historical data. They also show that seventy medium-sized cities with urban populations of 100,000 to 500,000 residents with at least one university and a catchment area of fewer than 1,500,000 residents have composed the ranking. They mention that The European Statistical Office (Eurostat) produce the Urban Audit database that helps to create indicators that are organised in six denomination or categories Smart Economy, Smart Mobility, Smart Governance, Smart Living, Smart People and Smart Environment. The present examples of indicators for the Smart Living denomination such as the number of cultural facilities, housing quality, number of educational facilities, health conditions, individual safety, touristic attraction and social cohesion. The European Initiative on smart cities is the second initiative, which enhanced by the European Commission or more specifically the Strategic Energy Technologies Information System (SETIS). (Marsal-Llacuna et al., 2015).

Several efforts as United Nations, (2016) indicate are currently underway to advance comprehensive key performance indicators for the smart city. A set of key performance indicators has been developed by a United Nations inter-agency group with the goal of turning them into a global smart sustainable cities index (United Nations, 2016). Anthopoulos et al., (2015) show an overview of comparative methods to assess the concept of the smart city based on diverse perspectives and aspects such as environmental sustainability, productivity, quality of life, resource, transportation, economy, education, and energy (table 5.6) (Anthopoulos et al., 2015).

Khatoun and Zeadally, (2016) point out that the assessment of the implementation of the smart city concept must consider different features such as ICTs infrastructures, quality of life, socio-economic and environmental issues, utilities and well-being of cities (Khatoun and Zeadally, 2016). Albino et al., (2015) state, "A smart city assessment must take into account that cities have different visions and priorities for achieving their objectives, but they must promote an integrated development of these different aspects" (Albino et al., 2015).

	Benchmarking Tool	Description
Pires et al. [15]	Local Sustainable Development Indicators	21 ECOXXI Indicators, grouped in the following sectors: Sustainable, Development Education, Marine and Coastal Environment Institutions, Nature Conservation and Biodiversity, Forest Planning, Air, Water, Waste, Energy, Transport, Noise, Agriculture, Tourism
Kourtit et al. [16]	Global City Performance Measurement Indexes	Economy, Research and Development, Cultural Interaction, Livability, Environment, Accessibility
Desouza and Flanery [3]	Resilience City Evaluation and Implementation Framework	City components: Resources and Processes (Physical) People, Institutions, Activities (Social)
da Cruz and Marques [17]	Sustainable Local Government Scorecard	Social, Economic, Environmental and Government *criteria*
Singhal et al. [18]	Competitiveness parameters	Physical Environment, Social Capital, Finance, Development, Investment, User Potential
UN Habitat [19]	Good Urban Governance indicators	Effectiveness, Equity, Participation, Accountability, Security
Lazaroiu et al. [20]	Model for computing "the smart city" indices	Economy, Mobility, Environment, People, Living, Governance
Duarte et al. [21]	Digital City Assessment Framework	Connectivity, Accessibility, and Communicability

Table 5.6: Smart City Benchmarking Tools
Source: (Anthopoulos et al., 2015)

Albino et al., (2015) debate that there are several approaches to assess the smart city concept and many assessment indicators have been advanced to measure the performance of smart cities. They display an advanced framework to assess the smart city concept. This framework is "composed of 60 indicators selected after a literature review which included EU project reports, the Urban Audit dataset, statistics of the European Commission, the European Green City Index, TISSUE, Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environment, and the smart cities ranking of European medium-sized cities. Surprisingly, they excluded the smart mobility dimension" (table 5.7) (Albino et al., 2015).

Smart City Dimension	Indicators of a smart city	No. indicators	Source
Smart Economy	Public expenditure on R&D, Public expenditure on education, GDP per head of city population, Unemployment rate,	60	Albino et al., (2015) according to Lombardi et al. (2012) (Albino et al., 2015)
Smart People	Percentage of population with secondary-level education, Foreign language skills, Participation in life-long learning, Individual level of computer skills, Patent applications per inhabitant		
Smart Governance	Number of universities and research centres in the city, e-Government on-line availability, Percentage of households with Internet access at home, e-Government use by individuals		
Smart Environment	ambitiousness of CO2 emission reduction strategy, Efficient use of electricity, Efficient use of water, Area in green space, Greenhouse gas emission intensity of energy consumption, Policies to contain urban sprawl, Proportion of recycled waste		
Smart Living	Proportion of the area for recreational sports and leisure use, Number of public libraries, Total book loans and other media, Museum visits, Theatre and cinema attendance		
Smart Mobility	Pollution, Innovative spirits, CO2, Transparent governance, Sustainable resource management, Education facilities, Health conditions, Sustainable, innovative and safe public transportation, Pedestrian areas, Cycle lanes, Green areas, Production of solid municipal waste, GWh household, Fuels, Political strategies and perspectives, Availability of ICT infrastructure, Flexibility of labour market	18	Albino et al., (2015) according to Lazaroiu and Roscia (2012) (Albino et al., 2015)

Table 5.7: List of Indicators for Smart Cities Assessment in Some Rating Systems. Source: Author (2016) based on (Albino et al., 2015)

Dubai's leadership has a new mission to make their city one of the efficient, safe and the happiest city on Earth. They established the Smart Dubai initiative in March 2014, which is its main goal to become the creative benchmark for smart cities seeking global sustainability and competitiveness. To implement the Smart Cities concept in Dubai, a Smart Dubai Index is created to be an applicable set of indicators that assess the success of Smart Dubai initiative. The International Telecommunications Union (ITU) and the Dubai Statistic Centre have an advanced Index Wheel to assess how utility infrastructures and government services in Dubai participate to the concept of Smart Dubai, and they add ICT as the main dimension to their Index Wheel (figure 5.5). This wheel is divided into six aspects following the six dimensions of Smart Dubai. Within each dimension, a set of substantial performance indicators has been developed to measure the success of the implementation of the smart city initiatives. This Index Wheel, as the Smart Dubai official website indicates "Will support decision makers to prioritise objectives, allocate resources, and enable city-leaders to support the smart city initiatives across all dimensions defining a smart city. In addition, a unified set of performance measures may enable collaboration and connectivity between the stakeholders of smart initiatives, which are now all striving for the same goal, following the same definition of success. Furthermore, "By creating a comprehensive set of key performance indicators for smart city initiatives Dubai takes on a pioneering role in the world: the Smart Dubai Index Wheel sets a standard easily transferred into other cities" (Smart Dubai, 2014).

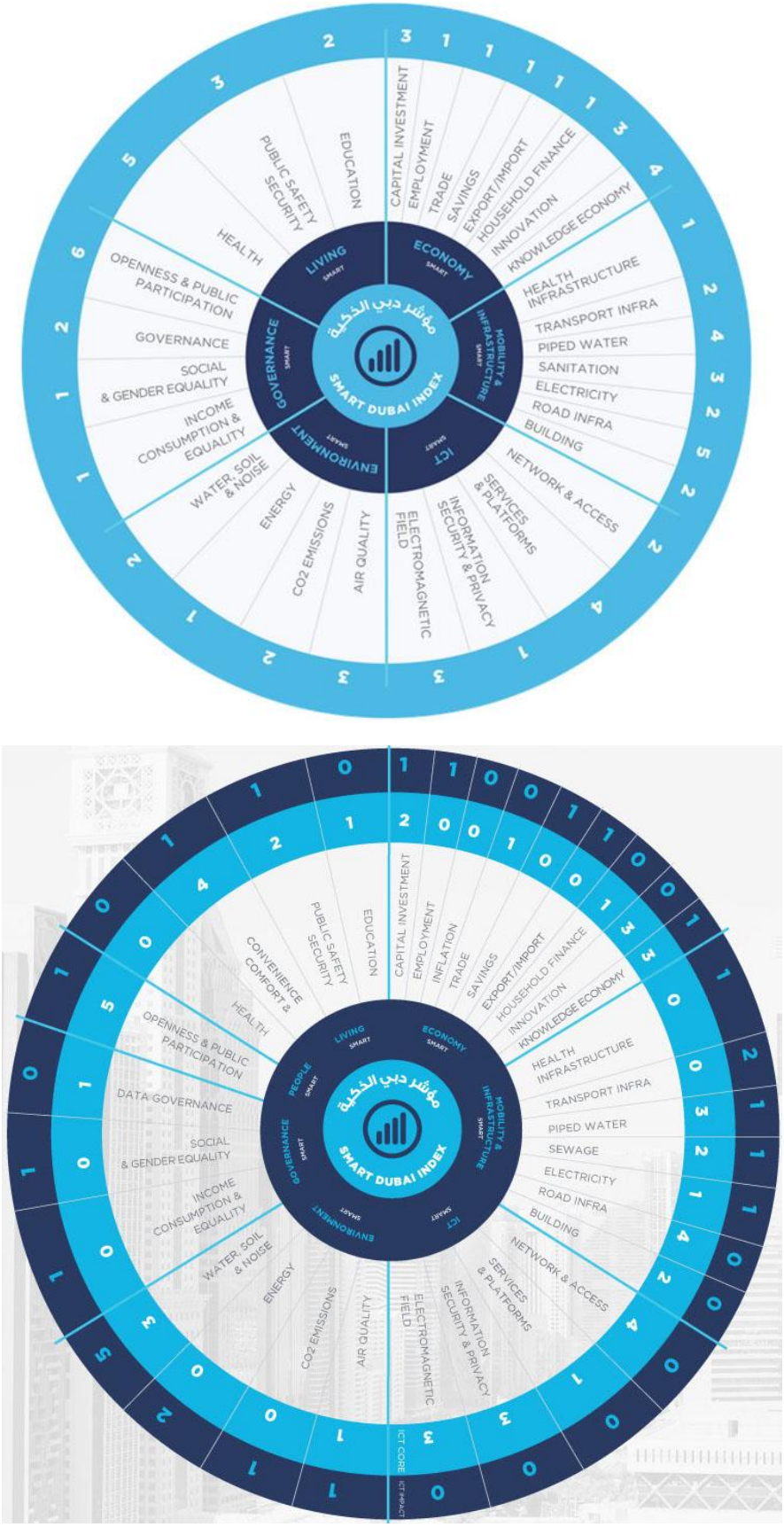


Figure 5.5: The Smart Dubai Set of Indicators.

Source: (Smart Dubai, 2014)

Boyd Cohen has been assessing the implementation of the smart city concept in many cities since 2012 by using his Smart City Wheel. He uses his Wheel as a framework for understanding six key aspects of the smart city. He also asserts, “It is never easy determining the correct number of indicators to use for such a significant task like benchmarking smart cities, which is a very complex concept” (B. Cohen, 2014). He tries to create and develop a manageable number of indicators. He was started from 8 indicators across the Smart Cities Wheel (figure 5.6) and raised that number to 62 in collaboration with the advisory committee (table 5.8). He confirms, “Each of the six components of the Smart Cities Wheel are assigned a set of indicators reflect an attempt to create a proxy for measuring each of the sub-components of the Wheel. Each component contains three subcomponents. Therefore, there are 18 total subcomponents in the model, and with 62 indicators, that leaves an average of almost 3.5 indicators per subcomponent” (B. Cohen, 2014).

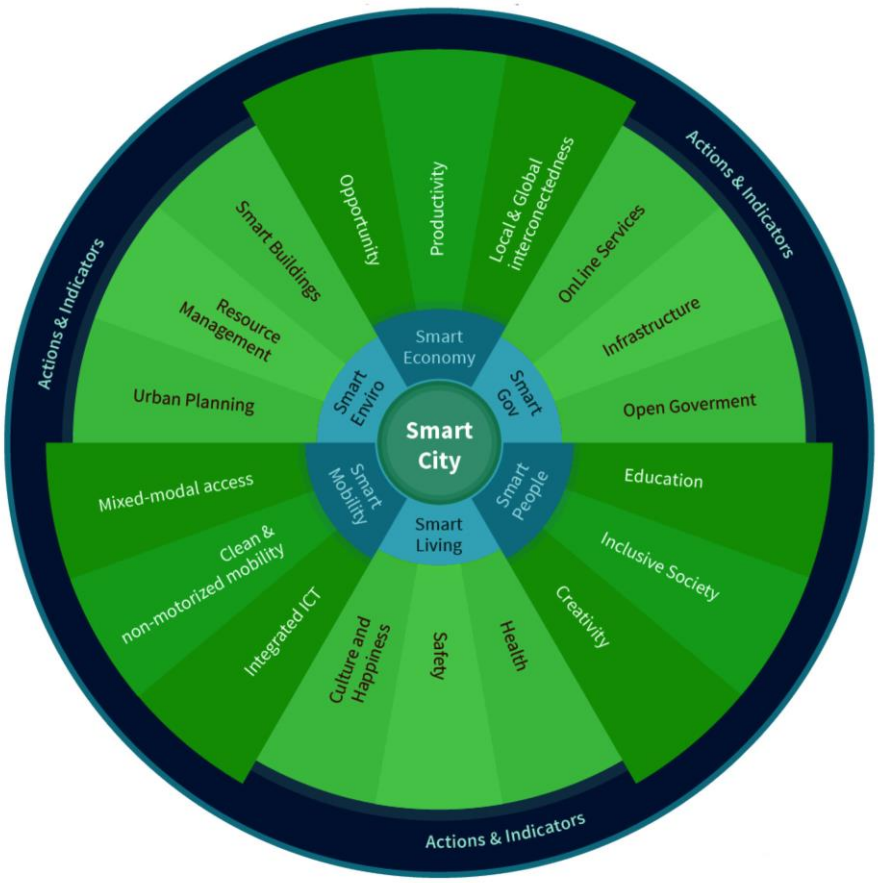


Figure 5.6: Smart City Wheel by Boyd Cohen and Re-Designed by Manuchis
Source: (B. Cohen, 2014)

Dimension	Working Area	Indicator	Description
	Smart Buildings	Sustainability-certified Buildings	Number of LEED or BREAM sustainability certified buildings in the city (Note: if your city uses another standard please indicate)
			% of commercial and industrial buildings with smart meters
			% of commercial buildings with a building automation system
		Smart homes	% of homes (multi-family & single-family) w/ smart meters
Environment	Resources Management	Energy	% of total energy derived from renewable sources (ISO 37120: 7.4)
			Total residential energy use per capita (in kWh/yr) (ISO 37120: 7.1)
			% of municipal grid meeting all of following requirements for smart grid (1. 2-way communication; 2.) Automated control systems for addressing system outages 3.) real-time information for customers; 4.) Permits distributed generation; 5.) Supports net metering
		Carbon Footprint	Greenhouse gas emissioned measured in tonnes per capita (ISO 37120: 8.3)
		Air qualty	Fine Particular matter 2.5 concentration (µg/m3) (ISO 37120: 8.1)
		Waste Generation	% of city's solid waste that is recycled (ISO 37120: 16.2)
			Total collected municipal solid waste city per capita (in kg) (ISO 37120: 16.3)
		Water consumption	% of commercial buildings with smart water meters
			Total water consumption per capita (litres/day) (ISO 37120: 21.5)
	Sustainable Urban Planning	Climate resilience planning	Does your city have a public climate resilience strategy/plan in place? (Y/N) If yes provide link.
		Density	Population weighted density (average densities of the separate census tracts that make up a metro)
		Green Space per capita	Green areas per 100,000 (in m2) (ISO 37120: 19.1)
Mobility	Efficient Transport	Clean-energy Transport	Kilometers of bicycle paths and lanes per 100,000 (ISO 37120: 18.7)
			# of shared bicycles per capita
			# of shared vehicles per capita
			# of EV charging stations within the city
	Multi-modal Access	Public Transport	Annual # of public transport trips per capita (ISO 37120: 18.3)
			% non-motorized transport trips of total transport
			Integrated fare system for public transport
	Technology Infrastructure	Smart cards	% of total revenue from public transit obtained via unified smart card systems
		Access to real-time information	Presence of demand-based pricing (e.g. congestion pricing, variably priced toll lanes, variably priced parking spaces). Y/N
			% of traffic lights connected to real-time traffic management system
			# of public transit services that offer real time information to the public: 1 point for each transit category up to 5 total points (bus, regional train, metro, rapid transit system (e.g. BRT, tram), and sharing modes (e.g. bikesharing, carsharing)
			Availability of multi-modal transit app with at least 3 services integrated (Y/N)
Government	Online services	Online Procedures	% of government services that can be accessed by citizens via web or mobile phone
		Electronic Benefits Payments	Existence of electronic benefit payments (e.g. social security) to citizens (Y/N)
	Infrastructure	WiFi Coverage	Number of WiFi hotspots per km2
		Broadband coverage	% of commercial and residential users with internet download speeds of at least 2 Mbit/s
			% of commercial and residential users with internet download speeds of at least 1 gigabit/s
		Sensor Coverage	# of infrastructure components with installed sensors 1 point for each: traffic, public transit demand, parking, air quality, waste, H2O, public lighting
		Integrated health + safety operations	# of services integrated in a singular operations center leveraing real-time data. 1 point for each: ambulance, emergency/disaster response, fire, police, weather, transit, air quality
	Open Government	Open Data	Open data use
		Open Apps	# of mobile apps available (iPhone) based on open data
		Privacy	Existence of official citywide privacy policy to protect confidential citizen data
Economy	Entrepreneurship & Innovation	New startups	Number of new opportunity-based startups/year
		R + D	% GDP invested in R&D in private sector
		Employment levels	% of persons in full-time employment (ISO 37120: 5.4)
		Innovation	Innovation cities index
	Productivity	GRP per capita	Gross Regional Product per capita (in US$, except in EU, in Euros)
	Local and Global Conexion	Exports	% of GRP based on technology exports
		International Events Hold	Number of international congresses and fairs atendees.
People	Inclusion	Internet-connected Households	% of Internet-connected households
		Smart phone penetration	% of residents with smartphone access
		Civic engagement	# of civic engagement activities offered by the muncipality last year
			Voter participation in last municipal election (% of eligible voters) (ISO 37120: 11.1)
	Education	Secondary Education	% of students completing secondary education (ISO 37120: 6.3)
		University Graduates	Number of higher education degrees per 100,000 inhabitants (ISO 37120: 6.7)
	Creativity	Foreign-born immigrants	% of population born in a foreign country
		Urban Living Lab	# of officially registered ENOLL living labs
		Creative Industry Jobs	Percentage of labor force (LF) engaged in creative industries
Living	Culture and Well-being	Life Conditions	Percentage of inhabitants with housing deficiency in any of the following 5 aereas (potable water, sanitation, overcrowding, deficient material quality, or lacking electricity)
		Gini Index	Gini coefficient of inequality
		Quality of life ranking	Mercer ranking in most recent quality of life survey
		Investment in Culture	% of municipal budget allocated to culture
	Safety	Crime	Violent crime rate per 100,000 population (ISO 37120: 14.5)
		Smart Crime Prevention	# technologies in use to assist with crime prevention, 1 point for each of the following: livestreaming video cameras, taxi apps, predictive crime software technologies
	Health	Single health history	% of residents w/ single, unified health histories facilitating patient and health provider access to complete medical records
		Life Expectancy	Average life expectancy (ISO 37120: 12.1)

Table 5.8: Smart City Indicators
Source: (B. Cohen, 2014)

5.4 Smart Urbanism (SU)

Smart urbanism (SU) as Luque-Ayala and Marvin, (2015) mention is produced by associating various concepts of the future vision of urban areas, advanced technology and modern cities' infrastructures. They mention that international institutions, companies, national and local governments have improved the SU vision and seek to illustrate the role of high-tech urban growth, e-citizens and the digital economy (Luque-Ayala and Marvin, 2015). In the urban design domain Nam & Pardo, (2011) assert that "the smartness in smart growth is treated as a normative claim and ideological dimension. Being smarter entails strategic directions. Governments and public agencies at all levels are embracing the notion of smartness to distinguish their new policies, strategies, and programs for targeting sustainable development, sound economic growth, and better quality of life for their citizens. They associate smart with achieving policy success in their jurisdictions" (Nam and Pardo, 2011).

Today's most updated data provided by technology on cities' physical recognition is remote sensing imagery. Remote sensing imagery in the urban context has been used not only for pattern recognition but also for building characteristics extraction and automatic reconstruction. The most classical methodologies for analysing settlement types based on remote sensing imagery as Marsal-Llacuna et al., (2015) discuss cluster analysis (to determine homogeneity patterns), principal component analysis (to determine differentiation patterns), and regression analysis (to determine the explicit functional relations between settlement patterns and their underlying variables). They add that there are other methods such as the use of decision trees, neural networks and the link between neural networks and the nodes of decision trees for urban settlements pattern classification, simulation techniques, and predicting urban growth by adding cellular automata techniques to satellite imagery. Marsal-Llacuna et al., (2015) point out that the initiative of smart cities seeks to advance urban performance by utilizing data, information and information technologies (IT) to provide effective services to people in order to control and improve existing infrastructure, to raise cooperation amongst various economic aspects and to promote innovative business schemes in both the private and public sectors (Marsal-Llacuna et al., 2015).

Neirotti et al., (2014) assert that a great number of urban living domains in which the approach might be utilised have led to creating various visions of the smart city concept. They display an overview of these domains that are relevant to the topic of urban development and examine in different aspects. They classify urban domains as hard and soft in connection to the significance that the ICT systems have as the main empowering technologies. They mention that hard domains indicate water and waste management, healthcare, mobility and transport infrastructures, and energy distribution networks. In contrast, soft domains contain aspects like public administration and (e-) government, social inclusion and welfare, and education and culture. Neirotti et al., (2014) show that "In these areas, ICT has a more limited role and is not necessarily aimed at processing and integrating real-time information. This is the case of education, where processes are not based to any great extent on handling transactions. In other cases, such as the one of innovation and social inclusion policies, SC initiatives are not characterised by new technology deployment but rather by public interventions aimed at creating the right societal and institutional conditions (e.g. incentives, ad hoc organizational bodies, etc.)" (table 5.9) (Neirotti et al., 2014). Furthermore, Neirotti et al., (2014) have grouped the implementation domains into six groups, which in turn contain some subdomains (table 5.10).

Prevalence of investments in:	Domain	Main objectives	References
"Hard" Domains	Energy grids	Automated grids that employ ICT to deliver energy and enable information exchange about consumption between providers and users, with the aim of reducing costs and increasing reliability and transparency of energy supply systems	Chourabi et al. (2012), Correia and Wünstel (2011) and Mahizhnan (1999) and Steria-Smart City (2011)
	Public lighting, natural resources, and water management	Managing public lighting and natural resources. Exploiting renewable resources such as heat, solar, cooling, water, and wind power	Accenture (2011), Correia and Wünstel (2011), Dirks et al. (2009), Hughes et al. (2013) and Nam and Pardo (2011), The Climate Group et al. (2011), Think (2011) and Toppeta (2010)
	Waste management	Applying innovations in order to effectively manage the waste generated by people, businesses, and city services. It includes waste collection, disposal, recycling, and recovery	Accenture (2011) and The Climate Group et al. (2011)
	Environment	Using technology to protect and better manage environmental resources and related infrastructure, with the ultimate goal of increasing sustainability. It includes pollution control	Atzori, Iera, and Morabito (2010), Caragliu et al. (2009), Chourabi et al. (2012), Inayatullah (2011), Nam and Pardo (2011) and Tiwari, Cervero, and Schipper (2011)
	Transport, mobility, and logistics	Optimising logistics and transportation in urban areas by taking into account traffic conditions and energy consumption. Providing users with dynamic and multi-modal information for traffic and transport efficiency. Assuring sustainable public transportation by means of environmental-friendly fuels and innovative propulsion systems	Atzori et al. (2010), Caragliu et al. (2009), Correia and Wünstel (2011), Dirks et al. (2009), Giffinger et al. (2007), La Greca et al. (2011), Munuzuri et al. (2005), Nam and Pardo (2011), Steria (2011), The Climate Group et al. (2011), Think (2011), Toppeta (2010) and Washburn et al. (2010)
	Office and residential buildings	Adopting sustainable building technologies to create living and working environments with reduced resources. Adapting or retrofitting existing structures to gain energy and water efficiency	Accenture (2011), Steria (2011), The Climate Group et al. (2011), Think (2011), Washburn et al. (2010)
	Healthcare	Using ICT and remote assistance to prevent and diagnose diseases, and deliver the healthcare service. Providing all citizens with access to an efficient healthcare system characterised by adequate facilities and services	Accenture (2011), Atzori et al. (2010), Correia and Wünstel (2011), Dirks et al. (2009); Nam and Pardo (2011), The Climate Group et al. (2011) and Washburn et al. (2010)
	Public security	Helping public organizations to protect citizens' integrity and their goods. It includes the use of ICTs to feed real-time information to fire and police departments	Accenture (2011), Dirks et al. (2009), Nam and Pardo (2011) and Washburn et al. (2010)
Soft domains	Education and culture	Capitalising system education policy, creating more opportunities for students and teachers using ICT tools. Promoting cultural events and motivating people participation. Managing entertainment, tourism, and hospitality	Accenture (2011), Dirks et al. (2009), Mahizhnan (1999), Nam and Pardo (2011) and Washburn et al. (2010)
	Social inclusion and welfare	Making tools available to reduce barriers in social learning and participation, improving the quality of life, especially for the elder and disabled. Implementing social policies to attract and retain talented people	Atzori et al. (2010), Bakıcı, Almirall, and Wareham (2013), Caragliu et al. (2009), Chourabi et al. (2012), Correia and Wünstel (2011), Giffinger et al. (2007), Mahizhnan (1999) and Toppeta (2010)
	Public administration and (e-) government	Promoting digitised public administration, e-ballots and ICT-based transparency of government activities in order to enhance citizens empowerment and involvement in public management	Accenture (2011), Bakıcı et al. (2013), Caragliu et al. (2009), Chourabi et al. (2012), Correia and Wünstel (2011), Dirks et al. (2009), Giffinger et al. (2007), Odendaal (2003), Steria (2011), Think (2011), Toppeta (2010) and Washburn et al. (2010)
	Economy	Facilitating innovation, entrepreneurship and integrating the city in national and global markets	Bakıcı et al. (2013), Caragliu et al. (2009), Chourabi et al. (2012), Correia and Wünstel (2011), Giffinger et al. (2007), Mahizhnan (1999) and Toppeta (2010)

Table 5.9: Classified Literature on the Domains of a Smart City
Source: (Neirotti et al., 2014)

Domain	Sub-domain	Description
Natural resources and energy	Smart grids	Electricity networks able to take into account the behaviours of all the connected users in order to efficiently deliver sustainable, economic, and secure electricity supplies. Smart grids should be self-healing and resilient to system anomalies
	Public lighting	Illumination of public spaces with street lamps that offer different functions, such as air pollution control and Wi–Fi connectivity. Centralised management systems that directly communicate with the lampposts can allow reducing maintenance and operating costs, analysing real-time information about weather conditions, and consequently regulating the intensity of light by means of LED technology
	Green/renewable energies	Exploiting natural resources that are regenerative or inexhaustible, such as heat, water, and wind power
	Waste management	Collecting, recycling, and disposing waste in ways that prevent the negative effects of an incorrect waste management on both people and the environment
	Water management	Analysing and managing the quantity and quality of water throughout the phases of the hydrological cycle and in particular when water is used for agricultural, municipal, and industrial purposes
	Food and agriculture	Wireless sensor networks to manage crop cultivation and know the conditions in which plants are growing. By combining humidity, temperature, and light sensors the risk of frost can be reduced and possible plant diseases or watering requirements based on soil humidity can be detected
Transport and mobility	City logistics	Improving logistics flows in cities by effectively integrating business needs with traffic conditions, geographical, and environmental issues
	Info-mobility	Distributing and using selected dynamic and multi-modal information, both pre-trip and, more importantly, on-trip, with the aim of improving traffic and transport efficiency as well as assuring a high quality travel experience
	People mobility	Innovative and sustainable ways to provide the transport of people in cities, such as the development of public transport modes and vehicles based on environmental-friendly fuels and propulsion systems, supported by advanced technologies and proactive citizens' behaviours
Buildings	Facility management	Cleaning, maintenance, property, leasing, technology, and operating modes associated with facilities in urban areas
	Building services	Various systems existing in a building such as electric networks, elevators, fire safety, telecommunication, data processing, and water supply systems. Computer-based systems to control the electrical and mechanical equipment of a building
	Housing quality	Aspects related to the quality of life in a residential building such as comfort, lighting, and Heating, Ventilation and Air Conditioning (HVAC). It includes all that concerns the level of satisfaction of people living in a house
Living	Entertainment	Ways of stimulating tourism and providing information about entertainment events and proposals for free time and night life
	Hospitality	Ability of a city to accommodate foreign students, tourists, and other non-resident people by offering appropriate solutions to their needs
	Pollution control	Controlling emissions and effluents by using different kinds of devices. Stimulating decisions to improve the quality of air, water, and the environment in general
	Public safety	Protecting citizens and their possessions through the active involvement of local public organisations, the police force, and the citizens themselves. Collecting and monitoring information for crime prevention
	Healthcare	Prevention, diagnosis, and treatment of disease supported by ICT. Assuring efficient facilities and services in the healthcare system
	Welfare and social inclusion	Improving the quality of life by stimulating social learning and participation, with particular reference to specific categories of citizens such as the elder and disabled
	Culture	Facilitating the diffusion of information about cultural activities and motivating people to be involved in them
	Public spaces management	Care, maintenance, and active management of public spaces to improve the attractiveness of a city. Solutions to provide information about the main places to visit in a city
Government	E-government	Digitizing the public administration by managing documents and procedures through ICT tools in order to optimise work and offer fast and new services to citizens
	E-democracy	Using innovative ICT systems to support ballots
	Procurement	Allowing the public sector improving procurement procedures and the associated contract management, with the purpose of assuring best value for money without decreasing quality
	Transparency	Enabling every citizen to access official documents in a simple way and to take part in the decision processes of a municipality. Decreasing the possibility for authorities of abusing the system for their own interests or hiding relevant information
Economy and people	Innovation and entrepreneurship	Measures to foster the innovation systems and entrepreneurship in the urban ecosystem (e.g. presence of local incubators)
	Cultural heritage management	The use of ICT systems (e.g. augmented reality technologies) for delivering new customer experience in enjoying the city's cultural heritage. Use of asset management information systems to handle the maintenance of historical buildings
	Digital Education	Extensive Use of modern ICT tools (e.g. interactive whiteboards, e-learning systems) in public schools
	Human capital management	Policies to improve human capital investments and attract and retain new talents, avoiding human capital flight (brain drain)

Table 5.10: Classification of Smart City domains and sub-domains.
Source: (Neirotti et al., 2014)

Gabrys, (2014) indicates that the recent literature on computational urbanisms have concentrated on the connection between advanced technology and the physical environment in cities and how this relationship might have "transformed into the ways in which cities are now being remade and marketed through both software and the material infrastructures of digital technologies. Ubiquitous computing remakes cities rather than displacing or virtually representing them by generating considerable amounts of data to manage urban processes, as well as by directly embedding devices in urban infrastructures and spaces" (Gabrys, 2014). The advanced technology in recent decades as Angelidou,

(2015) indicates created new outputs and solutions that aim to advance the concept of smart cities. They emphasise that these outputs utilize information and communication technologies to develop urban function administration in places like utilities and mobility. They state that the result will lead to an increased number of technology firms that are seeking to find their place in the smart cities product market. He point out that "the following ten years would see over $100 billion spent on technologies to support smart city development worldwide. By 2020, the annual spending on those core technologies was projected to be almost $16 billion" (figure 5.7) (Angelidou, 2015).

Hajduk, (2016) argues that this new trend will assist and solve many urban problems such as air pollution, mobility, traffic congestion, consumption of natural resources, modern communication infrastructure and utility needs. He adds that the concept of the smart city is a universal idea that aims to integrate many elements of urbanisation containing socio-economic and environmental issues (Hajduk, 2016). Manville et al., (2014) argue that urbanisation issues such as overcrowding, natural resources consumption, environmental pollution and land use management require creative and advanced methods to tackle the complexity of modern urban places. Therefore, Manville et al., (2014) say that the smart city concept is not only advanced approaches to operating the future vision of urbanisation but as the main concept to deal with many problems like utility management, traffic congestion and the complexity of urban infrastructures (Manville et al., 2014).

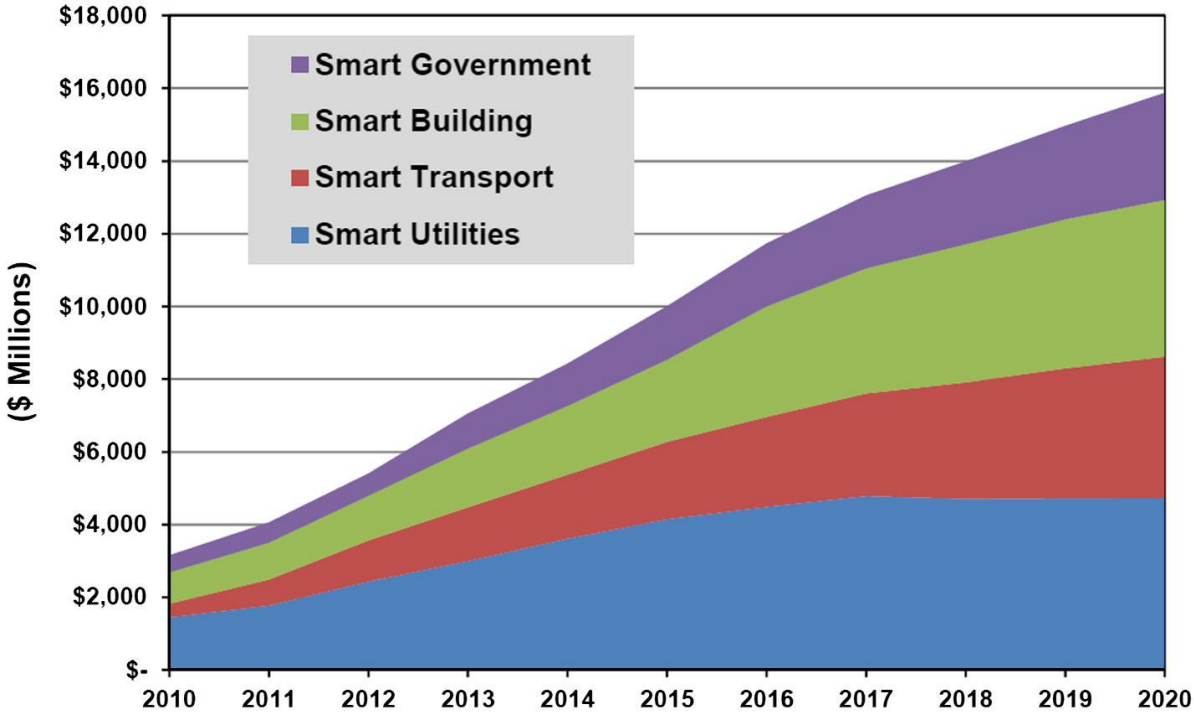


Figure 5.7: Smart City Infrastructure Investment by Industry, World Markets: 2010–2020
Source: (Angelidou, 2015)

5.5 The Internet of Thing (IoT) and Smart Cities

In the recent decade, the analysis of information has gained massive attention through the use of IoT, which allow different disciplines to record a huge amount of information that requires being clarified. These disciplines have been integrated to assess and manage big data by using various approaches. Cities have gained many benefits and solved various problems by using real-time systems assessment to analyse their information obtained from diverse aspects such as water, electricity, traffic, and gas. However, smart cities initiatives are facing a big challenge on how to build a holistic approach or model that can combine all systems to assess big data, and furthermore, can create a smart way to process back all this information transformed into knowledge to the people to promote their attitudes and assist them to advance prosperity. Elmaghraby & Losavio, (2014) indicate that there are huge amounts of pros in using ICTs and IoT in smart cities such as promoting urban quality, achieving well-being for their citizens, and implementing smart infrastructures like smart meters, smart mobility, and smart services. IoT is creating new systems and methods for managing and controlling these smart infrastructures, further producing smart sensors to respond to emergencies and disasters (Elmaghraby and Losavio, 2014).

The huge amount of information and big data methods are designed as a strong tool to contribute all the possibilities of IoT and the smart city. Jara et al., (2015) state that "Future Internet is the engine to reach the next generation of infrastructure, services and solutions to facilitate the sustainable development of its industry, buildings and citizens. Initial proofs of the potential of the Future Internet are found in the integration of the real-world in Internet through the smart objects". Jara et al., (2015) argue that "The challenge, for the big data and IoT, is to take benefit of this insight to really understand how things are interconnected. Then, we will be able in a close future, not only to understand or able to predict, act, manage and prevent these situations. Thereby, evolving from areas partially overlapped such as big data, IoT, Cloud Computing, physical devices and humans to a common ecosystem, that will be able to act/operate, enhance and fix based on all this emerging knowledge, understanding, and insight" (Jara et al., 2015). IoT has been defined as a platform for communication between citizens and as an efficient method of running the machines and big data, and also about the use of advanced technologies in a collaborative way (table 5.11)

	Definitions of Internet of Things	Source
1	Internet of Things is the marriage of minds and machines, that is, the union of big data running on the cloud computing platforms and physical devices/things.	(Jara et al., 2015)
2	IoT is generating prodigious amount of data, increasing sophisticated analytics mechanisms and tools that are providing insight that allow us to operate the machines in entirely new ways, more effectively and in a collaborative way.	(Jara et al., 2015)
3	IoT is all about digital technologies, semantic languages, and virtual identities. IoT improves the efficiency, accuracy, and effectiveness in operation and management of such innovation ecosystem aiming at guaranteeing high quality of life and stimulating innovation process of firms.	(Scuotto et al., 2016)
4	The Internet of Things (IoT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet.	(Zanella et al., 2014)

Table 5.11: Comparative Definitions of Internet of Things
Source: Author 2016

Barnaghi et al., (2015) point out that multimodal date gathering from diverse sources has been used by smart cities, involving different sorts of the IoT information such as traffic, water, electricity, weather, gas pollution, and noise information. They discuss that these data in smart cities have various qualities of information that depend on errors in assessments of the information combination devices, the nature of information communication, the granularity of the assessments in both spatial and temporal dimensions (Barnaghi et al., 2015).

Cities in recent years as Scuotto et al., (2016) mention play a key role in leading various companies in different sectors to implement ICTs, IoT and the new technology in the diverse domain of industry. They state that these cities have promoted the concept of smart cities that include sustainability to advance well-being in urban areas. They argue that the concept of smart cities does not only depend on collecting information through smart sensors and devices, in other words, is not only dependent on physical and IoT infrastructures but also relies on citizens that have the ability to advance IoT and its

infrastructures in urban spaces. They assert that companies require managing within the entire city ecosystem and with several diverse users in order to obtain better utilizing of IoT and smart cities opportunities (Scuotto et al., 2016).Urban IoTs as Zanella et al., (2014) indicate are invented to advance the concept of the smart city, which seeks to employ ICTs to promote different services, develop city infrastructures and achieve a better quality of life for its people. They point out that the concept of the IoT seeks to make the internet more prevalent and easy access and that will allow users to interact with an enormous diversity of advanced tools such as smartphones, electricity and heating sensors, and CCTV. They say that the diffusion of IoT can promote the advancement of many applications in cities, manage different information and produce modern services to people, firms, and governments (Zanella et al., 2014).

Khatoun and Zeadally, (2016) assert that the IoT is one of several models that has been suggested to assess the smart city concept. They also indicate that the broadband infrastructure is a key component to implementing the smart city concept, which is providing a platform for connection between citizens, firms, and different government foundations. They assert that both wired and wireless networks are significant to advance the smart city' services and information volume (Khatoun and Zeadally, 2016). Pouryazdan & Kantarci, (2016) debate that the Internet of Things has played a significant role to empower citizens' smart devices and develop smart cities infrastructures (Pouryazdan and Kantarci, 2016). Huang et al., (2016) point out that the integration between Internet of Things, smartphones, computers and the huge amount of information in the cloud will lead to creating a new path of integration between the physical and cyber world, produce sophisticated infrastructures and advance many creative applications. They add that this integration also will produce Socio-Physical Smart Systems (CPS3) like smart cities, smart infrastructures, smart utilities, smart mobility, smart buildings and smart methods of management different urban environment. They argue that in the age of advancement citizens will live in consolidated cyber-physical environments, however, they will encounter new challenges like how to avoid cyber-attack and protect privacy (J. Huang et al., 2016).

5.6 Information and Communication Technology (ICT)

In the recent years as Nam & Pardo, (2011) indicate that the smart city concept has transformed to a new aspect of utilizing ICT to produce and combine critical infrastructures and services of cities. They argue that "The initiatives of making a city smart have recently emerged as a model to mitigate and remedy current urban problems and make cities better as places to live. Hence, some view the smart city as an icon of a sustainable livable city. Yet, so far, we see academics have seldom tackled the practical concept" (Nam and Pardo, 2011) Lazaroiu & Roscia, (2012 point out that the smart city aims can be achieved by advancing and integrating ICTs with different systems in the city such as water, waste, gas, electricity, transportation and mobility, cooling and heating systems. They state, "The smart city is a new way of leaving and considering the cities" (Lazaroiu and Roscia, 2012). The fabric of the city nowadays is beginning to embrace the ICT regarding its materials and infrastructure while wireless solutions are invading our cities in ways that are hard to understand. Therefore, we will need to show how such developments can be combined so that cities can become smart in the way their urban designers and citizenry can utilise such technologies to promote the quality of life (Batty et al., 2012).

Höjer and Wangel, (2014) argue that the ICT development is commonly understood to be a technological development, while the increased interest in sustainable development comes from an understanding of the pressure that humanity imposes on global ecosystems, and urbanisation is a consequence of people moving to conurbations. They depict that the advancement of Information and Communication Technologies (ICT) and urban development as a symbiosis. They also indicate that the evolution of ICT has had a massive effect on how citizens live their lives and on how to work, leisure and community are organised, and furthermore, ICT has facilitated a number of new products, services and business models due to the reduction in the cost and size of computing capacity. They assert that ICT advancement has developed productivity, driving even cheaper products and fuelling the consumption community (Höjer and Wangel, 2014).

ICT has become an essential tool for the city to improve the efficiency, equity and quality of life for its citizens, and to support socio-economic aspects to reach their goals.

Information and Communication Technologies also can promote the city system by providing accurate information about different sectors such as transportation, environment, health, education and economical for instance to solve problems and make intelligent decisions. There is powerful evidence from research, studies, articles and case reports of the ability of ICT to support cities and meet their challenges. The two parts, information and communication, are playing an important role together. Information technology involves everything about how to process and manage data, while communication technology includes everything about how to use tools to transfer data from one system to others (Danar Sunindyo et al., 2013). Thus, ICT utilises computer-based systems as well as telecommunication technologies for the information and data storage, processing, and communication (Malapile and Keengwe, 2014).

The smart city initiative as Neirotti et al., (2014) argue is distinguished by the utilisation of (ICT), which assist the city to utilise its resources more efficiently in different urban aspects. They mention that Information and Communication Technologies methods can be observed as the main element that provides data to urban design to advance the socio-economic and environmental sustainability of cities. They discuss that the smart city which utilises ICTs infrastructures does not mean a good city, but rather it may develop and create different approaches to solving various problems in the city and advance the quality of life of its people. They mention that ICTs might be considered as the city's digital nervous systems that gain information from diverse aspects such as smartphones, various services, hospitals, and different government institutions (Neirotti et al., 2014). Kylili and Fokaides, (2015) show that the use of ICTs in the smart city concept will require utilising a smart grid. They mention that employing ICTs by smart grids in the smart city will assist in the collection and analysis of big data, like citizens' attitudes, and infrastructures and services action. They add that this will help to manage the natural resources, and efficient use of electricity, water and energy (Kylili and Fokaides, 2015).

Bifulco et al., (2016) point out that there are several approaches to the smart city concept that have emerged by focusing on different aspects that preference the smartisation procedure. They discuss that the huge amount of smart cities initiatives might be associated with the "integration of new technologies, in particular, ICTs and data management functionalities, expanded from elementary data acquisition to data processing and

interpretation. These advances have been widely exploited due to the diffusion of mobile devices, which allow people to participate in and contribute to their urban and metropolitan environment" (Bifulco et al., 2016). Shahrokni et al., (2015) debate that ICTs can transmit our cities to achieve urban sustainability aims and further obtain the smart city concept objectives. They suggest that ICTs might be utilised to promote the transformation to a less material-intensive economy. They assert that many of these advanced technologies are connected with the smart cities concept. They argue that the implementation of different ICTs-enabled solutions in the concept of smart cities will produce accurate data and that might lead to a good management of data and real-time feedback (Shahrokni et al., 2015).

The main significant feature of the concept of smart cities as Kraus et al., (2015) write is the availability of advanced ICTs infrastructures. They indicate that the modern innovations like the internet of things and sophisticated computer technologies are fundamental aspects of urban evolution. They add that these digital technologies and new data are the key elements to achieve a better quality of life, prosperity, equity and sustainable urban environments. They confirm that the application of ICTs in the smart city will develop the efficiency and participate in socio-economic, environmental and urban development (Kraus et al., 2015). Khatoun and Zeadally, (2016) assert that ICTs are one of the main concepts to promote smart cities' services and develop a new method of electronic services containing sales, shoppers, and delivery service. They confirm such smart cities' services that use ICTs will improve different aspects in cities such as mobility, utilities, quality of life, safety and environmental issues. They point out that the innovation framework H2020 initiative by the European Union has concentrated on advancing e-services (Khatoun and Zeadally, 2016).

5.6.1 ICT and Society

Individuals are increasingly using smartphones and computers with high capacities regarding battery life, sensing, and connectivity, while ICT infrastructures such as sensors, networks, CCTV, etc. will pervade our cities in the near future. Consequently, the new vision of urban environment in our cities will be a very intensive digital ecosystem. The combination of ICT devices and humans will characterise future urban scenarios and advance urban services. Such services will have the ability to inform the new vision of the

smart sustainable city and it will affect our way of living in the urban environments (Bicocchi et al., 2013). The progress of technologies and the availability of different sensors can provide and generate big data about various sectors such as transport in our cities. Sensing capabilities will play a fundamental role as a part of ICT infrastructure to improve the city life (figure 5.8). Moreover, humans can play a significant role by acting as a kind of social sensor through their computers, smartphones signal and social networks. That is needed in a high degree of awareness among people to realise complex situations and produce a type of collective knowledge of the surrounding physical and social environment (Bicocchi et al., 2013). The challenge is how ICT and their infrastructure can recognise various complex situations and to reconfigure the city system regarding big and varied data. The future vision of public participation in cities and especially in Baghdad will engage citizenry with experts from many fields in producing scenarios for promoting the quality of urban life. This will require a massive mobilisation of data, serious progress in models, policy integration and the most important thing is to educate citizens to enable them to use intelligent devices in traditional environments. Participation will be the main element to build a global knowledge resource that will clarify the accessibility to individuals, organisations and businesses.

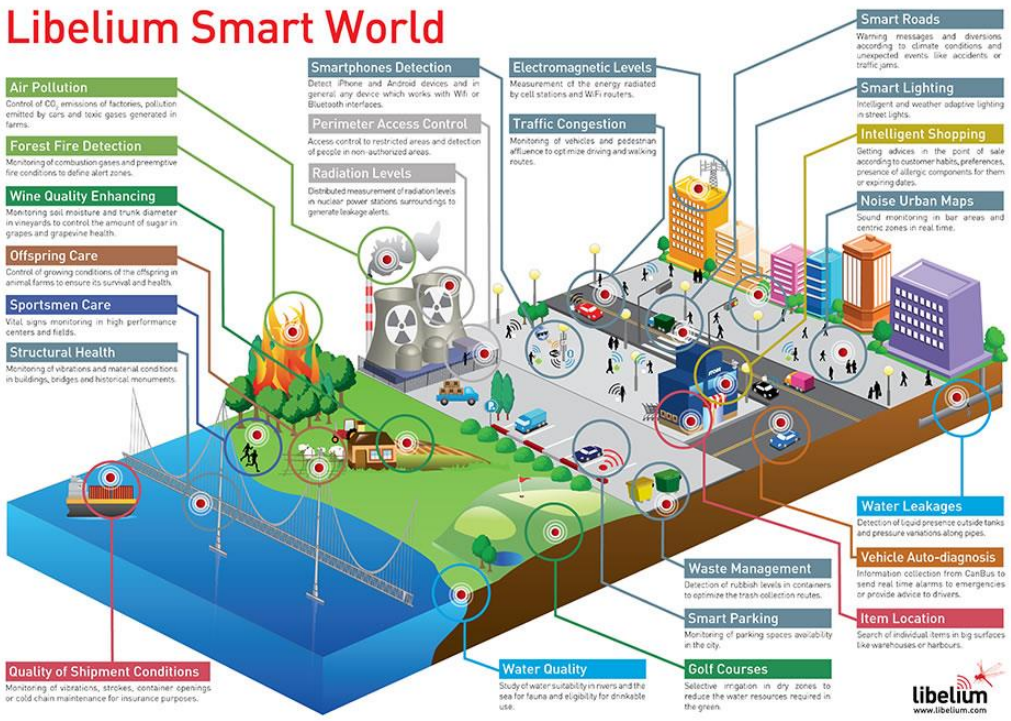


Figure 5.8: Sensors for Smart Cities.
Source: http://www.libelium.com/libelium-smart-world-infographic-smart-cities-internet-of-things/

On the one hand, individuals should be fully aware of the type of information they are participating in and of the prospect of welfare that they will be able to gain. On the other hand, individuals should manage their participating information and realise how their information is being analysed, administered and used. For that, we need a smart public system (a special one for Baghdad) able to deliver accurate information within a new and reliable framework that has the possibility of creating a democratic participation environment (Batty, 2012). ICTs have been considered by Granier and Kudo, (2016) as a strong element to advance people engagement and further decrease engagement costs by allowing people to engage through their smartphone in real time and at any area (Granier and Kudo, 2016).

5.6.2 ICT and Governance

The accessibility to the huge amount of information and working with diverse platforms will enable people to determine their choices in the urban environment from their computers and smartphones. In addition, the increase of complex information "big data" and the smart devices to utilize them will transform the possibilities for controlling urban infrastructure (Rabari and Storper, 2014). ICT will produce a new way of communication and interaction between citizens and government, and it will help us in different areas of our life to improve health care, access to education and housing or to increase safety in urban environments (Ericsson, 2013). ICT also will have the ability to clarify what type of society and government we will have in the future and it will form a new framework for open government (figure 5.9). According to M. Townsend in his book, *Smart Cities* "For a new cadre of civic leader, smart technology isn't just a way to do more with less. It's a historic opportunity to rethink and reinvent government on a more open, transparent, democratic, and responsive model" (Townsend, 2013:14). Big data, computer models, codes, hardware design for example are not just case studies but existing working technology and best practices for smart city innovations.

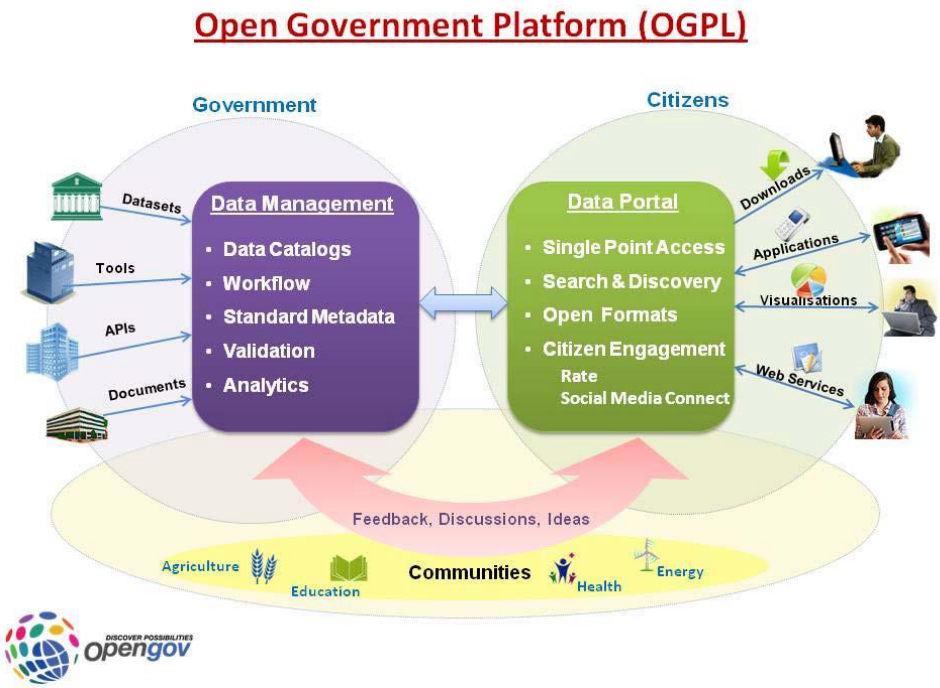


Figure 5.9: The Open Government Platform
Source: http://www.opengovplatform.org/features.

To comprise the goals of the smart city under the light of ICT in Baghdad, we will also need a new type of cooperation between traditional functions of government and business. Businesses with their expertise will provide hardware, software and information solutions, empower cities to be smarter while the government will engage their people and focus on the quality of life of their communities. Under the information age, the idea of governance will be some decentralization, and the traditional role of urban design will require new questions of the operation of utilities, the access of citizens to services, health and education (Batty et al., 2012). Bifulco et al., (2016) point out that the urban context is affected by the use of new technologies and globalisation procedures. They also mention that governments nowadays are increasingly using ICTs through the engagement of various sectors in managing big data to implement sustainable urban environments and achieve well-being in their cities (Bifulco et al., 2016).

The massive amount of information produced by different sectors in cities will require local governments to face new challenges such as running cases concerning information, participation big data, safety and the privacy of open data. Zoonen, (2016) points out that the majority of governments around the world nowadays are seeking to promote their

socio-economic and environmental development by using the smart city concept, indicating that the use of ICTs in developing the smart city concept will lead to advanced cities infrastructures, creating a new way of monitoring transportation and efficient use of energy. They argue that these procedures will produce a tremendous amount of information that requires smart systems and sensors to analyse and manage these data, hence, the participation of different sectors in cities would be necessary. They mention that governments will be responsible for creating a convenient framework that connects various information and further will decide which information can be accessed and opened up to citizens' use. They debate that there are pros and cons of using such big data. They mention that cities might be efficient and healthy; however, it might be turned into information-driven robotic spaces where innovation has no place (Zoonen, 2016).

UN-Habitat, (2016) indicate that the use of ICTs by using smartphones and different applications will advance cities' service and enable citizens control of the responsiveness of public institutions. The UN-Habitat mention that ICTs can be used in various sectors of local governance, which requires investing in more advanced sensor-based systems, improving infrastructure systems and establishing a capacity for auto-correction and adaptation. The UNs' Figure 5.10 provides a summary of the institutional background and political culture that are best able to nurture local approaches to e-governance and smart city investments (UN-Habitat, 2016).

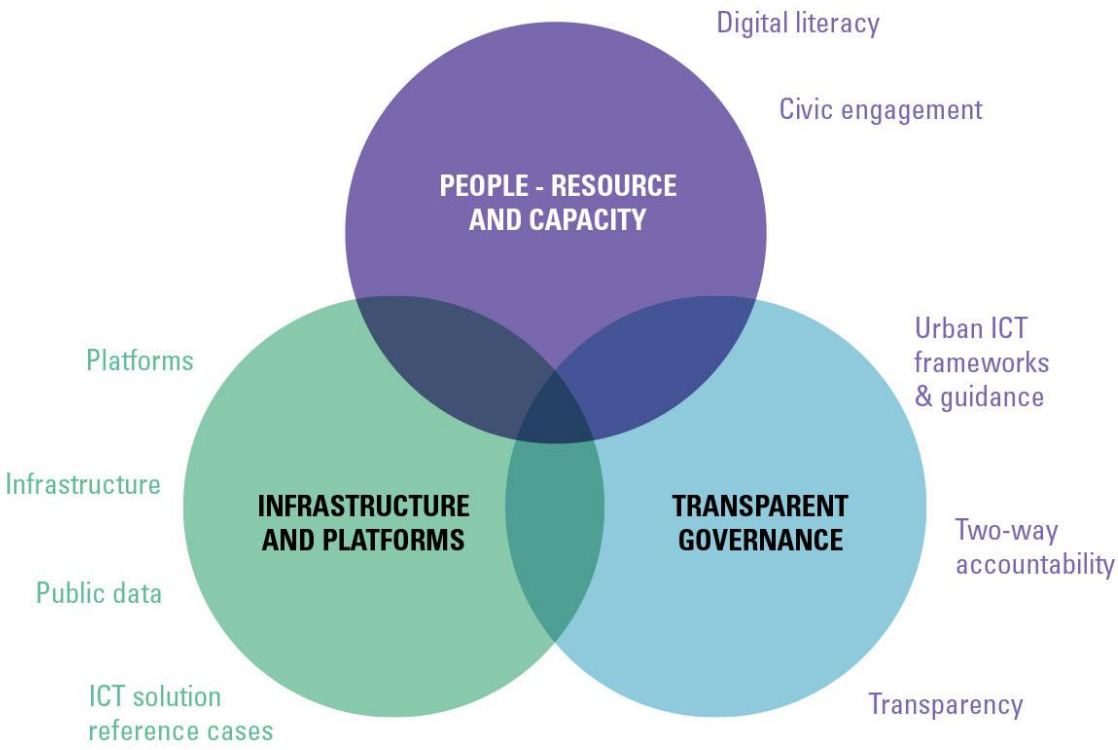


Figure 5.10: An ICT-based enabling environment for cities
Source: (UN-Habitat, 2016)

5.6.3 ICT and Urban Economies

In the economic dimension, there is a strong connection between ICT and future economic competitiveness. Information and communications technologies will produce a platform for collaboration between companies in knowledge-intensive activities and dynamic business structures. ICT "has been shown to improve efficiency in the delivery of services and productivity, as well as encourage new collaboration and innovation that fuels socio-economic development" (Ericsson, 2013). ICT contributes directly to develop the performance of a city's economy and the prosperity of its citizens. It will also produce modern markets for services from the running and sale of information to the markets that analyse vast data (Rabari and Storper, 2014). ICT will also, it is claimed, increase labour productivity, enhance competition in telecommunications and open up scope for productivity gains and competitive gains for essential industries.

To achieve a better economic performance in the city of Baghdad, we will need to manage, utilise and share varied information that works together for urban development take into account the balance between environment, economy and society. Open data and free access to city data with application programming interfaces are also key elements to create new business opportunities and add value for citizens. According to Ericsson, a commercial communication company, ICT will become an essential part of main products and services regardless of what that product or service is (Ericsson, 2013).

5.7 Complexity and Smart Cities

"Our understanding of cities is being transformed by new approaches from the complexity sciences" (Batty, 2012). In the last fifty years, the city was considered as 'system', which was defined as distinct sets of interacting entities, distinct from their wider environment, usually in equilibrium and organised from the top down. Batty argued that "Cities do not exist in benign environments and cannot be easily closed from the wider world, they do not automatically return to equilibrium for they are forever changing. Indeed, they are far-from-equilibrium. Nor are they centrally ordered but evolve mainly from the bottom up as the products of millions of individual and group decisions with only the occasional top-down centralised action" (Batty, 2012). He asserts the belief that cities are more similar to biological than mechanical systems and the increase of the sciences of complexity has changed the direction of the system theory from the top down to bottom up.

Nowadays, the city as Neirotti et al., (2014) argue is a complex system, which is distinguished by the huge amount of associated people, economics, various way of mobility, telecommunication networks, and utilities (Neirotti et al., 2014). Jara et al., (2015) argue, "Complexity used to be the result of the lack of understanding about the underlying laws, that is, simple rules, which drive the system. For that reason, the methodology is based on simplifying complexity to analyse complex patterns and discover correlations that can lead us to an explanation. Some techniques for this purpose are, on the one hand, fusion-fission dynamics based on regularly split and merge data in different subgroups to look up correlation among them, on the other hand, long-term association patterns by applying techniques with network analysis" (Jara et al., 2015). Nam & Pardo, (2011) state that "A solution to make a city smarter introduces a new level of complexity". They assert, "The solution should extend beyond technology, but we should still value the indispensable role of technology. Smart city integrates technologies, systems, infrastructures, services, and capabilities into an organic network that is sufficiently complex for unexpected emergent properties to develop" (Nam and Pardo, 2011).

5.7.1 Networks and Interactions

In the last decade, there have been dramatic improvements in networks that demonstrate that these structural characteristics are important for complexity. Networks and their dynamics enhance the relationships between the system elements in terms of their interactions. Batty believes that the key insight for understanding the city is in understanding the structure of these coupled networks. The different processes that bring individuals together to produce and exchange goods, ideas and information in cities define a multitude of networks that enable people to deliver materials and data to promote such efforts. These massive data require implementation standards for the integration of this data, for achieving quality standards and for determining the accuracy and error in such data (Batty, 2012). Batty mentioned that there are two types of networks: the first type, networks that are interactions between all the parts that form a set of objects. For example, networks between all areas that represent the movement from home and workplaces or movement from one place to another. The second type is networks that are relations between two various sets of objects, like between people and places. Therefore, understanding cities must extend to predicting flows and networks instead of just observing them. (Batty et al., 2012).

One of the fundamental ideas in this new science as Batty said is “that locations are really the nodes that define the point where processes of interaction being and end”. Therefore, analysing cities requires us to think of them as sets of actions, transactions and interactions rather than as sets of spaces, places and locations, and we also start to consider cities as patterns of flows and networks (Batty, 2013:09). In this context, I have represented and proposed in (figure 5.11) the main nodes, networks, flows and interactions in Baghdad in terms of what kind of networks we will have depending on function and location. This might explain the potential networks Baghdad might have in the future and gaining a better understand of what the city of Baghdad might become in terms of the new visions and how that will effect on the historic part. We will go for further explanations in this thesis in Chapter Five and we will also provide our smart sustainable urban design framework plan in chapter ten as a step toward improving the situation in the historic area of Baghdad.

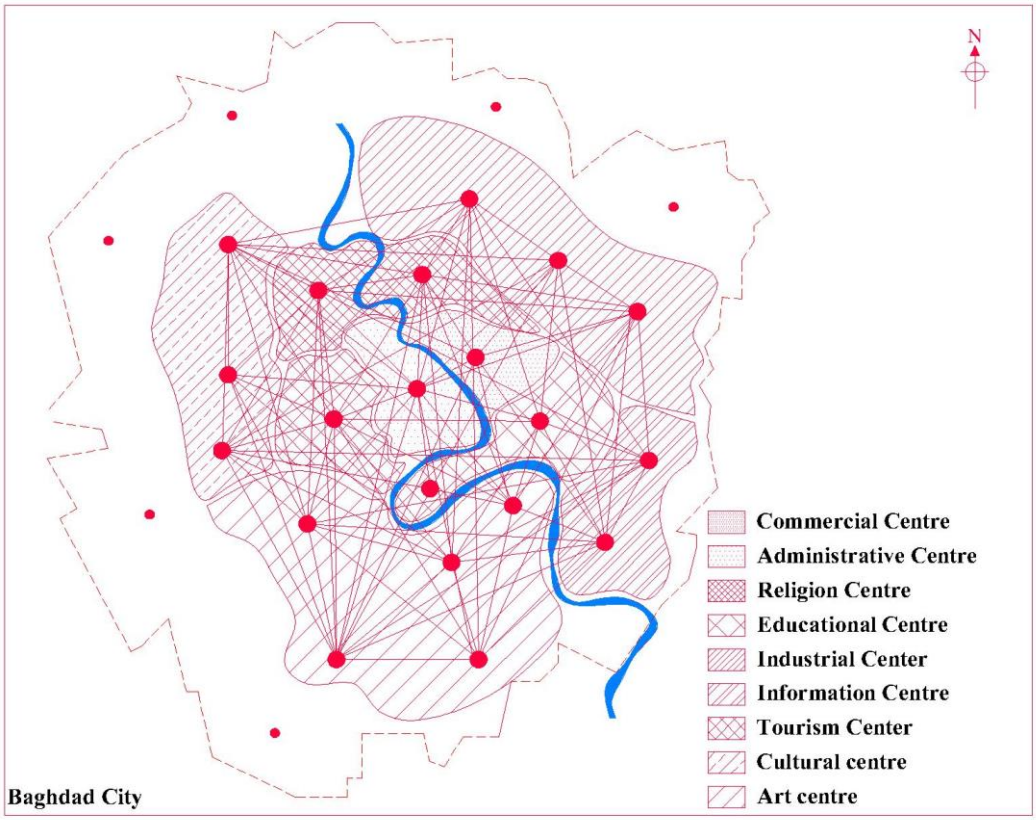


Figure 5.11: Networks and Interactions in Baghdad
Source: Author 2016

Jara et al., (2015) debate that several interacting aspects in cities that behave according to specific rules mean complex networks, and create a globally logical attitude. They add that "These networks are physical, social, biological, cultural and human networks that govern how the different parts of the world operate and how they affect our lives" (Jara et al., 2015). Lombardi et al., (2012) say that cities nowadays are a complex system due to the citizens' unpredictable attitudes. They consider the city as an area where various associated ecosystems live and communicate. Furthermore, they state that the city is an overlap-complicated system (Lombardi et al., 2012).

5.7.2 The Smart Complex City

Nowadays, governments and companies are seeking to embrace the notion of smart cities to be able to remain competitive, and that will require mobilising ICT to become ever smarter. ICT as a programme will be the essential element to better cities and as an important element of complexity theory. "Cities, which adopt ICT in diverse forms, change the very nature of the adoption process by using that same ICT. The nexus is complex, and

we ignore this interwoven complexity at our peril" (Batty et al., 2012). Developing a database that is using new types of media for collecting information through sensing and the automated recording of behaviour in the environment and communication will be part of new governance structures for smart complex cities. This development will create new complex and intelligence functions that use a massive amount of participation through ICT in making decisions in real time. As a result, we will need to produce new models and modern urban forms that can deal with these changes and adopt various notions of how cities might function. These new models also will provide new principles to resolve the conflict between modern and traditional perspectives and let us be more aware of the complicated situation in historic areas such Baghdad city centre and what is the best process to understand, generate and design that we need for the best urban future.

The future of ICT will represent the complexity sciences that are joined to various disciplines and professional fields. He defined a smart city as a complex of hard infrastructure with the availability and quality of knowledge communication and social infrastructure, and it is a tool for developing competitiveness in order to promote community and quality of life (Batty et al., 2012). Therefore, the smart complex city creates efficient urban systems and active urban life that can deal with contemporary challenges and complex urban problems in real time. Barcelona is an excellent example of smart complex systems, which show us the relationships and interactions between different systems in the city (figure 5.12).

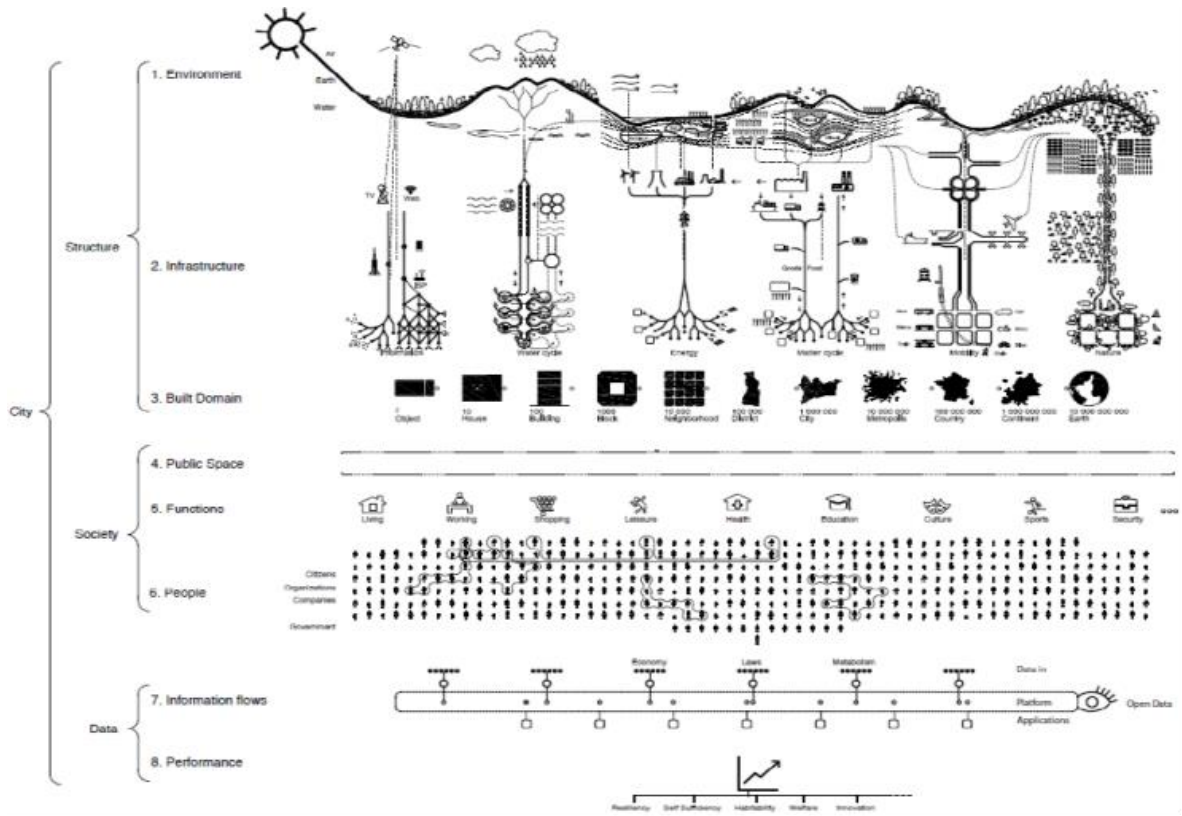


Figure 5.12: The Smart Complex City "City is System of Systems".
Source: Barcelona City Council.

This new approach of smart complex systems will bring the heritage conservation of historic areas such as Baghdad to a new vision that connects tradition and modernisation and will be the base for managing the new change in a dynamic perspective, to preserve cultural identity and the sense of place. However, the transition toward the smart city and complex systems require also adding identity, culture and tradition as significant subsystems and not depending only on technological innovations.

5.8 Smart City Challenges

The implementation of the smart city concept faces a big challenge on how to integrate different advanced technologies and various infrastructures to minimise the environmental impacts. This challenge will require the participation of diverse disciplines using ICTs, smart sensors, cameras, advanced devices, to achieve sustainable city environment and to provide our communities with a better quality of life in their cities (figure 5.13).

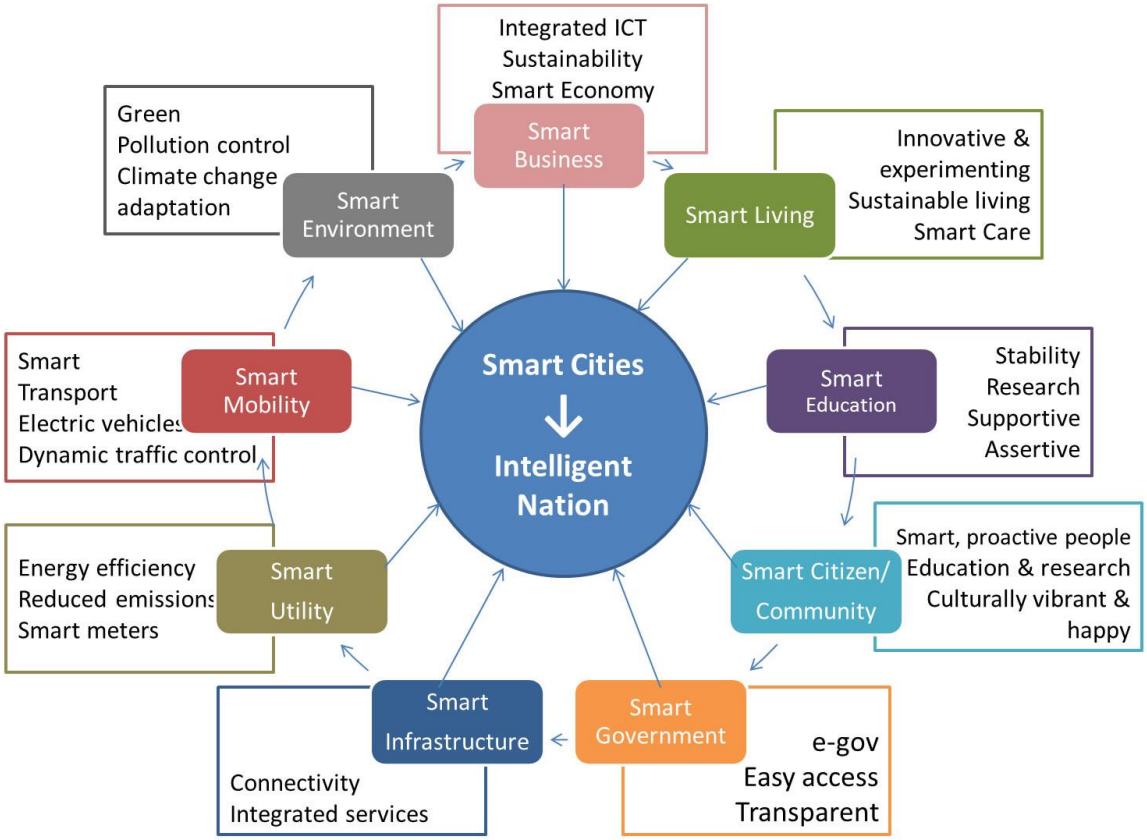


Figure 5.13: Smart Cities.

Source: https://technologyevaneglist.wordpress.com/2014/12/10/smart-cities-in-india/

There are various initiatives from governments, experts, and companies to address critical challenges facing cities around the world. According to the IBM executive report in 2009, the company has found through their expertise that cities are most often struggling to do more with less, bridge silos in information and operations, use civic engagement to drive better results and invest in infrastructure for better management. Tight budgets, scarce resources and legacy systems are a big challenge for implementing smart city goals, but using new and innovative technologies can help turn challenges into opportunities. Cities are based on a number of core systems such as infrastructures, networks and environments, transportation, communication, water and energy. The capability of these systems will determine how a city works and the ability to deliver its goals. If we go back to the plan of the Round City (762-766 AD) and compare it with IBM's diagram of analysing the future of city systems, we will observe that both have the same approach to thinking regarding the system hierarchy, multi-layered and each having two central fundamental things. Palace and mosque represent the central power and the place of making decisions of the Abbasid Empire, whereas in IBM represented by the man and the woman that are the basis of

communities. Nevertheless, IBM tries to be more democratic in the way of sharing data with a bottom-up vision to find the best solutions for improving city systems, while top-down was the main way to plan and construct the Round City (figure 5.14).

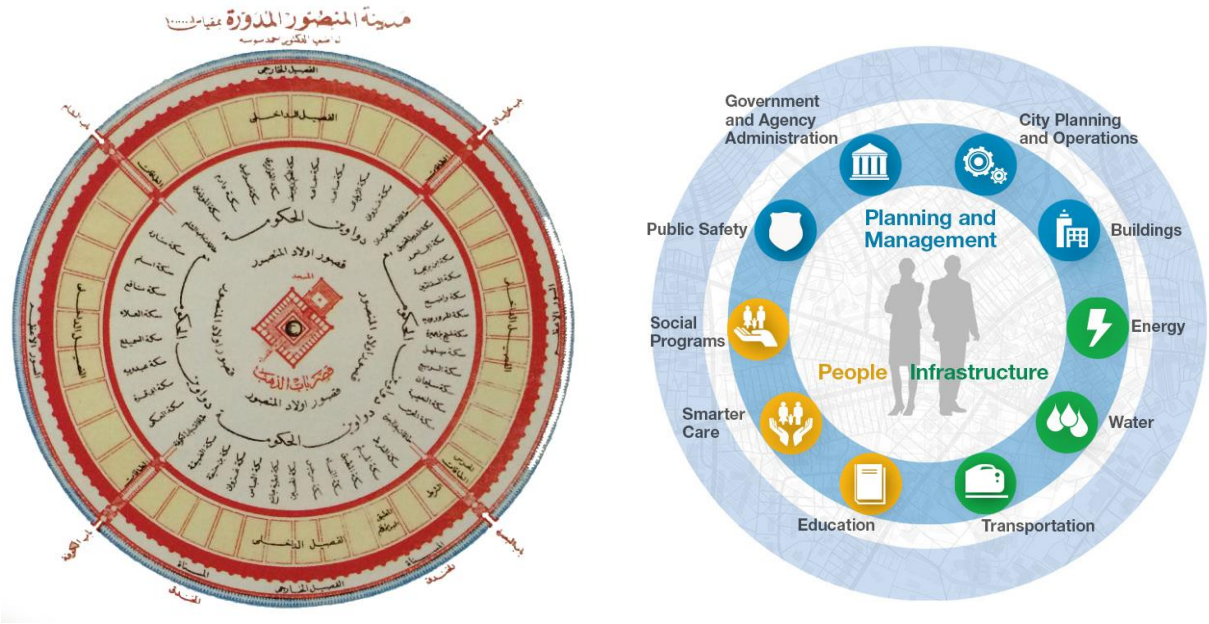


Figure 5.14: Comparative Analysis between the Round City and the Future of City Systems.
Source: Author based on (Sousa, 1952) and IBM

This shows that there is another challenge facing the city system to be smarter (especially for Baghdad) regarding what kind of system will be the best, top-down, bottom-up or something more complex and different that can shape the technology we employ in future cities.

Albino et al., (2015) argue that the future of the smart city will require urban sustainability schemes where all citizens in the city can live in prosperity. (Albino et al., 2015). The main challenges indicated by the United Nations, (2016) that face the concept of smart cities are to make sure of the participation of various sets of people, and how its applications are inclusive in terms of producing chances for all participants for instance women, the elderly and people with disabilities (United Nations, 2016). Due to the increase in the urban population nowadays as Nam and Pardo, (2011) assert the city is facing different problems such as pollution, traffic congestion, socio-economic and environmental risks. Therefore, cities will require producing smart methods to control these challenges. They indicate that the recent plans to create a good city that provides well-being for its citizens have become

an effective example for modern city development schemes. They emphasise that we must learn from new development plans prepared for different cities (Nam and Pardo, 2011). Khatoun and Zeadally, (2016) address key challenges that face the implementation of the smart city concept such as lack of investment, cost, high-energy consumption, smart citizens, privacy and cyberattacks. The following criteria represent the main challenges of implementing the concept of smart cities:

- In terms of lack of investment, the successful concept of smart cities requires investment in different sectors and creates job opportunities. Khatoun and Zeadally, (2016) point out that about $13 billion will be funded the establishment of the concept of smart cities in different cities around the world by 2020 (Figure 5.15). They argue that cities require a huge amount of money to achieve smart cities goals, the King Abdullah Economic City in Saudi Arabia, for example, has invested U.S. $70 billion in cooperation with a different organisation like Ericsson, Siemens, Cisco, Orange Business Services and other firms to get smarter (Khatoun and Zeadally, 2016).

- Another main challenge as Khatoun and Zeadally, (2016) assert is high-energy consumption. They mention that in 2011 about 21% of the world's electricity generation estimated by the U.S. Energy Information Administration was from renewable energy, with a vision growth to 25% by 2040. They show that the main reason for reducing the amount of the smart city investment is the lack of natural resources in the prediction of energy utilisation for the rest of the 21st century (figure 5.16) (Khatoun and Zeadally, 2016).

- The Smart people dimension is also one of the main challenges that the smart city concept seeks to achieve by allowing people to engage intensively in making decisions through different applications and systems like smartphones and social networks. Citizens are the main source of data that allow governments to estimate the consumption of water, gas and electricity (Khatoun and Zeadally, 2016).

- Privacy of citizens' information plays a significant part in achieving the concept of smart cities. The interaction of people with their smart devices in the complex network system in recent years brought into the focus which system or methods can provide privacy for citizens' private information (Khatoun and Zeadally, 2016).

- The huge amount of collecting and storing data in the cloud, and cyber-attacks have been one of the main challenges that threaten the implementation of the concept of smart cities. Many reasons of cyberattack displayed by Khatoun and Zeadally, (2016) according to IOActive Labs, is the absence of cyber security examining, lack of security characteristics in associated smart systems and absence of smart devices emergency response groups for example (Khatoun and Zeadally, 2016).

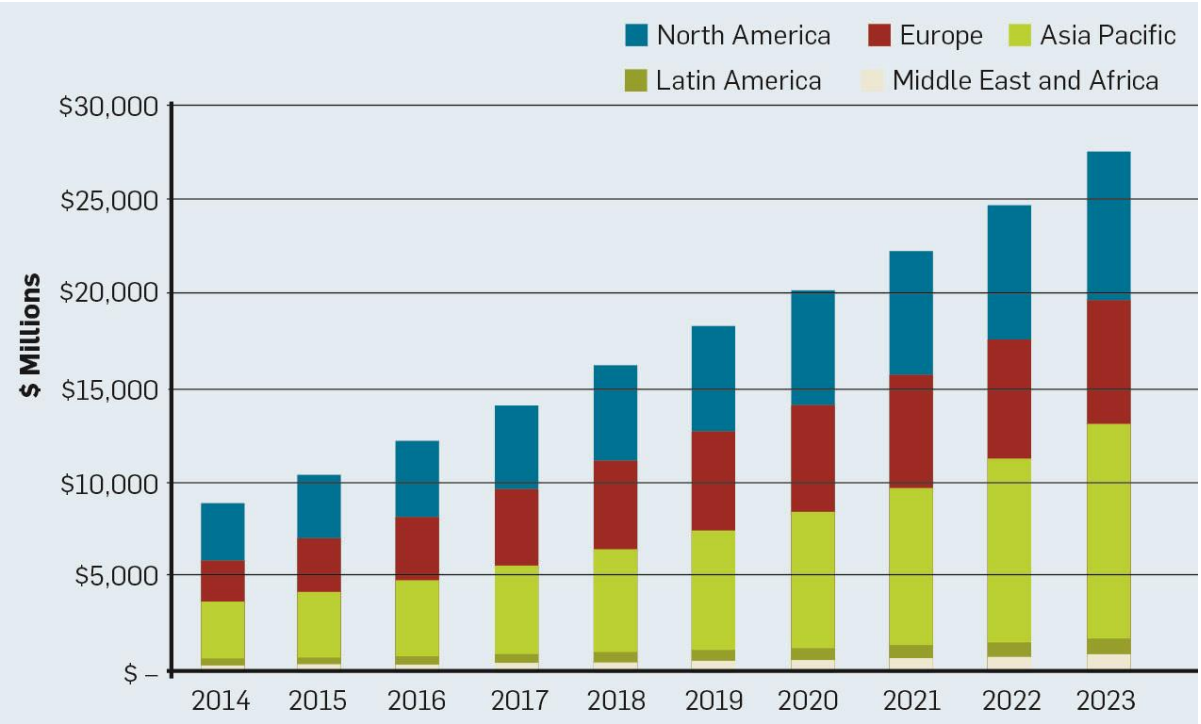


Figure 5.15: Smart City Infrastructure Investments by Industry, 2014–2023.
Source: (Khatoun and Zeadally, 2016) according to Navigant Research

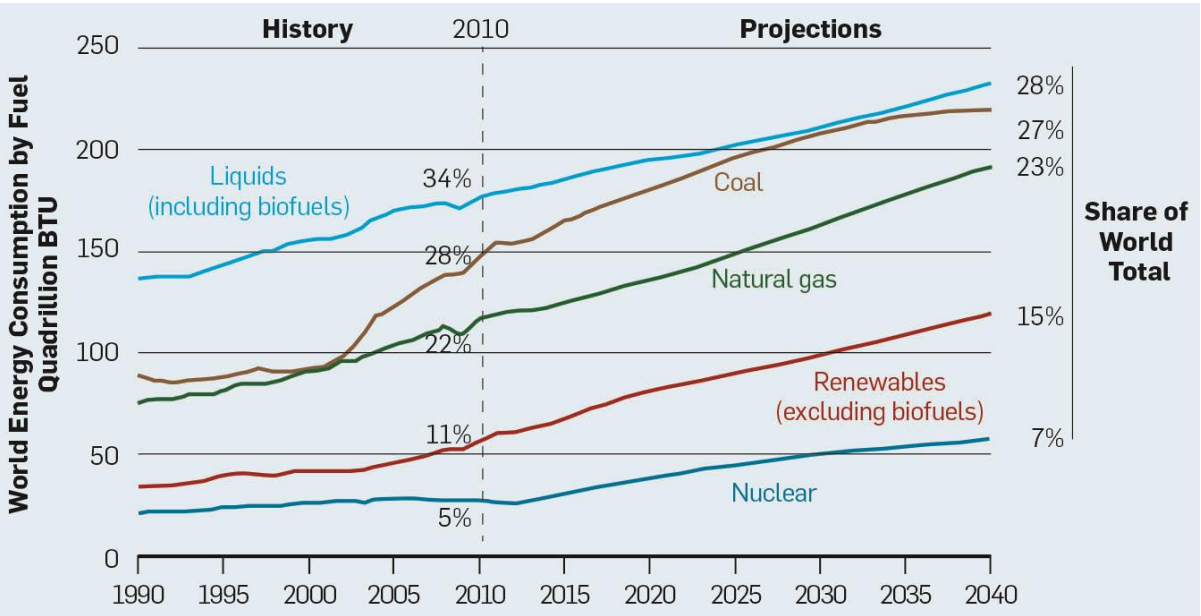


Figure 5.16: Estimating Future Energy Consumption.
Source: (Khatoun and Zeadally, 2016) according to International Energy Outlook 2013

5.9 Designing Smart Cities

Khatoun and Zeadally, (2016) point out that the implementation of the smart city concept requires different specialists from various aspects such as policy makers, engineers, sociologists, economists and experts in the field of ICTs. They indicate that private and public sectors have advanced several models for the concept of smart cities. They mention that the significant model is the one proposed by U.S. National Institute of Standards and Technology, which consider the smart city as a complex system of systems containing the six elements mobility, citizens, environment, economy, governments and the way we live in cities (figure 5.17). They confirm according to the European Parliament Policy Department that 34% of the smart city concepts in Europe have only one such element (Khatoun and Zeadally, 2016).

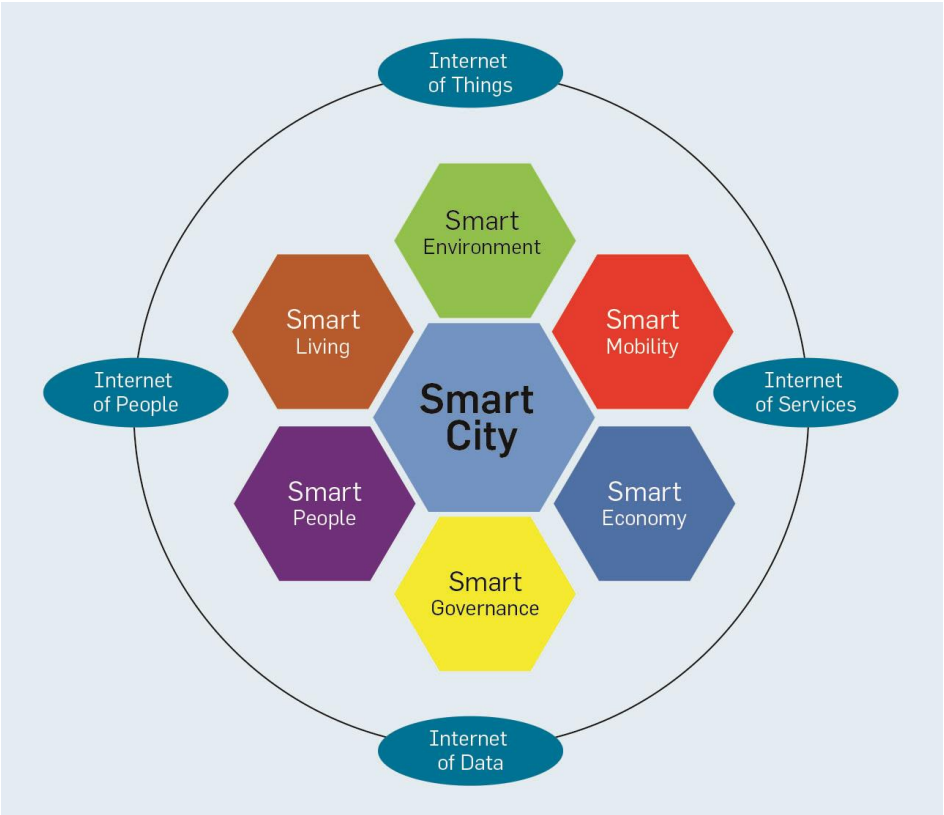


Figure 5.17: A Smart City Model.
Source: (Khatoun and Zeadally, 2016)

Angelidou, (2015) displays various examples of smart cities initiatives; Barcelona, Spain is one of these initiatives that seek to advance the use of technology in its physical urban arrangement by implementing efficient and sustainable urban mobility, creating a sustainable environment, is business-friendly and attracts capital, encourage people participation, gaining in transparency and democratic culture and improving education and healthcare. Barcelona's vision for becoming 'smart' is to implement the concept of "the city of the people". This initiative is not only about creating "futuristic images of a 'smart' regarding technology and design Barcelona, but it also promotes the area as a place where large-scale collaboration and knowledge exchange among the city's people and businesses advance the knowledge and innovation economy" (figure 5.18) (Angelidou, 2015).

Figure 5.18: Futuristic Image of Barcelona Smart City
Source: (Angelidou, 2015)

Another example mentioned by Angelidou, (2015) is London's strategy for the smart city concept. This initiative is to utilize advanced technology to develop London and improve the quality of life by cooperating between citizen and urban innovation and including the realization of urban futures in a climate of knowledge dissemination (figure 5.19). He indicates that London's strategy for the smart city contains less physical advancements compared to Barcelona's plan. He illustrates that "the 'Here East' project (figure 5.20) is one of them that illustrates very vividly the convergence of urban futures and the knowledge and innovation economy in a spatial setting. The project regards a digital quarter to be developed at Queen Elizabeth Olympic Park, using the buildings of the former Press and Broadcast Centres of the 2012 Olympics. It will be a campus commissioned to support the growth of London's technology sector by combining business, technology, media, education and data to create a local system of innovation. As such, it will provide space for start-ups, education and postgraduate research" (Angelidou, 2015).

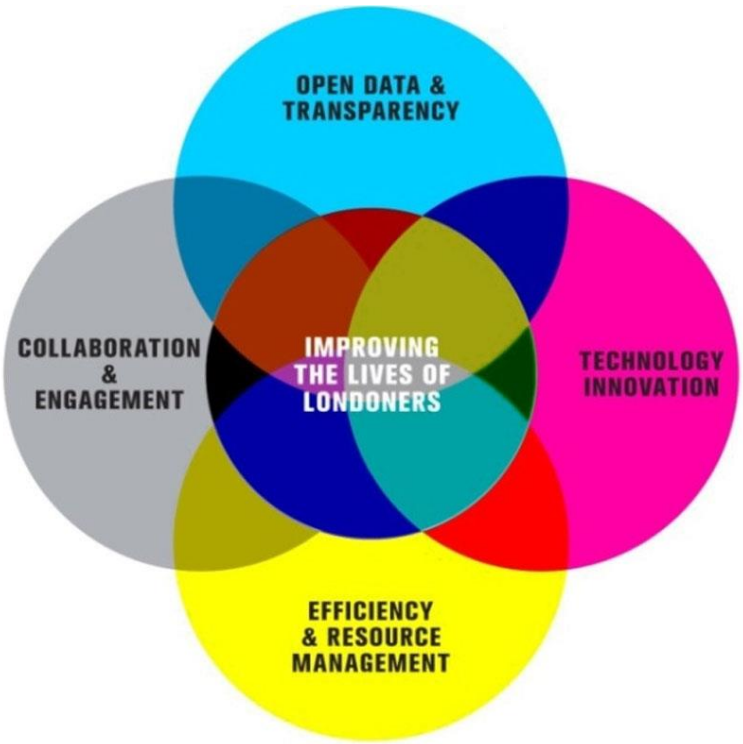


Figure 5.19: The Strategic Approach of the Smart London Plan of 2013
Source: (Angelidou, 2015)

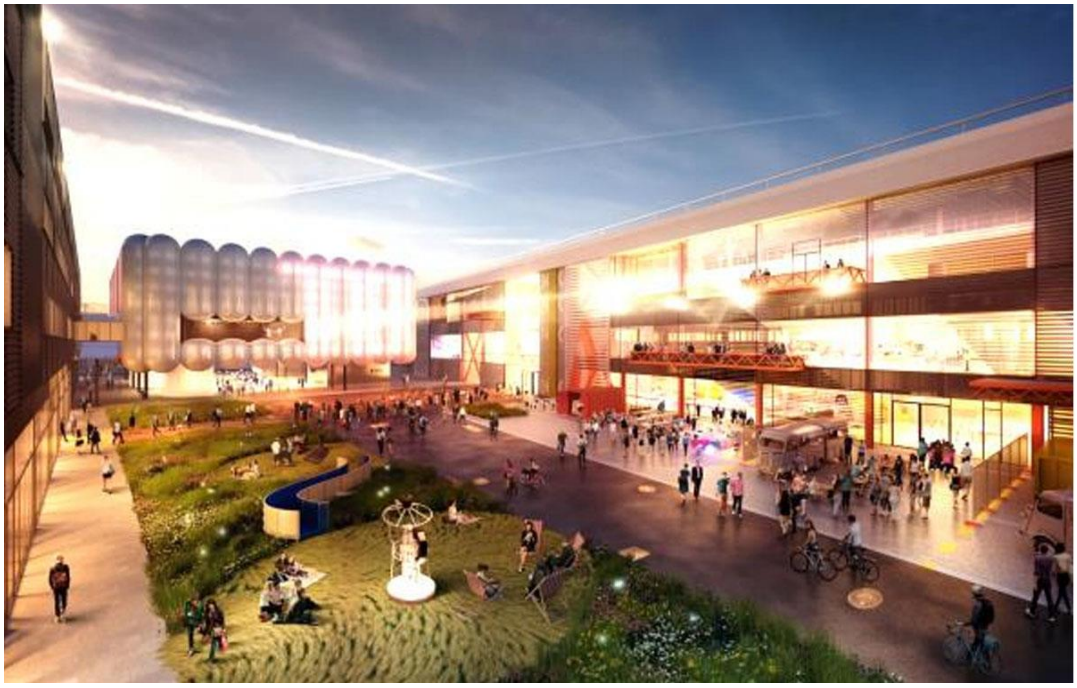


Figure 5.20: Futuristic Image of the 'Here East' Digital Hub, Part of London's Smart City Strategy
Source: (Angelidou, 2015)

5.9.1 New methods for design and planning

Batty in his article 'Smart Cities of the Future' displayed important principles and elements to plan smart cities. Divers simulation models operating have been evolved during the last 50 years at various spatial scales and through different temporal intervals to understand how cities function. The emergence of the smart city displays new challenges for these styles of modelling for many reasons. Firstly, cities nowadays have been converted from areas controlled by physical activities to places dominated by extensive utilisation of ICT. Secondly, advanced technologies and automation models have replaced several human activities (Batty et al., 2012).

As a result, smart cities will evolve new models in different sectors, a new type of information and activity will be managed over digital networks. The challenge is how these models might be utilized to inform planning at various scales and different times (Batty et al., 2012). We need to produce new effective systems that can share knowledge and experiences in the diverse process to produce systematic support for gathering data and

identifying priorities in the planning process (see: http://collaborative-intelligence.org/pt.html) (figure 5.21). These new models or systems also must have the capability to implement the balance between physical actions and the extensive use of information technologies in historic cities such as Baghdad.

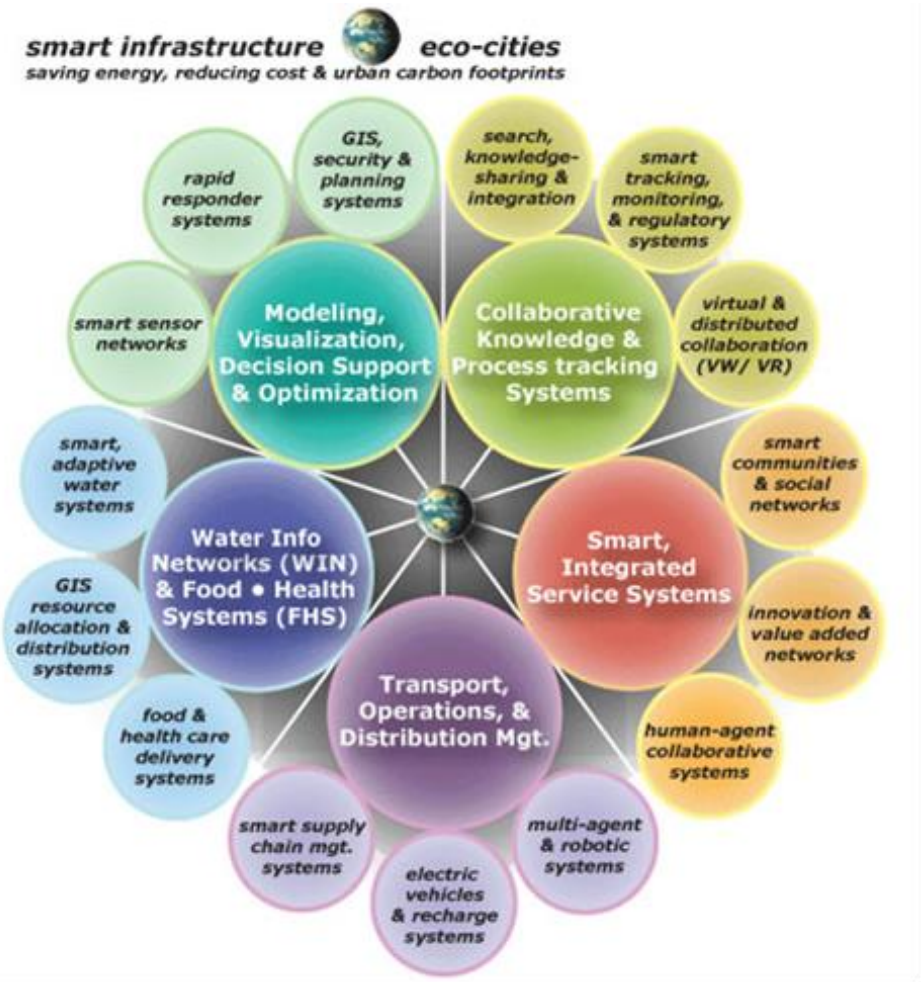


Figure 5.21: Smart Infrastructure.
Source: http://collaborative-intelligence.org/pt.html

5.9.2 New Data Systems and Integration

In order to perfect the complexity of the process for the smart city, we will require a new holistic system for joined information acquisition. This process will be able to produce the knowledge services that are able within systems to promote the following (Batty et al., 2012):

•The acquisition of data from multiple distributed sources, including services for participatory sensing and online communities

• The management of data streams

• The integration of heterogeneous data into a coherent database

• Data transformations and preparations

• Definition of new observables to extract relevant information

• Methods for distributed data mining and network analytics

• The management of extracted models and patterns and the seamless composition of patterns, models and data with further analyses and mining

• Tools for evaluating the quality of the extracted models and patterns

• Visual analytics for the exploration of behavioural patterns and models

• Simulation and prediction methods built on top of the mined patterns and models

• Incremental and distributed mining strategies needed to overcome the scalability issues that emerge when dealing with big data.

We will examine some of these points in detail and we will try in this thesis to illustrate the possibility to implement some of these as fundamental elements to promote the city system of Baghdad.

5.9.3 Coordination and Coupling

The combination, organisation and integration at various levels such as infrastructures and different services will allow the city function to be more active. This will demand a contemporary form of the database, modern methods of type analysis, new software for combining different elements in urban sectors, and new ways of coordination, which will allow such connectivity to become efficient. Smart cities should balance between efficiency and equity with a concentration on promoting the capability of its people to innovate over a balance of cooperation with competition. Therefore, if we want to reconstruct the historic part of Baghdad, we should create a new platform for integrating organisations to promote the city system and become more active and efficient in the way of dealing with various problems, sharing data and controlling services (Batty et al., 2012).

5.9.4 Governance and Smart Cities

The notion of governance that allows users of services to participate in improving city systems is a relatively new vision and is part of the wider debate about decentralisation of governance in the information age. The success of this idea will depend on privacy, safety as well as economic behaviours, social inclusivity and a host of cases that are being modified by new ICT (Batty et al., 2012). Open government generated by Web 2.0 applications and Social Media platforms have brought new organisational forms, through the ability of the internet and its users (Ferro et al., 2013). According to IBM through their smart cloud social collaboration for the government, agencies will leverage cloud infrastructure standards, virtual resources, and automated processes in a secure environment. According to IBM, U.S. agencies can:

• Connect people: Streamline communication and information sharing with access through mobile platforms and desktop clients; connect people regardless of role, affiliation, or location with Web 2.0 capabilities.

• Reduce costs: Share infrastructure with other agencies in the IBM Federal Community Cloud; access email and collaboration services without extensive, upfront investments in hardware, software, and IT skills.

• Provide flexibility: Pay for services based on usage on demand to reduce need for capacity based on usage projections; change the size of a project without adding or subtracting from computing infrastructure.

• Offer government-grade security: Meet privacy, security, and transparency standards specified by Federal Information Security Management Act (FISMA) moderate; improve application and data centre security controls for successful FISMA C&A compliance audit.

5.9.5 Participation and online communications

The new type of collaboration in evolving smart cities requires being managed from new forms of ICT. These new forms of online communication regarding mobilizing the wider citizenry will create at least four major modes of interactivity. (Batty et al., 2012). Participation in online communications will enable citizens to engage in actual design and planning and will be the main element to analyse the process of developing and designing smart sustainable urbanism master plan for Baghdad.

5.10 Comparative Analysis of A number of Smart Cities in EU using the six Smart City characteristics

The concept or initiative of the smart city is still in the earliest stage of advancement. However, many big cities in EU have at least one implemented initiative. Manville et al., (2014) shows the place of the city with inhabitants of more than hundred thousand that are applying the concept of smart cities in Europe (figure 5.22). They also illustrate the number of smart cities in each country in the 28 European countries, and the result shows that UK, Spain and Italy have the most considerable number of the implementation of the smart city concept (figure 5.23). In Figure 5.24, they confirm that the smart city norm is met by each country, with its city population of over 100,000. The large percentages are founded in Italy, Austria, the Nordic Member States, Estonia and Slovenia, and they are followed by the UK, Spain, Portugal, the Netherlands and Belgium. The lower proportions of the concept of smart cities to the total number of cities are seen in Ireland, France and Germany, most Eastern European countries and Greece. Moreover, they clarify the allocation of smart cities in Europe by smart cities characteristics (figure 5.25). They address two significant points to assess the success of smart city initiatives. Firstly, the successful smart cities should seek to implement various initiatives that cover all of the smart cities characteristics. Secondly, the successful smart cities initiative should seek to cover all of the features (Manville et al., 2014).

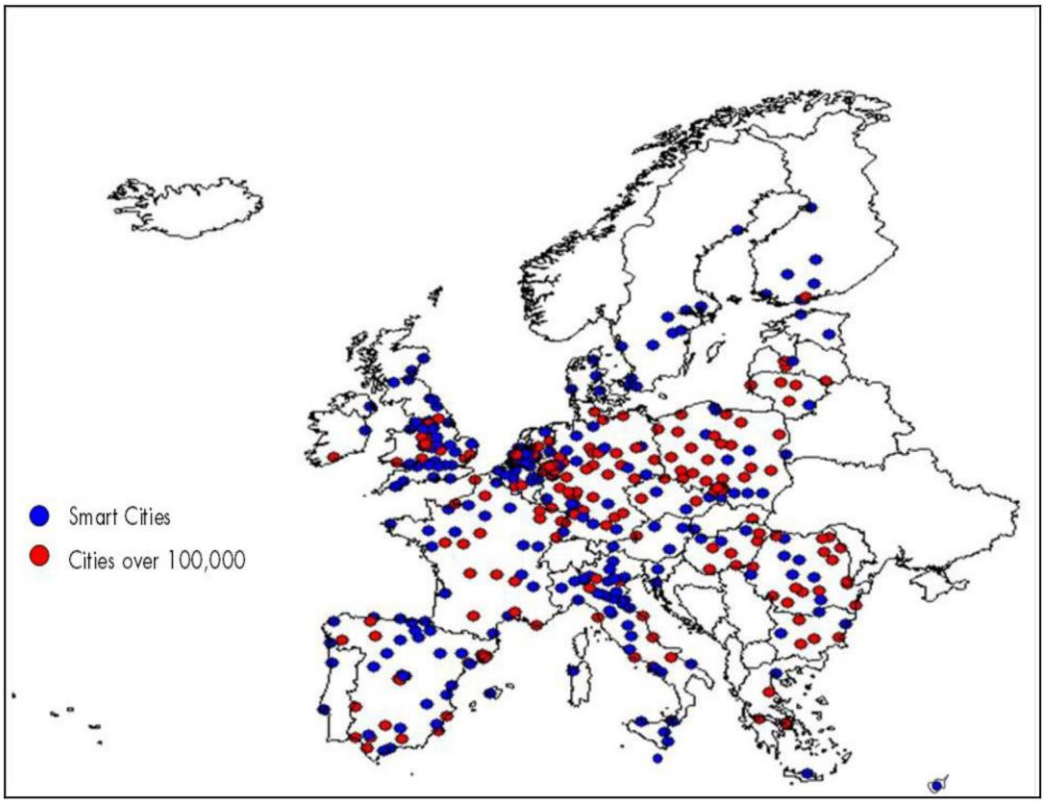


Figure 5.22: The Location of Cities with a Population of More than 100,000 that are not Smart Cities and Smart Cities in Europe.
Source: (Manville et al., 2014)

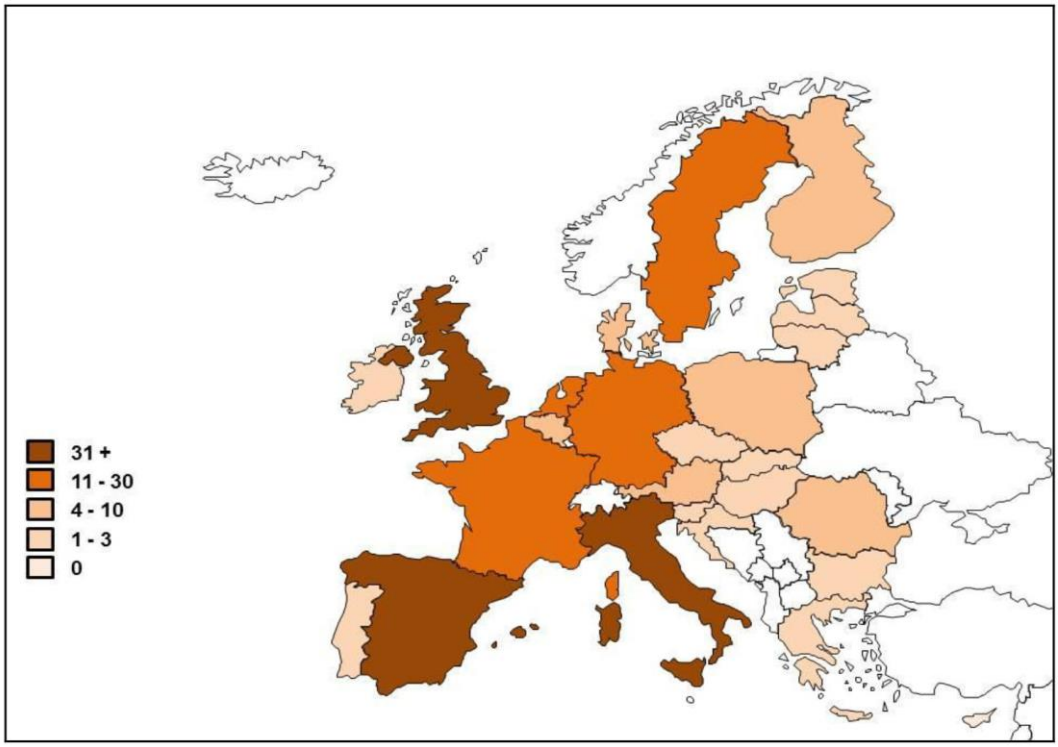


Figure 5.23: The Number of Smart Cities Per Country in Europe
Source: (Manville et al., 2014)

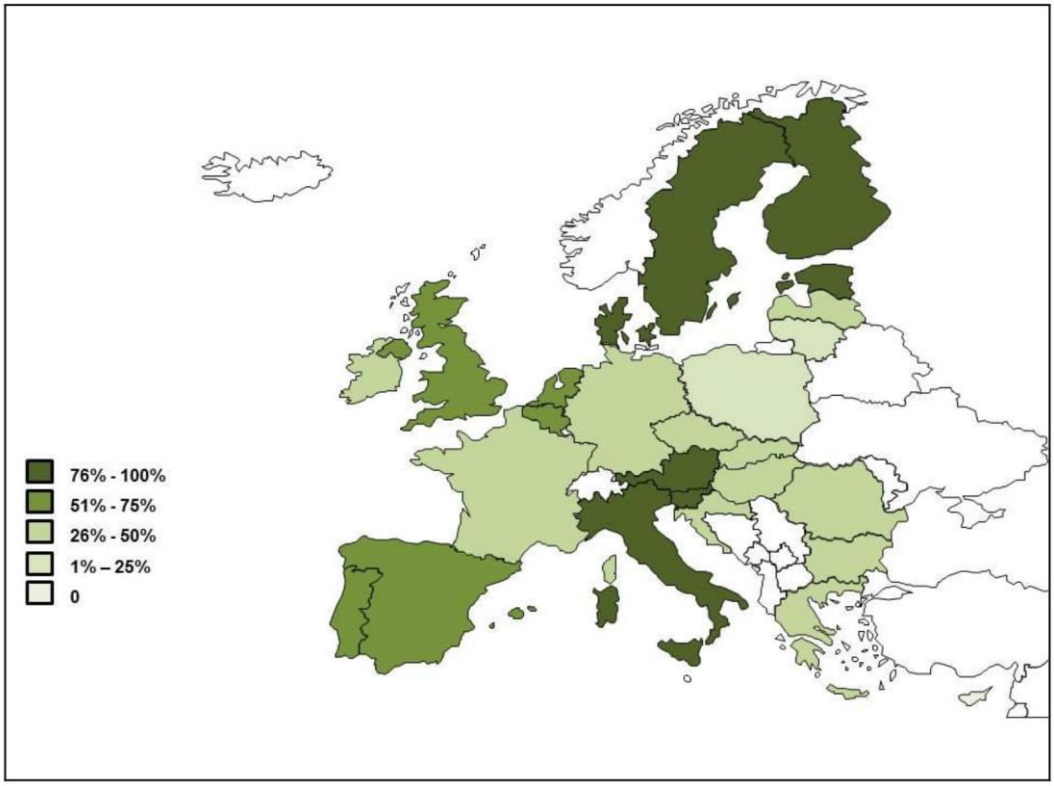


Figure 5.24: The Percentage of Smart Cities to Cities by Country in Europe.
Source: (Manville et al., 2014)

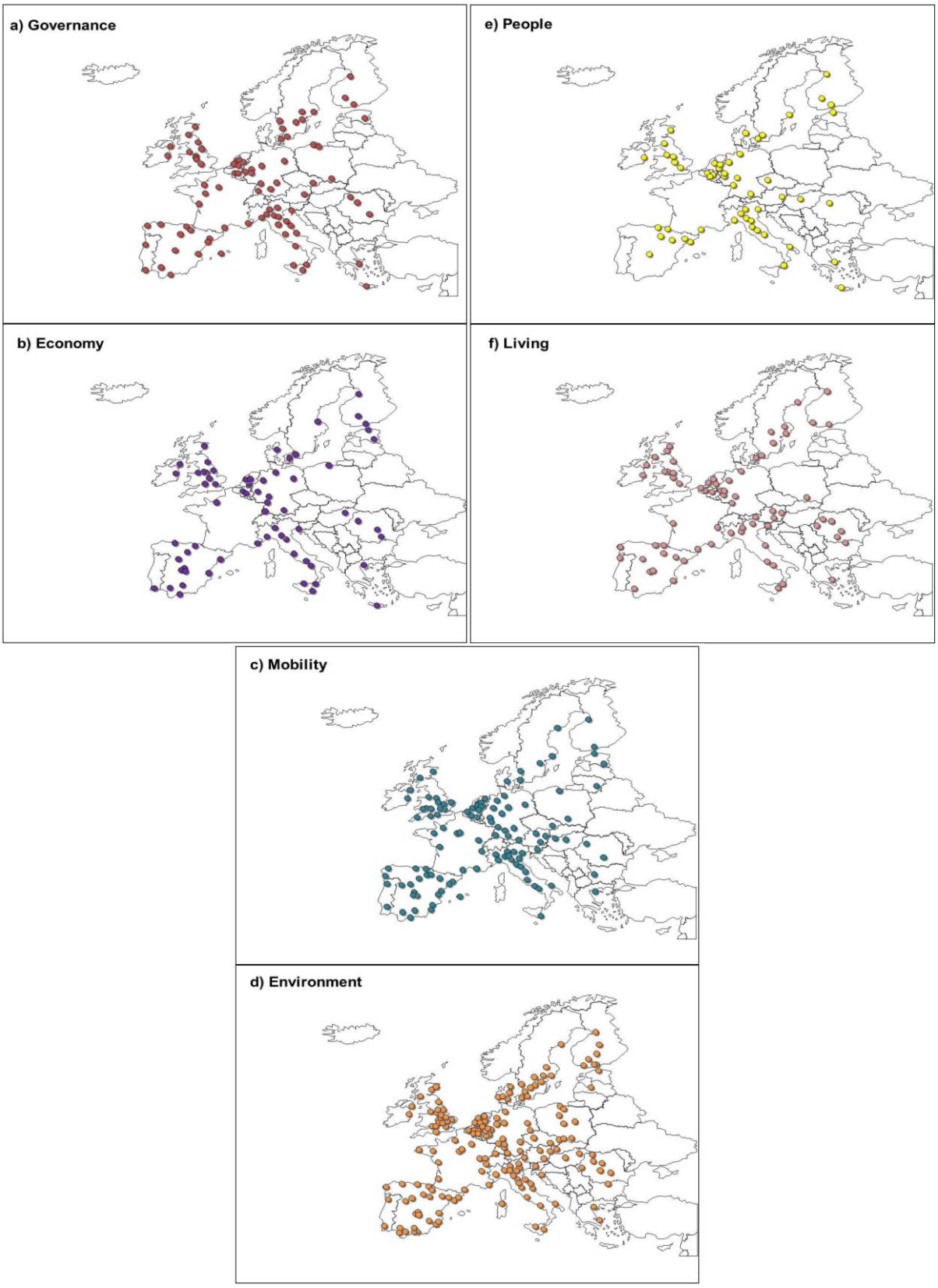


Figure 5.25: The Location of Smart Cities in Europe by the Smart City Characteristics.
Source: (Manville et al., 2014)

Manville et al., (2014) point out that the majority of the initiative of smart cities are founded in the UK, Spain and Italy, furthermore, the highest proportion of the smart city concept is founded in Italy, Austria, Denmark, Norway, Sweden, Estonia and Slovenia. They say that the six features of the smart city concept are connected with pan-European public goods issues; smart mobility and smart environment, for example, are presented in 21% and 33% of initiatives respectively, while each of the other four features such as smart people, smart governance, smart living and the smart economy is presented in 10% of the smart cities initiative, considering particular local strengths or weaknesses. They compare the initiative of smart cities in EU according to a database of 468 cities with inhabitants of 100,000 within the 28 countries in EU. A number of smart city initiative displayed by Manville et al., (2014) in (figure 5.26) indicate that the smart environmental dimension has a higher rate than the other features, followed by smart mobility, and this shows that the majority of these initiatives are seeking to solve environmental issues in their cities. They also compare in (figure 5.27) the size of the smart city with its six characteristics (Manville et al., 2014).

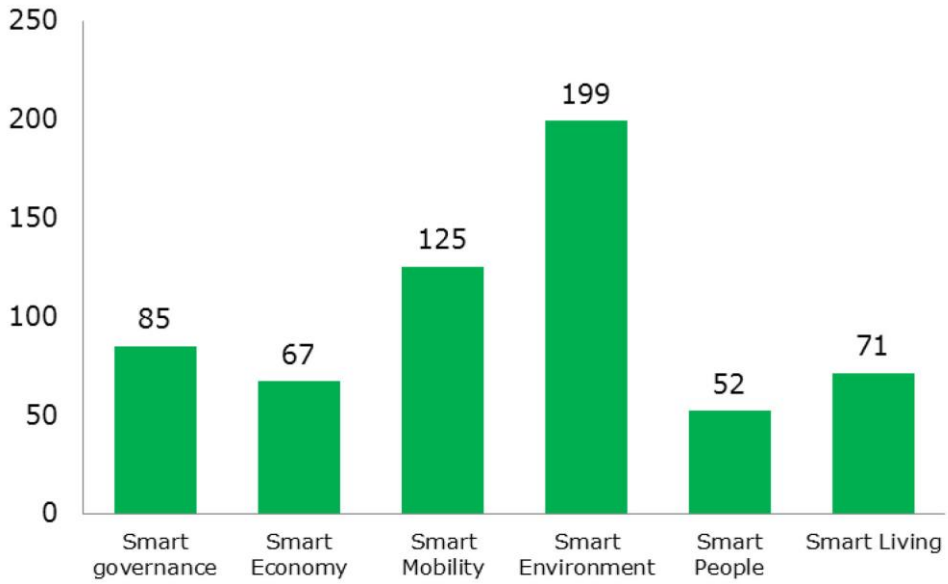


Figure 5.26: The Number of Smart Cities in the EU Presenting the Six Smart City Characteristics.
Source: (Manville et al., 2014)

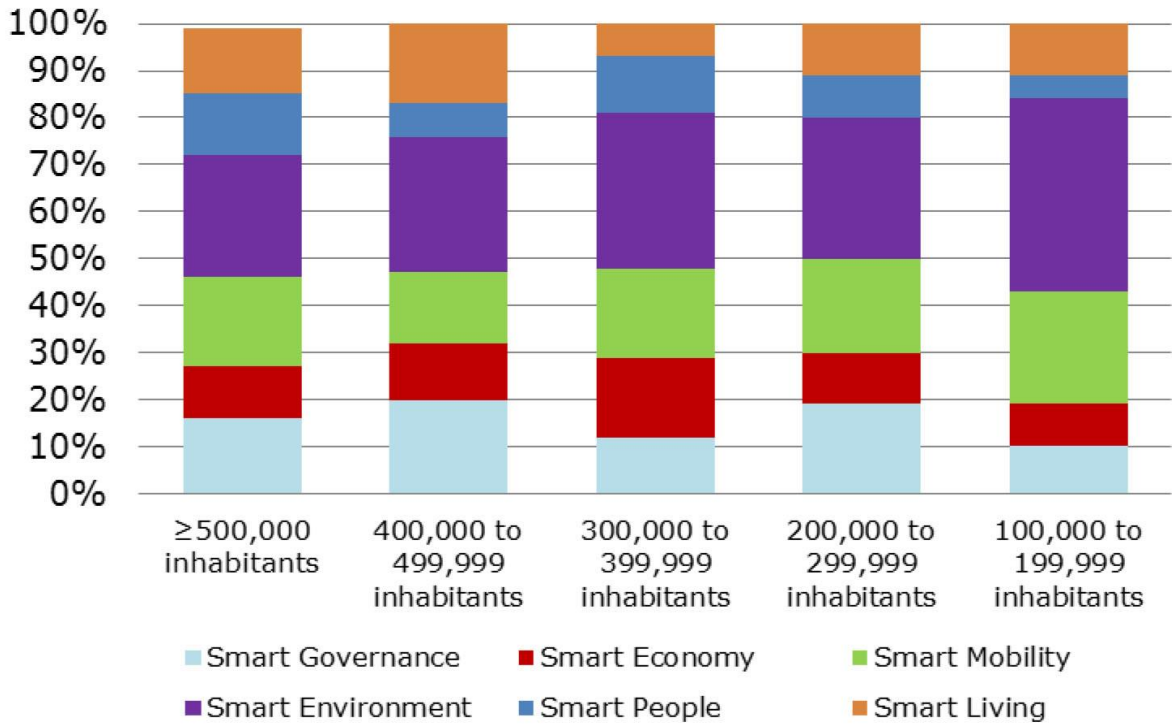


Figure 5.27: The Relationship between Smart City Characteristics and Population.

Source: (Manville et al., 2014)

Manville et al., (2014) assert that we should create different measurement methods to assess the success of the smart city concept. These approaches should be associated with the portfolio of the smart city initiatives and supported by their characteristics. They illustrate that the top-ranked smart cities by characteristics and performance-weighted scores (figure 5.28). They clarify that the outcome of their comparison is that Hamburg in Germany has concentrated on governance and people characteristics, whereas Copenhagen in Denmark has focused on its initiative on the economic aspect. (Manville et al., 2014).

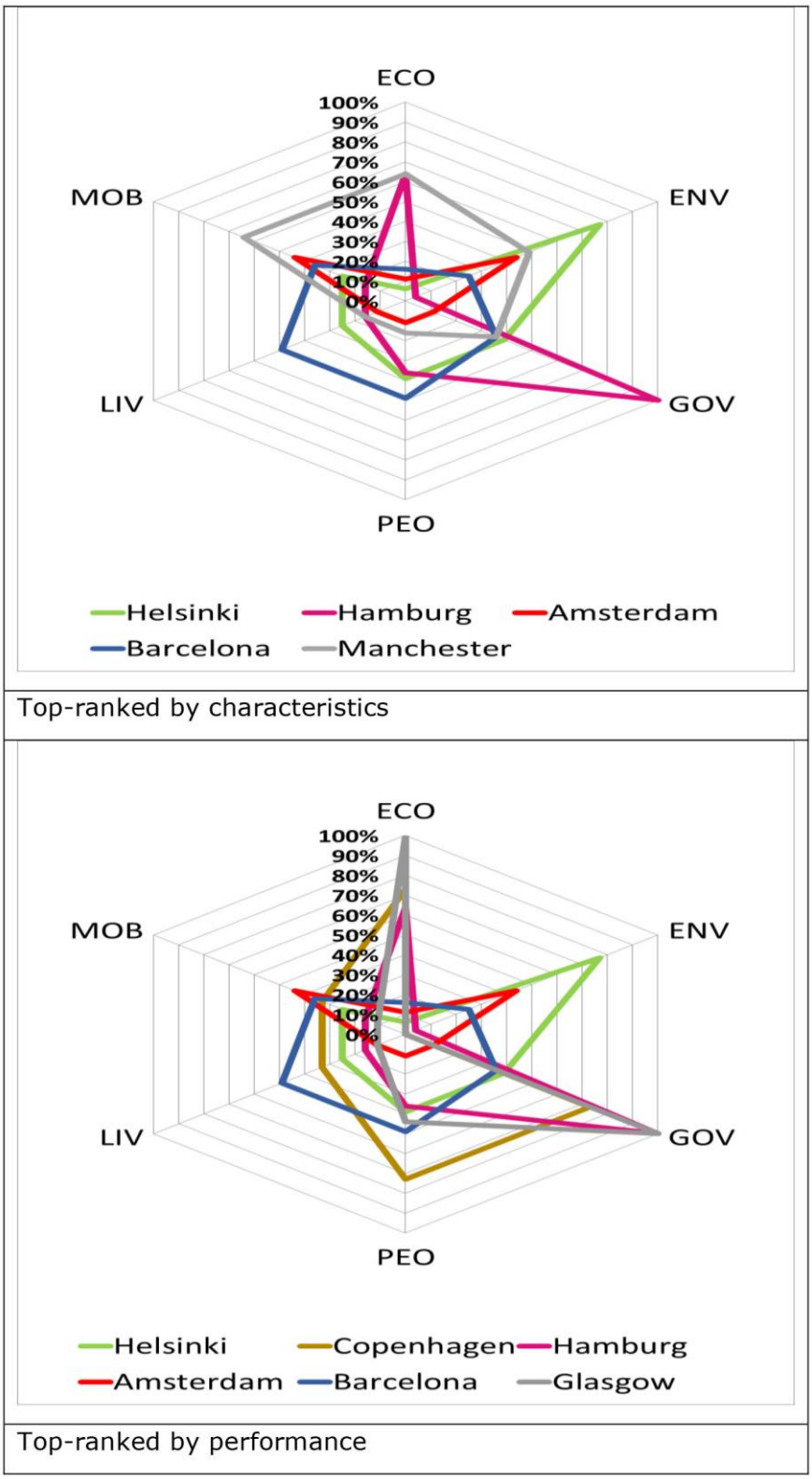


Figure 5.28: The Differential Emphasis on Smart City Characteristics Among the Top Five Ranking Cities.
Source: (Manville et al., 2014)

Comparative analysis of six smart cities in EU in terms of their assessment, economics and solutions deployed is made to understand differences in the implementation of the smart city concept (table 5.12). Each of these cities has different methods, trends, population and initiatives. The Amsterdam Smart City, for example, has five initiatives, climate, street, ship-to-grid (green energy), smart building management systems (ITO Tower Project), health Lab. Amsterdam Smart City projects have dealt with diverse subjects and employ all smart cities features like smart transportation and the management and transmission of power (Manville et al., 2014).

Comparative analysis of six smart cities in EU	Solutions deployed
SMART CITY AMSTERDAM	- Climate street - Ship-to-grid (green energy) - Smart building management systems (ITO Tower Project). - Health Lab
SMART CITY HELSINKI	- Open data platform (Helsinki Region Infoshare)
SMART CITY BARCELONA	-Control of lighting zones - Smart parking - Smart and sustainable architecture Media-tic Building - E-Governance
SMART CITY COPENHAGEN	- Cycling - Integrated public transportation
SMART CITY MANCHESTER	- Digital inclusion – EastServe - The Digital Home Environment Energy Management System
SMART CITY VIENNA	- Mobility solution 'eMorail' - Integrated mobility concept 'SMILE'
Description	
SMART CITY AMSTERDAM	- Amsterdam is the capital city of the Netherlands and has a population of around 800,000 inhabitants. - Amsterdam set out its sustainability targets in the Structural Vision 2040 and the Energy Strategy 2040. In these documents they stated the ambitions of: - climate-neutral municipal organisation in 2015 - 40% reduction in CO2 emissions in 2025, compared with 1990 levels - 75% reduction in CO2 emissions by 2040. - The Amsterdam Smart City (ASC) platform is a partnership between businesses, authorities, research institutions and the people of Amsterdam that initiates, stimulates and advances Smart City projects in Amsterdam.
SMART CITY HELSINKI	- The network of Smart City initiatives and projects in Helsinki is coordinated by Forum Virium, a private non-profit organisation owned by the city of Helsinki. - Helsinki's Smart City developments focus primarily on the development of digital services, mobile applications and open data services. - Opening up public data plays an important role in Helsinki's Smart City developments. - In July 2013, over 1,030 databases were available at the website, covering a wide range of urban phenomena, such as living conditions, employment, transport, economics and well-being. Geo-referenced, geographic information system data are well represented in this dataset.
SMART CITY BARCELONA	- The city of Barcelona wants to become the first self-sustaining city in

	the world. - ICT is a core element in the city's approach to becoming a Smart City. - The city of Barcelona has got the ambition to become a model Smart City for the whole world. Its vision is to: - integrate the information technologies in the city - relate the different areas and sectors - find synergies and added value - generate transversality and cooperative knowledge. The overall aims are: - to be efficient in city management and existent public services - to be environmentally sustainable - to create new opportunities for people and companies
SMART CITY COPENHAGEN	- Copenhagen has a vision to become the world's first carbon-neutral capital by 2025. - Copenhagen has an extensive network of cycle lanes, which is still being expanded. - The city of Copenhagen has built up a public transport system that tries to minimise travel times by connecting different transport modes in an optimal way. - The city wants to increase activities on the improvement of traffic flow through smart traffic management by the use of new technologies, thereby cutting CO2 emissions.
SMART CITY MANCHESTER	These ambitions have been established in Manchester's Digital Strategy in 2008, setting a local digital agenda for Manchester as a Smart City with three main priorities: - To activate citizens across society and reengage people in civic participation through digital inclusion - To generate employment opportunities by skill development and education of local people through digital industries - To generate creative and innovative digital services by investing in next-generation digital infrastructures through digital innovation.
SMART CITY VIENNA	- Vienna was listed as the world's number one Smart City in 2011336 and ranked fourth in the European list of Smart Cities of 2012. The main objectives concerning Europe 2020 targets are: - to reduce emissions significantly and in the long term create a zero emission city with zero emission buildings as standard - to reduce energy consumption significantly so in the long term there will be nearly zero energy standards in new and existing buildings by 2020 - to increase use of energy from renewable sources significantly - to raise awareness in the wider public about responsible use of resources - to give citizens an active role - to promote multi-modal transport systems by improving the public transport network, enhancing networking between individual transport carriers, and significantly reduce individual motorised transport - to position Vienna as a model European environmental city and leading European centre for research and technological development at an international level.
Assessment	
SMART CITY AMSTERDAM	- The main objective of the ASC platform is to help to achieve the targets set out in the Energy Strategy 2040 and to reduce carbon emissions in Amsterdam. - the ASC projects generated projected savings of 12.7 kiloton CO2 per year, which account for a reduction of 0.5% of overall CO2 emissions of Amsterdam per year. - Most Smart City projects developed in the ASC dealt with energy management systems for businesses. These projects tended to create

	most impact, primarily because businesses are more sensitive to energy costs than consumers. - The ASC is not the (technical) solutions but the collaboration, co-creation and partnering of stakeholders within the city of Amsterdam; stakeholder management and assessment were essential to the deployment and implementation of the ASC platform.
SMART CITY HELSINKI	- The Helsinki Region Infoshare Project is one of the pioneering open, urban data platforms. - The platform has recently been rewarded with the European Prize for Innovation in Public Administration in the category of empowering citizens. - The opening up of decision-making information via an electronic case management system gives citizens a great opportunity to be more involved in public decision-making. This is considered one of the major success factors of the Helsinki Region Infoshare Project. - The new services contribute to decreasing traffic congestion and mitigating negative environmental impacts of the Helsinki traffic system.
SMART CITY BARCELONA	- Control of lighting zones contributes to energy savings of 40–60% and thus helps in reducing CO2 emissions. It is also an investment in R&D and innovation. - Smart parking is still in the testing phase but is communicated as one of the cities' ten key projects, thereby benefiting from support at the highest levels. - Smart and sustainable architecture Media-tic Building was the basis for the construction of the building is that 'the cleanest energy is non-consuming energy', and using this measure the Media-tic Building is one of the most energy-efficient buildings in Barcelona. It demonstrates that buildings can contribute to the reduction of global warming. - E-Governance is the main goal[s] of the Open Data BCN Project to increase the transparency of the City Council by putting public data within reach of all the players in society. These players include citizens, businesses and institutions.
SMART CITY COPENHAGEN	- The cycling solution in Copenhagen is based on clear sub-targets. By 2025, the city wants to reduce travel time for cyclists by 15% and reduce accidents by 70% compared with 2005 levels. - The recent evaluation, conducted in 2012, showed that since 2008 cyclists' sense of security had increased by 25% to 76%. Major goals for 2025 are: - 75% of all trips in Copenhagen to be on foot, or by bike or public transport - 50% of trips to work or school in Copenhagen to be by bike - 20% more passengers to use public transport - public transport to be carbon neutral - 20–30% of all light vehicles to run on new fuels such as electricity, hydrogen, biogas or bioethanol. - 30–40% of all heavy vehicles to run on new fuels.
SMART CITY MANCHESTER	the Smart City strategy of Manchester are: - City leadership: get support from the highest level - Investments: in new digital infrastructures and services (even in economic crisis) - Exemplar projects: create awareness and inspiration among local stakeholders. - The Eastserve Living Lab made a contribution to increased digital inclusion in East Manchester. Residential broadband internet penetration increased from 2% of households in 2001 to 75% of residents in 2006.
SMART CITY VIENNA	- The aim of this solution is 'to promote electric vehicles as a supplementary form of mobility that can be combined with public transport'. Commuters may no longer need to own a car.

	- Coordination between technological factors such as infotainment, data recording, invoicing and the supply of electric power as well as the maintenance of a vehicle fleet requires streamlined processes and well-defined interfaces. The system will be updated continuously. - Customers choose a suitable connection from A to B, book a ticket electronically for all the necessary means of transport and make the payment electronically. This concept of 'one stop shopping' provides a high degree of user-friendliness.
Economics	
SMART CITY AMSTERDAM	- The main objective of the ASC platform is to help to achieve the targets set out in the Energy Strategy 2040 and to reduce carbon emissions in Amsterdam. - the ASC projects generated projected savings of 12.7 kiloton CO2 per year, which account for a reduction of 0.5% of overall CO2 emissions of Amsterdam per year. - The initial ASC project that ran from 2009 to 2011 had a EUR 3.4 million budget and was supported by the European Fund for Regional Development (40%), private funding (40%) and government funding (20%).
SMART CITY HELSINKI	- The project is funded by the city of Helsinki and a couple of surrounding cities in the Greater Helsinki region. The Finnish Innovation Fund Sitra and the Finnish Ministry of Finance have also contributed financial support to the project by means of grants. It is expected that in 2013 the open data platform will become part of the municipality and its operations. - Measuring European Public Sector Information Resources suggests that the public sector information market has a huge potential, estimated for EU and Norway to be between EUR 10.3 billion and EUR 44.9 billion.
SMART CITY BARCELONA	- E-government: Open Data BCN makes public data in the hands of the city council available for everyone. This data access may serve as a basis for further business models and innovative solutions. - The Media-tic Building was designed to save energy, and an energy study concluded that the energy savings correspond to 114 tons of greenhouse gas emission per year or, assuming that all energy comes from solar power plants, 700 photovoltaic captors would be necessary to produce such a quantity of energy. - Control of lighting zones in the long run it seems cheaper to invest in intelligent lighting technology than in 'dumb' lighting.
SMART CITY COPENHAGEN	- creation of jobs - improved city life - low-cost form of transport - reduced journey times and traffic congestion, leading to increased economic productivity (88% of cyclists use this mode of transport because it is the fastest or most convenient way of getting to work). - Running the bus system in Copenhagen costs DKK 930 million [EUR 125 million] annually, of which the city itself pays DKK 400 million [EUR 54 million]. The city requires a budget of about DKK 290 million [EUR 39 million] to achieve carbon neutrality in public transport until 2025. For the period 2013–2015, it is expected that DKK 300 million [EUR 40 million] will be invested in Smart traffic, excluding the costs for a traffic management system.
SMART CITY MANCHESTER	- In 2012 the Digital Strategy was updated with the objective of making Manchester one of the leading digital cities in 2020: 'The Vision for Manchester is to create a dynamic digital economy and a digitally inclusive city region which supports an enhanced quality of life for everyone who lives, works and studies here.' Investments in the digital infrastructure, implementation of broadband for all inhabitants, and ICT education play an important role within this strategy. - The IT cluster in the city of Manchester and the region boasts over

	8,000 companies employing 50,000 people.323 The growth of the IT sector increased by 50% over the past ten years, which is more than five times the national average, according to IBM.
SMART CITY VIENNA	- The project is still running and detailed financial information and market analysis will be available by October 2013. One of the first areas of feedback was that the price of the eMorail mobility package and included services is very important for commuters, and would influence the relative costs and benefits of a wider roll-out. - The multi-modal mobility platform itself is not able to contribute to the Europe 2020 targets but it has an impact and can assist in achieving a switch from individual mobility using personal private vehicles to trips using combined modes of transport. An integrated mobility concept aims to achieve time savings and energy savings, and to have a positive impact on greenhouse gas emissions by reducing traffic volume.

Table 5.12: Comparative Analysis of Six Smart Cities in EU in Terms of Assessment, Economics and Solutions Deployed.
Source: Author according to (Manville et al., 2014).

As previously discussed Barcelona is another significant and dynamic city that has implemented many smart initiatives such as control of lighting zones, smart parking, smart and sustainable architecture media-tic building and e-governance. According to Manville et al., (2014) it was listed 10 of the world's smart cities and 8 of EU smart cities. The city's aim to become the first self-sustaining city in the world by employing ICTs as an essential aspect to become active, achieve a sustainable environment, create new job opportunities, and be effective in city resource management. Citizens' participation plays an important role in the success of these initiatives (Manville et al., 2014).

In the last 25 years, Manchester has been advanced substantially through big investments in knowledge, inventions and innovative economy. The smart city concept of Manchester might be announcing itself as the main city for digital advancements in the next years. The key element of this initiative is to produce an active digital economy, develop the quality of life, create new jobs opportunities, and invest in advanced technologies infrastructure and employing ICTs as a significant element to promote urban quality (Manville et al., 2014).

These smart city initiatives in Table 18 show the variety in dealing with smart city characteristics that some of these concepts like Barcelona give priority to smart people dimension and e-government to improve public services and promote the relationship between the city council and its citizens through using open data platform. Whereas other initiatives like Copenhagen consider the implementation of smart mobility as the main

aspect to reduce CO2 emissions, air pollution, noise, improved city life and achieved a low-cost form of transport. Helsinki also has used urban data platforms as a substantial feature to achieve the aim of the smart city concept. Smart City Vienna has dealt deeply with environmental aspects, smart mobility, urban life and growth, utility infrastructure and people participation. The comparative analysis of six smart cities also includes the implementation of ICT resources in places and their ability to achieve smart cities goals (Figure 5.29). Manville et al., (2014) show that the comparative analysis of ICTs advancement in each of the six cities is clarified by five national indicators utilising 2008 and 2012 EU Digital Agenda Scoreboard information (Manville et al., 2014):

- ICT schools – number of computers for educational purposes per 100 Grade 4 students.
- Internet access – percentage of households living in urban areas with access to the Internet at home.
- Broadband – percentage of households having a broadband connection.
- E-commerce – percentage of internet users ordering goods and services online.
- E-government – percentage of individuals interacting online with public authorities.

The charts illustrate the advanced rates of ICT baseline in the six smart cities between the years 2008 and 2012 at four years intervals. There has been a good increase in ICTs employment rates from 2008 to 2012. In 2008, 45 percent represented the Barcelona ICT broadband, and this increased by 70 percent in 2012. It can also be seen that the number of ICT School grew from 10 percent in 2008 to 30 percent in 2012, and the internet access rises from 58 percent to 63 percent in the same period. Similarly, Copenhagen had the most significant percentage of ICT School advancement from 25% to 85 between 2008 and 2012. However, while there was no employment of ICT School in the smart city concept of Manchester, Helsinki, and Amsterdam.

A closer look at the information reveals that Copenhagen showed a slight fall off the ICT baseline figures in the e-government indicator from 50% in 2008 to 40% in 2012. Amsterdam also had displayed a decrease from 90% to 85% in the internet access indicator. Overall, we can see that all six smart initiatives seek to advance the use of ICT in the five national indicators ICT schools, Broadband, Internet access, E-commerce and E-government.

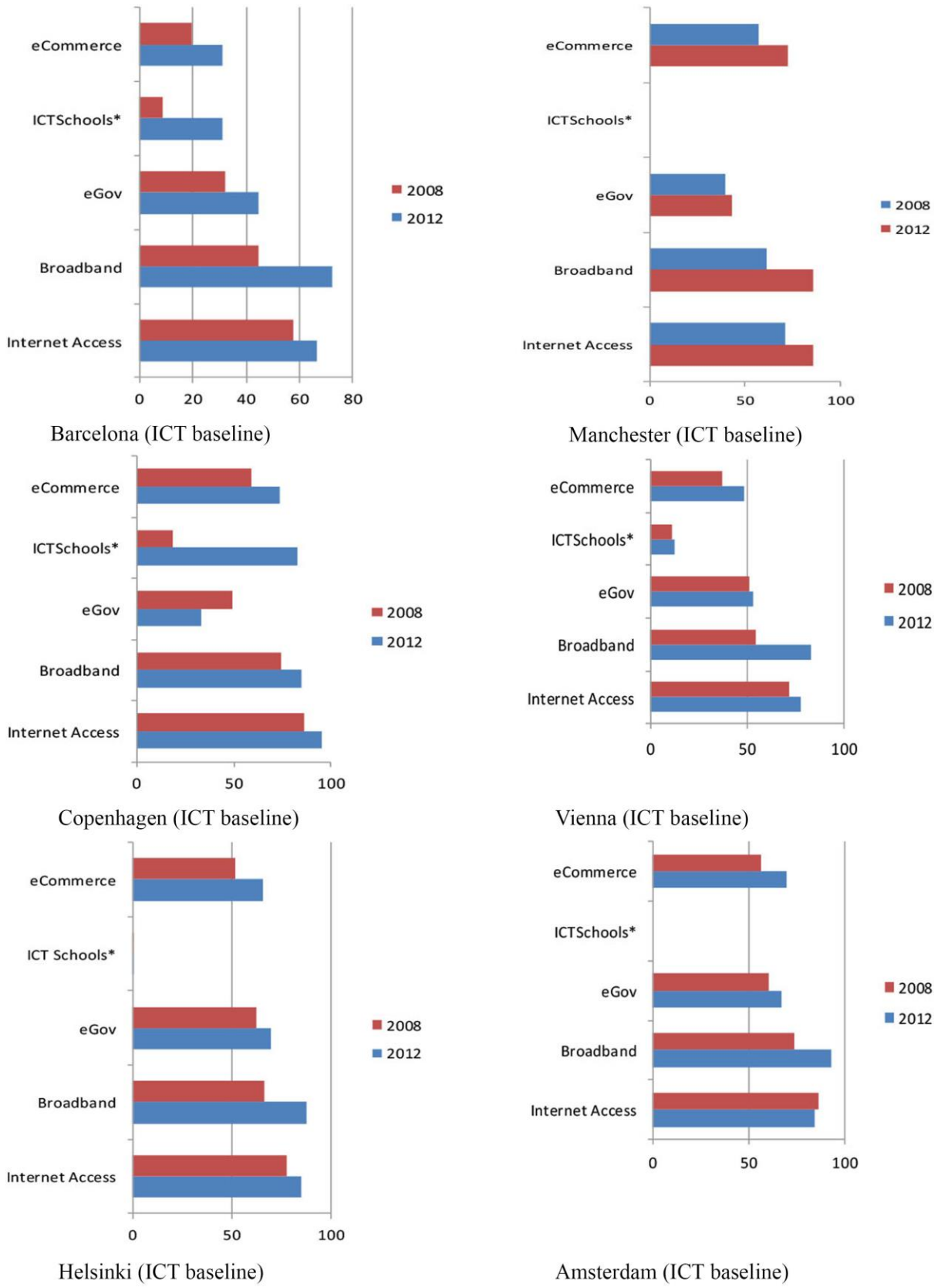


Figure 5.29: Comparative Analysis of Six Smart Cities in Terms of ICT Baseline.

Source: Author (2016) according to (Manville et al., 2014).

5.11 Discussion and Conclusion

The initiative of smart cities tries to measure what is happening at the current time in a city regarding urban information technology, quality of life and sustainability. Even though, controlling the quality of life and sustainability depend on static historical statistics, it can be advanced with the use of real-time data, allowing better and more accurate design of social policies. Marsal-Llacuna et al., (2015) clarify that the basic concept of the smart cities initiative can seek to evolve urban performance by using information, provide adequate services to people by Information and Communication Technologies (ICT). Furthermore, by using data the smart cities initiative will attempt to control and operate existing infrastructure and to raise cooperation between various economic aspects and to encourage innovative business models in both the private and public sectors. Marsal-Llacuna et al., (2015) believe that the amount of real-time information required to produce smart indicators to advance intelligent indices further will continue growing and that these are the first two necessary steps towards guaranteeing the success of the smart cities initiative (Marsal-Llacuna et al., 2015).

"The concept of a smart city is highly context specific". United Nations, (2016) mention that there are many design methods will require being pursued in designing the smart city and its infrastructures such as interoperability, flexibility sustainability, resilience, safety, and risk reduction. The United Nations, (2016) key findings and suggestions are as follows (United Nations, 2016):

- Promoting open data and open science models to trigger local innovation, and drafting appropriate data management policies and regulations to respond to privacy concerns.
- Ensuring that the design and development of smart cities and infrastructure integrates principles such as resilience, sustainability, interoperability, flexibility, risk mitigation and safety.
- Smart infrastructure has the potential to promote inclusive development (including gender inclusiveness) in cities by helping to generate data on informal settlements and informal sectors and other marginalized groups in society (including women,

the elderly and persons with disabilities). Such data can then be used to design infrastructure that specifically addresses the needs of such groups.

- Incorporating insights obtained from data generated from smart cities and infrastructure into governance processes by making data available in a timely fashion and effectively using it in policy formulation and decision-making.
- Collaborating with international standardization bodies, and promoting the development of interoperability standards and other standardization measures required to enable technologies related to smart cities.
- Conducting skills gap analyses in workforces, including in public sector entities, with regard to the skills required for the design, development and management of smart cities and infrastructure, and promoting multidisciplinary learning and suitable curriculum reforms at the primary and secondary school levels and in universities and technical and vocational education and training, in order to meet skills requirements.

Jara et al., (2015) conclude, "The recent changes in the world such as the lower cost for sensors, more capacity or data analysis, all the devices, machines, and appliances, communicating seamlessly with each other and with us, are allowing to build a world where information itself becomes intelligent, and comes to us automatically, when we need it, without having to look for it" (Jara et al., 2015). The concept of the smart city has become a combined method of linking through the whole society producing diverse services to determine cities aims. Nam & Pardo, (2011) indicate that the concept of the smart city is an organic correlation among people, technological, and governmental departments. (Nam and Pardo, 2011). Marsal-Llacuna et al., (2015) state "The basic concept of the Smart Cities initiative can be expressed as follows: the Smart Cities initiative seeks to improve urban performance by using data, information and Information Technologies (IT) to provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration between different economic actors and to encourage innovative business models in both the private and public sectors" (Marsal-Llacuna et al., 2015).

Angelidou, (2015) asserted that the concept of smart cities should be a significant part "of the urban planning and development discipline and they have always been urging it to move forward. In this sense, the majority of strategies for becoming 'smart' are not something that can be achieved here and now, but they imply a strategic approach to fulfilling a long-term aspiration. Therefore, the vision of the city of the future is an essential driver of the smart city discourse, be it within, or out of immediate grasp" (Angelidou, 2015).

5.12 Chapter Summary

This chapter comprises the literature review around the topics of smart cities, smart urbanism, internet of things (IoTs) and information, communication technologies (ICTs) and smart city challenges. It illustrates each of these subjects, along with various definitions that are commonly cited in the literature. It focuses specifically on smart city dimensions and examines the six key dimensions that promote the smart city concept (smart people, smart living, smart environment, smart economy, smart mobility, and smart governance) along with a review of common challenges and barriers. This chapter has investigated and analysed smart cities indicators (SCIs) and its assessment methods, it also shows an overview of comparative methods to assess the concept of the smart city based on diverse perspectives and aspects such as environmental sustainability, productivity, quality of life, resource, transportation, economy, education, and energy. The fifth chapter has argued that ICT and IoT are significant aspects to advance the concept of the smart city and to promote different services, develop cities infrastructures and achieve a better quality of life for its people. The argument of this chapter also concentrates on the comparative analysis of a number of cities in implementing the smart city concept. This assessment and comparison of diverse smart cities initiatives provide an objective base to advance a set of measurement methods appropriate to Baghdad city and especially to Old Rusafa.

CHAPTER 6: SMART AND SUSTAINABLE CITY

6 Introduction

The International Telecommunication Union (ITU-T) established in February 2013 a Study Group 5 (Focus Group on Smart Sustainable Cities) to analyse ICT solutions and projects that promote environmental sustainability in cities. The FG-SSC acts like an open platform for smart-city stakeholders such as academic, research institutes, non-governmental organisations, ICT organisations and others to exchange knowledge in the interests of identifying the standardised frameworks needed to support the integration of ICT services in smart sustainable cities. According to FG-SSC no clear standard or definition could describe a "smart sustainable city" while there is enough literature on what is making top global cities smarter such as New York, London, Tokyo, Paris, Copenhagen, Barcelona and Vienna. IBM defines "a smarter city as one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimise the use of limited resources" (Kondepudi, 2015). In this context, this chapter will try to conceptualize and define the aspects and implementation domains that constitute smart sustainable cities. It will endeavour to address the research aim two and question two-part A (page 3).

6.1 Smart Sustainable City (SSC)

We referred in the previous section that The International Telecommunication Union (ITU) is the United Nations specialised agency for ICTs which provides a global platform for all stakeholders to work together towards a sustainable interaction of ICTs and the environment. At its fifth meeting in June 2014, the FG-SSC agreed on the definition of Smart Sustainable City. ICT will play a fundamental role in promoting livability in cities, enabling us to live more sustainably and achieving social justice. The new vision "a system of systems" of the physical infrastructure elements of a city can enhance the management processes within a city. The smart sustainable city will employ ICT infrastructures in an adaptable, efficient, reliable, scalable, accessible, flexible, secure, safe and resilient way to promote the quality of life of its citizens and fulfil equity (figure 6.1). It will establish a sustainable method that meets the requirements of the present without sacrificing the ability to meet the requirements of future generations (Kondepudi, 2015).

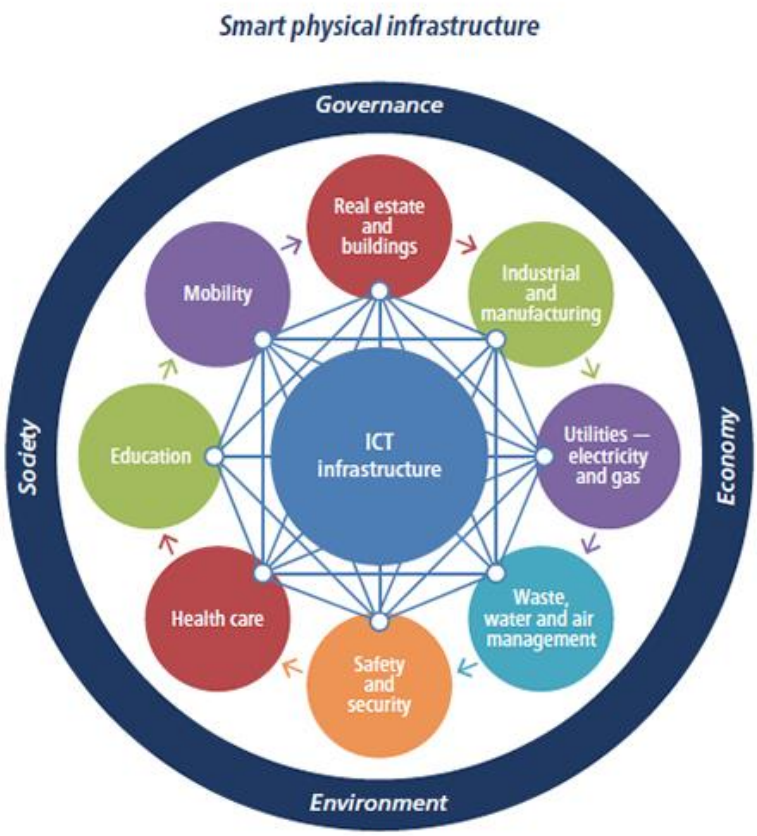


Figure 6.1: Smart Sustainable Cities Physical Infrastructure.
Source: https://itunews.itu.int/En/5215-What-is-a-smart-sustainable-city.note.aspx.

In order to achieve smart sustainable cities, urban designers and planners are trying to implement an integrated method for administrating cities as an integrated network in order to develop the quality of life. They seek to establish that by merging technological and social innovation and using ICT to promote the performance of sectors such as transport, energy, urban safety, health, education and waste disposal. They identify eight categories to be the main elements of smart sustainable city (SSC), these categories are: "(1) quality of life and lifestyle, (2) infrastructure and services, (3) ICT, communications, intelligence and information, (4) people, citizen and society, (5) environment and sustainability, (6) governance, management and administration, (7) economy and Finance and (8) mobility" (ITU-T, 2014a).

Bifulco et al., (2016) assert that there are many studies shows the importance of the implementation of sustainability within urban areas. They indicate that these research have examined the smart city method and its applications in urban context to produce sustainable socio-economic and environmental plans. They argue that new advanced tools that have implemented by the concept of the smart city can play a significant role to obtain sustainable aims. They point out that "there has been increasing interest in sustainability in smart cities from a quantitative perspective; namely, attention has focused on the development of measures and indicators" (Bifulco et al., 2016). Smart sustainable city (SSC) as Höjer and Wangel, (2014) indicate, should be considered as an aggregate concept. They assert that the key element to deal with local and global environmental issues, improve the quality of life and gain equity is to utilised ICT in the smart sustainable city concept (Höjer and Wangel, 2014). Hara et al., (2016) point out that any approach seeks to advance urban systems to be smart and sustainable should be able to promote the quality of life of the city's citizens. They assert, "An SSC is designed to solve the issues faced by cities, and its ultimate goal is to improve the quality of life of its citizens. The definition of quality of life and a methodology for its assessment have been developed in many countries, and in most cases, the scope is based on the triple bottom line of environment, society, and economy" (Hara et al., 2016). Girard, (2013) suggests that the smart sustainable city concept should be connected to technologies to create effective city systems. He says that smart sustainable city growth principles are synergies and circularization (Girard, 2013).

Ahvenniemi et al., (2017) write that the main role in dealing with climate change is to implement advanced technologies as the main aspect of reducing greenhouse gas emissions and promoting energy efficiency of the city. They emphasise that these advanced technologies should be inelegant, effective, use resources efficiently, create a sustainable environment, and enhance the quality of life of cities' citizens and financial sustainability. They indicate the concept of smart cities promotes the method of the sustainable environment as its key objective is decreasing greenhouse gas emissions in urban places by the deployment of advanced technologies (Ahvenniemi et al., 2017). In table 6.1, we will illustrate various definitions for the smart sustainable city (SSC) according to different literature that will provide us with a platform for understanding the most common elements, improving essential indicators and establishing an ICT infrastructure for smart sustainable cities (table 6.1).

	Definitions of Smart Sustainable City	Source
1	The Smart Sustainable City seeks to achieve concern for the global environment and lifestyle safety and convenience through the coordination of infrastructure. Smart Sustainable Cities realized through the coordination of infrastructures consist of two infrastructure layers that support consumers' lifestyles together with the urban management infrastructure that links these together using information technology.	Cassandras, (2016) according to Yoshikawa 2016 (Cassandras, 2016)
2	Smart Sustainable Cities use information and communication technologies (ICT) to be more intelligent and efficient in the use of resources, resulting in cost and energy savings, improved service delivery and quality of life, and reduced environmental footprint—all supporting innovation and the low-carbon economy.	Cassandras, (2016) according to Giffinger 2007 (Cassandras, 2016)
3	A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects	(Kondepudi, 2015) FG-SSC
4	A smart sustainable city is a city well performing in six (6) characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens. 1) Economy, 2) Mobility, 3) Environment, 4) People, 5) Living, 6) Governance.	ITU-T, (2014) according to Giffinger 2007 (ITU-T, 2014a)

5	A city striving to make itself "smarter" (more efficient, sustainable, equitable, and liveable).	ITU-T, (2014) according to Chourabi et al. (2012c) (ITU-T, 2014a)
6	A "smart sustainable city" is one in which the seams and structures of the various urban systems are made clear, simple, responsive and even malleable via contemporary technology and design. Citizens are not only engaged and informed in the relationship between their activities, their neighbourhoods, and the wider urban ecosystems, but are actively encouraged to see the city itself as something they can collectively tune in, such that it is efficient, interactive, engaging, adaptive and flexible, as opposed to the inflexible, mono-functional and monolithic structures of many 20th century cities.	ITU-T, (2014) according to ARUP (2011) (ITU-T, 2014a)
7	The "smart sustainable city" concept is really a framework for a specific vision of modern urban development. It recognizes the growing importance of information and communication technologies (ICTs) as drivers of economic competitiveness, environmental sustainability, and general liveability. By leveraging ICT as a core element of their development, the smart sustainable cities of the future will foster economic growth, improve the lifestyle of citizens, create opportunities for urban development and renewal, support eco-sustainability initiatives, improve the political and representative process, and provide access to advanced financial services. The right ICT infrastructure will affect the way each city will be created and evolved. It will enable smart sustainable cities to include vastly enhanced sustainable areas, such as smart buildings, smart infrastructures (water, energy, heat, and transportation) and smart services (e-substitutes and e-services for travel, health, education, and entertainment), which drastically change the urban experience for city dwellers and travellers.	ITU-T, (2014) according to Alcatel Lucent (2011) (ITU-T, 2014a)
8	A smart sustainable city is typically defined as "an environmentally conscious city that uses information technology (IT) to utilize energy and other resources efficiently." In Hitachi's vision, a smart sustainable city is one that seeks to satisfy the desires and values of its residents, with the use of advanced IT to improve energy efficiency and concern for the global environment as prerequisites, and in so doing maintains a "well-balanced relationship between people and the Earth."	ITU-T, (2014) according to Smart Cities: Hitachi (2014) (ITU-T, 2014a)
9	We define a "smart sustainable city" as the city that uses information technology and communications to make both its critical infrastructure, its components and utilities offered more interactively, efficiently and where citizens are made more aware of them. It is a city committed to the environment, both environmentally and in terms of cultural and historical elements.	ITU-T, (2014) according to Telefónica (2014) (ITU-T, 2014a)

10	A "smart sustainable city" has been defined as a city that uses information and communication technology to make both its critical infrastructure, its components and utilities more interactive, efficient, making citizens more aware of them	ITU-T, (2014) according to Azkuna (2012a) (ITU-T, 2014a)
11	Smart sustainable cities combine diverse technologies to reduce their environmental impact and offer citizens better lives. This is not, however, simply a technical challenge. Organizational change in governments – and indeed society at large – is just as essential. Making a city smart is therefore a very multidisciplinary challenge, bringing together city officials, innovative suppliers, national and EU policymakers, academics and civil society.	ITU-T, (2014) according to European Commission (2014) (ITU-T, 2014a)
12	A "smart sustainable city" is mainly based on the information and communication technologies. Through the transparent and full access to information, the extensive and secure transmission of information, the efficient and scientific utilization of information, SSC increases the urban operational and administrative efficiency, improves the urban public service level, forms the low-carbon urban ecological circle, and constructs a new formation of urban development.	ITU-T, (2014) according to FG-SSC-0005 (2014) (ITU-T, 2014a)
13	Smart sustainable cities are well managed, integrated physical and digital infrastructures that provide optimal services in a reliable, cost effective, and sustainable manner while maintaining and improving the quality of life for its citizens. Key attributes of a smart sustainable city are mobility, sustainability, security, reliability, flexibility, technology, interoperability and scalability. Foundational aspects include economy, governance, society and environment with vertical infrastructures such as mobility, real estate and buildings, industrial and manufacturing, utilities -electricity and gas, waste, water and air management, safety and security, health care and education. All of these are woven into a single fabric with ICT infrastructure as a core.	ITU-T, (2014) according to FG-SSC-0013 (2014) (ITU-T, 2014a)
14	It is a city with a large, efficient and widespread technological network that fosters dialogue between citizens and everyday objects. It integrates the huge amount of information available to generate intelligence and improve daily life in a lifestyle that is increasingly "smart". It combines innovation with the environment, mobility and quality of life. It is a new phenomenon, complex and rapidly changing. Technological innovation moves in several directions (green buildings, smart mobility, e-health, e-government, etc.).	ITU-T, (2014) according to FG-SSC-0014 (2014) (ITU-T, 2014a)

15	A Smart Sustainable City has been defined as a 'knowledge', 'digital', and 'cyber' or 'eco' city; representing a concept open to a variety of interpretations, depending on the goals set out by a Smart Sustainable City's planners. We might refer to a Smart Sustainable City as an improvement on today's city both functionally and structurally, using information and communication technology (ICT) as an infrastructure. Looking at its functions as well as its purposes, a Smart Sustainable City can perhaps be defined as "a city that strategically utilizes many smart factors such as Information and Communication Technology to increase the city's sustainable growth and strengthen city functions, while guaranteeing citizens' happiness and wellness.	ITU-T, (2014) according to Hwang et al. (2013) (ITU-T, 2014a)
16	Smart sustainable cities use information and communication technologies (ICT) to be more intelligent and efficient in the use of resources, resulting in cost and energy savings, improved service delivery and quality of life, and reduced environmental footprint –all supporting innovation and the low-carbon economy.	ITU-T, (2014) according to Cohen (2011) (ITU-T, 2014a)
17	A smart sustainable city is characterized by the integration of technology into a strategic approach to sustainability, citizen well-being, and economic development.	ITU-T, (2014) according to Woods *et a*l. (2013) (ITU-T, 2014a)
18	A smart sustainable city is one that "uses information and communications technologies to make the critical infrastructure components and services of a city – administration, education, healthcare, public safety, real estate, transportation and utilities – more aware, interactive and efficient.	ITU-T, (2014) according to Belissent (2010) (ITU-T, 2014a)
19	A smart sustainable city (SSC), which is generally defined as integration of multiple technological solutions to improve the quality of life of the residents, is expected to tackle the issues that cities currently have or will have in the future such as security, infrastructure protection, property vacancy, traffic-related problems including traffic jams, traffic accidents as far as modal shift and EV charging infrastructure. Information and communication technology (ICT) is desired to play crucial role in achieving successful SSCs.	(Hara et al., 2016)

Table 6.1: Definitions of Smart Sustainable City (SSC)
Source: Author 2016

6.2 A Smart Sustainable Urban Form

In recent years, considerable global issues and socio-economic and environmental crises have remarkably affected our communities and led to many problems in modern cities such as lack of biodiversity, the devastation of natural resources and inequity. These issues have provoked many professionals, policy-makers, academics, companies to search for solutions to reduce socio-economic and environmental effects by creating a new holistic approach to deal with such cases. Yigitcanlar and Lee, (2013) argue cities that seek to be zero-carbon, eco-cities and smart-eco are considered as cities that have a smart sustainable form with some differences in their method to implement urban sustainability. They debate that implementing different methods of urbanisation style to achieve sustainable urban growth in cities will produce sustainable urban form; it will also gain eco-environment, efficient use of resources and smart and friendly mobility. They identify "a smart eco-city is, in a broad sense, described as an ecologically healthy city using advanced technologies and having economically productive and ecologically efficient industries, a systematically responsible and socially harmonious culture, and a physically aesthetic and functionally vivid landscape" (Tan Yigitcanlar and Lee, 2013).

6.3 The influence of the Smart City Concept on Sustainable Behaviour and Planning

Khansari et al., (2013) discuss the impact of the smart city on sustainable behaviour and planning. They argue that the implementation of the multi-dimensional of urban sustainability, both top-down government decision-making and bottom-up people attitude will require being sustainable, effective and dynamic. They assert that in a bottom-up system citizens should have a significant role in decision-making and embrace the sustainable style of living to promote socio-economic and environmental aspects of sustainability. They mention changing citizens' attitude is fundamental to obtain the aims of urban sustainability. They emphasize that the collaboration between citizens and their government is important for implementing a modern mechanism of governance and participating all segments of society in decision-making. Khansari et al., (2013) show that the smart city concept advanced the relationship between governmental and non-governmental actors by utilising ICTs in different sectors and create smart methods of city

management such as e-governance and e-democracy. They say that the increasing of using advanced technology and e-services in smart cities has developed the prosperity of their stakeholders. They sum up in Figure 6.2 the influence of the smart cities concept on the behaviours of people in connection with city infrastructures like mobility, waste and energy behaviours and social sustainable behaviours like political participation (figure 6.2). They also debate that urban designers and planner need new methods to run, solve and assess many challenges that face our cities such as pollution, consumption of natural resources and information age. Therefore, they suggest that cities must be considered as a system of systems comprising socio-economic and environmental aspects as subsystems. In Figure 6.3, they summarize the influence of the smart cities concept on sustainable planning by implementing e-government and transforming urban infrastructures to be smart such as smart energy, smart land use and smart mobility (Figure 6.3) (Khansari et al., 2013).

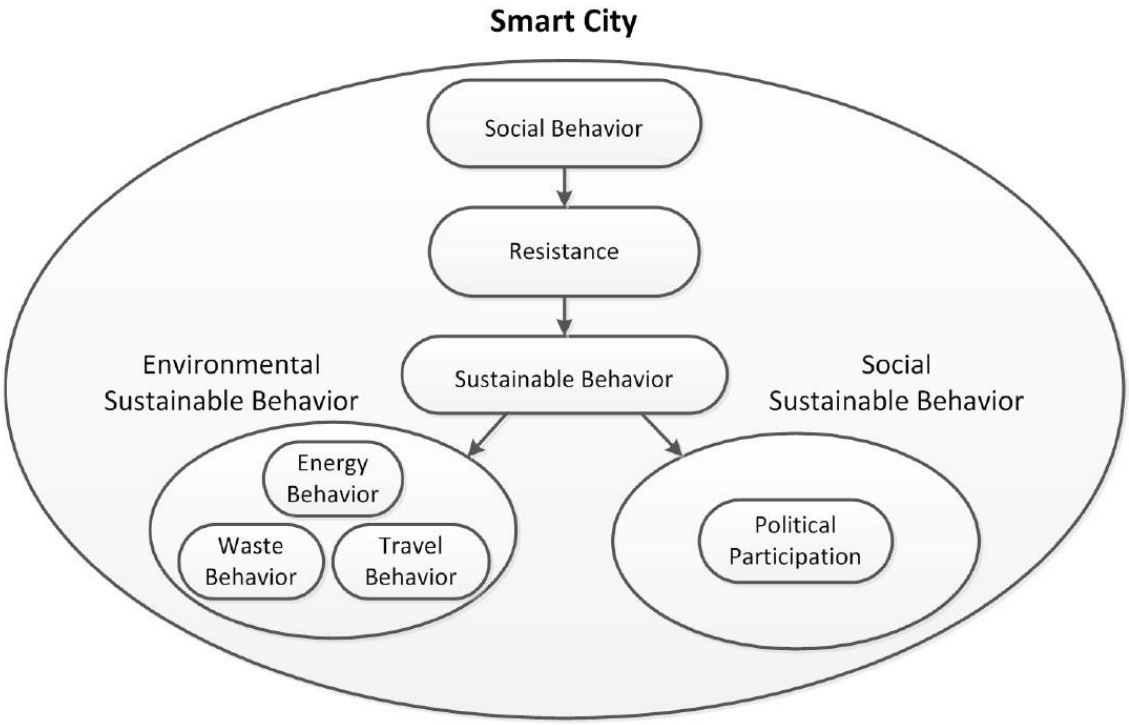


Figure 6.2: Impact of Smart City on Sustainable Behavior
Source: (Khansari et al., 2013)

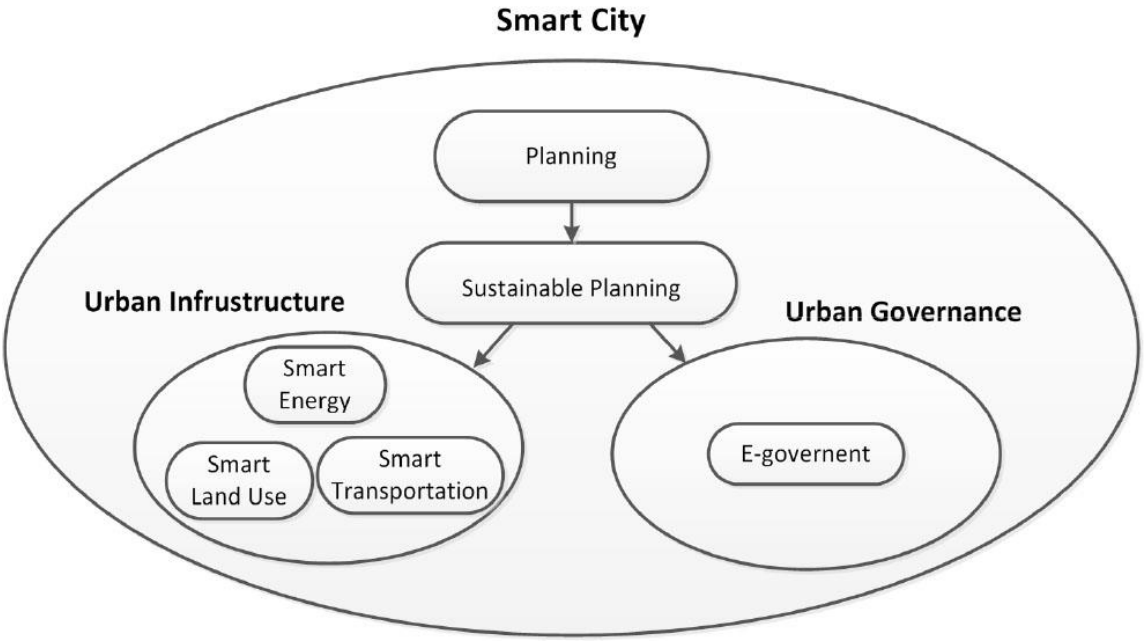


Figure 6.3: Impact of Smart City on Sustainable Planning
Source: (Khansari et al., 2013)

6.4 The influence of the Smart City Concept on Urban Sustainability

ITU-T, (2015) in their report indicate that there are significant aspects which lie at the core of smart sustainable cities operations such as people engagement (cities are for their citizens), economic development (cities should provide job opportunities and finance), environment aspects (cities should be sustainable in their functioning for future generations). Furthermore, smart governance (cities should be robust in their capability to manage policies and put together the various aspects) (ITU-T, 2015).

Gabrys, (2014) argues, on the one hand, cities are quarters of economic and innovation advancement, and in another hand, they are places of greenhouse gas emissions and natural resource consumptions. Therefore, he considers cities are significant centres for implementing urban sustainability projects. He observes that there is a new method in the implementation of the smart city concept that suggests utilizing sensors, smartphones and computers in urban infrastructures development and assessment to attain urban sustainability. He also asserted that the important role of people participation is the main element to achieve sustainability in the implementation of the smart city concept through their effective processes in computational sensing and monitoring practices (Gabrys, 2014).

Khansari et al., (2013) discuss that the association between stakeholders and policy makers should be sustainable and dynamic to implement the various aspects of urban sustainability. They state that one of the main aspects to achieve the goal of the smart city concept is to motivate people towards sustainable attitudes by using advanced technologies in their mobility, natural resources consumption and waste behaviours. They add that sustainable planning influenced by the concept of smart cities through transforming and developing urban infrastructures to be smart. They assert that all these changes in city infrastructures will enhance the sustainable urban development and promote the implementation of a sustainable environment (Khansari et al., 2013).

Smart planning as Khansari et al., (2013) argue will advance the ability of governments to deliver social, health and other public services while participating people in decision-making procedures. They debate, "Social sustainability will be enhanced as a result of this broad participation of citizens in their political system. Smart infrastructure plays an important role in sustainable planning and behaviours. In short, urban sustainability is realized when questions of social, economic and environmental sustainability have all been taken into consideration. On the other hand, in an urban environment, citizens can learn from and respond to environmental changes and can adapt their behaviours according to past experiences. In practice, benefiting from ICTs, citizens and social institutions can play an essential role in making a city more cognitive" (figure 6.4) (Khansari et al., 2013).

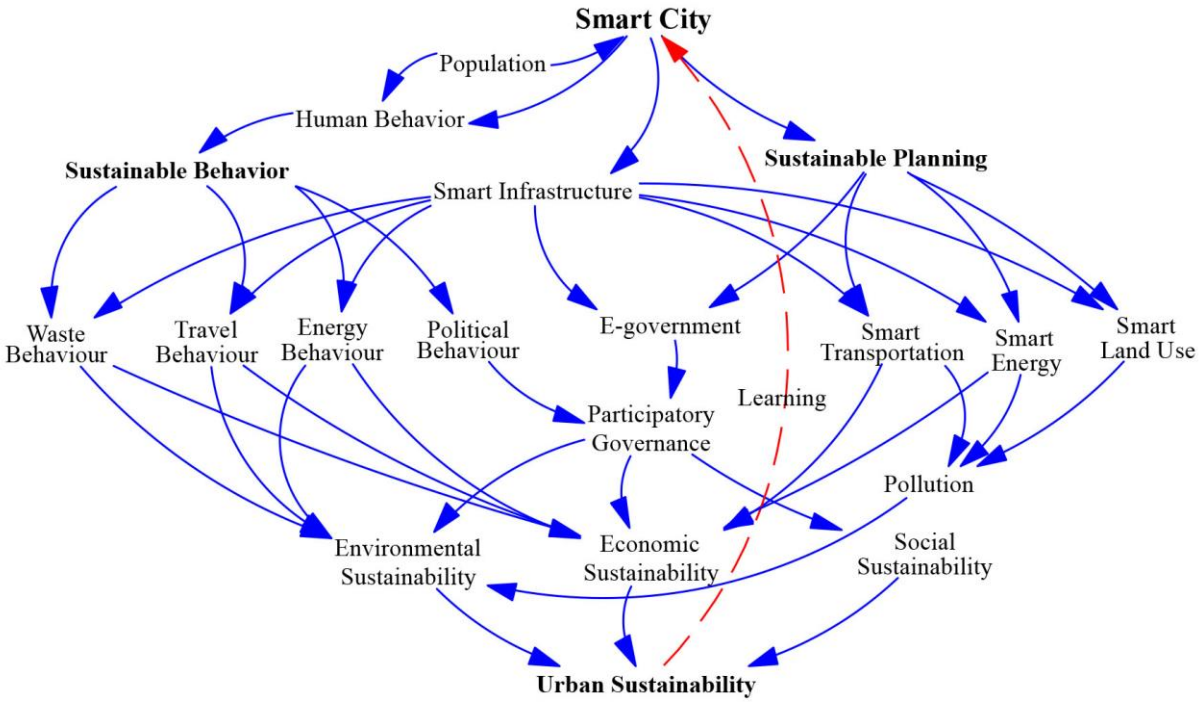


Figure 6.4: The Process of Achieving Urban Sustainability
Source: (Khansari et al., 2013)

6.5 Smart Sustainable Cities Indicators (SSCIs)

The United Nation Economic Commission for Europe (UNECE) and the International Telecommunication Union (ITU), (2015) have produced indicators reflected the content of the Sustainable Development Goals (SDGs) and assisted in measuring the city performance against the SDGs. 71 indicators are provided by UNECE–ITU, (2015) in table 6.2 and are structured regarding the area, topic and typology. In addition, these indicators have categorised as either core or additional. They mention that these SSCIs will promote cities in developing countries and countries with economies in transition, to advance their sustainable development while concentrating on a more transparent and effective use of their natural resources. They confirm that there are various objectives and benefits of using SSCIs such as smart sustainable cities indicators (SSCIs) were advanced as a tool to assess the implementation of the smart sustainable city concept and measure the level of its success (UNECE–ITU, 2015).

SSCIs might also be utilised as a tool to observe cities' advancement towards sustainable urban development in the global framework of the Sustainable Development Goals (SDGs). They can assist the city to develop smartly and sustainably. These indicators might also measure and realise which places are most critical or in which places cities are performing well. They can be utilised to set the city' priorities by identifying its strengths and the weaknesses, and by selecting the most critical aspects for the sustainable development of the city. Moreover, SSCIs can be seen as a good controlling tool to assess the changes in the city's achievement over a particular period and after various actions have been obtained (Table 6.2). They assert, "Sustainable growth can also be achieved with easier access to new and affordable technologies and will result in better living conditions for citizens"(UNECE–ITU, 2015).

Area	*Topic*	*No.*	*Indicator*	*Typology*
Economy	T1.1 ICT infrastructure	1	C1.1.1 Internet access in households	core
		2	A1.1.1 Electronic devices penetration	core
		3	A1.1.2 Wireless broadband subscriptions	additional
		4	A1.1.3 Fixed broadband subscriptions	additional
	T1.2 Innovation	5	C1.2.1 R&D expenditure	core
		6	C1.2.2 Patents	core
	T1.3 Employment	7	C1.3.1 Employment trends	core
		8	A1.3.1 Creative industry employment	additional
		9	A1.3.2 Tourism industry employment	additional
	T1.4 Trade – e-Commerce	10	C1.4.1 e-Commerce transactions	core
		11	A1.4.1 Electronic and mobile payment	additional
	T1.4 Trade – export/import	12	A1.4.2 Knowledge-intensive export/import	additional
	T1.5 Productivity	13	A1.5.1 Companies providing e-services	additional
		14	A1.5.2 Computing platforms	additional
		15	A1.5.3 SMEs trends	additional
	T1.6 Physical infrastructure – piped water	16	C1.6.1 Smart water meters	core
		17	A1.6.1 Water system leakages	additional
	T1.6 Physical infrastructure – electricity	18	C1.6.2 Smart electricity meters	core
		19	C1.6.3 Reliability of electricity system	core
	T1.6 Physical infrastructure – health	20	A1.6.2 Sporting infrastructure	additional
	T1.6 Physical infrastructure – transport	21	C1.6.4 Public transport system	core
		22	C1.6.5 Road traffic efficiency	core
		23	C1.6.6 Real-time public transport information	core
		24	C1.6.7 Share of EVs	core
		25	A1.6.3 Traffic monitoring	additional
	T1.6 Physical infrastructure – buildings	26	A1.6.4 Integrated management in public buildings	additional
Environment	T2.1 Air quality	27	C2.1.1 Air pollution	core

Area	*Topic*	*No.*	*Indicator*	*Typology*
		28	A2.1.1 Air pollution monitoring system	additional
		29	C2.1.2 GHG emissions	core
		30	C2.2.1 Quality of water resources	core
		31	A2.2.1 Water saving in households	additional
		32	C2.2.2 Waste water treatment	core
		33	C2.2.3 Household sanitation	core
	T2.2 Water	34	A2.2.2 Drainage system management	additional
		35	C2.3.1 Exposure to noise	core
	T2.3 Noise	36	A2.3.1 Noise monitoring	additional
		37	C2.4.1 EMF consideration	core
		38	C2.4.2 Solid waste treatment	core
	T2.4 Environmental quality	39	C2.4.3 Perception on environmental quality	core
		40	C2.5.1 Green areas and public spaces	core
		41	C2.5.2 Native species monitoring	core
	T2.5 Biodiversity	42	A2.5.1 Protected natural areas	additional
		43	C2.6.1 Renewable energy consumption	core
		44	A2.6.1 Renewable energy generation	additional
	T2.6 Energy	45	A2.6.2 Energy saving in households	additional
Society and Culture		46	C3.1.1 Students' ICT capability	core
		47	C3.1.2 Adult literacy trends	core
		48	C3.1.3 Higher education ratio	core
	T3.1 Education	49	A3.1.1 e-learning systems	additional
		50	C3.2.1 Electronic records	core
		51	C3.2.2 Sharing of medical resources	core
		52	A3.2.1 Adoption of telemedicine	additional
		53	C3.2.3 Life expectancy	core
		54	C3.2.4 Maternal mortality trends	core
		55	A3.2.2 In-patient hospital beds	additional
	T3.2 Health	56	A3.2.3 Health insurance	additional
	T3.3 Safety – disaster relief	57	C3.3.1 Vulnerability assessment	core
		58	C3.3.2 Disaster mitigation plans	core
		59	C3.3.3 Emergency response	core
	T3.3 Safety – emergency	60	A3.3.1 Disaster and emergency alert	additional
		61	C3.3.4 Information security and privacy protection	core
	T3.3 Safety – ICT	62	A3.3.2 Child Online Protection (COP)	additional
	T3.4 Housing	63	C3.4.1 Housing expenditure	core

Area	*Topic*	*No.*	*Indicator*	*Typology*
		64	C3.4.2 Slums reduction	core
		65	C3.5.1 Smart libraries	core
		66	C3.5.2 Culture infrastructure	core
	T3.5 Culture	67	C3.5.1 Protected cultural heritage sites	additional
		68	C3.6.1 Public participation	core
		69	C3.6.2 Gender income equity	core
		70	C3.6.3 Opportunities for people with special needs	core
		71	C3.6.4 Attractiveness for skilled people	core
	T3.6 Social inclusion	72	A3.6.1 Gini coefficient	additional

Table 6.2: Smart Sustainable Cities Indicators (SSCIs)
Source: (UNECE–ITU, 2015)

Indicators are identified by Ahvenniemi et al., (2017) as "figures or other measures that enable information on a complex phenomenon such as environmental impact to be simplified into a form that is relatively easy to use and understand". They add that the City need indicators to set targets and track and monitor progress on performance. They find out that urban sustainability measurements concentrate on the dimension of sustainability environment, while the smart city measurements concentrate more on socio-economic issues. They assert that the assessment of sustainability should be integrated with the concept of smart city growth and hence it is significant to combine sustainability and smart city frameworks so that both methods are accounted for in performance assessment systems. They confirm that the result of this integration will assist in ensuring that urban sustainability is not neglected in the concept of smart city growth. They illustrate in figure 6.5 the division of the number of indicators for both performance assessment system smart city and urban sustainability frameworks under the three main dimensions of sustainability. They also show in figure 6.6 the division of the indicators of both systems frameworks under the ten sector categories. Table 6.3 shows the division of smart city and urban sustainability frameworks under 10 sector categories and three impact categories. They argue, "The comparison of the two types of performance measurement systems suggests that the initial target of smart cities, defined as attaining sustainability of a city with the help of modern technologies, is not sufficiently addressed in some of the smart city frameworks. While environmental sustainability is an essential target of smart cities environmental indicators are underrepresented in the smart city frameworks analysed in our study". They "strongly recommend that the assessment of smart city performance

should not only use output indicators that measure the efficiency of deployment of smart solutions but always also impact indicators that measure the contribution towards the ultimate goals such as environmental, economic or social sustainability" (Ahvenniemi et al., 2017).

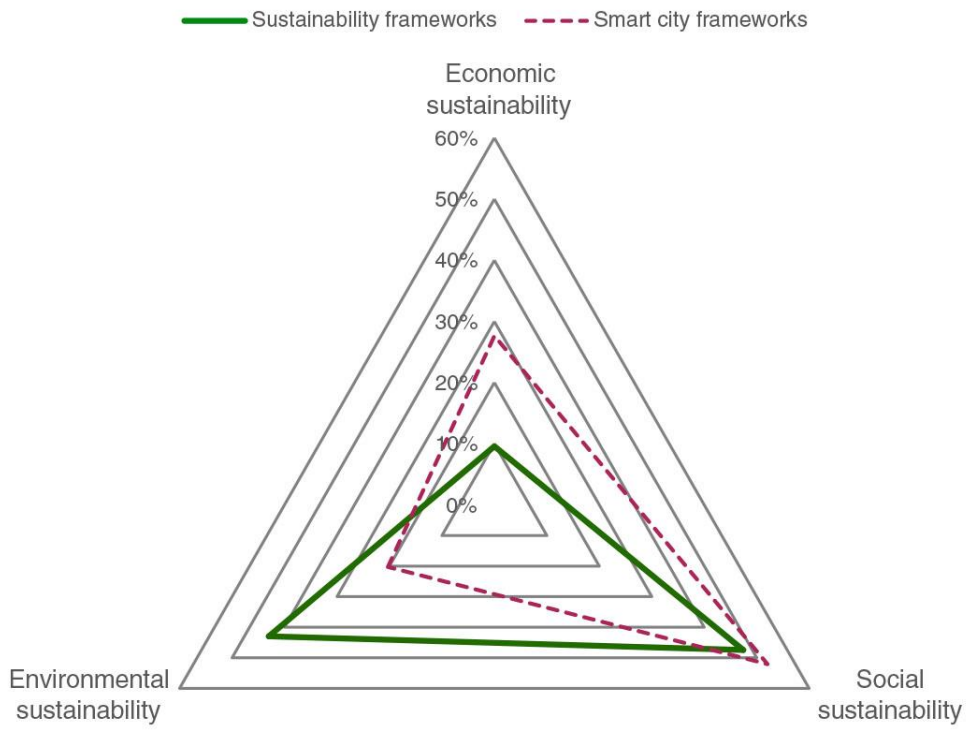


Figure 6.5: Division of the Number of Indicators for Both Smart City Urban Sustainability Frameworks Under the Three Dimensions of Sustainability.
Source: (Ahvenniemi et al., 2017)

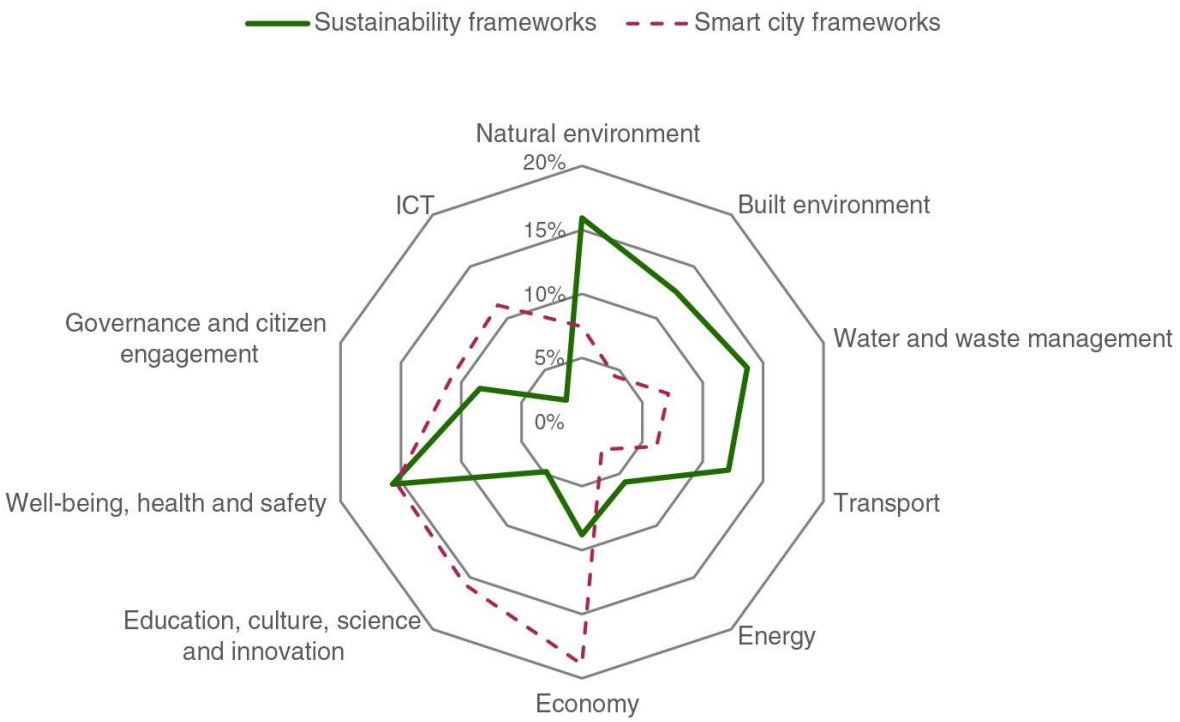


Figure 6.6: Division of the Indicators of Both Smart City Urban Sustainability Frameworks Under the Ten Sector Categories.
Source: (Ahvenniemi et al., 2017)

	Smart city frameworks								
	1. European Smart City ranking	2. Smart cities wheel	3. Bilbao Smart cities study	4. Smart cities benchmarking in china	5. Triple helix model	6. Smart City Profiles	7. Cityprotocol	8. Citykeys	*In total*
Number of indicators	64	26	48	43	45	21	190	73	*510*
Distributing the points among sectors[a]									
Sectors									
Natural environment	9	3	0	2	4	3	34	21	*76*
Built environment	0	2	0	0	0	5	27	11	*45*
Water and waste management	2	2	0	0	4	4	47	14	*73*
Transport	4	4	0	3	2	6	33	11	*63*
Energy	2	3	0	1	2	3	11	5	*27*
Economy	26	8	26	12	35	4	59	23	*193*
Education, culture, science and innovation	36	8	17	10	24	5	46	14	*160*
Well-being, health and safety	31	7	10	11	6	4	75	13	*157*
Governance and citizen engagement	18	5	11	10	8	7	27	25	*111*
ICT	0	10	32	37	5	1	21	9	*115*
Impact categories									
Environmental	11	13	0	6	11	22	99	45	*207*
Economic	36	10	54	27	40	7	69	39	*282*
Social	81	29	42	53	39	13	212	62	*531*

	Urban sustainability frameworks								
	1. ISO 37120	2. RFSC	3. BREEAM	4. LEED	5. CASBEE	6. STATUS (ICLEI)	7. Sustain Lane	8. UN HABITAT	*In total*
Number of indicators	100	24	62	53	75	46	46	42	*448*
Distributing the points among sectors[a]									
Sectors									
Natural environment	19	8	15	19	39	24	18	1	*143*
Built environment	4	2	36	26	19	9	7	10	*113*
Water and waste management	41	0	10	12	24	16	9	11	*123*
Transport	17	2	28	14	12	10	22	4	*109*
Energy	12	2	7	10	11	7	2	1	*52*
Economy	24	11	11	6	3	1	11	12	*79*
Education, culture, science and innovation	16	7	3	6	3	2	2	4	*43*
Well-being, health and safety	50	7	8	10	30	10	2	24	*141*
Governance and citizen engagement	11	7	5	3	3	11	19	17	*76*
ICT	6	2	1	0	8	2	0	0	*19*
Impact categories									
Environmental	64	14	56	60	60	66	54	12	*386*
Economic	25	13	17	11	4	0	6	10	*86*
Social	111	21	51	35	88	26	32	62	*426*

Table 6.3: Division of Smart City and Urban Sustainability Frameworks Under 10 Sector Categories and Three Impact Categories.
Source: (Ahvenniemi et al., 2017)

6.6 Smart Sustainable Cities Challenges

There are different methods to achieve the aim of SSCs, depend on the city needs, features, cultural aspects and socio-economic and environmental issues. Therefore, the implementation of smart sustainable cities has faced many challenges such as economic challenges, low levels of people engagement, technological challenges, scarcity of natural resources, environmental administration challenges, climate change challenges, shortage of smart sustainable cities expertise and growing inequality. ITU-T, (2015) assert that the method to SSCs should be comprehensive (ITU-T, 2015). The smart sustainable city as Höjer and Wangel, (2014) assert an underdeveloped idea. They mention that five challenges require being examined to materialise the smart sustainable city concept.

1- **Strategic Assessment:** Höjer and Wangel, (2014) argue that the measurement of the smart sustainable city concept is significant to advance the implementation of its approaches and practices. They point out that strategies might be utilised to determine which solutions are required. They say that without strategic assessment "Smart sustainable cities risks becoming just a label without validated content. In developing assessment methods, it is important to keep in mind that in practice it is the assessment, or the indicators included in assessment, that defines the important characteristics of a smart sustainable city" (Höjer and Wangel, 2014).

2- **Mitigating Measures**: Infrastructures improvement and investment in modern cities have led to the essential advancements in the quality of life, the implementation of smart mobility, the development of water and sewage management and effective systems for economic of different types. Höjer and Wangel, (2014) show that ICT infrastructure has played an essential role in advancing modern societies by using it for example to increase traffic flows in the city. They state, "The improvements in traffic might need to be paired with other measures. Similarly, counter-measures may be needed to realise the sustainability potential of ICT in other cases as well. Cities must craft mitigating measures at the same time as they encourage technology for efficiency improvements, and they must closely follow how ICT is shaping society" (Höjer and Wangel, 2014).

3- **Top-Down and Bottom-Up:** Cisco, Ericsson, IBM or Siemens are the main creators of services and systems of the smart sustainable cities concept. Top-down solutions by these firms as Höjer and Wangel, (2014) argue might reduce the creativity of the smart sustainable cities initiative. Whereas the bottom-up model is represented by societies could "have great expectations on the potential for innovation through involving people in the formulation and solving of problems" (Höjer and Wangel, 2014).

4- **Competence:** Höjer and Wangel, (2014) say that ICT can be an effective method to develop the implementation of the smart sustainable city concept and find better solutions for different problems. They confirm that city administrations and ICT companies should "increase city administrations' competences with regard to ICT solutions for Smart Sustainable Cities. This need has been recognised by the EU Smart Cities Stakeholder Platform, which has developed guidelines for public procurement for smart cities" (Höjer and Wangel, 2014).

5- **Governance:** Höjer and Wangel, (2014) debate, "the smart sustainable city calls not only for interconnecting devices but also organisations, requiring a reconsideration of which actors need to be involved in the planning and governance of the city. Moreover, for the diverse ICT in the city to work through concerted action, a coordinating body must play a role" (Höjer and Wangel, 2014). They suggest creating a team that has different abilities and skills to advance the concept of smart sustainable cities. They mention, "This team could then be given the assignment to promote smart sustainable city development. Over time, such a body could also develop the competence needed to scrutinise offers from ICT companies as well as play a role in balancing top-down and bottom-up approaches" (Höjer and Wangel, 2014).

6.7 Discussion and Conclusion

Höjer and Wangel, (2014) argue the integration between the sustainable cities concept and the smart cities concept could be raised awareness about the utilising of ICT in developing urban sustainability among urban designers, IT firms and government institutions. They debate, "The concept of Smart Sustainable Cities can thus be used as a common framework or joint vision for elaborating new collaborations, business models and ways of carrying out urban development. This, in turn, highlights the need to avoid getting caught up only in the technological challenges of developing Smart Sustainable Cities and rather taking a proactive approach to actor networks, governance, and policy innovations" (Höjer and Wangel, 2014).

Khansari et al., (2013) discuss that open government will permit stakeholders to engage actively in making decisions and the outcome is enhanced citizens' well-being and achieve the goal of urban sustainability. They add that the concept of smart cities will promote this vision by assisting stakeholders to policymakers to advance sustainable attitudes and planning. They assert that advanced technologies and ICT play a significant role in transforming people attitudes towards an effective and sustainable use of cities' natural resources, at the same time developing smart and efficient methods of delivering various services by companies and cities' governments. They emphasise that the concept of smart cities should have the ability to advance its method of management and operation different infrastructures to cope with the future need for its stakeholders. Smart cities Khansari et al., (2013) argue "are thus capable of altering the environmental and social behaviours of citizens, whether this means providing information about mechanisms for reducing energy consumption, or updates on travel routes. In addition, they facilitate smart governance and political participation among citizens and officials through the use of ICTs like e-governance and e-democracy. They affect urban infrastructures such as systems of water and land use, energy, and transportation, encouraging the use of renewable energy sources as a path to sustainable development. Nevertheless, in making use of these technologies, cities must deal with challenges related to privacy, security and government surveillance. In practice, residents will live in a "surveillance society"; that is, where societies are connected but completely unknown to one another. Another challenge facing smart cities is

to properly model and understand human behaviours through psychology, user experience design and social computing" (Khansari et al., 2013).

Ahvenniemi et al., (2017) suggest that the advanced technologies should have a significant role in advancing the concept of smart cities to be sustainable. They mention that cities cannot be smart if they are not sustainable. They assert that sustainability measurement should be involved in the development of the smart city concept, hence the integration between the smart city and sustainability city frameworks so that both methods are accounted for in performance assessment systems. They also emphasise the use of the term smart sustainable cities will ensure that sustainability is not neglected in smart city advancement. They recommend that "the assessment of smart city performance should not only use output indicators that measure the efficiency of deployment of smart solutions but always also impact indicators that measure the contribution towards the ultimate goals such as environmental, economic or social sustainability" (Ahvenniemi et al., 2017).

6.8 Chapter Summary

This chapter involves the literature review around the subjects of smart sustainable cities and identifies the term smart sustainable city (SSC) differently according to various literaturessdbm. It examines the influence of the smart city concept on sustainable behaviour, planning, and urban sustainability. This chapter has investigated smart sustainable cities indicators (SSCIs) and its assessment methods. It asserted that the assessment of sustainability should be integrated with the concept of smart city growth and hence it is significant to combine sustainability and smart city frameworks so that both methods are accounted for in performance assessment systems. The debating of this chapter also focuses on how the implementation of smart sustainable cities has faced many challenges such as economic challenges, low levels of people engagement, technological challenges, scarcity of natural resources, environmental administration challenges, climate change challenges, shortage of smart sustainable cities expertise and growing inequality. It concludes that cities cannot be smart if they are not sustainable.

CHAPTER 7: RESEARCH METHODOLOGY

7 Introduction

The research methodology chapter will examine the methodology adopted throughout this research that aims to realise the respective results. The research method is defined by Wilson as “a way to systemize (sic) observation, describing ways of collecting evidence and indicating the type of tools and techniques to be used during data collection”. Based on this delineation, he asserts, “a case study is first and foremost a research design, and it makes sense that a variety of methods could be used to collect the evidence, depending upon which angle one is taking in approaching the research question” (Wilson, 2016). Leech and Onwuegbuzie assert, “mixed methods research represents research that involves collecting, analysing, and interpreting quantitative and qualitative data in a single study or in a series of studies that investigate the same underlying phenomenon” (Leech and Onwuegbuzie, 2009).

This chapter will try to highlight the designed methodology and will illustrate a mixed research method of qualitative and quantitative methods that will be utilised in the case study area. The mixed research method will be employed to assess the physical urban context and form of the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa. This chapter will show different methods of gathering data including physical field survey and citizen questionnaires and the methods of analysis including descriptive and spatial analysis. These mixed methods will display different techniques such as questionnaires, interviews walking method, serial vision method and observation approach that will examine the urban context of the case study. As this thesis is seeking to develop the physical urban environment and improve the quality of life in Old Rusafa, therefore, a questionnaire survey is applied to clarify bottom-up opinions, whereas, interviews are utilised to illustrate top-down views. The integration of mixed research strategies will create a platform on how to preserve and develop the traditional urban context of the case study in a smart sustainable way.

7.1 Mixed Research Methods for Looking at the Case Study

In this research, various strategies at different levels of the research were implemented. The nature of the design of this thesis can be called a multi-strategy research. This thesis will implement a mixed research method that endeavours to bring information from both qualitative and quantitative methods. Qualitative and quantitative approaches are two different broad methodological systems selected to accomplish the aim of the research study. Therefore, to understand and solve research problems, this thesis will search for different approaches and use mixed research methods for gathering and analysing information. As this research considered the historic centre of Old Rusafa as a case study, thus, mixed research method approach has been implemented and many requirements have appeared when surveying the current situations in the old core of Baghdad. In addition, the mixed research methods design requires being synchronised with the information gathering. This thesis has utilised processes drawn from concurrent embedded forms of gathering information, in which both the quantitative and qualitative information are collected at the same time. This research employs various multi-methods of gathering and analysis data within a single study paradigm. We may proceed a qualitative process in which we observe an area and also interview stakeholders. In this research, I will implement an integration of structured interview as a quantitative approach and observation of the case study area; moreover, I will conduct qualitative methods as a research methodology.

Mixed methods research is defined by Johnson and Onwuegbuzie (2004) as “A class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language in a single study” (Johnson and Onwuegbuzie, 2004). Creswell and Plano Clark, (2011) say, “Mixed methods research is practical in the sense that the researcher is free to use all methods possible to address a research problem. It is also practical because individuals tend to solve problems using numbers and words, combine inductive and deductive thinking, and employ skills in observing people as well as recording behaviour” (Creswell and Plano Clark, 2011).

Bryman (2006) said, “There can be little doubt that research that involves the integration of quantitative and qualitative research has become increasingly common in recent years”. He

mentions, "Multi-strategy research provides such a wealth of data that researchers discover uses of the ensuing findings that they had not anticipated (Bryman, 2006). Denzin (2007) argues, "Mixed methods are direct descendants of classical experimentalism. They presume a methodological hierarchy, with quantitative methods at the top, relegating qualitative methods to a largely auxiliary role in pursuit of the technocratic aim of accumulating knowledge of 'what works" (Denzin, 2007). Sánchez-Algarra and Anguera (2013) argue, "Whether the quantitative paradigm is based on positivism and the qualitative paradigm on interpretative and constructivism, it is certainly the case that a consistent tradition is now taking shape in which the qualitative and quantitative methodological perspectives are being combined". They add, "It is considered that designs based on mixed methods do not use procedural approaches associated with anyone paradigm in particular, but rather than the traditional positions available share the logic of the scientific process, the fallibility of knowledge and the problems derived from the dissemination of this knowledge" (Sánchez-Algarra and Anguera, 2013).

Mixed research as Johnson et al., (2007) define, "is a synthesis that includes ideas from qualitative and quantitative research". They summarised that the integration between qualitative and quantitative might be influential at the research design, gathering information, and data analysis stages of the research procedure. They debate, "At the research design stage, quantitative data can assist the qualitative component by identifying representative sample members, as well as outlying (i.e., deviant) cases. Conversely, at the design stage, qualitative data can assist the quantitative component of a study by helping with conceptual and instrument development. At the data collection stage, quantitative data can play a role in providing baseline information and helping to avoid "elite bias" (talking only to high-status individuals). On the other hand, at the data collection stage, qualitative data can help in facilitating the data collection process (Johnson et al., 2007).

Axinn and Pearce, (2006) write, "Mixed method data collection strategies are those that are explicitly designed to combine elements of one method, such as structured survey interviews, with elements of other methods, such as unstructured interviews, observations, or focus groups in either a sequential or a simultaneous manner. They argue, "Mixed method strategies afford special opportunities to use multiple sources of information from multiple approaches to gain new insights into the social world. Varying the data collection

approach can (1) provide information from one approach that was not identified in an alternative approach; (2) reduce non-sampling error by providing redundant information from multiple sources and (3) ensure that a potential bias coming from one particular approach is not replicated in alternative approaches" (Axinn and Pearce, 2006:1).

7.1.1 Qualitative methods

Qualitative research is defined by Lewis as "A research process that uses inductive data analysis to learn about the meaning that participants hold about a problem or issue by identifying patterns or themes. Open-ended questions are used to gather information, which grouped into codes, themes, categories, or larger dimensions" (Lewis, 2015). Denzin defined qualitative research as "A field of inquiry in its right. It cuts across disciplines, subfields, and subject matter". He adds, "Qualitative research means different things in each of these moments". He debates, Qualitative research is multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of or interpret these things regarding the meanings people bring to them. Qualitative research involves the studied use and collection of a variety of empirical materials case study, personal experience, introspection, life story, interview, and observational, historical, interactional, and visual texts that describe routine and problematic moments and meanings in an individual's life (Denzin, 2007)

Qualitative data as Sánchez-Algarra and Anguera debate "must be sufficiently consistent and be obtained through careful description and recording, even though their content is variable and their analysis difficult due to the null standardisation of responses and their complex systematisation". They mention, "The techniques most particularly associated with qualitative methodology are the recording of observed behaviour, interviews, and the gathering of documental material, it being understood that the defining stage is that involving data collection as there is nothing to prevent the subsequent management, transformation and analysis of data from making use of quantitative methods". They say, "Qualitative methodology is based on a number of assumptions and is defined by a given set of characteristics, and thus no specific value judgments should be attributed to it" (Sánchez-Algarra and Anguera, 2013).

7.1.2 Quantitative methods

Quantitative studies as Denzin writes "emphasise the measurement and analysis of causal relationships between variables, not processes. Proponents claim that their work is done from within a value-free framework" (Denzin, 2007). Sánchez-Algarra and Anguera assert, "quantitative methodology tends to translate their observations into figures, and these numerical values are produced through the counting, measurement or verification of the item or order, thus enabling researchers to discover, verify or identify symmetrical (or non-symmetrical) relationships between the concepts derived from a theoretical framework developed in accordance with the criteria governing each one of the everyday situations to be studied. Regarding the assumptions of quantitative methodology, hypothesis testing requires that the criteria of representativeness and randomisation are fulfilled, which implies the use of adequate sampling techniques, as well as the possible use of sophisticated analytic procedures" (Sánchez-Algarra and Anguera, 2013).

Khalifehei (2014) asserts that quantitative method is the method that transforms information into numbers and utilises numerical analysis. He mentions that the researcher should understand what is she or he seeking for and should prepare all the features of the case study research before the information is gathered. The objective of the quantitative method as Khalifehei (2014) emphasises to enhance and employ theories, hypotheses and mathematical models that influencing the phenomena. He adds that this type of research process is a particular phenomenon as specific questions seem to be replied instantly employing quantitative research approaches. He indicates that one of the main pros of quantitative methods is that it produces reliable and quantifiable information that is usually generalizable to the higher population. The researchers in the quantitative analysis will permit to test a specific theory in contrast to the qualitative method that is more heuristic. He argues that one of the main cons of quantitative research is that it decontextualizes people attitude, in another word, it does not examine the case study from its real-world condition and neglects the impacts of variables that have not been constituted in the process. He adds that the quantitative method also lacks the depth and style of information that is existing with the qualitative approach. He concludes that it is impossible to realise the details about each participant as numerous contributors are employing quantitative research approaches (Khalifehei, 2014).

7.2 Fieldwork and data collection

Fieldwork as Jensenius (2014) asserted, "is often contrasted with quantitative data work, but while some quantitative datasets can be downloaded from the Internet or bought from data collection agencies, other datasets are the result of months and months of pestering officials, searching through archives, or accompanying data entry people in the field" (Jensenius, 2014). Fieldwork as a method to gather information for this research started in April 2016 and it was prepared according to a plan. The information has been collected from diverse sources associated with the various departments of Municipalities of Baghdad, the Presidency of the Mayoralty of Baghdad, Baghdad Heritage Department, and Urban Planning Department of Bagdad. It also obtains data from the academic sources such as the University of Technology and the University of Baghdad. The major part of obtaining data is from site visits. Two significant steps were taken to gather information during the visit in April 2016. The first one is various actions, which were commenced, including:

- Determining the study area, which is the area the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa. This area consists of a longitudinal strip extending approximately four kilometres between bab Al-Moatham and bab Al-Sharqi.
- Gathering comprehensive maps for various parts of Old Rusfa and evaluating their significance for the analysis method is examined.
- Gathering comprehensive plans prepared for the historic centre and for the capital city of Iraq. These plans were prepared by different groups and from different periods. These schemes show various approaches to develop, control and promote the growth in Old Rusafa. Most importantly, one of these plans examined the physical environment of the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa by The Municipality of Baghdad between 2009 and 2010.
- Site visits to update and assess the historic and architectural value, buildings uses, historic and traditional buildings, building heights and the structural condition of historical and traditional buildings in the case study area (the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa).
- Site visits and the taking of photographs for many diverse traditional and modern buildings from different parts around the historic core.

- These images were arranged and categorized on the map of Old Rusafa, according to their arrangement to ease their assessment in later stages when required.
- The site visits also displayed new concepts and challenges. In this regard, reviewing the fieldwork in the first steps of gathering information could also be examined as an empirical test.
- The assessment of the information collected concluded the first stages.

Taking photos and gathering maps was the first stage of the fieldwork method, in which the main goal was to document Al-Rashid Street, traditional alleys, new modern roads that penetrated the historic urban fabric, historical and traditional buildings. The second stage contains also taking photos and gathering the detailed maps of the selected places, furthermore, obtaining a new comprehensive plan from the Mayoralty of Baghdad prepared for Baghdad in 2013 and another study for Old Rusafa in 2010 which added new information about the development of the old city. These important two stages were consolidated as a significant part of the research methods. The third step was the field survey, which was a prerequisite for displaying the current situation and as an indicator for future planning proposals that reflect the cultural heritage of Al-Rashid Street. In addition, it defines the type and degree of urban design and planning steps to be taken and will be used as a means of development and rehabilitation, and as a tool for infrastructure investment in post regional planning.

7.2.1 Data collection

In all phases of the case, a wide variety of data from different sources has to be integrated. The source and type of data depending on the case and its nature. (Scholz and Tietje, 2002). Axinn and Pearce, (2006) say, “High-quality data collection is fundamental to the advancement of knowledge in the social sciences, Yet, advances in techniques for data analysis in the past half-century have far outpaced advances in data collection methods. This is likely to change in the coming decades, as new technologies and strategies bring the social sciences to the brink of a revolution in data collection methods. Some of the seeds of that revolution lay in mixed method data collection approaches” (Axinn and Pearce, 2006:1). They assert, “Mixed method data collection strategies reveals two key themes. The first theme is that mixing multiple methods affords opportunities to use the strengths

of some methods to counterbalance the weaknesses of other methods. Because all methods have strengths and weaknesses, combinations of multiple methods that achieve this counterbalancing aim are particularly valuable. The second theme is that mixing multiple methods is a valuable strategy for producing a comprehensive empirical record about a topic. Empirical documentation that combines redundant measurement using radically different approaches has special strengths for reducing errors, discovering new hypotheses, and testing hypotheses. These themes of counterbalancing strengths and weaknesses and comprehensive empirical documentation illuminate a set of common principles in the design of mixed method data collection" (Axinn and Pearce, 2006:185).

The thesis utilises a mixed research methodology. For the evaluation of the smart and sustainability stage, the quantitative method is employed, whereas, for assessment of the existing physical urban context and urban form of the historic core, qualitative methods are utilised. Gathering data for the two approaches is the difference. A structured interview is used for collecting data for the quantitative approach (this will be examined in the next chapter of this thesis) and for the qualitative approach walking with serial vision strategies is utilised.

7.2.2 Collecting Observational Data

The observational design is a highly important aspect in that it provides a framework and methodological basis for any study involving observational methodology (Sánchez-Algarra and Anguera, 2013). Observation as Khalifehei, (2014) confirms "A fundamental method of finding out about the world around us. Human beings are very well equipped to pick up specified information about our environment via our senses". He said, "Observation is an approach to data collection for research objectives, it is more than just looking or listening". He emphasises, "Observation must be selective. We are constantly bombarded by huge amounts of sensorial information. A human being is really good at selectively attending to what is understood as most useful to us. Observation controls this ability; methodical observation produces accurate planning of what we want to observe". He adds, "with the aim of making observation public, seeing or hearing has to be recorded by some method to allow the information to be analysed and interpreted. Observation in contemporary educational and social research deals with highly complex social phenomena

and provides major challenges for the researcher". He indicated, "Observation needs to recognize the observation method and also determine the observing tool" (Khalifehei, 2014).

Axinn and Pearce, (2006) say, "Observation Methods are an important tool in the social sciences, and a substantial literature describes these methods. Observational methods are different because they have the potential to yield unique sources of insight and introspection. Methods of observation can be further divided into different types based on the level of contact with those being studied: direct observation, unobtrusive observation, and participant observation". They assert, "Observation as a better means of obtaining data on social phenomena. Observation usually generates data in the form of field notes or recording" (Axinn and Pearce, 2006:8).

A qualitative method was utilised in the second section of this thesis to evaluate the existing physical urban context and form. This research aims to realise if the urban context and form of Old Rusafa are amenable to the smart and sustainable city concept. In this research methods chapter, we will debate the ability to utilise a combination of the walking and the serial vision method as a qualitative approach to gathering information. We divided the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa into four zones. We prepared a map for each zone, to take a sequence of photos and to show the walking sections that were produced after the researcher had walked in the main components of the case study. The researcher began from Tigris Riverfront and walked from the other side of Tigris (Karkh) to take pictures as there was no ability to walk along the Tigris Riverfront from the Rusafa side due to the lack of walking path and also for security reasons.

7.2.3 The Walking Method for Assessing the Area Between Al-Rashid Street and the Tigris Riverfront in Old Rusafa

Bassett, (2004) asserts, "Walking, as a fundamental human activity and way of interacting with the environment, has attracted the attention of poets, essayists, artists, philosophers and social theorists". He indicates, "Walking the city was a strategic device to give up conscious control, submit to risk and chance, and reveal the unconsciousness zones of

urban life. But for this to happen it was necessary to adopt an ultra-receptive posture, to put oneself into a state of grace with a chance so that something will happen". He adds, "Different theories and practices of walking and the Situationist and psyche geographic approaches, in particular, provide a rich source of ideas for exploring, experiencing and, it is hoped, understanding cities" (Bassett, 2004).

Wunderlich, (2008) said, "Walking is an embodied practice with specific lived qualities. It is also a mode of experiencing the place and the city and in this context is an aesthetic and insightful spatial practice". He mentions, "Walking is a 'mode of experiencing place' and 'the city'. It is a multifaceted activity and a temporal practice, which has an impact on design; as such urban walking has yet to be fully understood and engaged with". He adds, "Walking is an unconscious way of moving through urban space, enabling us to sense our bodies and the features of the environment. With one foot-after-the other, we flow continuously and rhythmically while traversing urban place. Walking is an experience we are not conscious of, ignoring its potential as an aesthetic, creative or simply insightful practice. It is while walking that we sensorially and reflectively interact with the urban environment, firming up our relationship with urban places". He concludes, "Walking calls for a sensorial urban design that encourages sensorial and social encounters and as a result promotes and enhances the sense of (and for) place. Both purposive walking and the walking experience in urban environments need in depth analysis and to be designed for in a more holistic manner, and walking needs to be accepted and explored as a significant and alternative design method in the practice of urban and place design" (Matos Wunderlich, 2008).

7.2.4 Serial Vision as a Method for Assessing the Area Between Al-Rashid Street and the Tigris Riverfront in Old Rusafa

Khalifehei, (2014) said, "Vision refers to what the human eye is physiologically able of seeing. On the other hand, vision is conceived in a variety of ways: how we see, how we are able, allowed, or made to see, how we see this seeing and unseeing. The visual is the most fundamental of all the senses". He adds, "The visual methods are used to study a variety of topics ranging from gender studies, community and power to spatial relationships, and spectatorship. Visual studies have taken a particularly meaningful role in

educational research in the last three decades. One of the strengths of visual research is the use of technology to showdown and repeat observations and encourage deeper reflection on perception and meaning. This is important since visual acuity questions the connotation, denotation and significance of observation that is too often taken for granted". He emphasises, "The idea of the sequence of pictures in urban design is the idea of looking at the environment as a collection of images. The analysis is aimed at detecting and categorising these pictures and design is aimed at making pictures. This means this activity is aimed at the perception of the place" (Khalifehei, 2014).

The urban landscape according to Cullen is composed of a series of related tangible and intangible areas, and he asserted that urban designer, planner and architect could create a more planned design if they realise the connection between the two elements. The serial vision technique regarding Cullen's view has determined aesthetic aspects of the city, recording the effective interaction between the form and the area it occupies. The serial vision approach indicated the significance of the individuality and visual practices. He argues that this type of data plays a fundamental role in producing an efficient city. The method of serial vision as Cullen emphasizes an optics in which movement at a consistent speed through the city will involve an existing view and hints at possible emerging views down an alley, a zigzag road or through a courtyard. Awareness of the place will allow the stakeholders to determine and sympathise with the physical urban environment and clarify meaningful navigation through the components of the city structure. Cullen discusses that the aesthetic of place might be indicated by content that includes optic group through "colour, texture, scale, style, character, personality and uniqueness". He asserts that these distributions can assist to realise the physical context of urban form and their utilisation might explain the ability of non-traditional resources (architectural detail, natural features, enclosures, relationships and scale) for guiding the urban planning or designing procedure that is critical to stakeholder's requirements and respectful of features of the place. Serial vision has enhanced by Cullen to clarify what people experience when they walk through a place, and their views change when they walk on a curving pathway reaching a courtyard or turning a corner, which produces a sense of discovery and drama. Serial vision is constituting of two things, firstly, is what we can see through our moving and secondly, is what we can anticipate in the appearing view. It is also the comprehension what we experience as we walk through the city (Cullen, 1996:9,10,11,12,57,86).

Olascoaga, (2003) asserts, “The consistency of visual survey depends on the use of similar and objective categories in the assessment of townscapes”. He mentions the, “Method of visual survey provides a list of concrete sensory, formal, and expressive categories against which a townscape can be appraised. The understanding and correct application of these categories allow consistent results among teams during and at the conclusion of the visual survey. There should be agreement in the application of categories, and a group revision of findings”. He argues, “The method of visual survey is useful for exploring and evaluating small areas of cities (such as neighbourhoods or districts) or small towns. However, when dealing with an inventory of the city as a whole, the exploration of the city demands large inputs of time, effort, and people. Therefore, the practical application of the visual survey is relative to the size and complexity of a city”. He concludes, “Visual survey is useful for perceiving the characteristics and spatial relationships of human-made and natural elements of the urban form. This method is also useful for assimilating the degree of maintenance or the state of conservation of urban elements and urban areas. Finally, complemented through previous studies, knowledge, and documentation, the visual survey is also useful for identifying architectural and designed landscape styles, and for determining urban assets, such as works of exceptional design or craftsmanship, curiosities, and associations to important personages, events, or messages. For all these reasons, visual survey constitutes a valuable tool for an empirical diagnosis of cites” (Olascoaga, 2003).

This research utilised a camera as a capturing device for the collection of visual data. The researcher walked through the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa and used a map as a beginning point for each zone, to take a sequence of photos. All pictures in the linear series were connected to each other. The walking and serial vision were prepared to evaluate the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa that is described in the previous part. Starting from Figure 7.1, which shows the land use plan of Baghdad according to the Municipality of Baghdad 2016, and then another map that shows that the land uses plan of the boundaries of the municipality of Rusafa (figure 7.2).

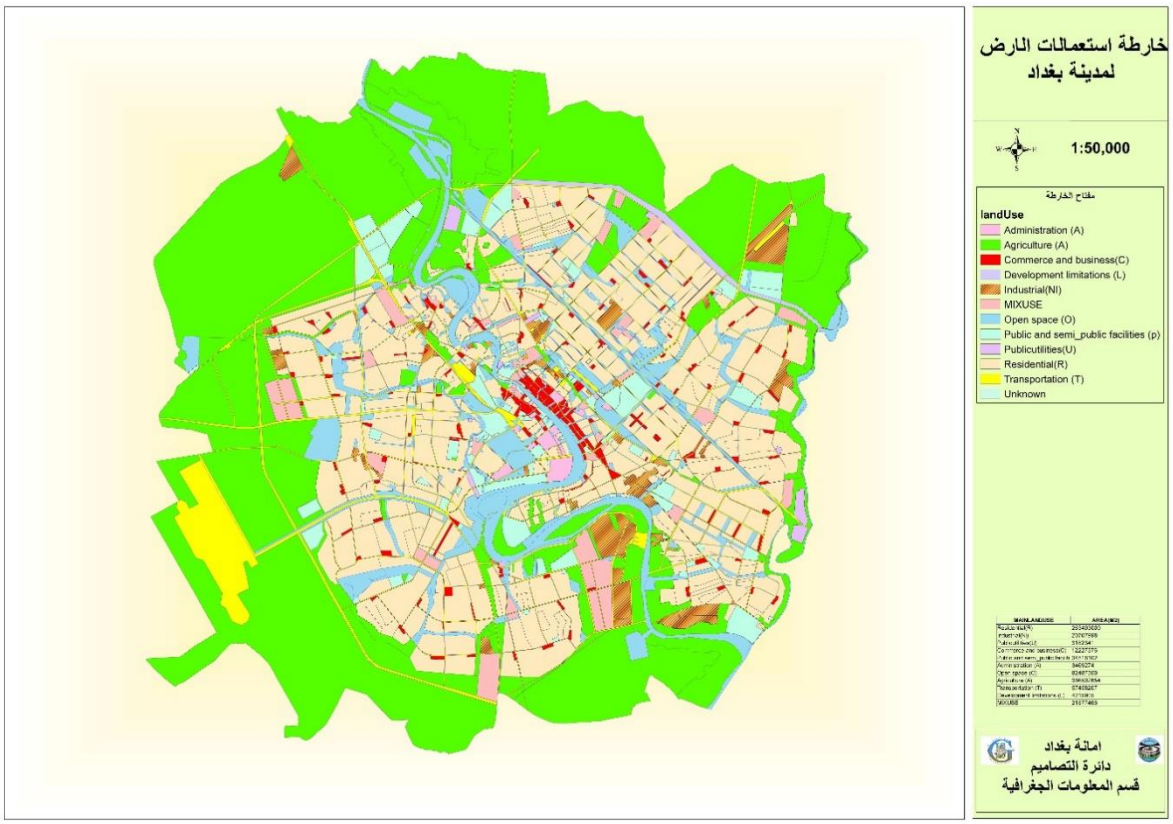


Figure 7.1: Land Uses Plane of Baghdad
Source: (The Municipality of Baghdad, 2016)

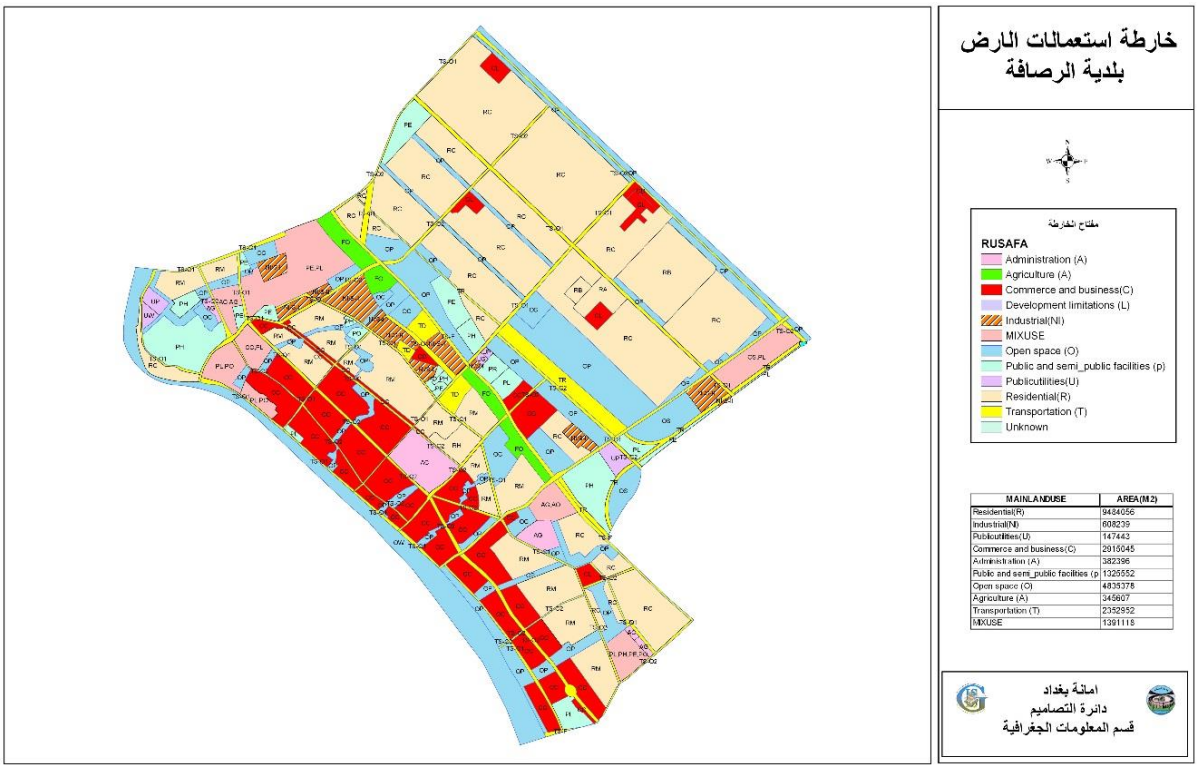


Figure 7.2: Land Uses Plane of the Boundaries of the Municipality of Rusafa
Source: (The Municipality of Baghdad, 2016)

7.3 Collecting Interview Data

Axinn and Pearce, (2006) indicate, “A key feature of surveys is standardised questions. Although social scientists recognise that respondents' interpretations of questions are not standardised, many feel that question standardisation is a minimum criterion for using data to test hypotheses. Comparability of the questions is the key”. They argue, “Many social scientists would treat comparisons based on asking respondents different questions as perhaps interesting, but not a rigorous test of a hypothesis. Substantial evidence indicates that differences in question-wording result in responses that are not comparable. For purposes of standardisation, survey questions are compiled in a questionnaire”. They mention, “The use of a questionnaire imposes a high level of structure on the survey interview, which makes it difficult to use surveys to uncover completely new hypotheses. That is, researchers' ideas about what should be measured and how it should be measured must be concrete before a survey begins to produce a questionnaire”. They add, “The discovery of new research questions or new approaches to measurement is limited, and to the extent that it does occur, revised measurement must await the next survey. This level of standardisation and structure allows well-trained interviewers to administer a survey as intended by the survey designer and to administer it to a vast number of respondents. Thus, survey methods can be used to take a census of a population or to interview a large representative sample of a population. This is considered a positive aspect of surveys because inferences based on large, representative samples are known to be more reliable than inferences based on small or non-representative samples” (Axinn and Pearce, 2006:4)

The objective of this fieldwork survey is to realise the opinions, values, behaviour, and situations of Old Rusafa citizens. In the quantitative method, a structured interview for data gathering techniques is utilised. We specified the number of candidates before conducting the interview, which age group and which qualification they hold and we classified their professional category. Furthermore, we devised an interview comprising six groups of questions starting from factors that represent the historic centre of Baghdad (Old Rusafa); the second group is conducted for accessibility, infrastructures and facilities. The third group tried to investigate deterioration, pollution and other problems in Old Rusafa, the fourth group examined land management problems, the fifth group has surveyed the

importance of sustainability indicators and the final group explored smart city characteristics in Old Rusafa.

7.3.1 The steps of interview

The majority of development plans have not considered the requirements of the old city's citizens; it has concentrated more on the development of the physical issues. Therefore, this innovative survey will seek to participate with citizens in determining the constraints and potentialities of the historic core and to involve them in the design guidelines proposal for their heritage and its urban context, aiming to develop their living circumstances. Data collected from 100 successfully filled questionnaire forms were analysed and discussed, and this will be displayed in detail in the next chapter of this thesis. This part presents the various steps of the interview starting from selecting the interviewees to translating the interviews from Arabic to English.

7.3.2 Selecting the interviewees

We have endeavoured to interview Baghdadi citizens from different knowledge backgrounds and different institutions such as the Mayoralty of Baghdad, the University of Technology, the University of Baghdad and the Federal Board of Supreme Audit.

7.3.3 Interviewing procedure

The researcher managed the interviews, and he endeavoured to find citizens who are living, working and interesting in developing the historic core and policymakers that have a future vision on how to advance the case study area. In the process firstly, the researcher introduced himself and informed people why they were being invited to participate in a research study (developing Old Rusafa). If he/she answered positively, the second step was to explain for the interviewees why the research is being done and what it will involve. Then the researcher gave them a research information sheet (See Appendix 1) and asked people to take time to read the following information carefully and feel free to ask if they would like more information or if they do not understand anything mentioned in the

information provided. This information also clarifies the purposes of the research project and its objective briefly. Each interview took about 30 to 40 minutes.

7.3.4 Ethical issues considerations

The Manchester Metropolitan University has provided the researcher ethical approval for this research (See Appendix 2). The researcher had informed the interviewee before they started each interview verbally that this interview was voluntary and that he/she can leave at any step. They were also informed that there was no compulsion to respond to any question that they did not like and that the interview was confidential, anonymous and without any photography or voice recording. The researcher clarifies to the interviewees that the interview would not extract anything particularly personal and the questions were not of an individual, private or sensitive nature.

7.3.5 Translation interviews

Axinn and Pearce, (2006) indicate, “Common language is an essential ingredient in a successful mixed method data collection. Language creates the meaning that accompanies social interactions and frames behaviour; language creates the building blocks of ideas that guide all aspects of social interaction and behaviour. To attempt to observe or interview others without knowing their language and then to draw meaningful conclusions about their ideas, behaviour, or social interaction is to engage in social research at great peril. They argue, “At best, the outcome is likely to be characterised by moderate levels of measurement error that generate misleading conclusions. At worst, the level of such error may be so high that the researcher's insights into social cause and consequence will bear no resemblance to the actual social world being studied. To the extent that researchers purposefully engage in introspection to help derive insight into cause and consequence, lack of a common language will exacerbate these problems”. They assert, “Language is of fundamental importance when social scientists from one country attempt to study those in another” (Axinn and Pearce, 2006:189). The researcher prepared the questionnaire survey in English, and for Baghdadi citizens, in the main language of Arabic. Therefore, a translated version from English into Arabic was given to the interviewees. Then, we have translated all participant answers to the English language once again (See Appendix 3).

7.4 Case Study Methods (the Area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa)

Case study methods as confirmed by Shaban, (2009) are "used to probe deeply and intensively to gain insight and understandings of phenomena that are new, not-understood, or unexamined". He asserts, "Case study methods allow researchers to understand the how and why of contemporary events, problems and situations in ways that do not require control over those events or problems". He adds, "Case study methods require the researcher to understand the case in context where information about the case and its context is collected over considerable time and following considerable engagement" (Shaban, 2009). Case study research as Wilson, (2016) indicates "is multi-faceted and can be undertaken by using a positivist or an interpretive stance, can take a deductive or an inductive approach, can use qualitative and quantitative methods, [and] can investigate one or multiple cases" (Wilson, 2016).

Khalifehei, (2014) emphasises, "The case study method allows a researcher to investigate the data within a specific context directly". He confirms, "In the majority of cases, a case study method selects a small geographical area or a very limited number of individuals as the subjects of study". He adds, "Case studies, in their true essence, explore and examine real contemporary phenomena through detailed contextual analysis of a restricted number of events or conditions, and their relationships". He also said "Case study research brings us an understanding of a complex issue or object and can expand experience or add strength to what is already known through previous research" (Khalifehei, 2014).

Rashed, (2013) indicates, "Case study research is an approach in which the researcher explores either single or multiple cases through a detailed investigation, often with data collection over a period, to discover one or more events, programmers, activities, or processes". He said, "A case study is often determined by time and place and assists the researcher to use multiple sources such as in-depth data and a variety of research methods (interviews, observations, reports, and documents from official meeting or informal interviews), as part of the investigation". He adds, "Besides, questionnaires can be used within the case study to provide information on a particular issue of interest, dealing with a

physical, social, historical, or economic setting. An advantage of the case study approach is that it delves into deep levels of detail to examine a given situation" (Rashed, 2013).

Scholz and Tietje mention, (2002) "The case study approach presented is an empirical inquiry that investigates a contemporary problem within its real-life context. Understanding the problem and its solution requires integrating a myriad of mutually dependent variables or pieces of evidence that are likely to be gathered at least partially by personal observation". They say," The case study researcher often feels intrinsically motivated to investigate a certain case for nonscientific reasons. This may hold true for a new type of educational or public health program or a specific project in urban development" (Scholz and Tietje, 2002).

7.5 Case Study Chosen

Wilson (2016) asserts that the case study is not a methodological option but rather an option of what is to be examined, he mentions that whatever approach we utilised we select to explore the case study (Wilson, 2016). Rashed (2013) emphasises, "In case study research, the researcher first identifies the case and the bounded system and asserts that it is suitable for research regarding providing an in-depth understanding of the cases or a comparison of several cases. Moreover, if a collective case study approach is adopted, cases with different perspectives within the problem process should be selected. Case studies could either be a single instrumental case study, collective or multiple case studies, or an intrinsic case study. The latter focuses on a unique or unusual case. The researcher describes the unique case in ways that differentiate it from the others, based on a collection of features or the sequence of events" (Rashed, 2013).

This research investigates the historic centre of Old Rusafa as a pragmatic case study area, which might produce a comprehensive understanding of the particular needs for smart sustainable urban development in one of the significant historic area. The old core of Baghdad is a unique traditional area going back a thousand years and the historical components that survive to this day consist of essential buildings, spines and monument of clusters that show the traditional urban sense of the city. Old Rusafa has suffered from many serious problems for decades such as the rapid urban of changes and has affected the

traditional urban context, the gradual deterioration of the traditional urban and social fabric of the traditional spaces, the lack of conservation of the traditional buildings, and the poor infrastructure. These issues have affected the homogeneity of the traditional urban context in the historic core. Therefore, this research will seek to find a smart sustainable framework that might develop the physical urban environment and improve the quality of life for their stakeholders.

7.6 Outline and Scope of Research (Case Study Information: Old Rusafa)

Rusafa is the core of Baghdad and has a long history, which spans well over a thousand years, and has become a complex urban organism. The area of old Rusafa once enclosed within the old wall is approximately 5.4 square kilometres, has a population of about 203,000 (1980), and contains nearly 15,700 buildings (JCP 1984). Currently, Rusafa forms a contrasting mixture of dense irregular traditional fabric and modern gridiron developments often conflicting with each other in form, scale, and function (Al-Hasani, 2012).

Old Rusafa, located on the eastern bank of the Tigris River, is an integral part of the central business district and is the largest of all historic areas (Karkh, Adhamiya, and Kadhimiya) in the city (Figure 7.3). The importance of Rusafa is of not only local but also of regional and national dimensions (Al-Akkam, 2012). It contains the biggest concentrations of traditional suqs and workshops and some of the most significant mosques and government and administrative buildings in Iraq. Below the main reasons for choosing this area as a case study are outlined:

a. The area of old Rusafa represents the main core and the oldest part of Baghdad.
b. Old Rusafa contains several significant historic buildings: 132 monuments are listed, twenty-one monuments of which belong to the Abbasid Empire (762–1258) and the rest to Ottoman Period (1638–1917). Therefore, it is considered as an important heritage that demands emergency protection for its historic identity (JCP, 1984).
c. The decline of the traditional urban fabric in most Iraqi cities and Arab world cities have brought into focus the extent to which sustainable design policies

can contribute to the management of change in historic areas; old Rusafa is a good example of this phenomenon.

d. The significant features in the historic part of Baghdad such as narrow alleys, natural shading, mix-use, human scale pattern, and a walkable and zero carbon environment provide an extraordinary base to implement sustainable standards.

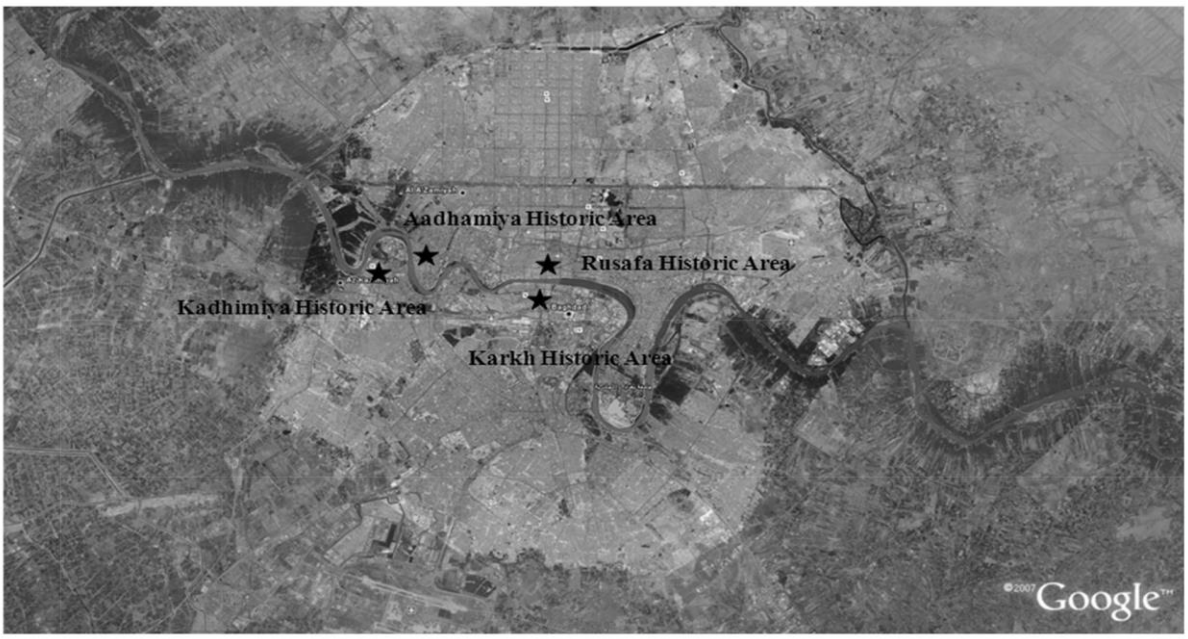


Figure 7.3: Existing Historic Areas in General Plan of Baghdad
Source: (Al-Akkam, 2012).

7.7 Existing Physical Condition of the Case Study

According to the JCP (1984) surveys, Rusafa accommodated more than 50% of the population and employment of the CBD (Central Business District) of Baghdad; it occupies 5.4 square kilometres, which is approximately 23% of CBD area. The majority of its buildings have two or fewer storeys, giving it a predominantly low horizontal skyline. The land use pattern of Rusafa is fairly mixed with residential use and road transport facilities at around 23% and 20% respectively. Commercial, business, and industrial uses represent other significant types. The residential areas are now squeezed onto the inner part of old Rusafa, between the service and industrial part of Sheik Omer Street and the predominantly commercial and business part of Rashid Street. Some reasons for the deterioration of the physical and environmental conditions of old Rusafa include high population densities, clearances for new roads, and neglect of the historic urban fabric. In 1984 more than 50% of all buildings in the case study were in a poor or very poor structural condition and further deterioration has occurred (Figure 7.4).

Figure 7.4: The Area of Old Rusafa, Building Structural Condition
Source: (JCP, 1984)

The complex development and transformation in the traditional urban fabric have created three separate and partly conflicting urban systems. The first one is because of the neglected historic urban fabric that suffers from insufficient infrastructure, social and amenities facilities, and it is inhabited by an overcrowded and poor population. This part, occupying decaying old suq structures and expanding into the former residential district included busy local markets and manufacturing facilities. The second part is the modern service centre, characterised by Western types and contains banks, shops, government building, cinemas, restaurants, hotels and constituted by individualistic blocks in Old Rusafa, in both functional and architectural terms. The third part represents the industrial part that causes enormous congestion, pollution and unacceptable encroachment on public space (Bianca, 2000:252,253).

Old Rusafa has lost 25% of its original historic fabric since World War I, by official demolition for new roads and clearance programmes alone. The area of Rusafa is characterised by commerce and business, hotels and restaurants with tourist and entertainment facilities, a civic centre, including the headquarters of the Baghdad municipality, supplies and technical services. Moreover, the land use of Rusafa includes many activities. The industry is represented by two types of activities. The Sheikh Omar zone is the first type, which is related to large-scale car maintenance, whereas the other type is traditional crafts. The old housing includes the textile, printing, and wood- and metal-working industries. The second activity is commerce and business, represented by Al-Rashid Street, which is considered as one of the highest concentrations of commercial and business activities. In addition, public and government offices were constructed between Port Said Street and Muthanna bin Harith Shaibani. Housing is another function, which is concentrated at the centre of Kulafa and Sadoun. Rusafa also contains areas of heritage value and possesses the distinctive culture of patrimony, historically and religiously concentrated in the heart of the city centre in the area between the Bridge of Bab Al-Mudtham to the north and Al-Jumhoria Bridge to the south. The heritage value represented by the traditional urban fabric contains a large number of old buildings and small houses. The significant mosques, monumental buildings and traditional markets plus private houses were located on the riverfront (Al-Akkam, 2013).

7.8 The Main Urban Components of the Case Study

JCP planners identified five main types of urban form in Old Rusafa. The first type was the traditional homogeneous places located mostly between Khulafa Street and Kifah Street. The second type was the traditional fabrics built between the two World Wars, including Rashid and Kifah Street. Modern period blocks were the third type starting in the bank's district of Khulafa Street in the 1950s, and finally, the Sheikh Omar area developed in the early 1940s consisting mostly of large, one-storey garages, stores and services workshops. JCP planners tried to achieve compatibility between these different urban forms in Old Rusafa, with conservation and urban design plans approached complementing each other. Therefore, to attain this aim, they suggest that the Municipality of Baghdad should apply development control in two stages: firstly, by passive control with guidelines and regulations to control private growth in conformity with plans, and secondly, by active control assisting or initiating comprehensive development projects to assist the implementation of the overall concept. Several focal places in the historic centre were selected by JCP planners to illustrate these approaches such as the riverfront, Rashid Street, historical spines, the suq system and the Sheikh Omar zone (JCP, 1984).

7.8.1 Tigris Riverfront

The River Tigris is the most significant natural feature in Baghdad throughout history, as the main source for irrigation, recreation and transportation. The morphology of Old Rusafa was influenced by the Tigris, and all-important functions were located on its bank or very close to it such as the Citadel, traditional suqs, mosques and monumental buildings. The riverfront is divided into separate areas of various architectural features (Al-Akkam, 2012). However, the riverfront nowadays is almost neglected and its character has been disturbed by numerous tall buildings which have been built near to some magnificent buildings such as Al-Mustansiriya School which was built in 1227.

7.8.2 Rashid Street and Squares

In the late of the 19th century, the Ottomans began to cut the first axis in the traditional urban areas and attempted to import Westernization into the urban evolution pattern (Al-

Hasani 2012). The opening of Rashid Street in 1908 (completed by the British in 1917) was the first change in the traditional urban fabric (Al-Silq, 2008). The traditional style buildings on Rashid Street had a consistent type, which gave the street a continuous character. However, its unique character is now threatened by numerous high-rise offices blocks, traffic jams, parking on street and by the neglect of its fabric (Al-Hasani, 2012). The street became the most significant feature and the centre of business in Baghdad city for decades. In Table 7.1, Al-Akkam, (2012) shows important surveys of land use criteria in the central area Central Business District (CBD), which comprises a wide strip of significant places of activity. He asserts that Old Rusafa has three levels: local, national and global (Al-Akkam, 2012).

7.8.3 Historical Spines

One of the most significant elements to develop the traditional urban fabric is the regeneration and enhancement of the five major pedestrian alleyways within Old Rusafa. These five spines have historically been the vital arteries of the organic form of the old area and helped create a sense of homogeneity and continuity between the different areas of the city (Sousa, 1952). They provide, more than any other urban feature, a vivid and coherent means of understanding the image of the complex form of Old Rusafa. Moreover, they offer the best walks by citizens and tourists to explore the richness of the old city and offer a great possibility for reconnecting the historic area that has been dismembered by the modern road. Five historical spines were identified according to JCP; they are (Figure 7.5):

1. Bab Al Wastani to the Citadel walkway 2000-meter long
2. Bab Al Wastani to the Suqs walkway 2200-meter long
3. Bab Al Talisim to the Sinak walkway 1600-meter long
4. Gailani to the Maidan walkway 2500-meter long
5. Maidan to the Mustansir walkway 1700-metre long

7.8.4 Suq Area

Suqs are an important component of the traditional urban life of Baghdad, and they are together with commercial functions a focus for social interaction. The main suqs of Old Rusafa are concentrated in the Bab Alagha area near Al Mustansiriya School and extend

northeast through the Shorja Suq which is part of the Central Business District (JCP 1984). Nowadays, the suq system is suffering from a rapid change in the mode of production, with a very poor condition due to the lack of maintenance and unregulated temporary structures. Moreover, the Shorja Suq has suffered from being cut by Kulafa Street and its heavy traffic stream (Al-Akkam, 2012).

7.8.5 Boundaries and Wall

The main wall of Old Rusafa was built in 1123 AD and in the late of the 19th century was demolished due to the expansion of the old city. In the 20th century, the main wall was replaced by a modern wide road. The main problem today is that there is no clear definition of the city centre, no effective relationships of the main city centre with secondary centres and there is a lack of a clear vision for future growth (Al-Akkam, 2012).

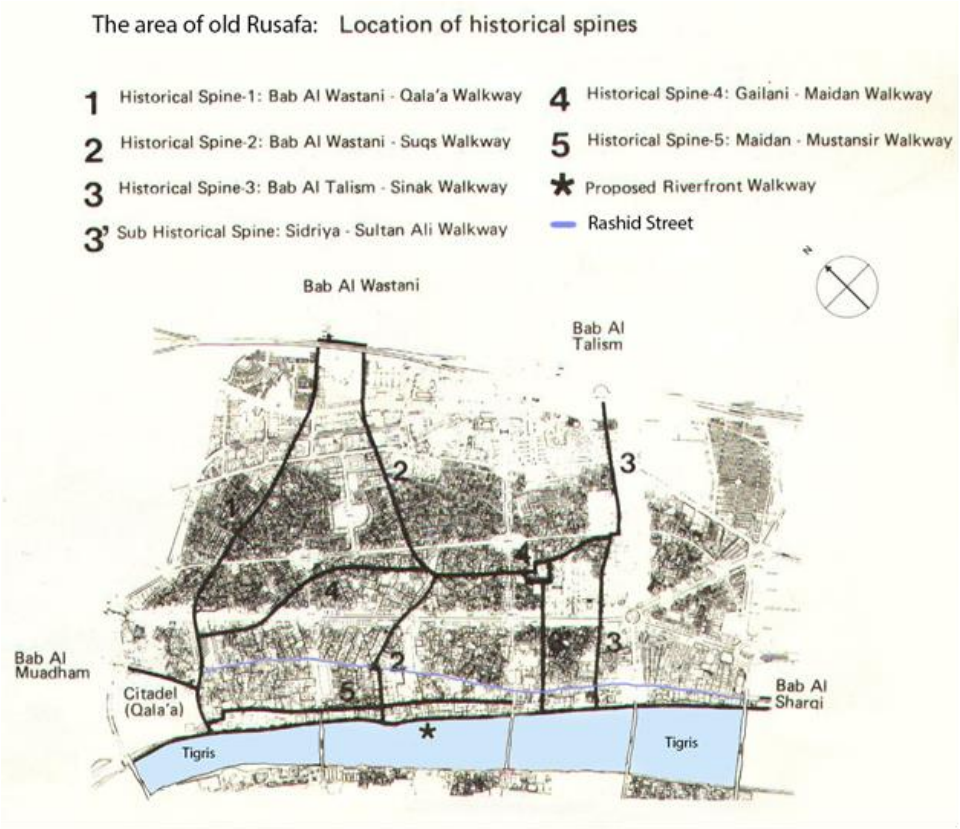


Figure 7.5: The Area of Old Rusafa: Location of Historical Spines
Source: (JCP, 1984).

Survey of land use for Baghdad C. B. D

Type of land use	Area per hectare / 1995	Area per hectare/ 2000
Administration	354.2	319.7
Commerce	266.8	408.7
Housing	634.2	519.9
Public facilities	133.9	291
Industry	83.9	57.3
Transportations	66.5	453.8
Public utilities	7.2	5.6
Open areas	109.5	128.6
Forests	14.9	41.4
Water planes	245.5	345.5
Military area	15.2	-
Temporary sites	3.1	-
Vacant area	82.1	467.1
Total	2016.4	3038.6

Land use criteria in central area C. B. D

Type of land use	Current criteria 1000 person/ hectare	Planned criteria by comprehensive development 1000 person/hectare	The difference 1000 person/hectare
Administration	1.2	1.1	-0.1
Commerce	0.9	1.5	0.6
Housing	2.1	1.9	-0.2
Public facilities	0.4	1.07	0.6
Industry	28	0.21	-0.07
Transportations	2.3	0.2	-0.3
Public utilities	0.024	0.02	-0.004
Open areas	0.37	0.6	0.23
Forests	0.05	0.15	0.1
Water planes	0.8	0.8	Zero

Output and planned Criteria (Intensity of use) - (Person/Hectare)

Type of Land Use	Existing Criteria 2000 Person/ Hectare	Criteria of Comprehensive Development Plan 2000 Person/ Hectare	Existing Criteria Person/ Hectare		Criteria of Comprehensive Development Plan 2000 Person/ Hectare	
			Karkh	Rusafa	Karkh	Rusafa
Administration	751	847	368	2460	409	3833
Commerce	997	662	1794	769	855	576
Housing	419	521	305	559	383	684
Public facilities	1987	931	3265	1576	604	1455
Industry	3172	4727	24753	2005	11527	3393
Transportation	400	498	259	625	366	654
Public utilities	36958	48375	354803	23139	1083600	29025
Open areas	2430	1483	2516	2376	1206	1751
Forest	17859	6543	8447	69418	10127	5294
Lacks/Water plan	1084	1103	717	1644	730	167

Table 7.1: Survey of Land Use for Baghdad
Source:(Al-Akkam, 2012).

7.9 The Problem of General Urban Design Policies

One of the main challenges in the case study of this research today is how to find a platform that could solve the battlefield between various architectural styles and ideologies. This conflict between, on the one hand, the modern development that shows no consideration for the traditional urban context and, on the other, the large stock of abandoned, decaying or misused traditional buildings has led to the confusion and chaos in the case study area. The main causes for the present shortage of consistency in the traditional urban fabric are (JCP, 1984):

- Urban growth that has shown little opportunity for continuity and organic expansion.
- Insufficiency of a comprehensive master plan that can adapt urban design methods related to the special feature of the historic core.
- The new architectural evolution projects that have been built in Old Rusafa have ignored and isolated the existing traditional urban fabric.
- The lack of clear conservation methods that have the ability to implement the renovation, preservation, rehabilitation and promotion the traditional buildings.
- The lack of clear policy and development schemes that would improve and give a positive motive to advance methods that would be applicable in other locations.
- The ongoing conflict and political instability situation in Iraq and particularly in Baghdad.

7.10 The Problem of Urban Form

The case study of this research comprises three main models of the urban form requiring various sorts of treatment methods:

The traditional urban fabric represents the first type, which despite being in worse form and with huge ruined districts remains a homogeneous feature based on the historical methods of urban life. These traditional areas show a variety of historical or more evolutionary typologies. Long strips of historic urban fabric have been left between Khulafa Street and north of Kifah Street. The zone of the south of Khulafa

Street has been dissected by new wide roads and combined with modern blocks. Hence, small parts have stayed intact, among which are Jadid Hassan Pasha, Haidar Khana, and Muraba'a. Maintaining the homogeneous structure of these places is one of the main problems to deal with; this can be done by implementing the full range of active conservation methods from the renovation of one building to typologically adapted infill with new structures in response to the dominant situation (JCP, 1984).

- The transitional urban fabric consisting mainly of collonaded rows of buildings along the street built between 1918 and 1940 is the second type of urban form. Rashid Street is the prototype of this streetscape, with a few secondary roads leading to the riverside. Kifah Street is another significant example with its connections with Rashid Street. Human scale and the fascinating environment that it creates for pedestrians is the extraordinary quality of this urban pattern. Furthermore, the unity of these road fronts has been disrupted by the deterioration of the original structures and the infill of modern buildings, which failed to respect the colonnade method or ignored the harmonious determination of the old streetscape (JCP, 1984).

- Modern blocks of varying height and shapes represent the third type of urban forms. This pattern has been started in Khulafa Street during 1950, then continued in the bank district south of Rashid Street during 1960, and followed up by the most recent Khulafa Street projects. Lack of urban integration is the main problem of most of these buildings. They are imagined as isolated "show projects", and do not relate to the older structures nor other buildings of their group. Thus, they have not set an urban form of their own, but, reproducing other places, they cause a great deal of architectural disruption (JCP, 1984).

There are different intermediate problem places to be found beside and between these three basic forms because of the conflict of two types of form such as the demolished buffer areas between modern development and the traditional urban fabric. Moreover, they are conditioned by a mixture of various sorts of buildings within the traditional zone, such as large parts of Mustansir Street, the section of the Shorja suq and the former residential

quarter nearby. The Sheikh Omar zone is on the border of the historic core, but still within the former city walls. This land is occupied by a few residential places, extensive workshops, factories, garages and premises, which have occupied the empty area. The space-consuming feature of these activities, which mostly are occupied only on the ground floor, has resulted in an accumulation of low sheds and compounds (JCP, 1984).

A clear mission emerges from this analysis; it is to establish functional and formal relationships between the different isolated parts of the urban structure in order to provide a new and complex coherence adapted to the changed situations. Another important issue is that the unity of the traditional urban fabric is lost, and it is very hard to reproduce or replicate it. In addition, we must seek to sophisticated planning scheme that may succeed in establishing compatibility between the existing parts of the urban system. This can be done by careful consideration the appropriate sort of connections and divisions, transitions and differentiation, and by complementing them with well-matched new parts. Ultimately, this can be the most favourable and most meaningful result of a large-scale rehabilitation scheme such as the Old Rusafa case study. To obtain these aims we must tackle smart sustainable solutions, conservation strategies and urban design policies, and most importantly to differentiate between two different zones of intervention in the case study (JCP, 1984):

- Traditional districts that are specified by a more or less homogeneous historical urban fabric, even if partially transformed during the transitional period. These places also contain a number of single modern building or blocks, which of course will remain, at least into the near future.

- Districts that are not improved in historical times like the Sheikh Omar zone, districts where the traditional urban fabric has already been demolished such as Khulafa Street, and furthermore, neighbourhoods that are suggested to be converted into future redevelopment places. These areas also include isolated monumental buildings that must be given environmental preservation.

It is also important to consider two main concerns in the development of the historic core:

- The first concern is the type and the number of conservation projects, like a renewal of the traditional buildings, preservation of environmentally essential parts of the urban fabric, infill of empty places with new buildings that have related

typology to re-establish the coherence of the traditional urban fabric, and the consolidation of vital functions such as modern social facilities.

- The second concern is the use of the modern principles and methods in the advancement of the historic centre, such as approaches to smart cities concepts, the use of ICT and IoT, norms of smart urbanism and urban sustainability approaches. It is, however, important to integrate these concepts with the principle of conservation that would safeguard the coherence of the modern advancement in itself.

These two main methods should, therefore, be integrated and not conflicted, and their main aim is to solve the conflict between the modern and the traditional norms and find a smart and suitable way to enhance the urban context of Old Rusafa. To implement this objective, a convenient means of advancement control on two levels should be established by the Municipality of Baghdad. In this context, development would be managed in two ways (JCP, 1984):

- Passive management could mean that an appropriate set of rules, guidelines and regulations is to be implemented by which private initiative is driven in such a way as to follow the overall method of advancement. Therefore, the Municipality of Baghdad might manage the current area of development by controlling the private building activity, without the participation of essential public funds.

- Active management could implement comprehensive urban advancement schemes partly or financed or supported by the Municipality of Baghdad, which could offer a significant step in accomplishing the overall method of advancement. As these plans are controlled and authorised by the Municipality itself, it could manage the project entirely. These sort of schemes might require solving complex issues in districts of strategies significance.

7.11 Selection of Main districts for Integrated Smart Sustainable Urbanism framework

Due to the time available and the limitation of this research, it has not been possible to propose a complete urban design solution for the whole of Old Rusafa, nor to address all chosen action places with the same degree of detail. However, it is fundamental to emphasize, support and represent the principles of the structuring scheme by advancing the

framework for the selected area, for two main purposes. The first one is due to the planning problems, which might not be solved without a convenient feedback from the urban design stage, which could assert the actual suitability of the abstract planning assumptions. Secondly, the Municipality of Baghdad might evaluate a more visual explanation of the implication of the general planning framework.

The following smart and sustainable urbanism framework for the selected area can be seen as an endeavour platform to translate the structure plan principles into dimensional form and to come to a step closer to the reality, which can be materialised only by actual accomplishment. However, it should be noted that the urban design schemes and the framework presented are at no more than a conceptual stage and that they might require more advanced and detail before they could be taken as design proposals in architectural terms. Different plans have been prepared by various groups like JCP 1984, which show a variety of methods corresponding to particular interests, background and personal style. These schemes might bring a great richness to our research, and it will benefit research framework when considering future more detailed plans in Old Rusafa. The selection of focal areas for the research framework and urban design scheme, and the degree of detail in their treatment was dependent on the desire of the Municipality of Baghdad and by the prerequisites of the total research project structure.

An adequate amount of three-dimensional data should be produced on the modern redevelopment places; the treatment also should have the ability to solve the problems in Old Rusafa. Because of the importance of the historic centre and its size, a framework and urban design scheme are preferable to a concentration on limited places, and this has dictated the more schematic method of this research. The area between Rashid Street and the Riverfront is an essential part of Old Rusafa that might pose both conservation and development problems. The basis of the proposals for the rehabilitation of main districts is detailed assessments of the existing architectural heritage and general design guidelines. This research will examine the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa. This area consists of a longitudinal strip extending approximately four kilometres between bab Al-Moatham and bab Al-Sharqi. I will divide this area into four zones (A, B. C, D) (figure 7.6).

Figure 7.6: The Area Between Rashid Street and the Riverfront in Old Rusafa
Source: Author (2017)

7.11.1 Historical Background of Al-Rashid Street

In the urban planning scene, Al-Rashid Street has not only been considered as the first modern street in Baghdad but also in Iraq. The traditional street is about 3,120 m long and about 12 m wide started by Khalil Pasha in 1915 and completed by the British around 1917, the street linked the two old gates of Old Rusafa and was characterised by its colonnaded paths and with its traditional two floor buildings, human scale, architectural unity and convenient shading paths for pedestrians. The traditional buildings and the variety of architectural styles on both side of Al-Rashid Street show the story of the development of the old city over the last one hundred years. Its building can be characterized by the workmanship and traditional materials, which have been quite remarkable assets to good design and detailing. The arcade of these traditional buildings along both of its sides provides a collonaded walkway approximately 3.5 m wide and 5 m high. Physically and morphologically, this street is divided into four main areas due to the construction of bridges from 1939 to the present that resulted in physically cutting Al-

Rashid Street into these parts. Nowadays, there are several high modern buildings, which penetrate the traditional street of Old Rusafa, and ignore the unique character of the road and confused the urban scene of the historic centre. This has been started since the 1950s because of a lack of efficient urban designs policies and urban development controls. Al-Rashid Street has represented the commercial and cultural centre of Baghdad for many decades and today it is a part of the CBD area of the capital city (JCP, 1984).

7.11.2 Historical Background of Tigris Riverfront

The Tigris River is one of the essential natural aspects that play a significant role in promoting the prosperity of Baghdad from the past decades until now. It has been considered as the main source of irrigation and developing the surrounding agricultural areas of the capital city of Iraq. Furthermore, it has become the space of entertainment and the element of connection with other cities. Three boat bridges crossed the Tigris River and connected between Old Rusafa and Al- Karkh during the late Abbasid period (1055-1258) when Old Rusafa expanded into its familiar rectangular form. JCP (1984) stated, “There are no specific written references to the form of riverfront in the Abbasid period, strong evidence including some archaeological finds suggests that Rusafa's riverfront was walled like the rest of the city. The only opening to it was the central gateway facing the bridge”. They also assert, “The riverfront was public property, and consequently people were not allowed to build directly on the riverfront with the exception, perhaps, of Caliphs and other important or rich notables. It was only after the destruction of the riverfront wall that houses began to appear directly on the Tigris, a trend that became persistent in the nineteenth century. Today, the Rusafa Riverfront retains a number of outstanding monuments, mosques, traditional suqs, khans and private houses out of key with their surroundings but it also suffers from the impact of modern buildings, from the decay of historic structures and total environmental neglect” (JCP, 1984). The Tigris Riverfront has displayed the possibility for conservation and rehabilitation of its historic buildings; it also can be an attractive part of Old Rusafa. Moreover, the Riverfront will have the opportunity to become an economically, culturally and socially crucial area of the historic centre.

7.12 Discussion and Conclusion

The area between Rashid Street and the Riverfront is a significant part of Old Rusafa that might pose both conservation and development problems. Therefore, this area was selected as a case study area, and mixed research method (quantitative and qualitative) was adopted for the evaluation of the physical urban context of the case study area and the amenability of this area to smart sustainable cities concept. An observation approach will be utilised to gather information for the qualitative research method. Furthermore, the qualitative research approach will utilise walking and serial vision as an observation method to collect the visual information for the area between Rashid Street and the Riverfront. Later this research will produce a sequence of photos according to the qualitative information that has been gathered during the walking through the case study area with an explanation for each picture. A structured interview and questionnaire survey will be utilised for the quantitative research method to gather information from a large number of stakeholders. Participants' opinions will be a significant part of the research methodology that aims to determine the conventional approach to advance the historic centre.

7.13 Chapter Summary

This chapter has examined the research method and the strategies that were embraced for gathering and analysing the information. The comprehensive mixed research method for this empirical thesis is a cross-sectional comparison conducted as an integration of qualitative and quantitative research methods. The first section of this chapter examines the importance of mixed research methods for looking at the case study and identifies the two approaches quantitative and qualitative method. Then this chapter determines the study area, which is the area the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa. It clarifies the processes of fieldwork and data collection methods such as the walking tool, observation approach, and serial vision. Moreover, this chapter shows the procedure of collecting interview data and the steps of the interview process. Finally, this section of the thesis has explained how this research investigates the historic centre of Old Rusafa as a pragmatic case study area, which might produce a comprehensive understanding of the particular needs for smart sustainable urban development in one of the significant historic areas.

CHAPTER 8: THE CASE STUDY AREA (OLD RUSAFA) ANALYSIS AND EXAMINATION

8 Introduction

Baghdad and especially the historic core Old Rusafa has its own determinants which could be local, national and international with various and significant processes and techniques of mapping, sampling, surveying and analysing that require more consideration in analysing the traditional centre. It is important that the analysis should be designed in a way that examines the determination of the work on the local context of Old Rusafa. These determinations contain the availability and type of the information that might be gained, the current and the available literature on Old Rusafa, the availability of techniques for fieldwork, time determination etc. It might also depend on the kind of organisational structure of urban design methods followed in Old Rusafa and Baghdad as well.

This chapter will illustrate the case study information and develop a comprehensive understanding of the existing physical condition. It will seek to bring to particular light aspects of the case study (the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa), which has been chosen as the case study area of this thesis. This part also will clarify the information gathering method and exemplify the analytical stage of the gathering data. It will utilize the methodological approaches and tools that analyse the fieldwork to answer and elaborate the research questions. Using various sources such as maps, photographs and legislative texts, this chapter endeavours to cover the research aim three and question one part A (page 3) along with thesis methods, which will be utilised to achieve and fill the research gap.

8.1 Field Survey Structure

The information below is the main data of this thesis. The technique of gathering information, the approaches adopted in the process, and the type of this information are the main aspects of the methodological approach. This will demand including an accurate plan for the method to gain the goal of this research. The field survey aims to assess the current situations of the social and urban contexts of traditional areas (the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa) to facilitate successful advance and improvement of the historic core. It will assess the four zones of the case study area (the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa will be divided to Zone A, Zone B, Zone C and Zone D) according to eight elements:

1. Historical background
2. Historic and Architectural Value
3. Historic and Traditional Buildings
4. Building Uses
5. Building Height
6. Structural Condition Assessment of Buildings
7. Observation Survey for Al-Rashid Street
8. Observation Survey for Tigris Riverfront

8.1.1 Historical Background

Historical background is one of the main element to assess the physical urban context of the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa. This section of the field survey examines the importance of each part of the case study and shows how each section contains traditional buildings, traditional paths, traditional baths, significant mosques, traditional Baghdadi houses and historical buildings, and it mentions who and when these buildings were built. Furthermore, it displays the name of these traditional areas and presents how each area was in the past.

8.1.2 Historic and Architectural Value

One of the significant elements in the examining of the case study area to achieve smart and sustainable indicators is historic and architectural value. Therefore, the case study buildings of each zone will be examined in this field investigation through seven categories; these categories are historic buildings, early traditional, art nouveau, art déco, modern buildings, empty spaces and unknown. The results of this section promote this thesis to find what is the best type of potential conservation projects which could be used to develop the case study area, such as renewal of traditional buildings, a preservation of the physical urban fabric. It also assists to find the possibility of using new methods in the advancement of the historic centre, such as the smart sustainable cities concept.

8.1.3 Historic and Traditional Buildings

The four zones of the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa will be examined by historical and traditional buildings category that denoting a particular use or date according to this field examination. It is essential to determine the location and number of the traditional and historic buildings in each zone of the case study area to assess the case study opportunities and constraints. The conflict between heritage and modern life in the traditional area has led to both pros and cons results. This study will utilise the historical and traditional buildings category to evaluate and assess the physical environment in the historic centre. The main strategies of urban conservation will determine by examining this category, and that will lead to clarifying appropriate strategies that might apply to Old Rusafa.

8.1.4 Building Uses

The traditional area is facing many problems, the tendency towards modernism, for example, one of an essential issue that has affected the physical, socio-economic, cultural situations in the historic area. Determining and analysing building uses will enable us to understand the complicated situation in the area between Al-Rashid Street and the Tigris Riverfront. On the other hand, it will reduce negative outcomes by creating new opportunities, promoting urban conservation processes and implementing the concept of

smart sustainable cities. The case study area include many traditional and modern suqs that represent an important part of the CBD of Baghdad. Therefore, the case study area will be investigated by nine main building use categories (mixed-use commercial and administrative, residential, mixed-use, parking, entertainment, not occupied, open spaces, industrial, religious) according to this field survey.

8.1.5 Buildings Height

The majority of the CBD area of Baghdad was in Old Rusafa. In addition, Al-Rashid Street is considered as one of the most significant commercial streets in Baghdad. Thus, we can see that there is diversity in buildings height in the area between Al-Rashid Street and the Tigris Riverfront starting from zero level up to thirty. Illustrating the skyline of the case study area is a significant issue in the planning procedure. Therefore, buildings height of the case study will be evaluated to understand what are principles should be utilised to achieve the requirements of the case study development.

8.1.6 Structural Condition Assessment of Buildings

The need for a smart sustainable framework strategy to develop the physical urban context of the case study area and to create a platform that might solve the conflict between traditional and modern design principles will require an assessment of the structural condition of historical and traditional buildings. This category will play an important role in the preservation of the case study identity. Therefore, eight categories (under construction, very good, good, acceptable, poor, deteriorated, ruins and empty spaces) were utilised to evaluate the case study area buildings.

8.1.7 Observation Survey for Al-Rashid Street

The Observation Survey for Al-Rashid Street will advance the field survey and knowledge to measure and assess the physical condition of the case study area. It will help this research to determine the smart sustainable dimensions that could preserve the identity of the case study area and form the framework for the future city. We can assess from

observation survey the conditions of the historical and traditional building that located on this traditional street. Moreover, it will show the differences of architectural styles in each zone of the case study area. We will examine the skyline of Al-Rashid Street by this survey.

8.1.8 Observation Survey for Tigris Riverfront

Observation survey for Tigris Riverfront is an important method to evaluate the physical urban situation in this part of the case study area. It will present potentialities of advancing the urban heritage context of Tigris Riverfront and preserve its identity. It also will assess the skyline of the Tigris Riverfront, historical and traditional buildings conservation and pedestrian movement along the riverfront.

8.2 Field Survey for Al-Rashid Street Zone A (Haidar Khana Area and Hassan Pasha Area)

In the Zone A, we will exclude the location of the Iraqi ministry of defence (which was the location of the old citadel) from our field survey due to the security reasons and the complex political situation in Iraq.

8.2.1 Historical background of Haidar Khana Area

Haidar Khana was an old district going back to the Abbasid period, and it was called Al-Thalatha Souk. This area has many paths, and each of these paths has a name such as Bakers' path, Dinar path (later was called Al Mamoun Street) and Zaka path (later was called Mutanabi Street). Furthermore, this area contains several significant mosques like Haidar Khana mosque, which was built by Dawood Pasha in the 1827 AD and was considered the most outstanding monument in the Ottoman era. Another essential mosque was the Mosque of the Wali of Baghdad Hussein Pasha, which was built in the 1693 AD. Haidar Khana area also has significant houses like the house of Wali of Baghdad Ahmed Pasha Bazarkan which was built in 1690 AD. This house was turned into a school after the end of the First World War.

8.2.2 Historical background of Hassan Pasha Area

Hassan Pasha area was considered as part of Al-Thalatha Souk and then was known as Sultan Market Place related to the Sultan Tegrel Bek Seljuk in the 1063 AD. This area included many features such as Al-Wazir Mosque which was built by Hassan Pasha in the 1597 AD, Al-Sarai area, the Ottoman soldiers Mess, the shrine of Papa Korcor, Mutanabi Street and French Consulate. Hassan Pasha area included many palaces, gardens and cultural institutions in the time of the Abbasid period like Al-Muwaffaqia School, which was built by Muwaffaq Ibn Abed Allah in the 1141 AD.

8.2.3 Historic and Architectural Value in the Zone A (Architectural Types)

Historical and architectural value is one of the significant elements in the examining of the case study area to achieve smart and sustainable indicators. Therefore, the Zone A buildings have been examined in the case study field investigation according to their historical and architectural importance dividing them into seven categories (historic buildings, early traditional, art nouveau, art décor, modern buildings, empty spaces and unknown) (figure 8.1). The vast majority (45%) of five hundred and fifty buildings have no architectural style according to the outcomes of the field survey of the historical and architectural value in Zone A, whereas, historical buildings were recorded at 10% in this survey. From Figure 8.2, we can see that the traditional buildings accounted for 13% of all buildings in the case study area Zone A. The results also asserted (figure 8.2) that modern buildings in the Zone A were recorded at 11%. Art Nouveau (Art Nouveau is the building constructed by brick and steel I section going back to the late 1920s and early 1930s and are characterized by their organic lines that influenced by European style that began to reach Iraq at the time) was another essential element that has assessed by the field survey of the old centre of Baghdad, which was accounted 5% of all building in zone A. Furthermore, the Art Déco category (Art Déco is the building constructed of brick and steel I section with geometric decoration of the brick material and using the iron material in the quarry of the balconies. This type is characterised by straight lines and angles in their architectural elements of its elevations, and going back to 1930s and early 1940s) accounted 4% in this examination. The field survey also shows that empty spaces recorded 12% of buildings in the zone A of Al-Rashid Street.

Figure 8.1: Historic and Architectural Value in the Zone A (Architectural Types)
Source: Author (2017) According to The Municipality of Baghdad

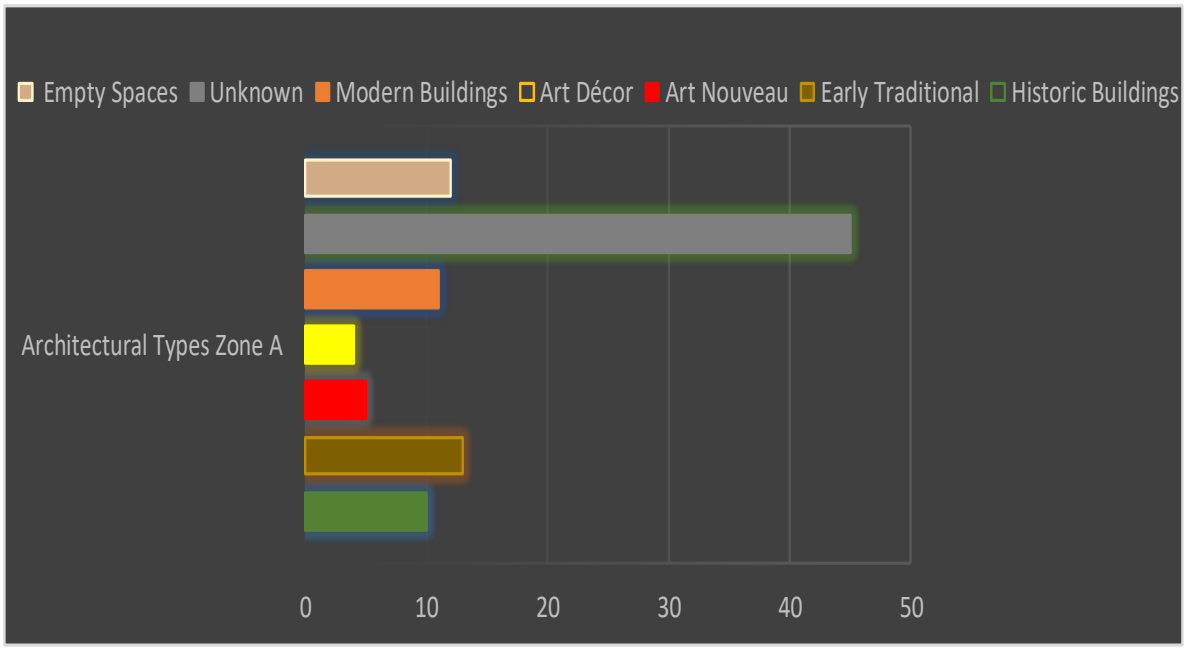


Figure 8.2: Historic and Architectural Value in the Zone A (Architectural Types)
Source: Author (2017)

8.2.4 Historic and Traditional Buildings in Zone A

This field examination of Old Rusafa Al-Rashid Street Zone A revealed that there were thirty-five buildings considered as traditional buildings within zone A, denoting a particular use (Khan Al-Mdallal and Al-Rasheedia School). Moreover, this part of Al-Rashid Street has included fourteen historical buildings, denoting a particular use (Saray building and its Qushla clock tower that was built in 1869, Al-Srajeen Suq that was built in 1802 and court zone) (figure 8.3). The Zone A contains several significant suqs such as Mutanabi Street that includes the book market and Saray suq for selling stationery. This part from Old Rusafa (zone A) has embraced many traditional mosques such as Ahmadiya mosque which was built by Ahmad Pasha in 1769, Numaniya mosque which was built in 1772 by Fatima Biktash al-Sayid Wali to memorialize her husband, Numan Agha lbrahim and Saray mosque that was built in 1704 by Hasan Pasha. The Zone A district as it was asserted by this survey contained some of the significant traditional buildings such as the Baghdad Museum that was built in 1910. Moreover, this part of the case study area includes traditional Baghdadi house like Kihami house which was built in 1920 and Salima Daud house that was built in 1900.

Figure 8.3: Historic and Traditional Buildings in Zone A
Source: Author (2017) According to The Municipality of Baghdad

8.2.5 Buildings Uses in Zone A

The concentration of various uses in Al-Rashid Street Zone A was very high, containing different activities such as commercial and administrative activities. Therefore, nine main buildings use categories, which have been investigated in the case study area of the survey of Zone A (Mixed-use commercial and administrative, residential, mixed-use, parking, entertainment, not occupied, open spaces, industrial, religious) (figure 8.4). Mixed-use commercial and administrative (55%) were the majority of buildings uses in the case study area Zone A according to the field survey of Al-Rashid Street in Old Rusafa (figure 8.5). Furthermore, the data from Figure 8.5 asserted that the other mixed-use category (commercial and residential or industrial) was recorded 25% of the building uses in the Zone A. However, it can be seen from the information in Figure 8.5 that the open spaces category was only recorded 5% in this field survey of the Zone A of all building uses. Similarly, industrial and entertainment categories accounted for a similar rate of 2% each of them. Moreover, from the data in Figure 8.5, it is clear that 4% of building uses in the Zone A of the traditional street were religious categories. Unoccupied buildings in the case study area Zone A have recorded 4% of all the buildings. It is obvious from Figure 8.11 that there are diverse buildings uses in Al-Rashid Street Zone A, which supports the significance of the need of finding new smart sustainable approaches to develop Old Rusafa.

Figure 8.4: Buildings uses in Zone A
Source: Author (2017) According to The Municipality of Baghdad

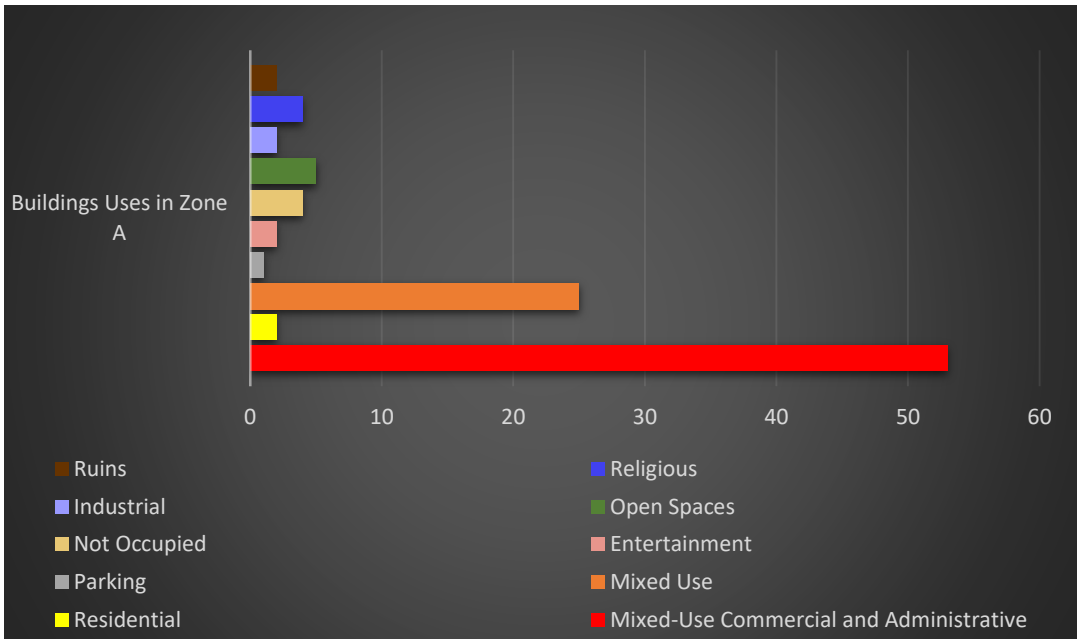


Figure 8.5: Buildings uses in Zone A
Source: Author (2017)

8.2.6 Buildings Height in Zone A

According to the survey of Zone A, we can see that the majority were mix-uses buildings as this area represents the main part of CBD area of Baghdad, therefore, we can observe that there is a variety in building height in the Zone A of Al-Rashid Street starting from zero storeys up to thirty (figure 8.6). The outcomes show that 47% of the buildings in the Zone A have two storeys, whereas, 1% of buildings in the Zone A were considered to have just four floors. It is clear that there is strong evidence from Figure 8.7, 23% of buildings in Zone A being single storey. Moreover, buildings that have three storeys accounted for 14% according to the field investigation of the historic core of Baghdad Zone A. This survey reveals that two storey buildings (buildings that have ground and first floor) have recorded 13% in the field investigation of Al-Rashid Street Zone A. It can also be seen from Figure 8.7 that buildings with four floors to thirty storeys in the zone A of the case study area accounted for 3% of its buildings. The skyline of Al-Rashid Street is a very fundamental issue to be clarified in the planning processes. Thus, building height of the case study is significant to understand what concepts should be utilised to fulfil the requirements of the case study development.

Figure 8.6: Buildings Height in Zone A
Source: Author (2017) According to The Municipality of Baghdad

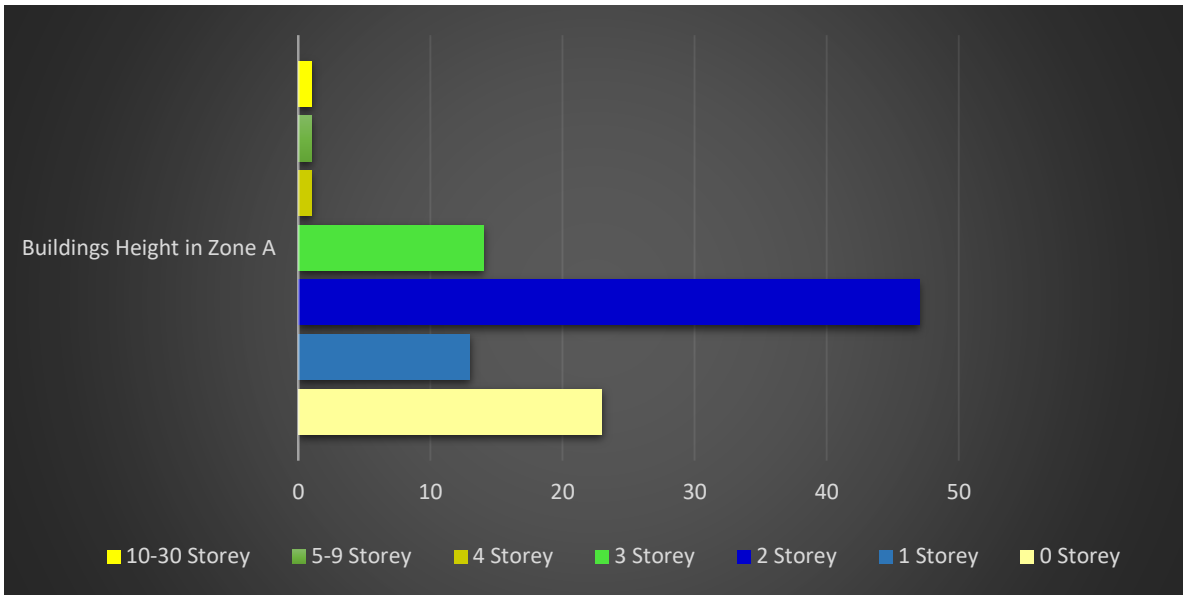


Figure 8.7: Buildings Height in Zone A
Source: Author (2017)

8.2.7 Structural Condition Assessment of Buildings in Zone A

The improvement of the physical urban context of Al-Rashid Street in Old Rusafa and the preservation of its identity will require an assessment of the structural condition of historical and traditional buildings in the case study area. Eight categories (under construction, very good, good, acceptable, poor, deteriorated, ruins and empty spaces) were used to evaluate Zone A buildings (figure 8.8). The results, as indicated in Figure 8.9, showing that 10% of all buildings in Zone A were in a very good structural condition. Furthermore, we can see from the result in Figure 8.9 that buildings in a good structural situation have accounted for 29% of zone A buildings. However, the data from Figure 8.9 emphasize that 17% of buildings in Al-Rashid Street Zone A were in a poor situation. In addition, Zone A buildings were in a deteriorating category, recorded at 23% of its buildings. Furthermore, this examination believes that buildings in an acceptable structural situation accounted for 20% and these buildings are in urgent need to be preserved. It can be seen from the field survey that there are no buildings under construction or in an excellent condition in this area. Furthermore, empty spaces accounted for just 1% of buildings in the Zone A.

Figure 8.8: Structural Condition Assessment of Buildings in Zone A
Source: Author (2017) According to The Municipality of Baghdad

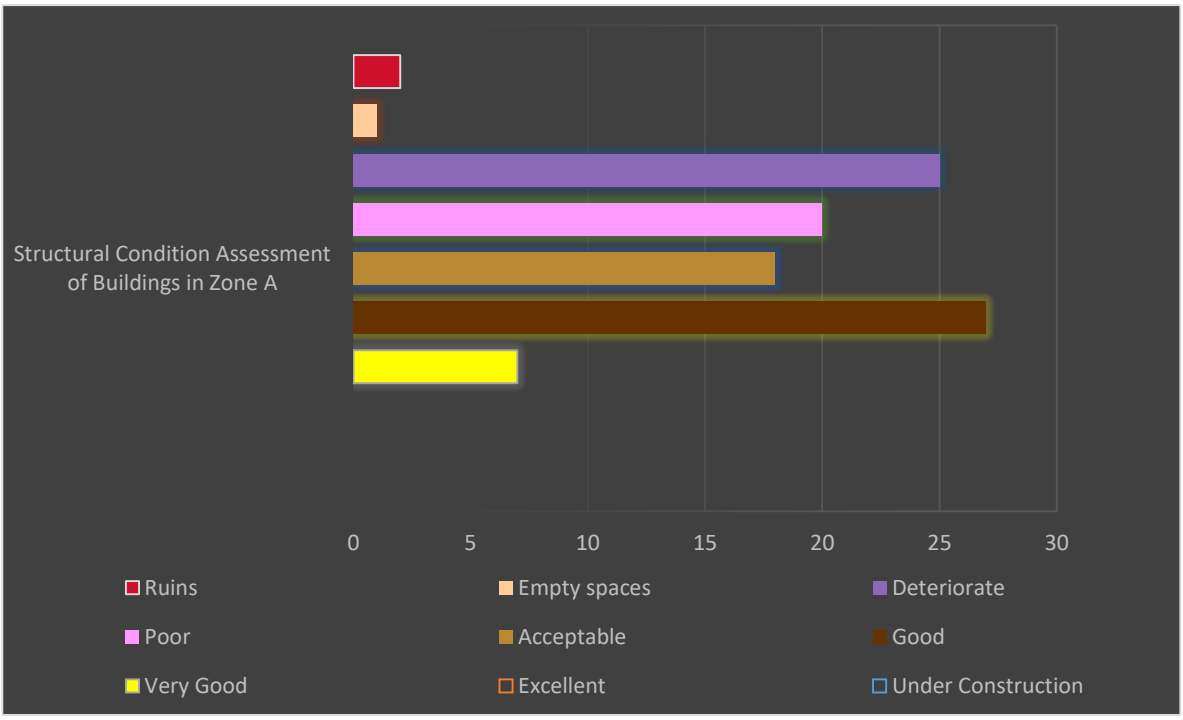


Figure 8.9: Structural Condition Assessment of Buildings in Zone A
Source: Author (2017)

8.2.8 Observation Survey for Al-Rashid Street Zone A

Figure 8.10: Observation Survey for Al-Rashid Street Zone A
Source: Author (2017)



1, 2, 3: walking from Al-Rasafi square toward Al-Rashid Street zone A, we can see that this part of our case study was missing clear cycle path, sitting areas and green areas and still people were walking on the road as a result of goods for sale on the pavement (figure 8.10).

4, 5, 6, 7: Zone A contains many significant historical and traditional buildings such as Haydar Khana mosque, which was built by Dawood Pasha in the 1827 AD. We can see also from photo number six in Figure 8.10 there is some work preservation to its dome, whereas, in photo number seven we can observe that the traditional building in Al-Rashid Street zone A still require urgent need to be conserved.

8, 9, 10: It is clear from photos above that there are different architectural styles in zone A, however, the majority were of unknown style. Furthermore, the majority of building height in this part are between two to three floors. The shaded arcade was still present in Al-Rashid Street on both sides of zone A.

11, 12: Walking toward the old citadel area, we can see Al-Maidan square and Al-Maidan bus station that represent an important part of one of the traditional hubs in Old Rusafa. Moreover, we can see also from photo twelve the Ministry of Municipality and Public Works building.



13, 14, 15: This part of the case study zone A contains many modern buildings and is the beginning of the location of the Iraqi Ministry of Defence, which was the location of the old citadel. It can be observed from photo number fifteen the concrete wall that surrounded this area and even prevents pedestrians from walking on the other side of Al-Rashid Street.



16, 17, 18: The end of zone A in the field survey was the location of Uzbeki mosque, which was built in 1681 by Abd al-Aziz Khan as a tomb of Quli Khan and rebuilt again in 1818 in the time of Daud Pasha, and Bab Al-Muadham square.

8.2.9 Observation Survey for Tigris Riverfront Zone A

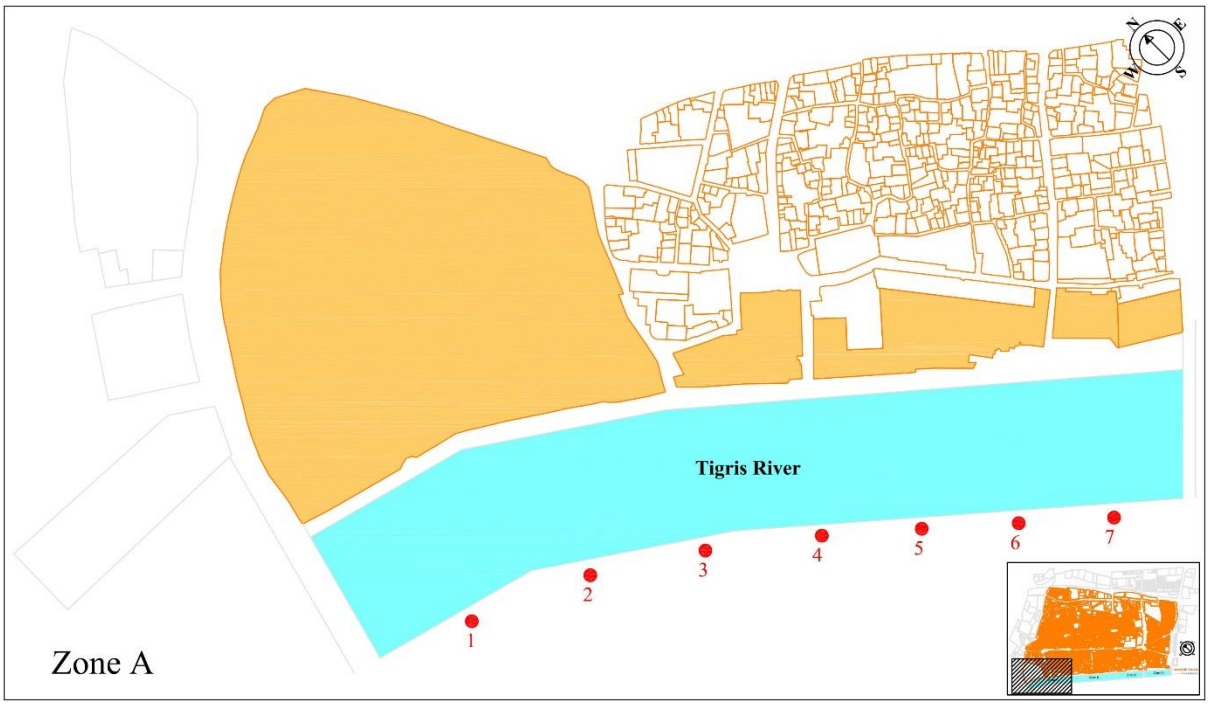


Figure 8.11: Observation Survey for Tigris Riverfront Zone A
Source: Author (2017)

1: The ministry of defence buildings is the beginning point of the Tigris Riverfront of Old Rusafa, which also represents the old citadel area. We can see from photo 1 in Figure 8.11 that there is a concrete wall as a way to protect these buildings from any outside attack. However, this wall has separated and blighted the riverfront, and nobody can walk near this area.

2: Continuing to walk along Karkh riverfront edge facing the case study area. The next building to the ministry of defence buildings is The Abbasid palace was built between 1180 and 1225. This traditional building showed poor conservation of its history and even was neglected. The relation between the Abbasid palace and Tigris Riverfront was poor and ignored by the governmental institutions that could develop this area for visitors and tourists.

3: The traditional school was another traditional building located On Tigris Riverfront of Old Rusafa. This building displays a good state of repair to its white elevations and structure. However, the site plot boundaries prevent pedestrian movement along the riverfront (figure 8.11).

4: A new building with traditional form was constructed in recent years. This land was empty ten years ago. The designer used yellow brick and arched windows style.

5: Continuing to walk along Tigris Riverfront we can see next to the new building there is a one-floor traditional building called the house of the governor connected to a mosque from its left side. This historic building requires intensive conservation work.

6: Qishla tower is a famous tower clock and is one of the important monument in Old Rusafa due to a large number of visitors each day. This monument is surrounded by traditional building and known as the 'Sarai Building'. The tower clock and Sarai building were built in 1869. Many artists, poets, journalists, reporters and singers came to this place on each Friday to meet and show their works and talents overlooking the river.

7: Cultural Baghdadi centre and Al-Wazir Mosque were two main traditional buildings at the end of the zone A. Al-Wazir Mosque was built by Hassan Pasha in 1600 and rebuilt again by the Awqaf in 1957 after being ruined by the severe floods of 1831. Next, we will move to zone B after the bridge.

8.3 Field Survey for Al-Rashid Street Zone B (Saba Abkar and Ras Al-Qarya)

8.3.1 Historical background of Saba Abkar Area

The Saba Abkar area is located on the shores of the Tigris and surrounded by other districts such as Ras Al-Qarya, Al Morabaa and Al-kader-Khana. It was called at the beginning of the 20th century Sharia Pachachi House. This area contain many landmarks like Numan Al- Pachachi Mosque which is located in the alley between Al-Nehr Street, Al-Rasheed Street and the house of the Russian consulate, which is today a set of stores, Mr. Al - Badawi 's hospice in the centre of Al - Rashid Street, the Baghdad Chamber of Commerce, Dar Al-Qassed occupied today by Hafiz al-Qadi building which is located in Al-Wathba Square and the National Cinema.

8.3.2 Historical background of Ras Al-Qarya Area

Ras Al-Qarya area is located on the shores of the Tigris and surrounded by other districts, for example, Bab Al-Agha, Dahana and Saba Abkar area. This area was an agricultural settlement that already existed in Baghdad and then an ancient place going back to the Abbasid period. It has been extended since the third century AD when it was surrounded by the palaces of the caliphs, princes and the houses of the state. The main palace in this area was the Palace of the Crown, which became the official seat of the Abbasid Caliphate in the last three centuries of its history, estimated to be located at the Firefighting building in the centre of Al Nahr Street. The alleys from this place to the surrounding areas are still in radial form and are one of its features. In that area also was the house of Prince Malik. In recent centuries, this area has witnessed the emergence of several commercial, religious and service buildings such as Khan al-Kandir, Khan Sayyid Kaseb, Khan al-Karaj, the Haidar Bath, which dates back to the tenth century of migration (16 AD) (1069 AH - 1658 AD) and Al-Kasqy Mosque which was built in 1658 AD.

8.3.3 Historic and Architectural Value in Zone B (Architectural Types Survey)

A total number of buildings (1433) in Zone B were examined by the case study field survey according to the importance of their historic and architectural value dividing them into seven categories groups (historic buildings, early traditional, art nouveau, art déco, modern buildings, empty spaces and unknown) (figure 8.12). The outcomes of historic and architectural value in Zone B show that the majority (70%) of buildings have no architectural, whereas historical and traditional buildings were recorded 2% for each of the two categories. The results also, as indicated in Figure 8.13, show that 10% of the buildings in Zone B were modern. Art nouveau was another significant aspect that has evaluated by the field survey of the historic centre of Baghdad, which was accounted 7% of all building in Zone B. Moreover, the Art Déco category accounted for 8% in this investigation. The field investigation also displays that empty spaces recorded 1% of buildings in the Zone B of Al-Rashid Street.

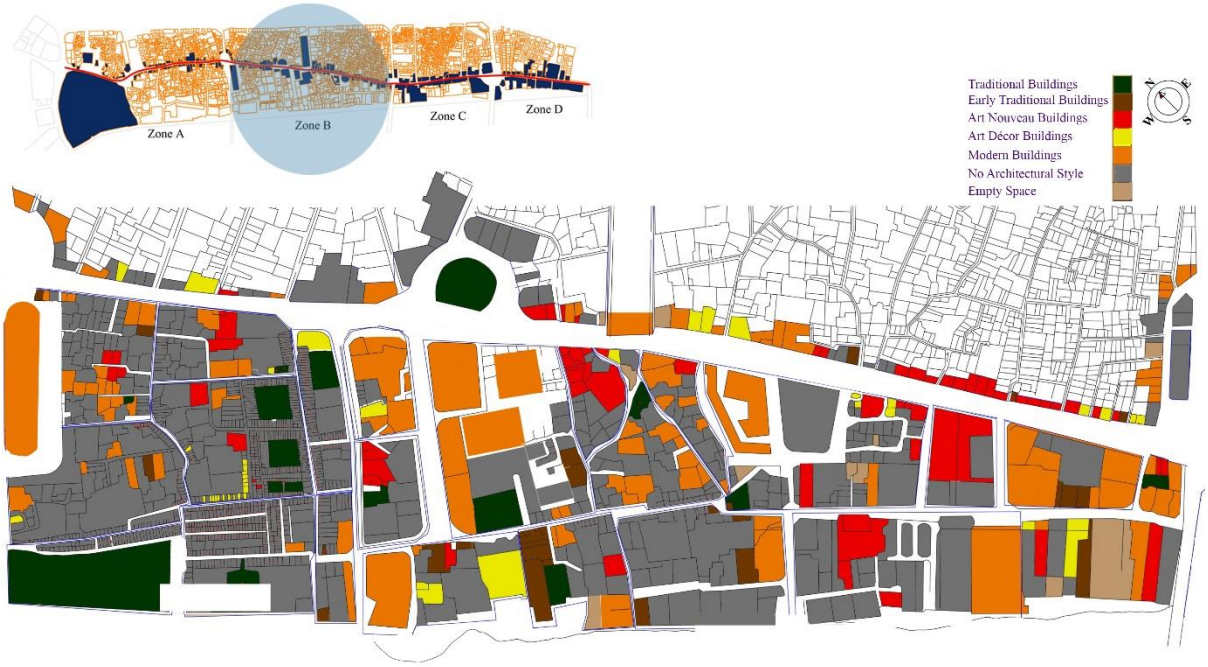


Figure 8.12: Historic and Architectural Value in the Zone B (Architectural Types)
Source: Author (2017) According to The Municipality of Baghdad

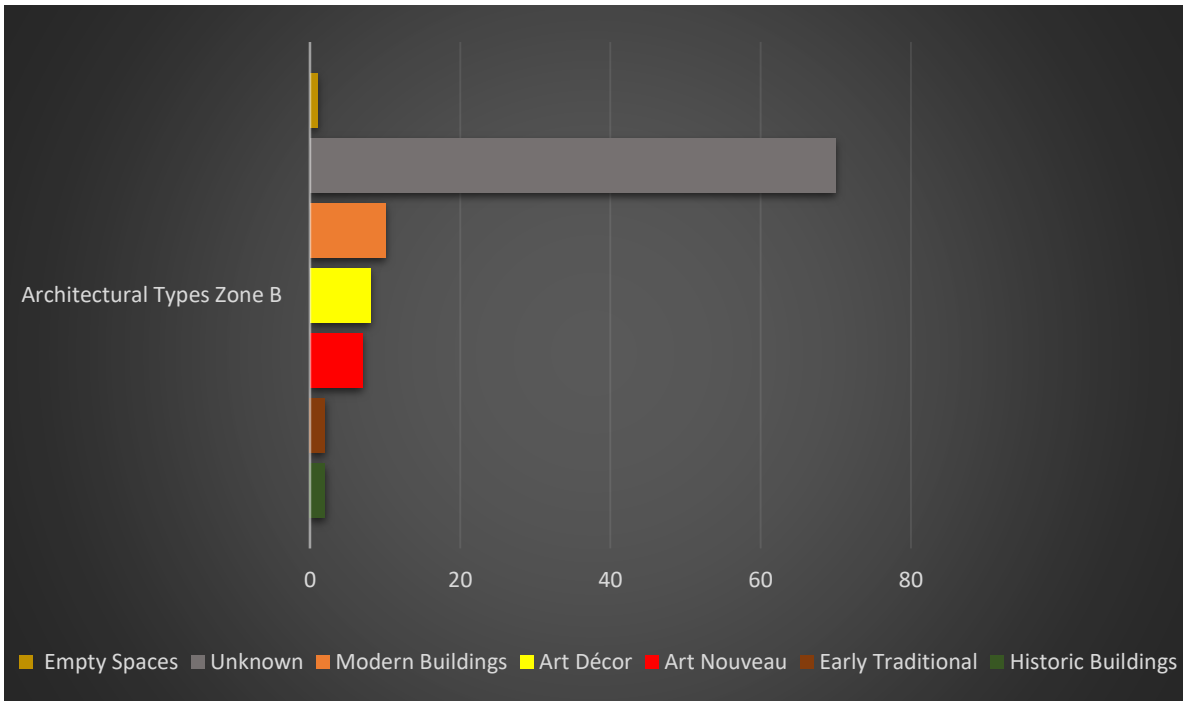


Figure 8.13: Historic and Architectural Value in the Zone B (Architectural Types)
Source: Author (2017)

8.3.4 Historic and Traditional Buildings in Zone B

The field investigation of Al-Rashid Street Zone B in Old Rusafa displayed that there were 44 buildings identified as historical and heritage buildings within zone B, denoting a particular use (Khan of Shah Bandar and Khan Yassin Khudairi) (figure 8.14). The Zone B thrived with many significant old mosques, traditional houses, historical buildings, traditional khans, traditional baths and contains some important suqs in Old Rusafa. The Zone B area as it was confirmed by this survey contained some of the significant historical buildings going back to the Abbasid period such as Al-Mustansirya School, which was built in 1227-1234 AD and has considered as one of the most remarkable Islamic buildings in Iraq. This part from Old Rusafa has embraced many traditional mosques such as Al Asifi tomb and mosque that was built by Daud Pasha in 1825, Qaplani mosque that was built in 1676, Khafafin mosque is minaret was built 1202, Ahmadi mosque that was built in 1800, and Wifaiya mosque that was built in 1650 and rebuilt in 1885. Moreover, this part of the case study area includes traditional suqs, for example, Al-Saffarin suq and Shoja suq in Bab Al-Agha area were built in 1800.

Figure 8.14: Historic and Traditional Buildings in Zone B
Source: Author (2017) According to The Municipality of Baghdad

8.3.5 Buildings Uses in Zone B

The Zone B of Al-Rashid Street in Old Rusafa include many traditional and modern suqs that represent an important part of CBD of Baghdad (figure 8.15). Mixed-use commercial and administrative, residential, mixed-use, parking, entertainment, not occupied, open spaces, industrial, religious were nine main buildings uses categories that have been examined in the case study area of the investigation of the Zone B. The majority of building uses in the case study area Zone B were mixed-use commercial and administrative (70%) according to the field survey of Al-Rashid Street in Old Rusafa (Figure 8.16). Moreover, the data from Figure 8.16 indicates that the other mixed-use category accounted for 2% of the building uses in the Zone B. It can be seen from the information in Figure 8.16 that the open spaces category was only recorded at 5% in this field survey of the Zone B of all buildings uses. Similarly, parking and residential categories were rated with a similar score of 2% for each of them. From the data in Figure 8.16, it is clear that 8% of buildings uses in the Zone B of the traditional street were religious categories. Buildings that were industrial uses in the case study area Zone B have accounted for 6% of all the buildings. It is obvious from the Figure 8.16 that there are different building uses in Al-Rashid Street Zone B that emphasized the significance of the need of finding new smart sustainable methods to advance the case study area.

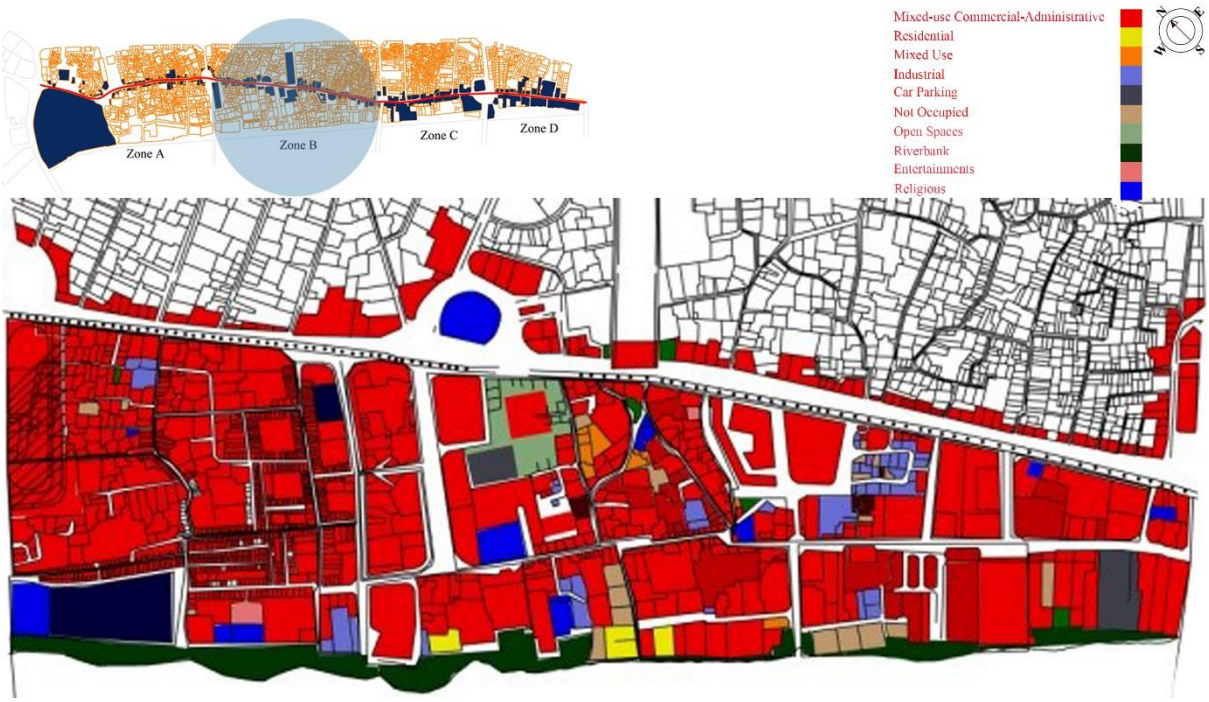


Figure 8.15: Buildings uses in Zone B
Source: Author (2017) According to The Municipality of Baghdad

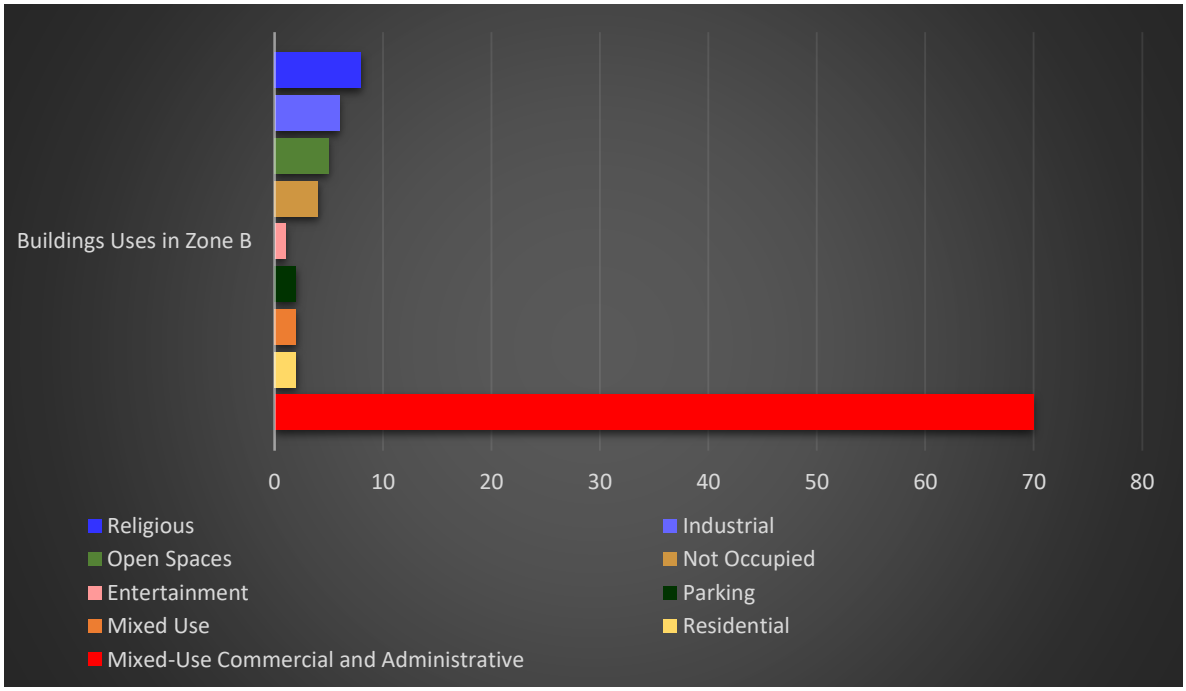


Figure 8.16: Buildings uses in Zone B
Source: Author (2017)

8.3.6 Buildings Height in Zone B

The majority of the CBD area of Baghdad was in Old Rusafa. Thus, we can see that there is diversity in buildings height in the Zone B of Al-Rashid Street starting from zero level up to thirty (figure 8.17). It is clear that there is strong evidence from Figure 8.18, 42% of buildings (1433) in the Zone B have two storeys, whereas, 1% of buildings in the Zone B were considered to have just ground floors. The field investigation of the historic core of Baghdad reveals that the one floor or buildings with just ground and first floors were recorded 35% of the whole buildings in the zone B. It can also be seen from the Figure 8.18 that buildings with three floors in the Zone B of Al-Rashid Street accounted for 15% of its buildings. Moreover, buildings in Zone B that have five to nine storeys have recorded 3% of buildings according to the field survey. The outcome of our investigation also shows that 1% of the buildings have ten to thirty storeys. Clarifying the skyline of Old Rusafa is a very fundamental issue in the planning procedure. Therefore, building height of the case study is a very significant to be evaluated to realise what are principles should be used to fulfil the requirements of the case study development.

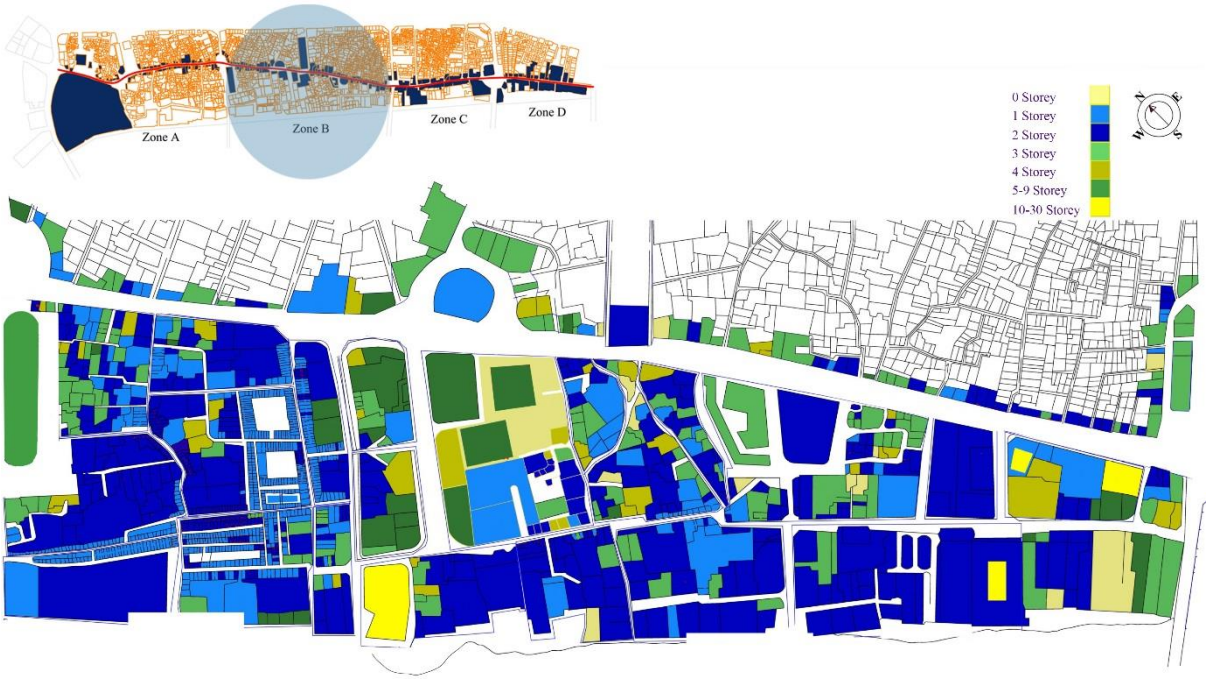


Figure 8.17: Buildings Height in Zone B
Source: Author (2017) According to The Municipality of Baghdad

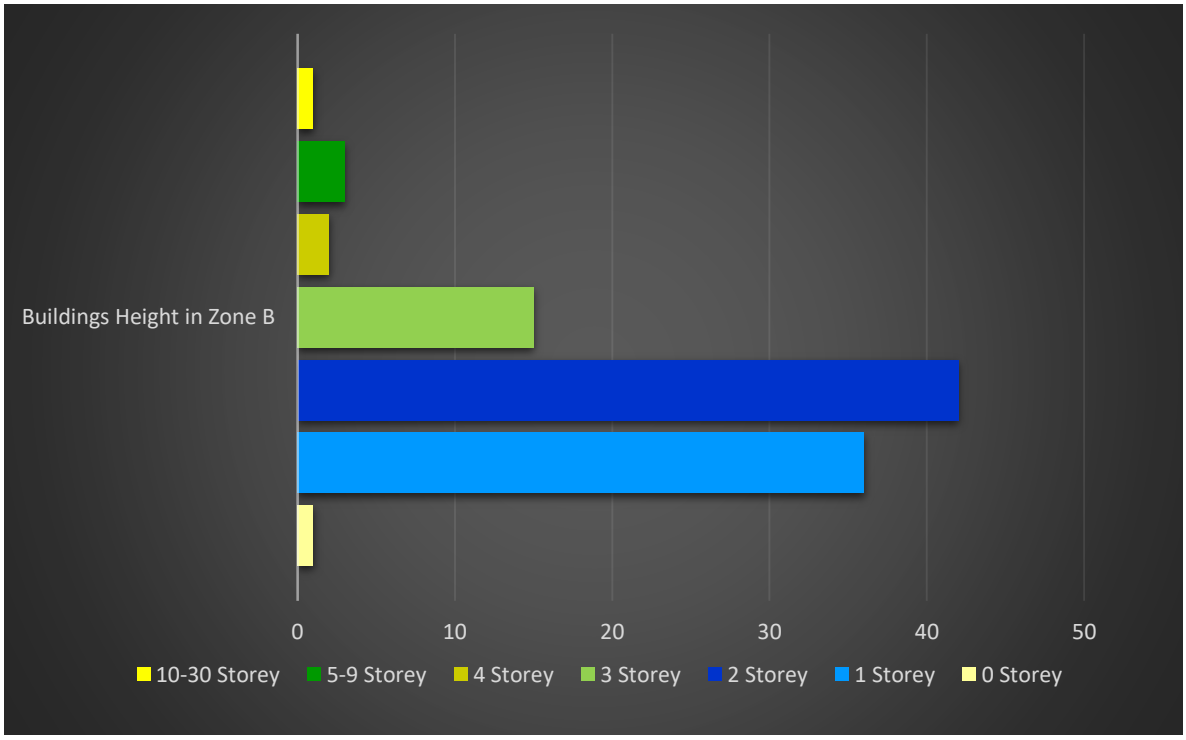


Figure 8.18: Buildings Height in Zone B
Source: Author (2017)

8.3.7 Structural Condition Assessment of Buildings in Zone B

The assessment of the structural condition of historical and traditional buildings in Zone B is very important to improve the physical urban context of Al-Rashid Street in Old Rusafa and promote the identity of the case study area. The evaluation of the case study Zone B was done by utilising eight categories: under construction, very good, good, acceptable, poor, deteriorated, ruins and empty spaces (figure 8.19). According to the field survey of the assessment of structural condition in the Zone B, we can see that very good structural condition has accounted 7% of all buildings in Zone B. However, the information from Figure 8.20 asserts that 45% of buildings in Al-Rashid Street zone B were in poor situation. In addition, we can see from the result in Figure 8.20 that the deteriorating buildings were recorded with 5% of the case study area. Furthermore, this investigation confirms that buildings in an acceptable structural situation accounted for 20% and these buildings had an urgent need to be improved. The good structural condition of buildings in Zone B was recorded for 22% of all buildings. It can be seen from the field survey that there were no buildings under construction in this area. Furthermore, empty spaces accounted for 1% of buildings in the Zone B.

Figure 8.19: Structural Condition Assessment of Buildings in Zone B
Source: Author (2017) According to The Municipality of Baghdad

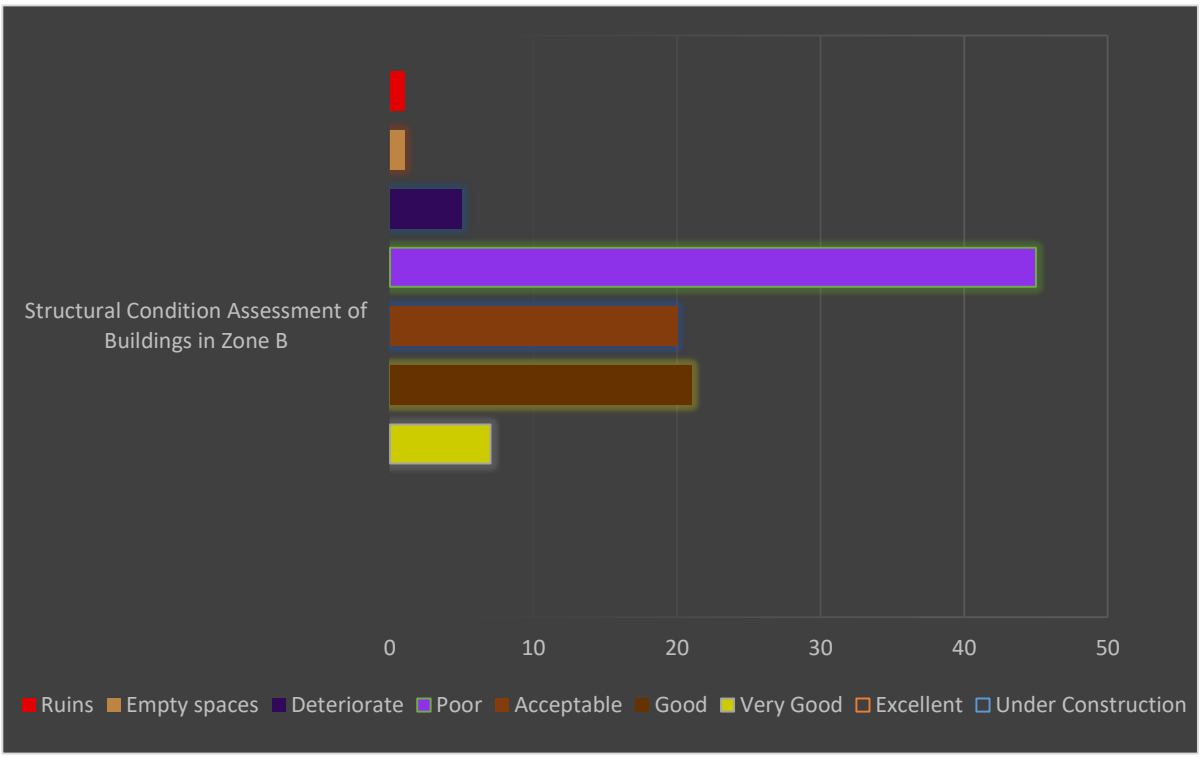


Figure 8.20: Structural Condition Assessment of Buildings in Zone B
Source: Author (2017)

8.3.8 Observation Survey for Al-Rashid Street Zone B

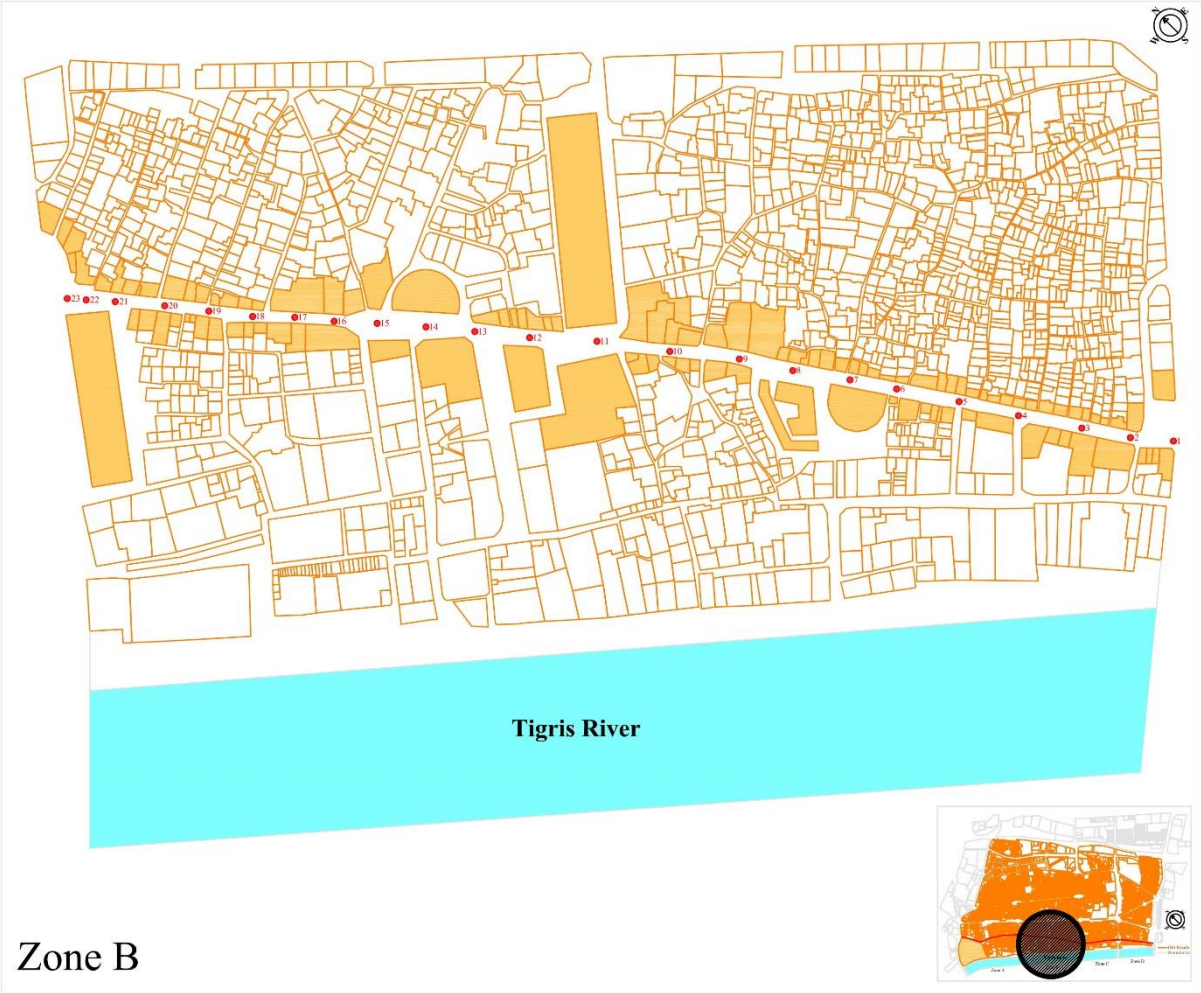
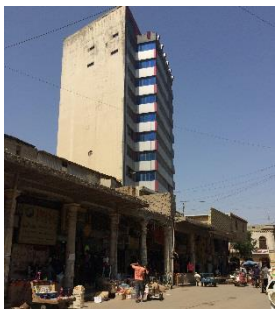


Figure 8.21: Observation Survey for Al-Rashid Street Zone B
Source: Author (2017)



1, 2, 3: Starting to walk from Hafez Al-Qadhi square toward Zone B in Al-Rashid Street, we can see there is a police station that checks each car enters Zone B. Car movement in this part of our case study has become one way after 2003.


4, 5, 6: Continue to walk in the zone B, it is clear from photos above there are different architectural style. From photo number five in Figure 8.21, we can see there is one floor traditional building and next to it there is high modern building which confuses the skyline of Al-Rashid Street, whereas, in photo number six we can find the homogeneity of human scale, building height and buildings architecture style, even if these traditional buildings require urgent preservation to its identity.


7, 8: Lorries that carry goods were banned from entering Al-Rashid Street until midnight, therefore, merchants are hiring workers with their trolleys to transfer their goods from the boundaries of Old Rusafa to their shops. Thus, we can see from photos seven and eight these workers pushing goods in the middle of Al-Rashid Street and causing some traffic congestion.

10, 11: Continue to walk through Al-Rashid Street; we can see from photo number ten in Figure 8.21 that there is an open green area with a statue in the middle. From the two above photos, we can also see that people are walking in the middle of the road; this is because of merchants' goods that obstruct people from walking in the shaded path walk.

12, 13, 14: It can be observed from above photos that there is no clear walking path and cycle path. Moreover, we can see that the infrastructure of the traditional street was in a poor condition.

15, 16, 17: This part of the case study is significant due to including many significant historical and traditional buildings, further, contain several governmental buildings like the central bank of Iraq which surrounded by concrete wall to protect the bank from a car bomb and armed robbery. We can also be observed Morjan mosque in photo number seventeen, which considered as a landmark in the traditional street of Old Rusafa.



18, 19, 20: Continuing to walk toward zone A, we noticed that Al-Rashid Street zone B is the busiest part of our case study, because of the concentration of the significant traditional suqs like Shorja suq that plays an important role in promoting the economic aspect of Baghdad. It is obvious from photos nineteen and twenty in Figure 8.21 that this part of the traditional road was very busy and there were a huge number of pedestrians, which give this research a clear view about the possibility of transferring Al-Rashid Street to be just for pedestrians.



21, 22, 23: Reaching the end of Al-Rashid Street Zone B, we can see that there was no control for these small traders in the traditional road and they were disturbed the urban scene of Old Rusafa. They even disturbed the traffic in this important square known as Al-Rusafi Square.

8.3.9 Observation Survey for Tigris Riverfront Zone B

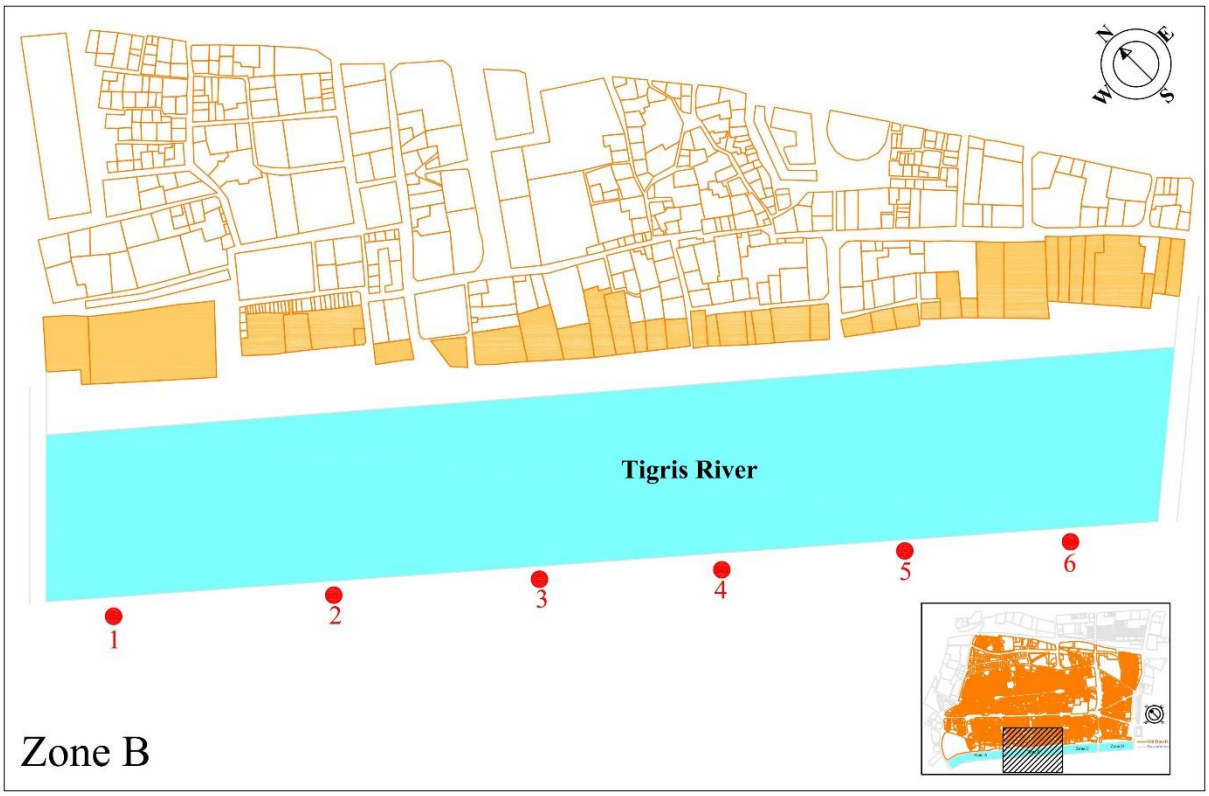


Figure 8.22: Observation Survey for Tigris Riverfront Zone B
Source: Author (2017)

Figure 8.23: Observation Survey for Tigris Riverfront Zone B
Source: Author (2017) according to Municipality of Baghdad

1: Asifi tomb and mosque was the first building of the Tigris Riverfront of the zone B survey. This building was built by Daud Pasha in 1825 on the site belong to Al-Mustansiriya School. Asifi mosque was originally a traditional building called Dar al-Quran. Next to the Asifi mosque the fabulous historical building Al-Mustansiriya School, which was built by Caliph Mustansir, its construction started from 1227 to 1234. This historical school represents one of the most significant Islamic buildings in Baghdad.

2: Khafafin Mosque was another historical monument in Old Rusafa, its name came from its location in Khafafin Suq (Sandal-Makers). Zumarrad Khatun, mother of Caliph Nasir built this magnificent traditional building in 1202.

3: In the zone B, we can see from photo three in Figure 8.22 and Figure 8.23 that there is an empty area between the edge of the Tigris and the plot area of zone B buildings, which was used as a parking area. Next to Khafafin Mosque, there were many traditional buildings like Znad Café (Qahwa is synonymous with cafés) that was built in 1920 and considered as a fundamental element in the urban life of Baghdadi community at that time. Next to these traditional buildings, we can see modern high buildings have penetrated the urban heritage context of this area.

4: Continuing to walk along the Tigris Riverfront we can see from photo four in Figure 8.22 and Figure 8.23, there is a traditional mosque on the left of the high building call Ihsai mosque or Takya Khalidya that was built around 1660 and was also restored by Muhammad Najib Pasha in 1846, and in 1940 by the Awqaf.

5: Continuing walking, we can see there were various types of two-floor traditional buildings and three to four modern buildings. We can see also a walled concrete surrounding a big area in the Zone B that indicate that some of these buildings were related to government.

6: We can see at the end of the Zone B that we can see from photo six in Figure 8.22 and Figure 8.23, there were new buildings, which replaced many important traditional Baghdadi houses like Mahmud House was built in 1890 and Sasson house, which was built in 1900.

8.4 Field Survey for Al-Rashid Street Zone C (Al Morabaa Area)

8.4.1 Historical background of Al Morabaa Area

Zone C includes part of the Sinak area, Al Morabaa area and Sayed Sultan Ali. Al Morabaa area is surrounded by other areas such as Saba Abkar, Haj Fathi, Sultan Ali and Sinak area, Al Morabaa was considered as the oldest part going back to the Abbasid period. This area includes some important school which was built by Ibn al-Derini in 1146 AD. In the past, this land contains many orchards like Al-Armosh orchard in 1735AD. These orchards were watered by a water wheel located near the mosque of Sultan Ali. Another important part of Zone C is Sayed Sultan Ali area 1125 AD going back to the Abbasid period. This area also includes some of important mosques, buildings and houses such as the Mosque of Sayid Sultan Ali and the school that was built by Mujahid al-Din al-Dweidar. This part of Zone C has expanded to include several other areas, like the Seven Abkar. In 1923, the Municipality of Baghdad considered this area as part of Al Morabaa area.

8.4.2 Historic and Architectural Value in Zone C (Architectural Types Survey)

The case study survey in the zone C was examined ninety-five buildings according to their historic and architectural value dividing them into seven category groups (figure 8.24). As is noticed from the comparison bar chart historic buildings, early traditional, art nouveau, art déco, modern buildings, empty spaces and unknown (figure 8.25). It was found that the modern buildings category represents 21% of our survey while historic buildings category record 1% of buildings in the zone C. Moreover, the traditional buildings account 13% of buildings in the zone C. Art nouveau and art décor were two aspects that this survey was evaluated, 18% of buildings were found art nouveau and only 5% as an art décor. The outcomes of this part as it is shown in Figure 8.25 were emphasized that 29% of buildings were had an unknown architectural style, in addition, empty spaces were also confirmed by this study, recorded at 13% of the whole built form in Zone C.

Figure 8.24: Historic and Architectural Value in the Zone C (Architectural Types)
Source: Author (2017) According to The Municipality of Baghdad

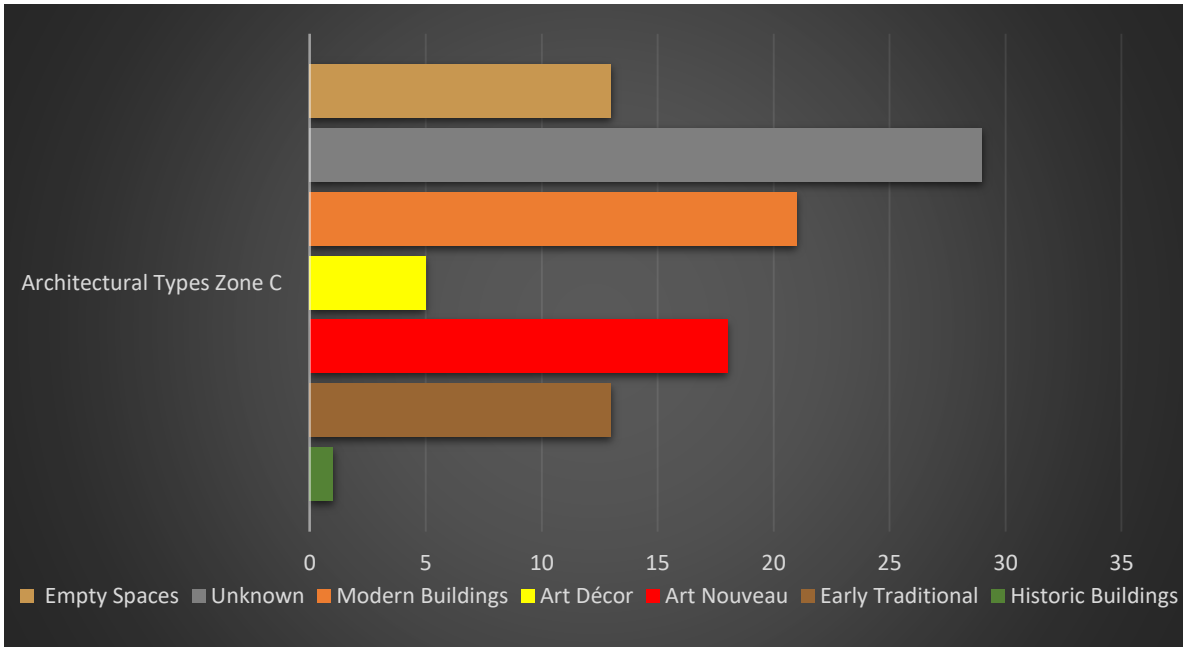


Figure 8.25: Historic and Architectural Value in the Zone C (Architectural Types)
Source: Author (2017)

8.4.3 Historic and Traditional Buildings in Zone C

The investigation displayed that there were 22 buildings identified as heritage buildings within Zone C, denoting a specific character like Al-Naqeeb House or denoting a particular use (Brazilian Café, Alaa Al-Deen Cinema, British Resident's House) (figure 8.26). This survey has considered previous studies (JCP Development of Old Rusafa 1984, Study of the Department of Antiquities and Heritage / the University of Baghdad in 1994, Study of the Municipality of Baghdad / Department of Antiquities and Heritage in 2004 and Study of the Municipality of Baghdad 2010).

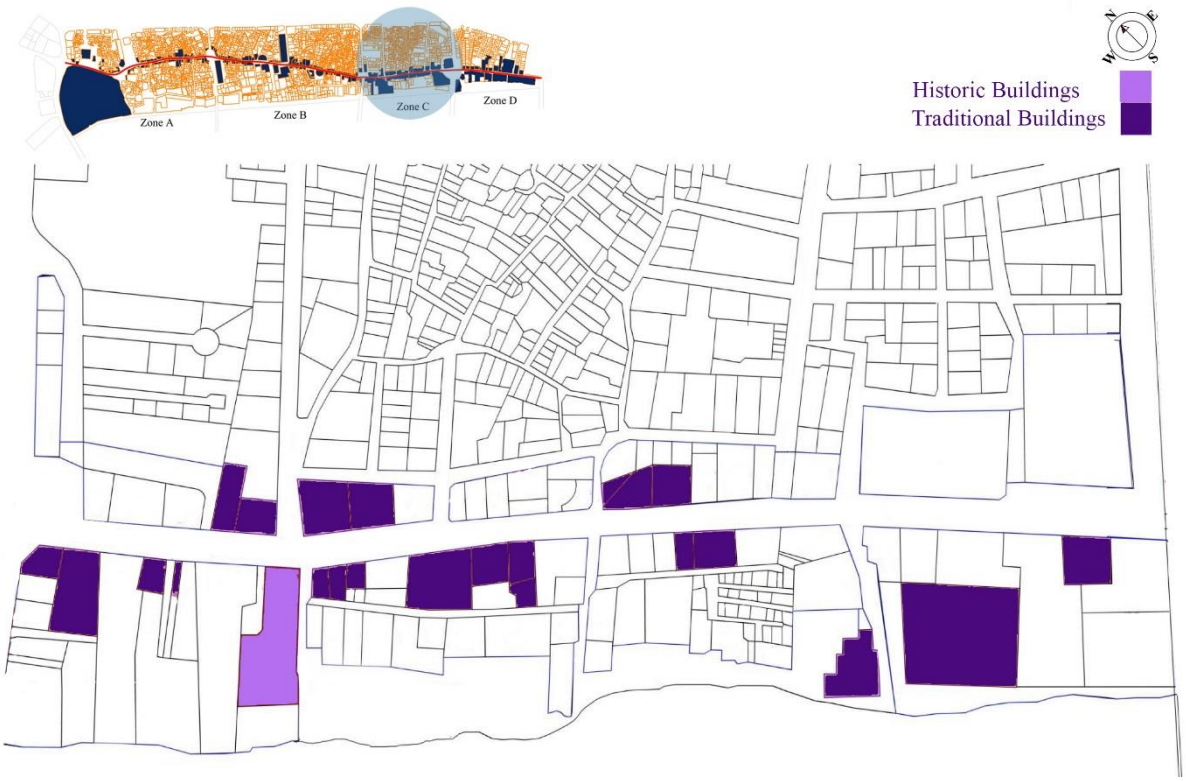


Figure 8.26: Historic and Traditional Buildings in Zone C
Source: Author (2017) According to The Municipality of Baghdad

8.4.4 Buildings Uses in Zone C

One of the important commercial street in Baghdad from 1917 until now is Al-Rashid Street, which considered as it refers to the glorious time of capital city of Iraq. We examined the case study area in this investigation of Zone C according to buildings uses with nine categories: commercial and administrative, residential, mixed-use, parking, entertainment, not occupied, open spaces, industrial, religious (figure 8.27). The field investigation of the case study area Zone C showed that the majority of building uses in this part were commercial and administrative uses, which recorded 48% (figure 8.28). Moreover, the second prevalent use in Zone C is mixed-use which accounted for 19% of the building uses in the Zone C. It can be seen from the information in Figure 8.28 that the not occupied category displayed the third highest number in this field survey of Zone C, accounting for 13% of all buildings uses. The data from Figure 8.28 indicates that parking and entertainment were recorded at 4% and 5% respectively according to the Zone C survey. Similarly, open spaces, industrial and religious categories were rated with a similar score of 2% for each of them. It is apparent from the figure below that there are diverse building uses in Al-Rashid Street Zone C that confirm the importance of the need of finding new principles to promote this area to cope with future city development.

Figure 8.27: Buildings uses in Zone C
Source: Author (2017) According to The Municipality of Baghdad

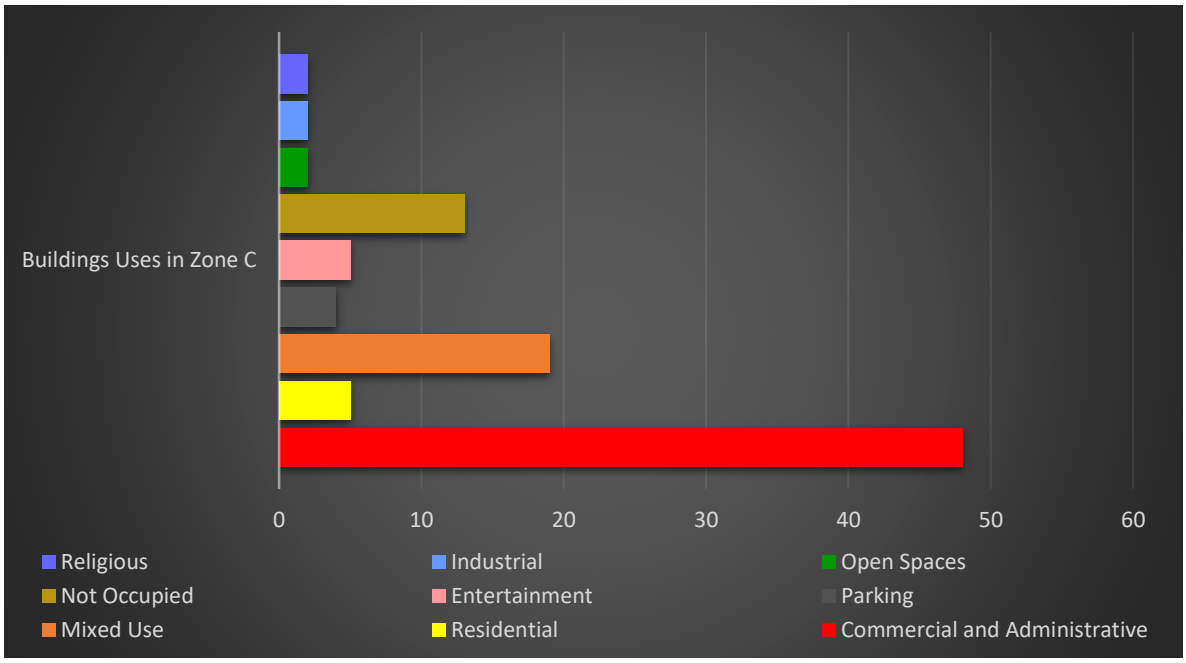


Figure 8.28: Buildings uses in Zone C
Source: Author (2017)

8.4.5 Buildings Height in Zone C

Commercial buildings require at least one to two floors to fulfil their needs. As Old Rusafa represents an important part of the CBD of Baghdad, therefore we can see that the majority of its buildings have at least two floors (figure 8.29). From Figure 8.36, we can see that 43% of the buildings in Zone C have two storeys, whereas, 5% of buildings in the Zone C were considered to have five to nine floors. The field survey of the case study also reveals that the zero floor or buildings with just ground floor were recorded 14% of the whole built form in the Zone C. It can be observed from the Figure 8.30 that buildings with one floor in the zone C have accounted 16% of its buildings. In addition, buildings that have three storeys have recorded 15% of buildings in the field survey of the Zone C. The result of our analysis also shows that 7% of the buildings have four storeys. In the planning procedure, buildings height of the case study is very significant to assess in order to clarify the skyline of Old Rusafa and understand what are the right methods of conservation and smart sustainable requirements, which need to be implemented.

Figure 8.29: Buildings Height in Zone C
Source: Author (2017) According to The Municipality of Baghdad

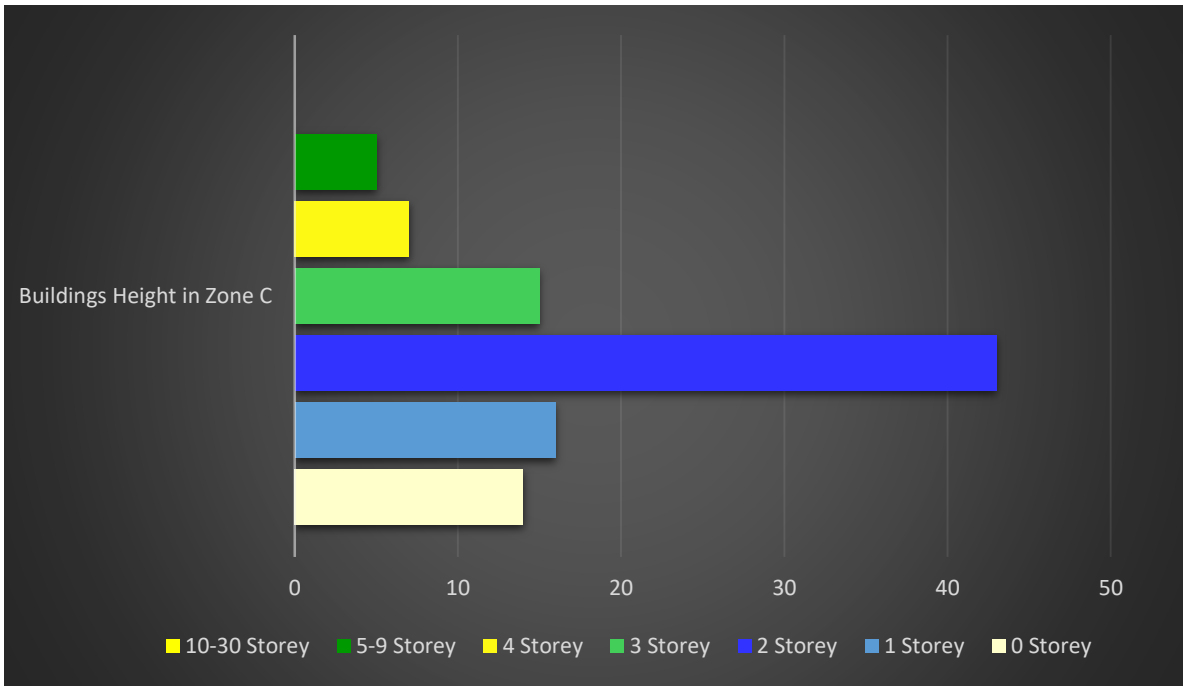


Figure 8.30: Buildings Height in Zone C
Source: Author (2017)

8.4.6 Structural Condition Assessment of Buildings in Zone C

One of the fundamental elements to enhance the physical urban context of Old Rusafa is to assess the structural condition of its buildings and especially historic and traditional buildings that represent the identity of the case study area. This assessment will provide a clear view of buildings, which might be preserved and buildings might be removed that have no architectural style. Therefore, we evaluated the case study Zone C with seven categories: under construction, excellent, very good, good, acceptable, poor, deteriorate and empty spaces (figure 8.31). The data from Figure 8.32 indicates that the assessment of structural condition in the Zone C shows that 32% of buildings were in the good situation. We can see also from Figure 8.32 that 32% of buildings were in an acceptable condition according to the field survey of the Zone C. Strong evidence of very good structural condition (7%) was found according to the field survey of Al-Rashid Street in Old Rusafa. Moreover, the field investigation of structural condition assessment of buildings in zone C shows zero results for both under construction and excellent categories. In addition, we can see from the result in Figure 8.32 that the empty spaces were recorded with 11% of the case study area. According to the field survey in the Zone C, 7% of buildings were in deteriorating condition. Furthermore, this investigation confirms that buildings in poor structural situation were accounted for 7% and these buildings require to be conserved and improved.

Figure 8.31: Structural Condition Assessment of Buildings in Zone C
Source: Author (2017) According to The Municipality of Baghdad

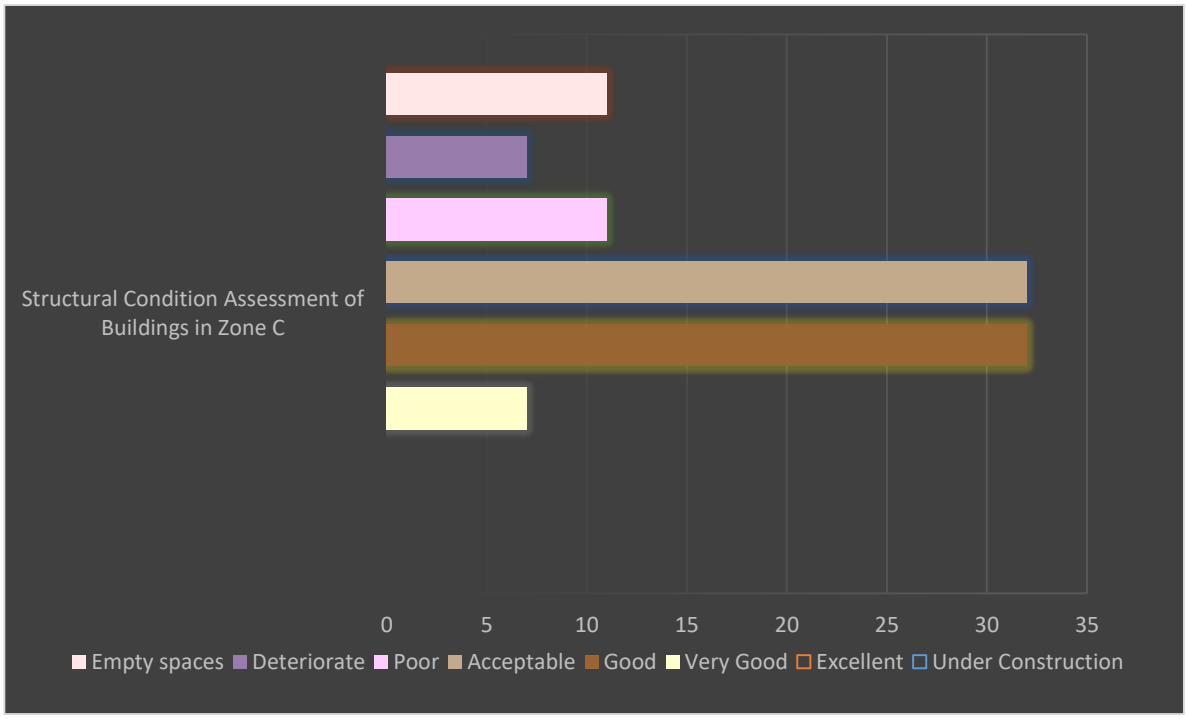


Figure 8.32: Structural Condition Assessment of Buildings in Zone C
Source: Author (2017)

8.4.7 Properties Ownership in the Zone C

This part of the investigation will clarify properties ownership as it considered as a significant issue in the development of the case study area in the Zone C (figure 8.33). It is clear from figure 8.34 that government properties were also related to different government institutions such as the Ministry of Finance, Ministry of Culture and the Municipality of Baghdad. Therefore, we assessed the case study Zone C with three categories: private property, government property and religious property. It can be observed from the Figure 8.34 that over half of buildings (65%) in Old Rusafa Al-Rashid Street Zone C were considered as private property. The data from Figure 8.34 indicates that the field survey of religious ownership in the Zone C accounted for 2% of whole buildings.

Figure 8.33: Properties Ownership in the Zone C
Source: Author (2017) According to The Municipality of Baghdad

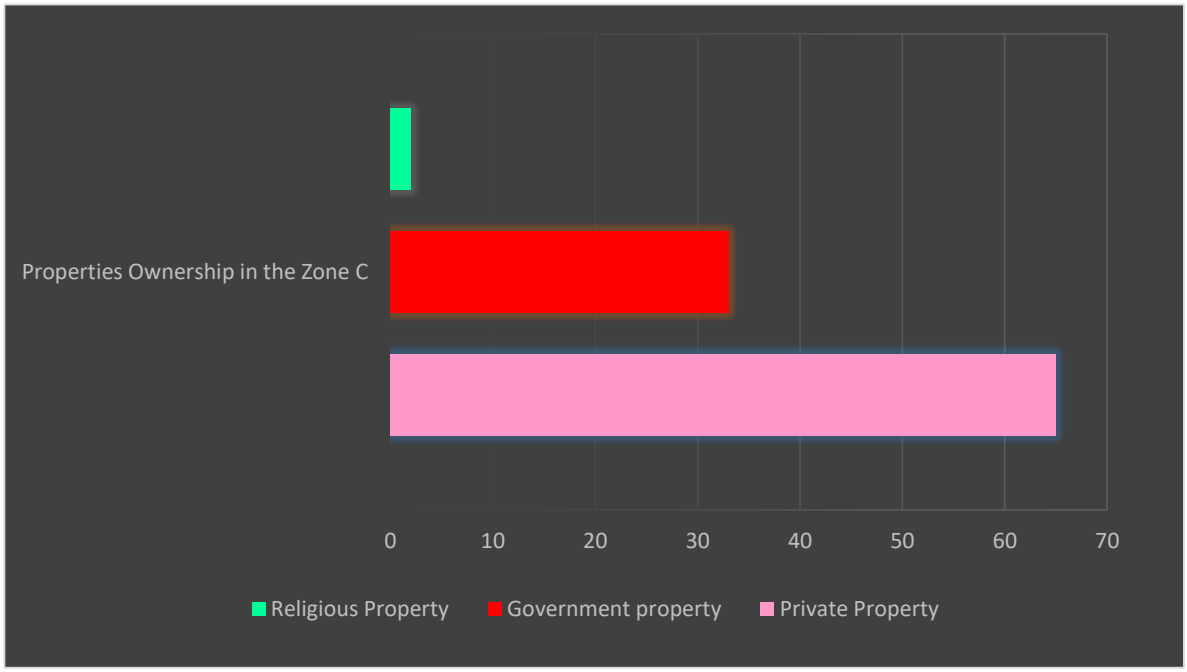


Figure 8.34: Properties Ownership in the Zone C
Source: Author (2017)

8.4.8 Observation Survey for Al-Rashid Street Zone C

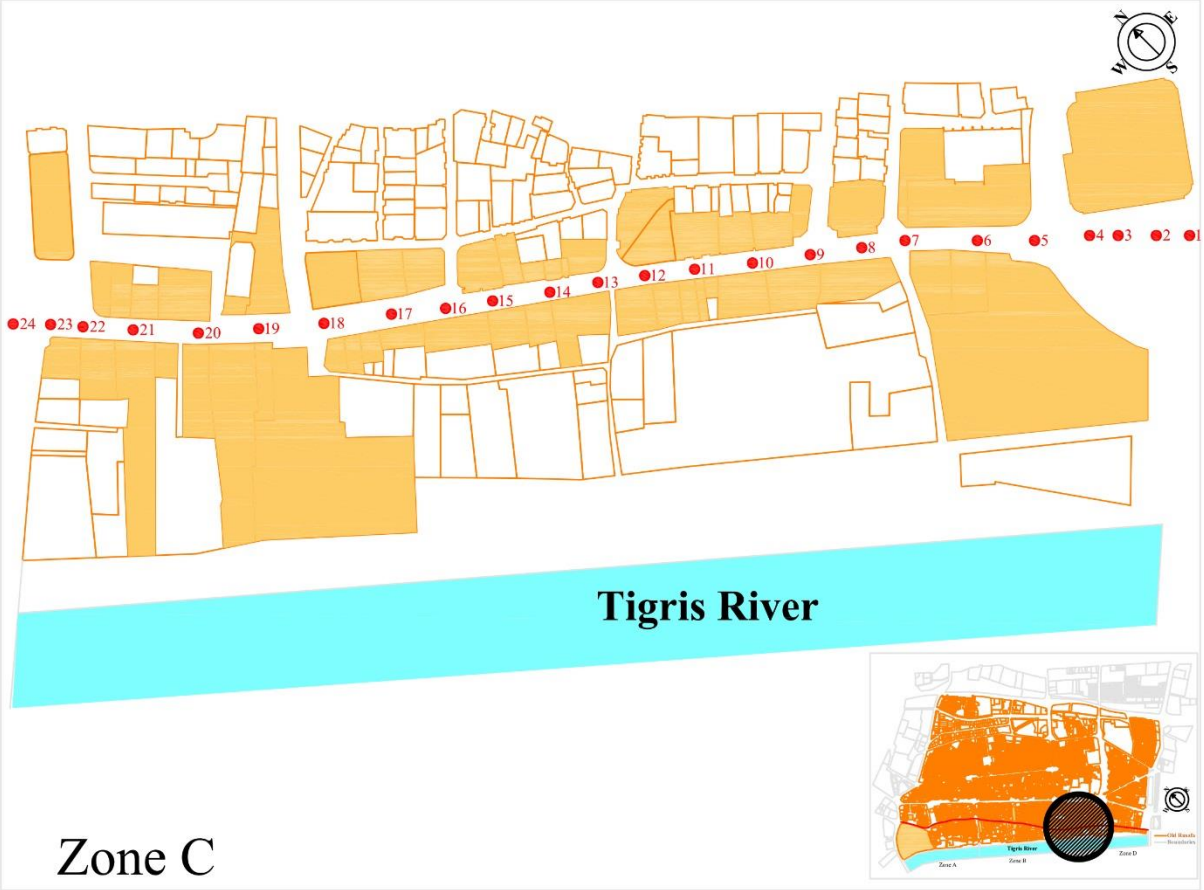


Figure 8.35: Observation Survey for Al-Rashid Street Zone C
Source: Author (2017)

Figure 8.36: Observation Survey for Al-Rashid Street Zone C Right
Source: Author (2017) according to Municipality of Baghdad

Figure 8.37: Observation Survey for Al-Rashid Street Zone C Left
Source: Author (2017) according to Municipality of Baghdad




1, 2, 3, 4: After Al-Sunk Bridge is the beginning of Zone C and the third part of Al-Rashid Street. We can see also that the second part of this junction was also neglected, and a huge six-floor concrete building (Sinak parking) is the first building in the Zone C. The next high building in the area is Sinak Communication Centre (figure 8.35, 8.36, 8.37).




5, 6, 7, 8: Continue to walk on this part, we can see that there is diverse buildings style such as modern, traditional and Art Déco, and also each of these buildings has different height and number of floors. The traffic movement in the Zone C was in the opposite direction, and there is no path for cycling or any green area. The concrete wall that protects governmental buildings prevents pedestrians from walking on the pavement and forces them to walk on the road.




9, 10, 11, 12: The majority of buildings in the zone C require urgent maintenance, conservation, redevelopment and rehabilitation to their function, elevations and structural condition. Continuing to walk through Zone C we noticed that there was not any type of implementing smart sustainable indicators in Old Rusafa and especially Al-Rashid Street (figure 8.35, 8.36, 8.37).



13, 14, 15: Continuing to walk towards Zone B, we still see that the second floor of some traditional buildings was not occupied and suffer from a poor structural condition. We can see also that some of the second floor and the roof of traditional buildings were utilised as a store and were reconstructed with a temporary steelwork (figure 8.35, 8.36, 8.37).



16, 17, 18: This part of Al-Rashid Street is busy, and we can see that there are no official spaces for car parking. Therefore, when cars parked on the side of the road, this will lead to traffic congestion in Al-Rashid Street Zone C. Another reason for traffic congestion is that some of the mini lorries stop to unload their cargo and goods on the side and sometimes in the middle of the road.



19, 20, 21: The end of Zone C, we noticed that some of these traditional buildings elevations have been preserved and rehabilitated in a good way. Continue to walk toward the end of zone C Hafez Al-Qadhi Square, we can see there is a green area, however, it is not designed to be a part of the pedestrian walk path or as an area for people to get rest.

8.4.9 Observation Survey for Tigris Riverfront Zone C

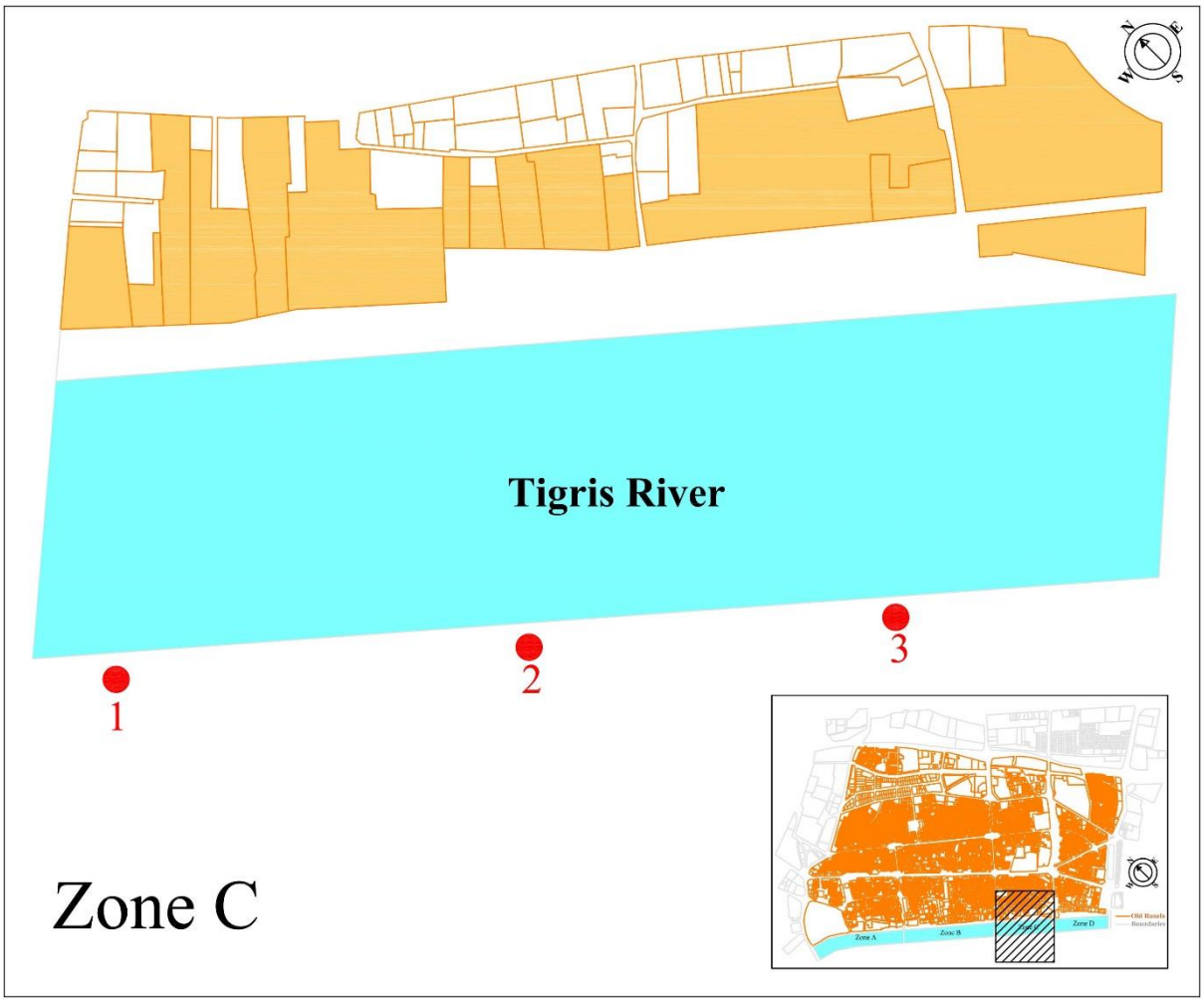


Figure 8.38: Observation Survey for Tigris Riverfront Zone C
Source: Source: Author (2017)

Figure 8.39: Observation Survey for Tigris Riverfront Zone C
Source: Source: Author (2017) According to Municipality of Baghdad

1: Sayid Sultan Ali mosque with its white dome was an essential building of the Tigris Riverfront of the Zone C survey. This mosque was built in 1682 by Ibrahim Pasha and was restored by Sultan Abd al-Hami in 1892 (figure 8.38, 8.39). When Rashid Street was expanded in 1934, the mosque was partly demolished.

2: Zone C and D was smaller than zone A and B. Also the last two zones the researcher found difficult to took serial photos from the other side of Tigris Riverfront or even from Old Rusafa side due to safety and security situation. We can see that after the Sayid Sultan Ali mosque discontinues the walking path of Zone C Tigris Riverfront (figure 8.38, 8.39).

3: Several traditional buildings in the Zone C were demolished and neglected. Furthermore, this part contains several historical buildings such as Ibn Al-Jawzi Tomb, which was built in 1200, ex. British residency built in 1900, Naqib riverfront house built in 1900, Danial riverfront house built in 1923, Vartan Mina's house was built in 1900, Inspectorate house built in 1900 and Khidhairi riverfront house built in 1900. The majority of these traditional buildings were demolished.

8.5 Field Survey for Al-Rashid Street Zone D (Sinak Area)

8.5.1 Historical background of Sunk Area

Located on Old Rusafa on the shore of the Tigris River and surrounded by traditional areas such as Ras al-Sakia and Bab al-Sheikh, this area includes some of the important traditional houses like the house of the Minister Nizamuddin Abi Nasr Al-Muzaffar bin Ali bin Jahir, Minister of the Caliph Al-Muqtafi. This area was known as Senak in times of Ottoman. It has been mentioned more than once in the records of the Sharia Court in Baghdad since the beginning of the thirteenth century of migration (1881 AD). The Waqf documents reveal that there were a large number of gardens and orchards related to different families, for example, the orchard of Muhammad Ibn Jawad 1224 AH, the orchard of Abd Allah 1321 AH and the garden of Jenina belonging to the heirs of Muhammad Ali Khan Al-Nawab, which later turned into a communication building. There was a mosque known as the Mosque of the Sinak going back to 1901.

8.5.2 Historic and Architectural Value in Zone D (Architectural Types Survey)

The survey was carried out a number (62) of buildings according to their historic and architectural value dividing them into six category groups (figure 8.40). As is observed from the comparison bar chart historic buildings, early traditional, art nouveau, art déco, modern buildings and unknown (Figure 8.41). It was found that the modern buildings category represents 45% of our survey while the unknown category record 26% of buildings in Zone D. Moreover, the traditional buildings account for 25% of buildings in Zone D. On the other hand, each of the two categories (art nouveau and art décor) records only 2% of this investigation.

Figure 8.40: Architectural Styles in Zone D
Source: Author (2017) According to The Municipality of Baghdad

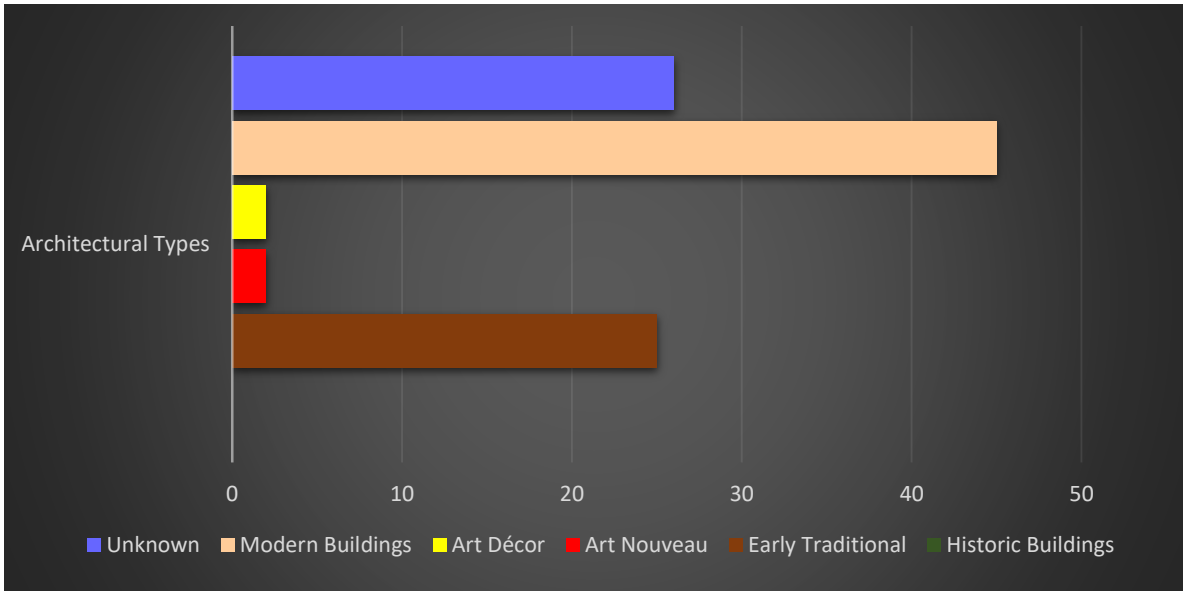


Figure 8.41: Historic and Architectural Value in Zone D (Architectural Types)
Source: Author (2017)

8.5.3 Historic and Traditional Buildings in Zone D

The survey revealed that there were 12 buildings identified as heritage buildings within Zone D, denoting a certain period of time (Dar al-Khudairi) or denoting a specific character (Dar Khalil Pasha, House of the British Resident and others) (figure 8.42). This investigation has considered previous studies (JCP Development of Old Rusafa 1984, Study of the Department of Antiquities and Heritage / the University of Baghdad in 1994, Study of the Municipality of Baghdad / Department of Antiquities and Heritage in 2004 and Study of the Municipality of Baghdad 2010).

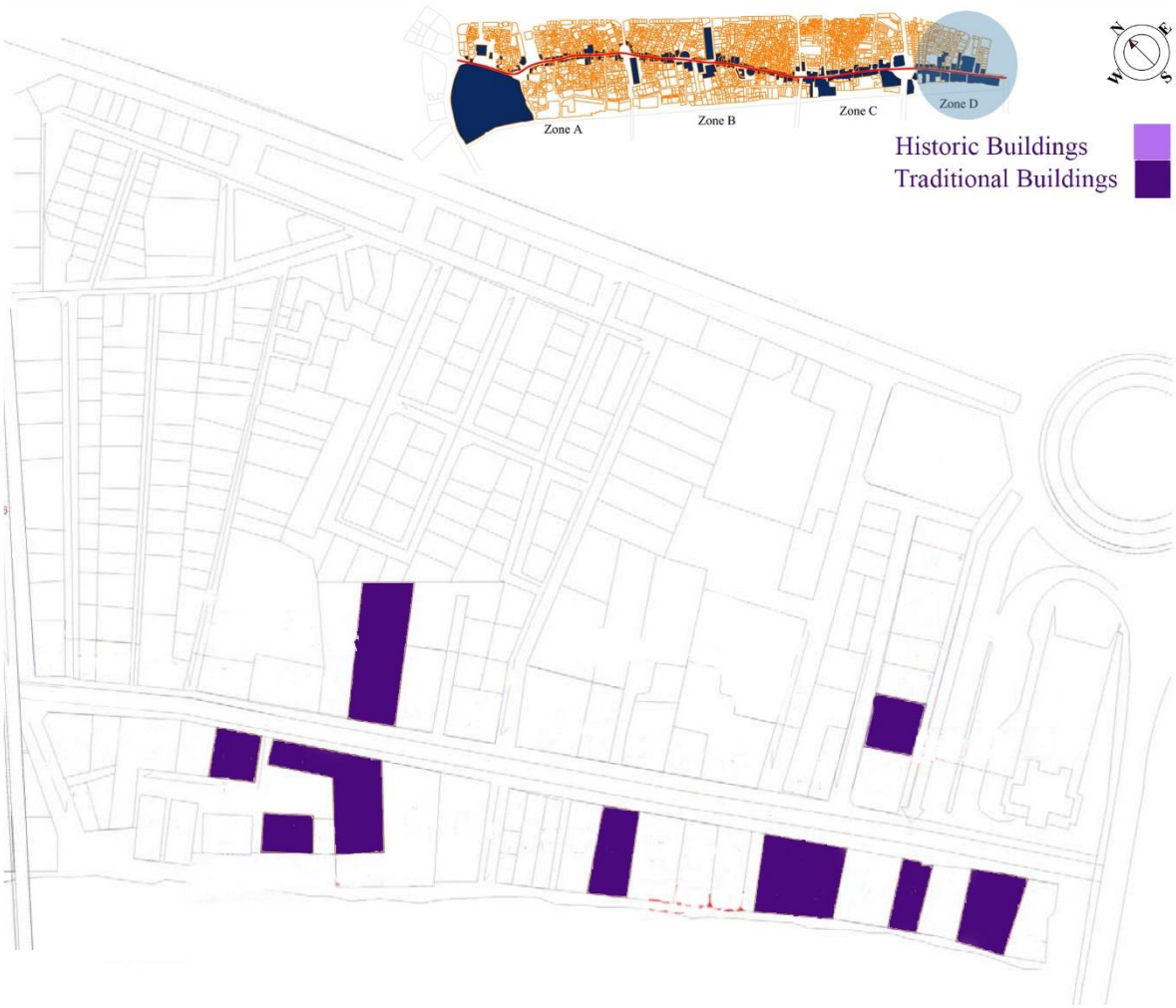


Figure 8.42: Historic and Traditional Buildings in Zone D
Source: Author (2017) According to The Municipality of Baghdad

8.5.4 Buildings Uses in Zone D

Old Rusafa has different activities such as living, working, shopping and governing that make the historic core vital (figure 8.43). This research has endeavoured to identify building uses through field survey and updating previous studies. Therefore, commercial and administrative uses were most prevalent in Zone D, which accounted for 50% (figure 8.44). This research indicates that Al-Rashid Street represents the essential part of CBD of Baghdad. The outcomes of this survey also show that 15% of buildings uses are mixed-use, whereas the residential activity has recorded 3%. The results, as confirmed in Figure 8.44, indicating that 17% of buildings are not occupied, and 6% of the area in the Zone D is open spaces. Moreover, 4% of the spaces in Zone D was utilised as a parking area. The examination of Zone D in Al-Rashid Street shows that the dominant use in the ground floor was commercial, each building divided into several shops, whereas, in the higher levels was occupied as offices for lawyers, doctors and companies.

Figure 8.43: Buildings uses in Zone D
Source: Author (2017) According to The Municipality of Baghdad

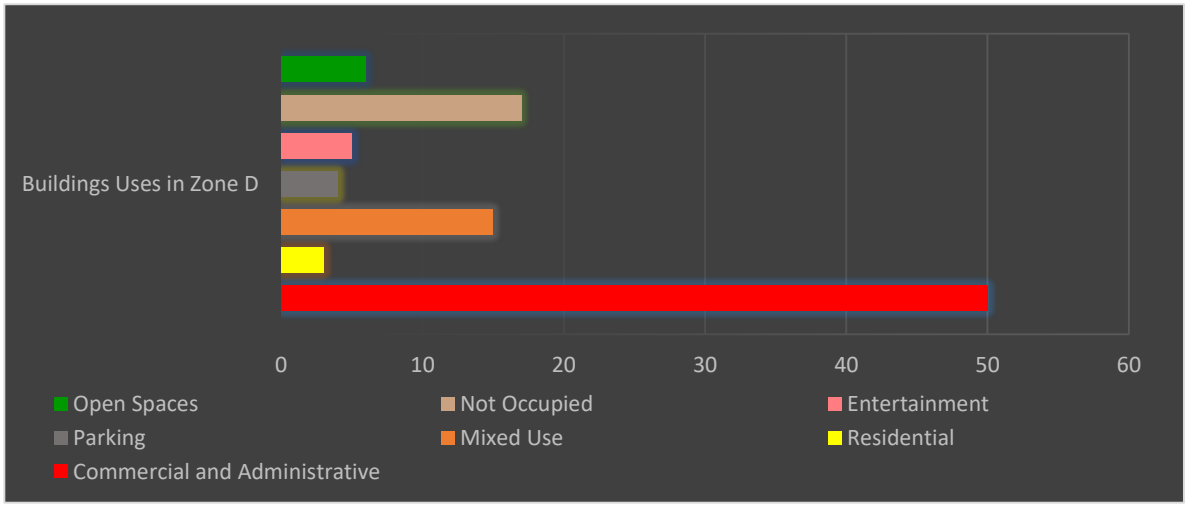


Figure 8.44: Buildings uses in Zone D
Source: Author (2017)

8.5.5 Buildings Height in Zone D

Al-Rashid Street is considered as one of the most significant commercial streets in Baghdad. Therefore, its buildings were commercial uses and had many storeys (figure 8.45). The survey revealed that the majority of zone D buildings have two to three floors, which account for 17% and 16% respectively (figure 8.46). The result of our analysis also shows that 7% of the buildings have one storey. The investigation also reveals that the zero floor or buildings with just ground floors were recorded as 8%. The field survey displays that 8% of the zone D buildings have five to nine floor, whereas, buildings that have ten floors or more account for only one building.

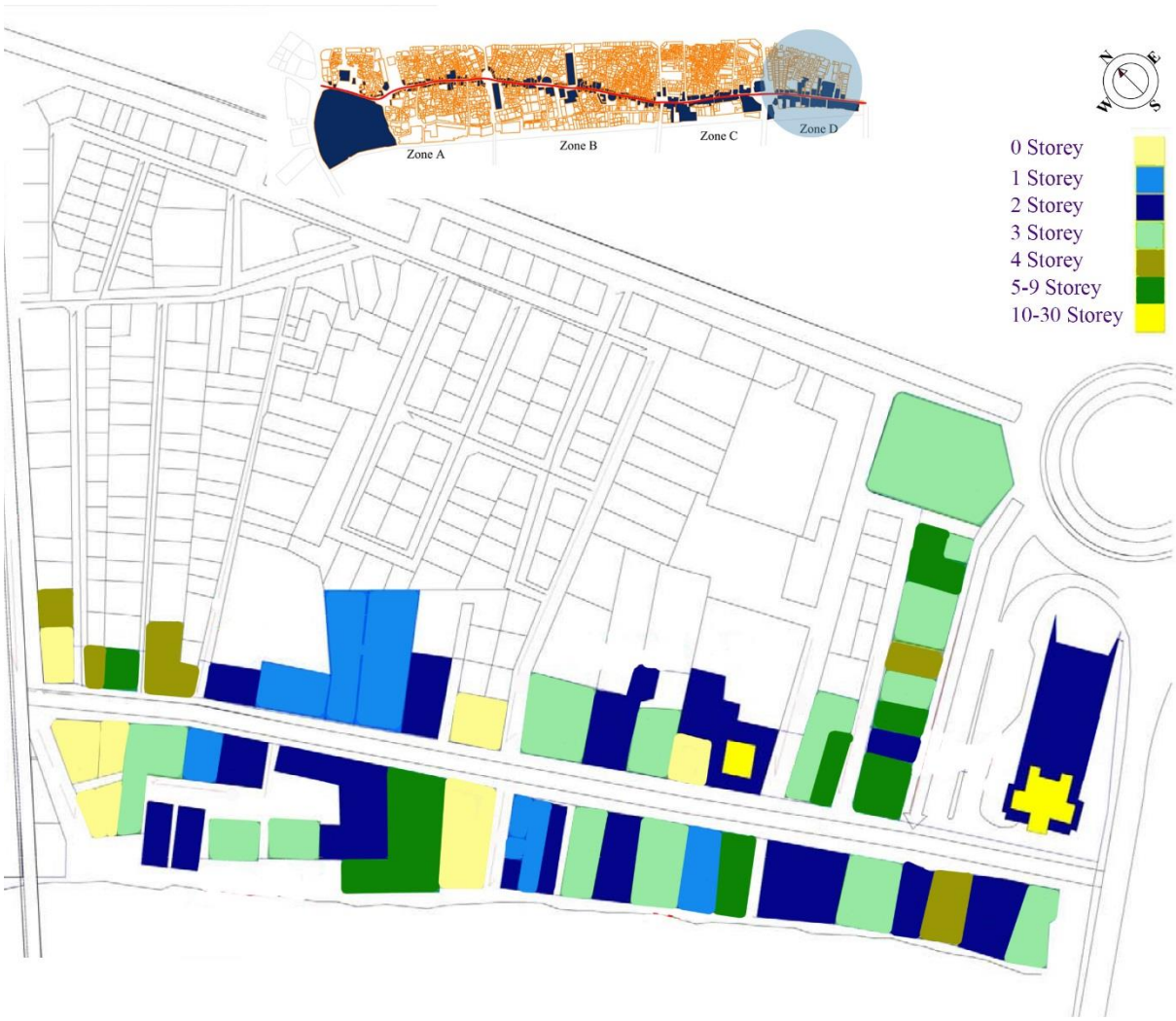


Figure 8.45: Buildings Height in Zone D
Source: Author (2017) According to The Municipality of Baghdad

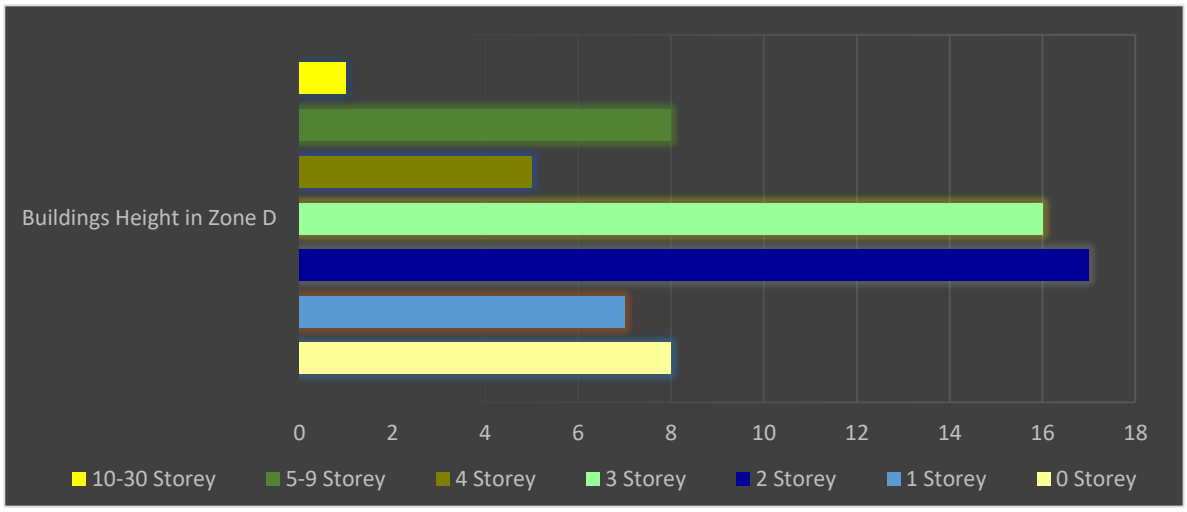


Figure 8.46: Buildings Height in Zone D
Source: Author (2017)

8.5.6 Structural Condition Assessment of Buildings in Zone D

Structural condition assessment of buildings in Zone D is a significant part in this research that reveals buildings situation and the urgent need of preservation to some of the monuments and traditional buildings in Old Rusafa (figure 8.47). Substantial evidence of acceptable structural condition (28%) was found in Figure 8.48 according to the field survey of Al-Rashid Street in Old Rusafa. From the data in Figure 8.48, it is clear that 34% of the structural condition assessment of buildings in Zone D was in good condition. Moreover, 11% of the buildings were very good, however, buildings that require being preserved or rehabilitated and were assessed according to the field survey as poor or deteriorated recorded 7% for each of the two categories. In addition, we can see from the result in Figure 8.48 that the empty spaces accounted for 13% of the case study area. The assessment of building situations according to this investigation shows that Old Rusafa requires a new approach to be advanced and this is what this study seeks to do.

Figure 8.47: Structural Condition Assessment of Buildings in Zone D
Source: Author (2017) According to The Municipality of Baghdad

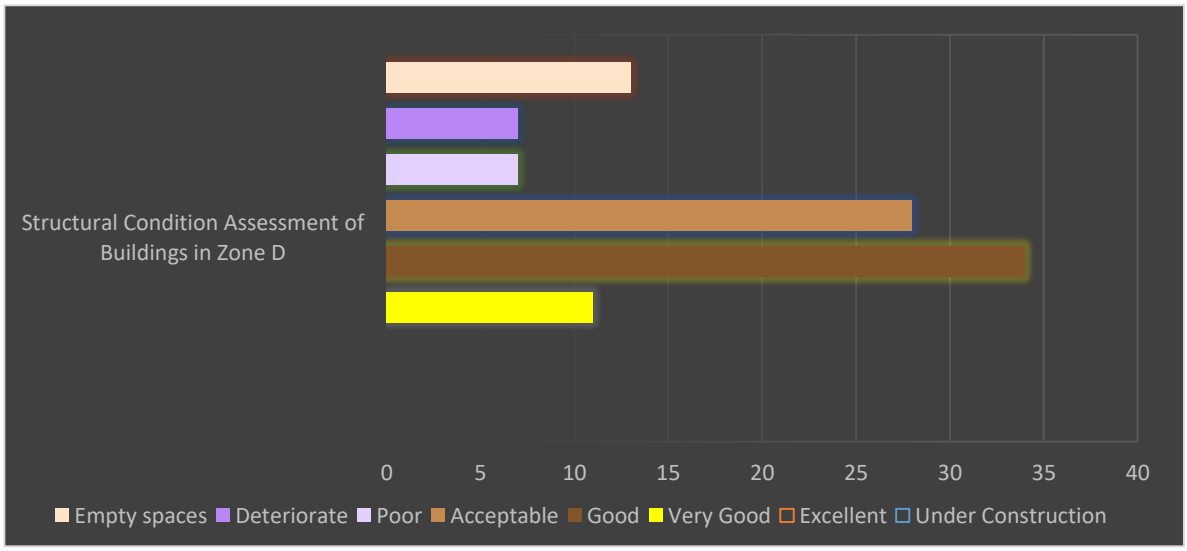


Figure 8.48: Structural Condition Assessment of Buildings in Zone D
Source: Author (2017)

8.5.7 Observation Survey for Al-Rashid Street Zone D (Sinak Area)

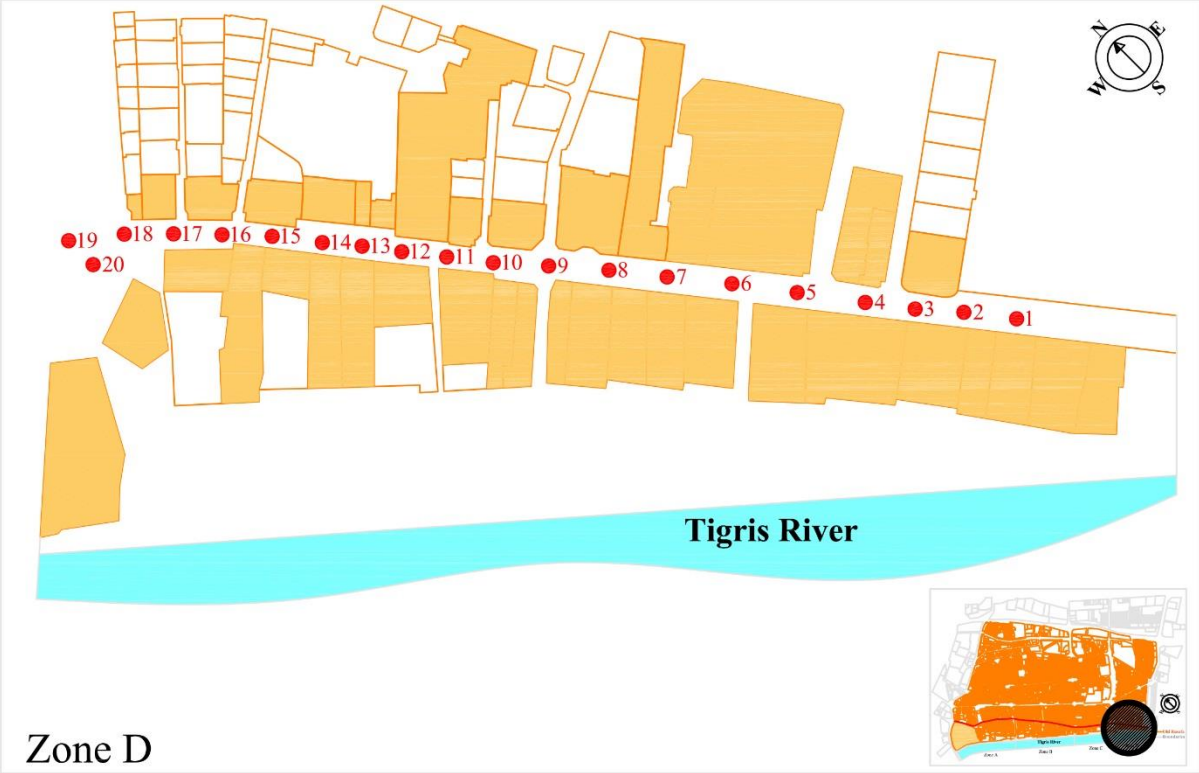


Figure 8.49: Observation Survey for Al-Rashid Street Zone D
Source: Author (2017)

Figure 8.50: Observation Survey for Al-Rashid Street Zone D Rights
Source: Author (2017) According to Municipality of Baghdad

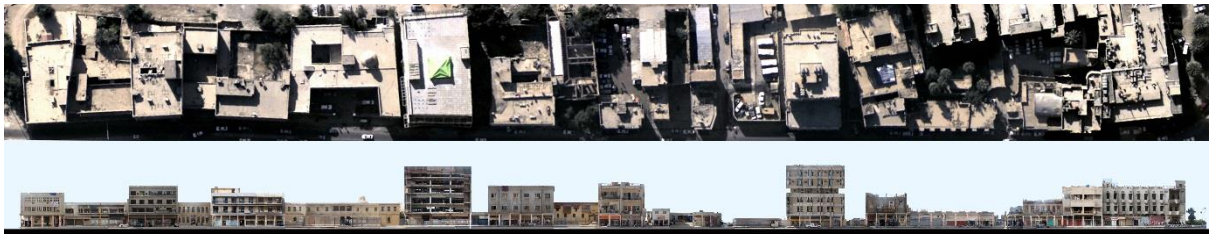


Figure 8.51: Observation Survey for Al-Rashid Street Zone D Left
Source: Author (2017) According to Municipality of Baghdad




1, 2, 3, 4: We can see that the first point of zone D field survey started with high new commercial buildings their design going back to the late 1950s (figure 8.49, 8.50 8.51). These modern design buildings have appeared in different forms and materials, most of them are concrete. These modern buildings have affected the traditional urban context of Old Rusafa and particularly the homogeneity of Al-Rashid Street with its traditional buildings.

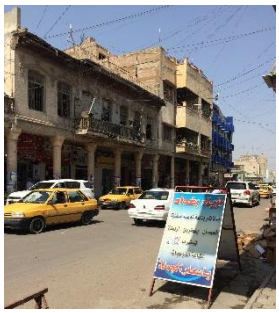



5, 6, 7, 8: At the beginning of each zone, there is a police station, which affects the traffic movement in the street and urban scene. We can see also that there is a concrete wall in the front of each governmental building for safety and security issues. Continuing to walk in the zone D, we can see that the traffic movement of cars was in opposite directions.

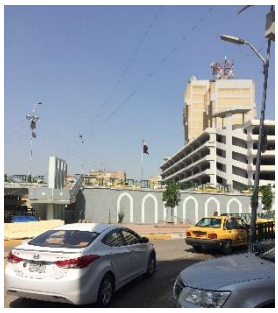


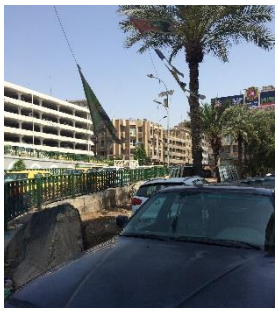

10, 11, 12: The shaded pedestrian sidewalk on both sides of Al-Rashid Street is one of the main features that represents this street. However, the continuity of the sidewalk has disturbed by empty open spaces and the new roads that penetrated the traditional urban context. Continue to walk toward zone C; we can see that there were a few traditional buildings in the zone D which show an urgent need for conservation and rehabilitation (figure 8.49, 8.50 8.51).






13, 14, 15, 16: Continue to walk in Al-Rashid Street, and we can see the coherence between the traditional buildings and the new building is not good regarding the relationships of heights, materials, architecture types and even functions. Furthermore, we noticed through our observation survey for Al-Rashid Street Zone D that there is no green area and cycle path (figure 8.49, 8.50 8.51).



17, 18, 19, 20: The end of zone D and the continuity of Al-Rashid Street is disturbed by Al-Sinak Bridge. We can see also that this important square is not used and neglected, whereas, we can develop this square to improve the urban scene of Old Rusafa.

8.5.8 Observation Survey for Tigris Riverfront Zone D

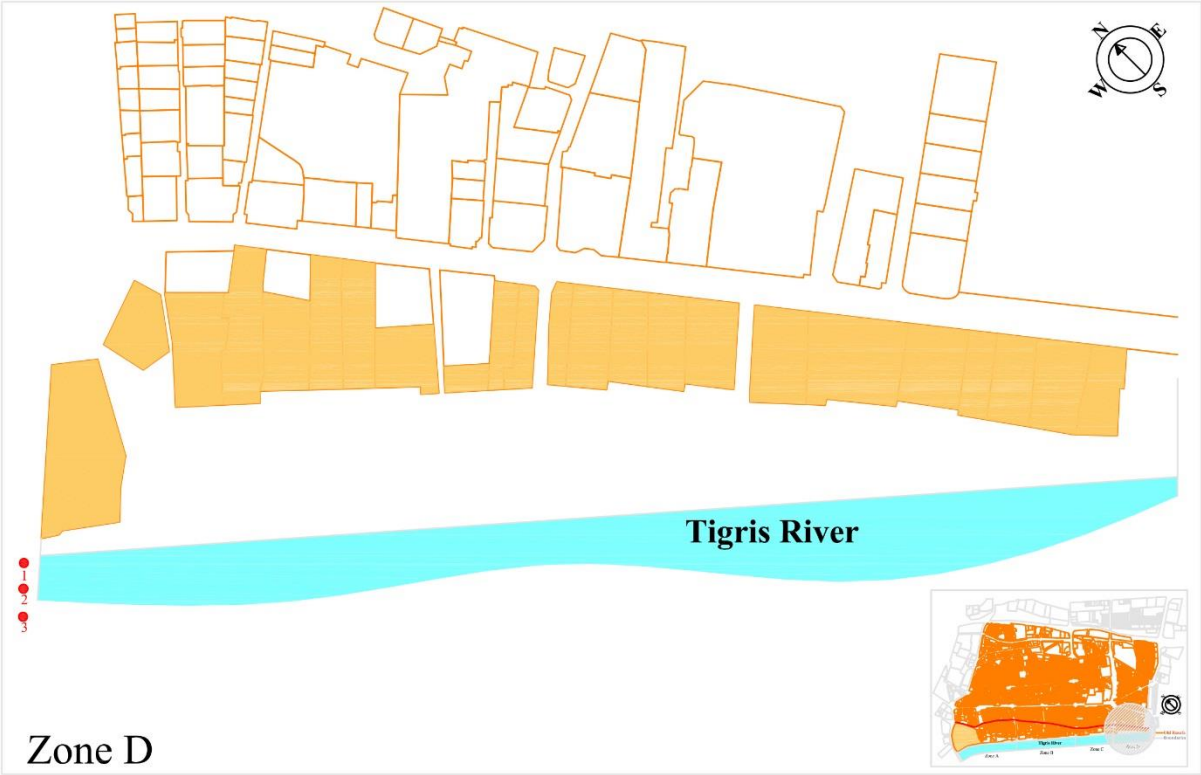


Figure 8.52: Observation Survey for Tigris Riverfront Zone D
Source: Author (2017)

Figure 8.53: Observation Survey for Tigris Riverfront Zone D
Source: Author (2017) According to Municipality of Baghdad

1: The researcher found it difficult to take serial photos for Zone D from the other side of Tigris Riverfront or even from Old Rusafa side due to safety and security situation, the Iraqi government prevents anybody to taking photos in this area.

2: The urban context of Zone D and its buildings are a modern design model. We can see also that there are car parks and road between the plot area of zone D buildings and the Tigris Riverfront (figure 8.52, 8.53).

3: I would like to indicate that I took these serial photos on my responsibility, as the authority might prevent it. This part showed differences in buildings height, the range of building height was two to twenty floors (figure 8.52, 8.53).

8.6 Discussion and Conclusion

This section from the thesis has examined the research strategies that were embraced for gathering and analysing the information. The methodology that has evolved for this empirical dissertation is a sectional comparison conducted as an integration of qualitative and quantitative research approaches. The field survey of this thesis has aimed to examine the physical urban situation of the area between Al-Rashid Street and Tigris Riverfront in Old Rusafa and defining the potentialities and constraints of this city. The field investigation has illustrated the historical and architectural value, buildings use, historic and traditional buildings, building height and the structural condition of historical and traditional buildings in the case study area. It has also taken photos and gathered maps as a part of fieldwork methods. In addition, in this section, we have utilized a combination of the walking and the serial vision method as a qualitative approach to gathering information.

8.7 Chapter Summary

This Chapter has been defined by each section in the outcomes concerning the goals of evolving the pertinent enquiries. The complex development and transformation in the traditional urban fabric have created three separate and partly conflicting urban systems:

1. The first one is because of the neglected historic urban fabric suffering from insufficient infrastructure, social and amenities facilities, and inhabited by a crowded and poor population.
2. The second part is the modern service centre, its character is Western-type and contains banks, shops, government building, cinemas, restaurants, hotels and constitutes inconsistent blocks in the old Rusafa, in both functional and architectural terms.
3. The third part represents the industrial part that causes enormous congestion, pollution and unacceptable encroachment on public space.

This chapter has also examined the main challenges in the case study such as the conflict between the modern development that shows no consideration for the traditional urban context and the large stock of abandoned, decaying or misused traditional buildings that have led to creating confusion and chaos in Old Rusafa. We assert in this chapter two main

concerns in the development of the historic core. The first concerned is the type of potential conservation project, such as renewal the traditional buildings, preservation of the physical urban fabric. The second concerned is the use of the new methods in the advancement of the historic centre, such as the smart sustainable cities concept. In addition, this chapter examined the data gathered by the field survey of the area between Al-Rashid Street and Tigris Riverfront in Old Rusafa. The field survey has tried to assess the current situation of the existing physical urban context and urban form of the case study area. The outcomes of this investigation in terms of historical and architectural value show that the vast majority of buildings have no architectural style, which was recorded as 70% and 45% of buildings in Zone B and A respectively. Moreover, historical buildings recorded the highest in the Zone A (10%) in this survey. From Figure 8.54, we can see that the highest number of traditional buildings were founded in Zone D that accounted 25% of its buildings. In addition, the majority of modern buildings found in Zone D, which recorded 45% of its buildings, whereas, there were no historical buildings in this zone. The majority of buildings that have Art Nouveau architectural style found in Zone C that accounted 18% of its buildings. The Art Déco category recorded the highest number in Zone B that accounted 8% of its buildings (figure 8.54).

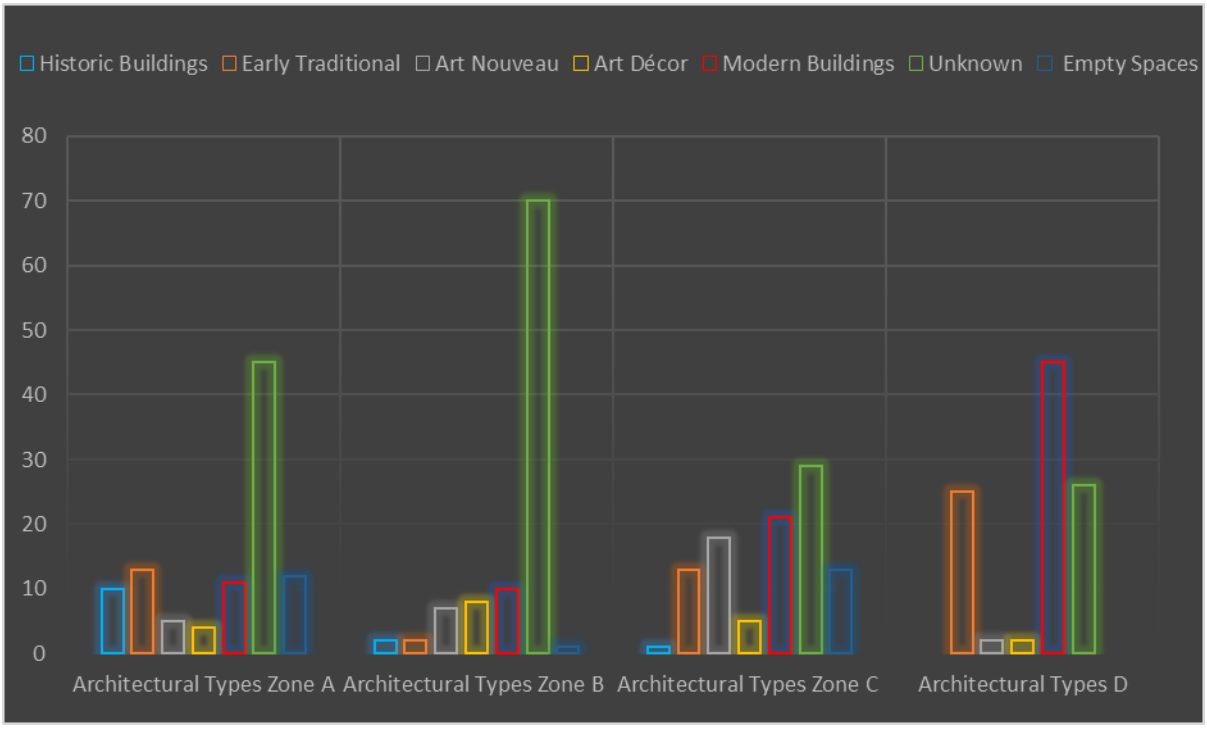


Figure 8.54: Historic and Architectural Value in the Area between Al-Rashid Street and Tigris Riverfront in Old Rusafa (Architectural Types)
Source: Author (2017)

The case study area has shown diversity on its buildings uses such as commercial, administrative, residential, mixed-use, parking, entertainment, industrial and religious activities. We can see from Figure 8.55 that the concentration of building uses differed from one zone to another in the case study area. Mixed-use commercial and administrative represents the majority of building uses in the case study area; Zone B was recorded the highest number (70%) of mixed-use buildings according to the field survey (figure 8.55). Furthermore, the data from Figure 8.61 assert that the highest figure of another mixed-use category (commercial and residential or industrial) was recorded at 25% in Zone A. However, it can be seen from the information in Figure 8.55 that the open space category was only recorded 2% in this field survey of Zone C. Similarly, industrial categories accounted in Zone A and C for a similar rate of 2% each of them. Moreover, from the data in Figure 8.55, it is clear that 2% of building uses in Zone A and B of the traditional street were residential categories. It is obvious from Figure 8.55 that there are diverse building uses in the case study area that asserted the significance of the need of finding new smart sustainable methods to develop Old Rusafa.

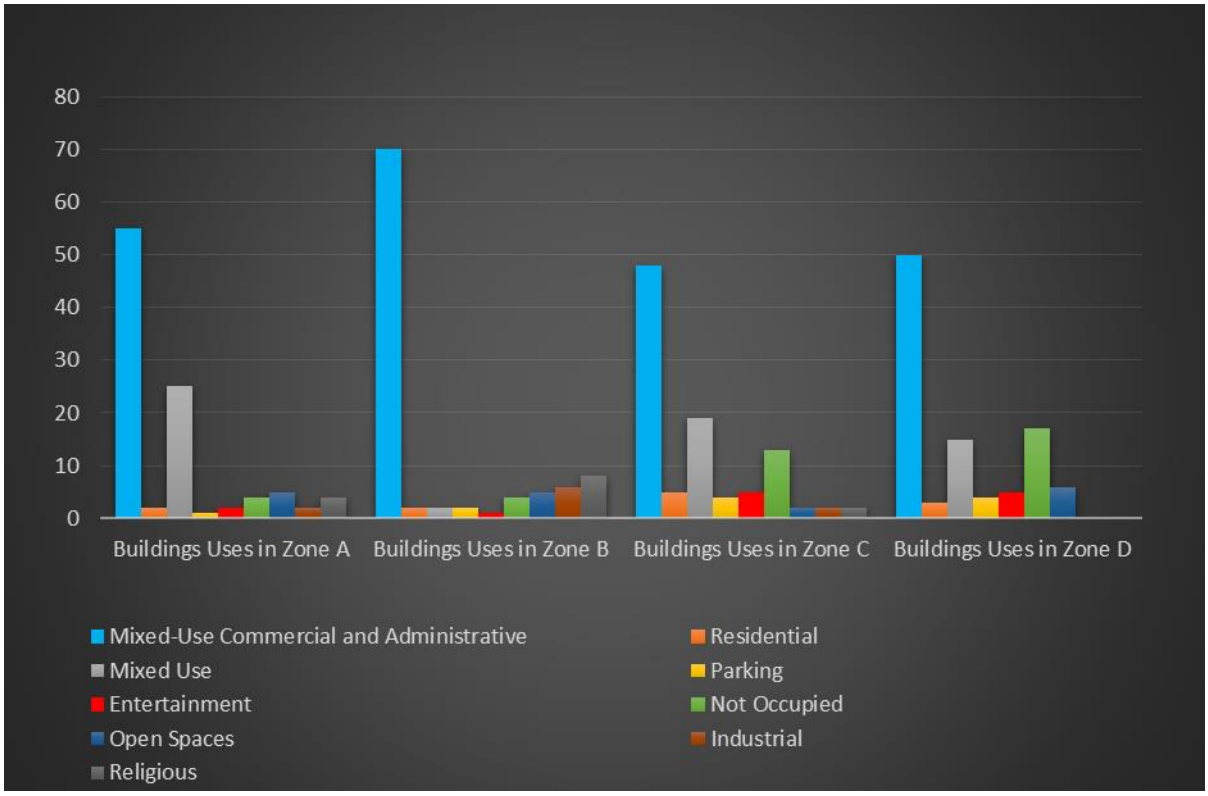


Figure 8.55: Buildings Uses in in the Area Between Al-Rashid Street and Tigris Riverfront in Old Rusafa
Source: Author (2017)

This area was considered as representing the main part of the CBD area of Baghdad. Therefore, we can observe that there were variations in building height in the area between Al-Rashid Street and Tigris Riverfront in Old Rusafa starting from zero storeys up to thirty (figure 8.56). The outcomes show that 47% of the buildings in Zone A have two storeys, whereas, 17% of buildings in the Zone D was considered to have just two floors. It is clear that there is substantial evidence from Figure 8.56, 23% of buildings in the Zone A have only a ground floor. Moreover, buildings that have three storeys were accounted 15% in Zone B and C according to the field investigation of the case study area. It can also be seen from the Figure 8.56 that buildings with ten to thirty storeys were recorded 1% in each of Zone A, B and D buildings. The results of this field survey show that the majority of buildings (36%) have ground and the first floor was founded in Zone B. The skyline of the area between Al-Rashid Street and Tigris Riverfront in Old Rusafa is a fundamental issue to be clarified in the urban design processes, thus, buildings height of the case study area is very significant to be considered to realize what concepts should be utilised to fulfil the requirements of the case study development.

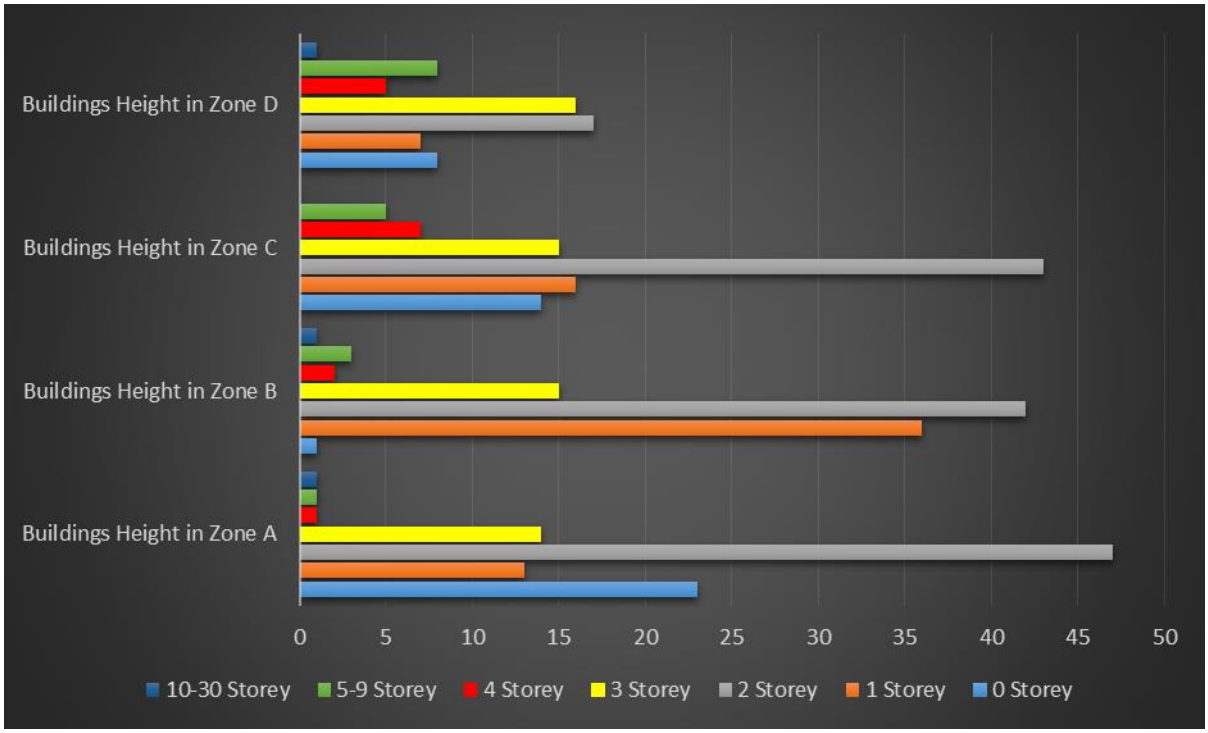


Figure 8.56: Buildings Height in the Area Between Al-Rashid Street and Tigris Riverfront in Old Rusafa
Source: Author (2017)

The development of the physical urban context of the case study area and the preservation of its identity will require an evaluation of the structural condition of historical and traditional buildings. Therefore, eight categories (under construction, very good, good, acceptable, poor, deteriorate, ruins and empty spaces) were used to evaluate the case study area buildings (figure 8.57). The results, as indicated in Figure 8.57 show that very good structural condition buildings in Zone B and C were accounted as 7% for each of them of all of their buildings. Furthermore, we can see from the result in Figure 8.57 that buildings in a good structural situation in Zone D and C have accounted for 34% and 32% respectively. However, the data from Figure 8.57 emphasizes that the majority of buildings in the case study area Zone B were found in a poor situation, which recorded 45% of its buildings. In addition, Zone A buildings that were in the deteriorating category have been recorded as 23% of its buildings. Furthermore, this examination believes that buildings in an acceptable structural situation accounted for 20% in each of Zone A and B and these buildings require an urgent need to be preserved. It can be observed from the field investigation that there are no buildings under construction or in an excellent condition found in this case study area.

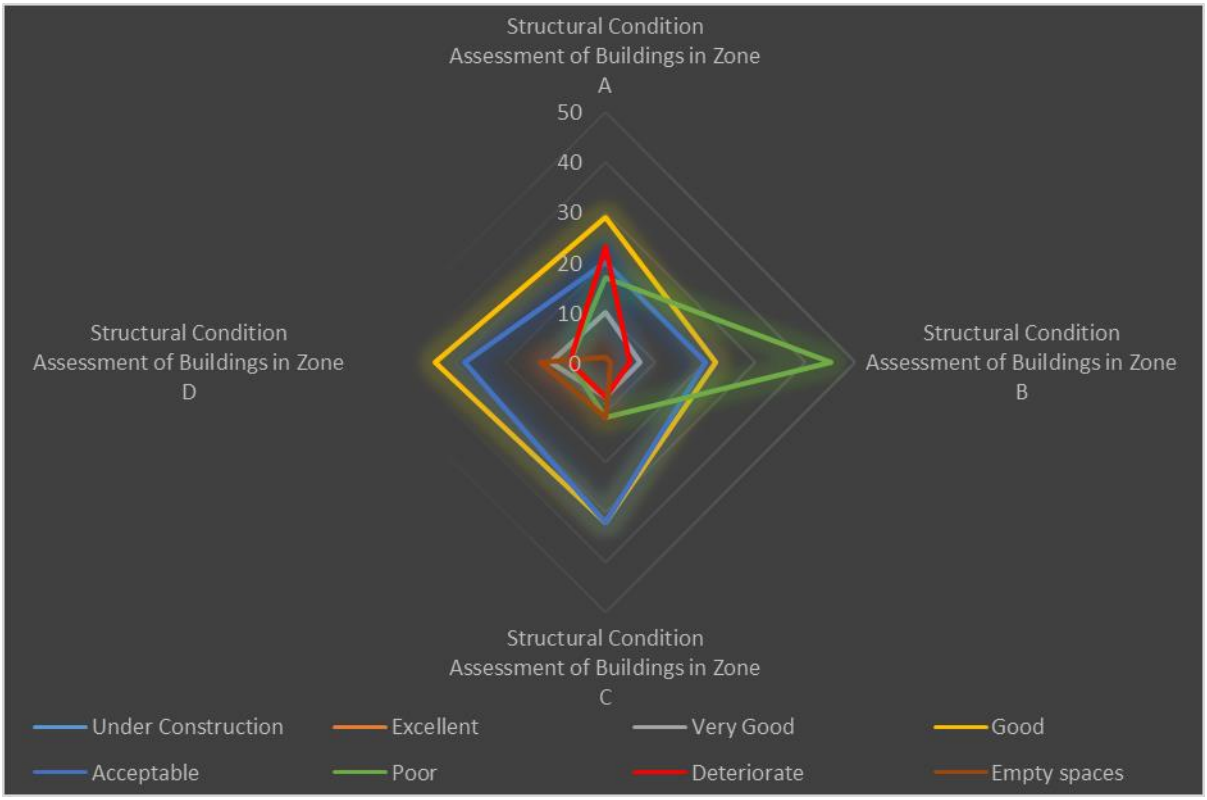


Figure 8.57: Structural Condition Assessment of Buildings in the Area Between Al-Rashid Street and Tigris Riverfront in Old Rusafa
Source: Author (2017)

CHAPTER 9: THE CASE STUDY DATA ANALYSIS AND EXAMINATION

9 Introduction

This chapter will respond to study aim three, question one part A and question two section B (page 3), which will provide insight into the thesis structure and its research framework. The answers gathered from the investigation produced a huge amount of information that has been analysed according to the methodology that was explained in Chapter 7. According to the questionnaire survey, beneficial outcomes and recommendations have been identified. This section displays this analysis in line with the structure of the survey, and also primary essential guidance to be utilised for practical case study. The structured interview in this research include seven parts, and each of one of these components involves various questions. The first section introduces general questions. The second delivers the analysis of factors that represent the historic centre of Baghdad (Old Rusafa). The third part displays the analysis of accessibility, infrastructures and facilities in the historic centre of Baghdad. The fourth is the analysis of deterioration, pollution and other problems in Old Rusafa. The fifth investigates land management problems. The six debates the importance of sustainability indicators and the last section discusses the significance of smart city characteristics. Finally, I will seek to summarise the outlines and findings of this chapter.

9.1 Interview structure

Citizens' participation in making decisions is one of the essential elements in developing cities to become smart and sustainable and to find an appropriate way to preserve the historic physical environment. Furthermore, it is one of the research goals in advancing the historic core of Baghdad. The structured interview in this research included seven parts, and each one of these elements involves various questions. This script of interview structure is provided in Appendix 2. In the following we will show the interviews main parts and subparts.

1. General Questions.
2. Factors that represent the historic centre of Baghdad (Old Rusafa).
3. Accessibility, infrastructures and Facilities.
4. Deterioration, Pollution and other problems in Old Rusafa.
5. Land management problems.
6. Sustainability Indicators.
7. Smart City characteristics

9.1.1 General Questions

This first part elicits information about the relevant age group, their qualification, their gender and their professional category. The information collected from this general section will be used to classify the professional and institution of categories of the participants when analysing the data.

9.1.2 Factors that represent the historic centre of Baghdad (Old Rusafa).

This part includes two main sections, and each section assesses the historic part regarding different categories. When we asked these questions in this section, we were looking for the residents' opinion about the physical environment that they were living in, and furthermore, how they evaluated the historic centre as a place that has various activities.

9.1.2.1 The historic centre of Baghdad (Old Rusafa) as a place for

Living: it is very important to assess how people feel and how they consider these traditional Baghdadi houses and this historic area as a place for living.

Working: another question is how the participant in this interview finds Old Rusafa as a place for working. Is it easy to find a job in this area, are there many opportunities as this district represent the major part of CBD of Baghdad?

Shopping: the traditional areas in Old Rusafa contain many modern and traditional markets or suqs, these suqs have local and national impacts, and therefore, we should evaluate how people assess the shopping activity in this area and if it covers all their needs.

Investing: the value of the land is very high in this area, and trade and economic exchanges are very good, which make it a target for different citizens, companies and even government institutions. At the same time, there are many obstacles like heritage regulation building, land ownership and building regulations will face anyone who wants to invest in this centre. This point is significant to assess how investing in these traditional properties will affect the socio-economic aspects.

Tourism: Old Rusafa contains many historic buildings, traditional suqs, hammams, old cafes, libraries and interesting heritage physical environments, which make the old city the best place for tourism, however, due to many difficult circumstances like war and social issues we need to understand how Baghdadi people estimate tourism activity.

Governing: many government buildings are located in the historic part such as the Municipality of Baghdad, the Ministry of Defence and the Central Bank of Iraq. These important buildings have increased the pressure on this part through increasing traffic congestion, changing the skyline of the urban context of the city, raising the pressure on historic part infrastructures. Thus, questions are put to the interviewees to evaluate citizens feeling about this activity.

9.1.2.2 The main factors that represent the historic centre of Baghdad (Old Rusafa)

The old city has diverse features, which make it unique from other modern areas. These characteristics such as equity, human scale, privacy, safety, natural shading, walkable and natural environments have influenced cooperation, interaction and the relationship between neighbours. These city aspects even have advanced the quality of life for its residents and

promoted traditional social values in Old Rusafa. We ask questions that assess peoples' opinion about if these aspects still play a fundamental role in their life.

9.1.3 Accessibility, Infrastructures and Facilities

This section includes three parts that consider three main criteria, accessibility, infrastructures and facilities to assess the historic core. In addition, each one of these criteria also has sub-aspects to assess. Hence, questions are prepared to estimate citizens' views about a different method of transportation condition, infrastructure situation and availability of different facilities like education, healthcare, cultural, social, leisure and shopping facilities.

9.1.3.1 The accessibility in the historic centre of Baghdad (Old Rusafa)

Old Rusafa has different transportation method such as cars, public transport and a little use of a motorcycle. Thus, if we want to reduce air and noise pollution in this area, we should seek to advance pedestrian corridors and encourage people to utilise clean and healthy ways in their day commuting like cycling and walking. Moreover, we should implement smart sustainable methods of transportation such as electric vehicles, Personal Rapid Transit (PRT) throughout the city, Light Rapid Transit System (LRT) connecting to neighbouring cities and Group Rapid Transit (GRT) Corridor. Therefore, a question was prepared to assess the current transportation systems through people's opinions.

9.1.3.2 Infrastructures in the historic centre (Old Rusafa)

The case study area is suffering from poor infrastructures. Therefore, to see how we can implement new infrastructure such as photovoltaics (PV), waste to energy and concentrated solar power (CSP) for energy infrastructure, use water recycling and segregation of waste streams. A question has been asked to evaluate the existing water, energy, sewage, waste, and transportation infrastructures.

9.1.3.3 Facilities in the historic centre of Baghdad (Old Rusafa)

The case study contains many facilities that make the area more vital and create variety in the urban context. Understanding people's opinion about healthcare, education, religious, cultural and shopping facilities will provide us with a clear vision of how we can develop and advance more facilities.

9.1.4 Deterioration, Pollution and other problems in Old Rusafa

The traditional core faces many challenges and problems. The area has a huge amount of deteriorating building especially those that have historical and cultural value. Furthermore, Sheik Omar Street, is the main source of air and noise pollution. This part will be separated into three main components that deal with the main tangible and intangible problems in the case study.

9.1.4.1 The deterioration rate in the main components of Old Rusafa

The case study has a historic urban fabric of narrow alleys and traditional Baghdadi houses. Further, this area contains many monumental buildings that have deteriorated and are neglected. Citizens' opinion is significant to estimate the deterioration of the main components of the case study. Thus, we have asked a question that helps us to find a convenient way to advance and assess the main elements in this area.

9.1.4.2 The most tangible problems in the historic centre of Baghdad

Due to the opening of the four main roads Khulafa Street, Kifah Street, Rashid Street and Sheik Omar Street between World War One and Two many problems such as lack of safety, land use management and traffic congestion have occurred and changed the urban context of Old Rusafa. Evaluating these problems by Baghdadi citizens will assess and rate the level of tangible problems in our case study.

9.1.4.3 The rate of pollution in the physical environment of Old Rusafa

The concentration of governmental, commercial and industrial activities in this area have led to increasing noise, visual, air, water and land pollution. Assessing people's feeling

about these problems is essential. This would help us to know which one of these issues causes a higher effect on their physical environment.

9.1.5 Land management problems

Managing land uses in the case study area are very complicated issues due to the conflicting ownership of plots, lack of appropriate governmental planning methodologies for conserving heritage values, lack of appropriate regulations for preserving heritage value and decentralized decision-making, the conflict between the Municipality of Baghdad and the State Board of Antiquities and Heritage in managing historic buildings and places. All these issues have led to the demolition and neglect of many traditional monuments. Therefore, in this regard, it is significant to evaluate citizens' opinion about these complex problems, and a question has been asked to estimate the main management problems in Old Rusafa.

9.1.5.1 The main land management problems in Old Rusafa

Lack of local skilled experts in preserving heritage values, lack of the participation of local communities in of the documentation of the cultural heritage and an appropriate identification of the cultural heritage values are essential problems that require an urgent solution to preserve the rest of the historic physical environment in Old Rusafa. Thus, this research has asked a question to understand citizens' opinion that would help this research to make an appropriate framework to deal with such problems.

9.1.5.2 The attitude of the government towards participation of local citizen in conserving heritage values of Old Rusafa

This research has considered citizens' participation as one of the most important aspects of the redevelopment the case study area. It also believes engaging people in making decisions and cooperating in the process of any development scheme will contribute to achieving one of the smart and sustainable methods goals. Governments should play the main role in letting their local citizens share their opinion about their urban development projects. Consequently, in this thesis, we interviewed people to estimate their feeling about the attitude of government towards their participation.

9.1.5.3 The government intention towards promoting cultural heritage area in Old Rusafa

The case study of this research has experienced many development plans; some of these plans have dealt with the old city as a significant area to be advanced as part of the comprehensive development plan of Baghdad. Others, like JCP in 1984 has produced a development scheme to conserve and develop the old city. However, the majority of these schemes have not been implemented due to different reasons like policy issues and wars. Therefore, a question has been raised to evaluate the promotion of cultural heritage area in Old Rusafa by its government.

9.1.6 Sustainability Indicators

A set of urban sustainability criteria has been examined by this research to determine the most relevant criteria to the historic centre of Baghdad that can be assessed in the traditional fabric such as socioeconomic development, and environmental management. By interviewing Baghdadi citizens to gain their point of view about various indicators, would enable this research to set the framework that could implement urban sustainability in Old Rusafa. This section contains five parts and each one has examined different sets of indicators.

9.1.6.1 The importance of quality of natural environment in the historic centre (Old Rusafa)

Natural environment, low gas emission, low use of energy and natural shading are the main features of the urban context of Old Rusafa. It was built to cope with the hot and dry weather during summer, to avoid sandstorms and to minimise the thermal load on the buildings' envelopes, especially houses. Therefore, a question has been asked to evaluate the importance of some of the main indicators that would assist this thesis to produce an appropriate vision on how to advance the physical and natural environment of the case study.

9.1.6.2 The importance of social interaction in the historic centre (Old Rusafa)

Social interaction is a very significant element to promote the smart sustainable city concept. This aspect also plays a fundamental role in the configuration of the social structure of Baghdadi citizens. Thus, enhancing the sense of community, strengthening social interaction and civic life, the standard of living, equity and social participation have been assessed according to public opinion to rate the importance of promoting social interaction in the case study.

9.1.6.3 The importance of a better accessibility to services and facilities in the historic centre (Old Rusafa)

Accessibility to services and facilities is determined as one of the main sustainable indicators that can be assessed in Old Rusafa. Hence, we have prepared a structured interview to evaluate citizens' accessibility to various activities and if they require any type of transportation to get their daily needs.

9.1.6.4 The importance of public health in the historic centre (Old Rusafa)

The healthy environment is the basis for achieving a sustainable environment, and this will require decreases in toxic and nontoxic pollutants in the case study area. In this regards, we have assessed citizens' feeling about how important it is to advance Old Rusafa by obtaining clear water, air and land, and in which way we can reduce individuals' stress.

9.1.6.5 The importance of economic viability in the historic centre (Old Rusafa)

The economic dimension is essential to be assessed in our case study as it represents the CBD area of Baghdad city. This dimension can play a significant role in promoting healthcare, security, resilient and sustainability in the traditional urban context of Old Rusafa. In addition, it is important to find a convenient way to decrease the cost of developing infrastructure, reducing poverty in the historic core and evaluating how the importance of urban maintenance through peoples' opinion. Therefore, a structured interview has been prepared in this regards.

9.1.7 Smart City characteristics

This research is seeking to implement the smart city concept in the traditional core; therefore, we should examine the six smart city characteristics that might be the right solution to solve case study problems. Also to create a successful smart sustainable city strategy for Old Rusafa we should adopt a multi-dimensional approach to maximise such synergy and minimise negative spillover effects. Thus, as this research aims to improve the quality of life for the case study people, we have evaluated the impotence of the six characteristics; smart people, smart living, smart environment, smart economy, smart mobility, and smart governance through citizens' opinion.

9.1.7.1 The importance of smart governance in Old Rusafa

In this part, three main aspects have been assessed e-services, interaction and collaboration with the public, and open data by using ICT, in order to understand citizens' opinion on how they could participate with their government or the Municipality of Baghdad to develop the physical environment of Old Rusafa. Moreover, how could the Municipality of Baghdad create an open service and information platform for their stakeholders to gain their opinion?

9.1.7.2 The importance of smart economy in the historic centre (Old Rusafa)

One of the main dimension that would promote the smart sustainable framework for the case study is to link the invention of an urban context that stimulates modern industrial activities. Thus, we have assessed peoples' opinion on how to advance the innovation, and flexibility of the labour market, as well as the international expansion of the Old Rusafa local economy through using e-business, e-commerce and increasing productivity.

9.1.7.3 The importance of smart mobility in the historic centre (Old Rusafa)

To fix the broken structure of the traditional urban fabric, we should seek to discover new smart and sustainable methods of transportation in the case study that also can reduce air and noise pollution. Therefore, a question has been asked to estimate citizens' opinion about the importance of reducing CO2 emission, finding an efficient method of commuting

and the significance of integrating transport. This assessment would help the research framework to find appropriate approaches that could reduce traffic congestion, improve accessibility, safety, network management, convenience and public perception in Old Rusafa.

9.1.7.4 The importance of smart environment in the historic centre (Old Rusafa)

The environmental characteristics, considered as the main aspect of smartness that determines well-being raises the availability of green places in cities and leads to gain a sustainable environment. This characteristic can offer various types of socioeconomic advantages. Thus, it is significant to assess citizens' view about the importance of smart environment regarding smart energy, pollution control and monitoring, green buildings, green urban planning, resource use efficiency and improving water quality.

9.1.7.5 The importance of smart people in the historic centre (Old Rusafa)

To implement the smart sustainable concept in Old Rusafa, we need to educate citizens and advance their educational level, and they should have the ability to participate in developing their areas through sharing information with their government and using advanced technologies in making decisions. This will require evaluating citizens' feeling about the importance of e-skills, e-working, e-education and e-training. Therefore, a structured interview has been done in this regards.

9.1.7.6 The importance of smart living in the historic centre (Old Rusafa)

The implementation of the smart sustainable concept in Old Rusafa will require utilising sophisticated technologies to improve the quality of life, enhancing ICT and its applications, using modern mobility, employing a new approach of communication between governments and their citizens, efficient use of natural resources, safety and advancing urban quality. Therefore, we have asked a question to evaluate citizens' opinion about the importance of ICT-enabled lifestyles, healthy living, safe living, diverse cultural facilities, good quality housing and accommodation.

9.2 Analysis of the Data Collected by the Questionnaire Survey (The Local Citizens' Views)

We have discussed in the previous chapters the significance of urban heritage, urban sustainability, smart urbanism and the concept of smart and sustainable cities. In addition, we identified the main norms and indicators to achieve the aims of these new methods that might be implemented in our case study to create an advance smart sustainable framework for Old Rusafa. One of the main goals of this thesis is engaging Baghdadi citizens in the process of advancing the physical urban environment of the case study area and consider their opinion as one of the key stages to integrate the thesis methodology. Therefore, we have adopted in our investigation peoples' views and attitudes towards urban heritage and smart sustainable city norms by interviewing them and then analysing the information and presenting answers as graphs and tables.

9.2.1 General Questions

9.2.1.1 Citizens' Characteristics

In this section of the interview, we asked people four questions about their socioeconomic position such as age, qualification, gender and their professional category. In terms of age, the result shows that 78% of the participants were aged between 31 and 50, while 22% of the participants are separated by 12% between age group 20-30 year, 8% between age group 51-60 and 2% from 61 and above (Figure 9.1).

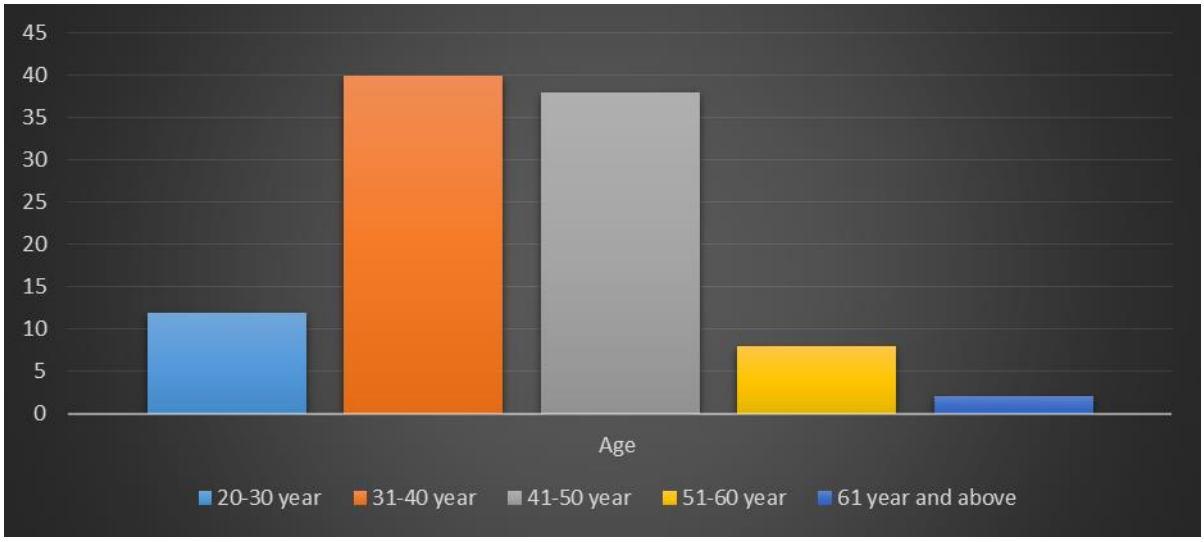


Figure 9.1: Age Group of the Participants
Source: Author (2017)

9.2.1.2 Participants Qualification

It is significant to know participants' qualifications to assess their answers in the later stages and give us a clear view of how they understand research problems and questions. The participants represented a wide range of Iraqi universities and institutes. Thus, it was practical to arrange them into fewer coordinated clusters for the benefit of the data analysis process. Then, the responses to this question were categorised into four groups (undergraduate, postgraduate, high degree and other) (Figure 9.2). The investigation shows that 41% have an undergraduate qualification and an approximately comparable percentage of postgraduate (25%) and higher degree (28%). A further 6% of whom classified their qualification in the other option were also counted.

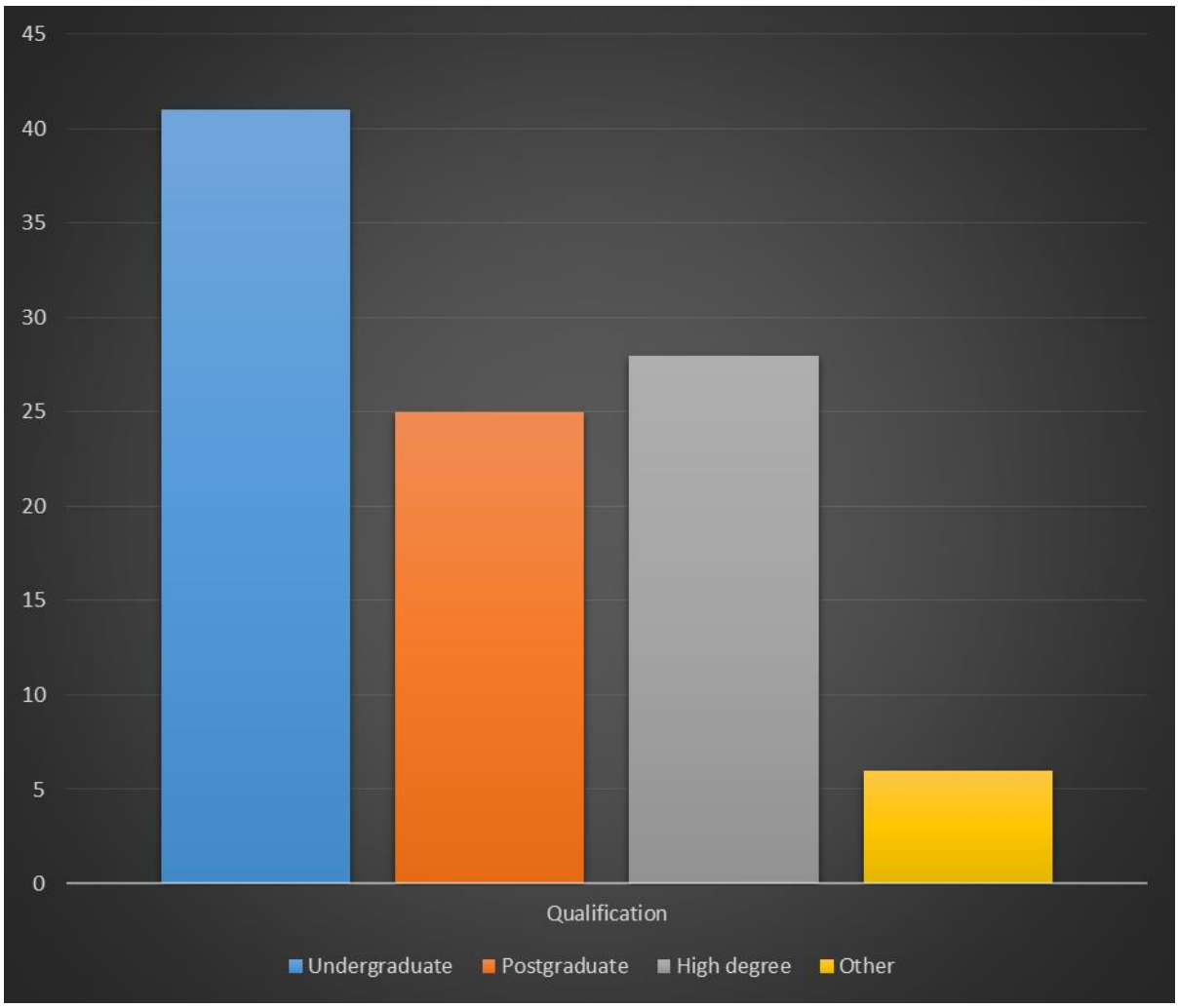


Figure 9.2: Participants Qualification
Source: Author (2017)

9.2.1.3 Participants Gender

The survey of the gender group of the respondents displayed that the rate of males participating in this investigation was 41%, while the corresponding rate for females was 59% (Figure 9.3).

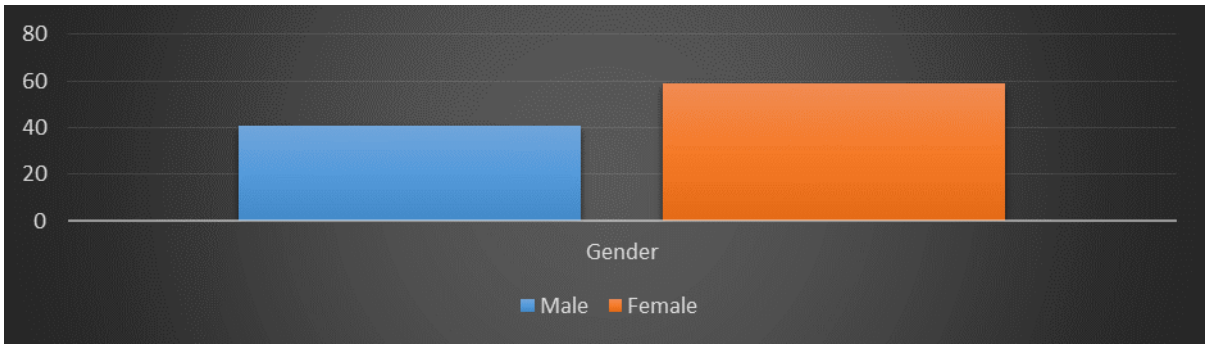


Figure 9.3: Participants Gender
Source: Author (2017)

9.2.1.4 Professional Categories

The survey involved a number of participants according to their professional categories dividing them into five category groups, as indicated in the comparison bar chart academic, proficient, local residents, policy maker and other (Figure 9.4). It was found that the academic category represents 22% of our respondents while the professional category record 40% of participants. On the other hand, only 10% of the investigation participants are policymakers that show interest in receiving back the result of this study. The professional categories of people who are local residents are less than 30%, which also suggests that this research can change and find solutions to the poor physical urban environment where they live.

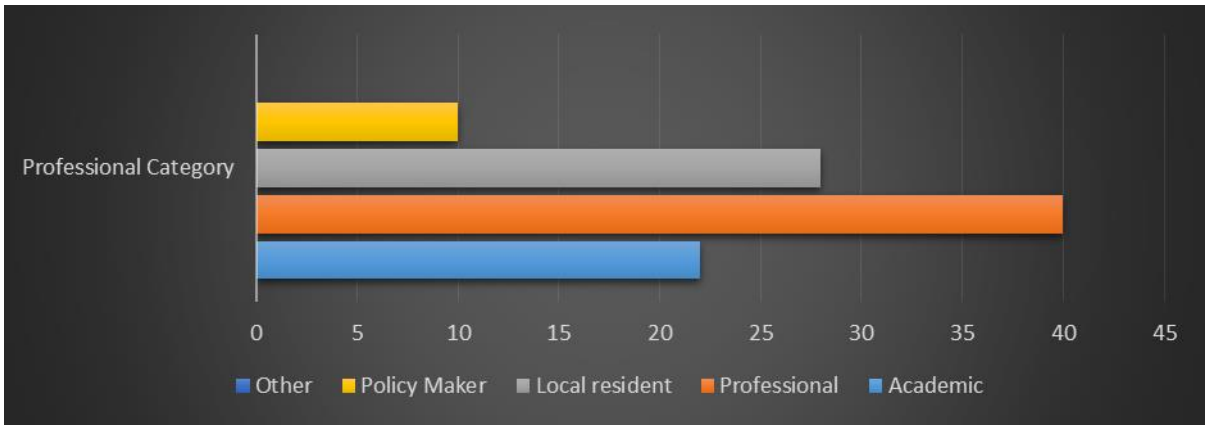


Figure 9.4: Participants Professional Category
Source: Author (2017)

9.2.2 Factors that represent the historic centre of Baghdad (Old Rusafa)

9.2.2.1 The Historic Centre (Old Rusafa) Activities

The historic centre of Baghdad has many activities such as living, working, shopping and governing that make the old part of the city vital. This research has endeavoured to assess these activities through people's opinions, as one of the main aims of this thesis is to engage citizens in making decisions and the process of urban development. This area is suffering from many problems like air and noise pollution, poor infrastructure and lack of advanced services. Therefore, poor and very poor options were the most regarded choices in the question of how they consider the traditional area as a place for living, which accounted for 39% and 24% respectively (Figure 9.5). However, the majority of respondents to questions about other activities have emphasised the level of good and very good among the responses because there are many opportunities for jobs and work as this area represents the major part of CBD of Baghdad. The outcomes show that 42% of the responses agree that this area is a good place for working and 26% are very good. Moreover, 50% of the participants believe that Old Rusafa is a very good place for shopping and covers the majority of their requirements. The results, as indicated in figure 9.11, showing that 70% of the respondents are agreed that this area is a very good and a good place for investing. About half of the participants also indicate that the traditional core is a good district for touring and governing activities.

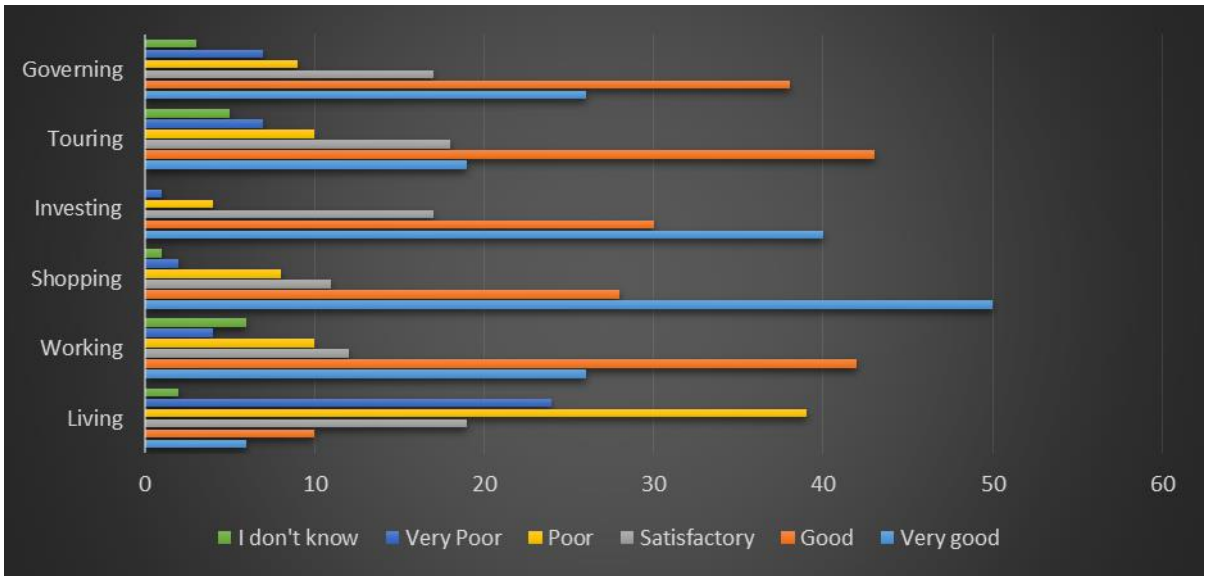


Figure 9.5: The Historic Centre Activities
Source: Author (2017)

9.2.2.2 The Main Features of Old Rusafa

The participants in this survey have assessed the main features of the old centre by providing six short answers very good, good, satisfactory, poor, very poor and I do not know. The respondent agreed that the main characteristics of the traditional core have influenced the relationship between neighbours and played an essential role in creating the livable and sustainable environment. The traditional urban fabric that consists of the traditional courtyard Baghdadi houses and narrow alleys has shaped the physical environment to be more natural and cope with the tough climate. The human scale was one of the features that 90% of the respondents had agreed as very good and a good aspect that has promoted the traditional social values in Old Rusafa. Whereas, 78% of participants have indicated that quality of life was in a poor or a very poor condition due to the deterioration of the built environment and this aspect is what this thesis seek to improve. The result of our analysis also shows that 90% of the interviewees considered the accessibility of shopping was good, very good and satisfactory as there are many elements that have promoted this aspect such as walkable and natural environments (70% of the respondents felt that these characteristics are good and very good) and traditional suqs that are located near them. The investigation also displays that 61% of the responses indicated that the privacy feature was a very good and a good aspect, and this is due to characteristics of the traditional urban form of the old city (Figure 9.6).

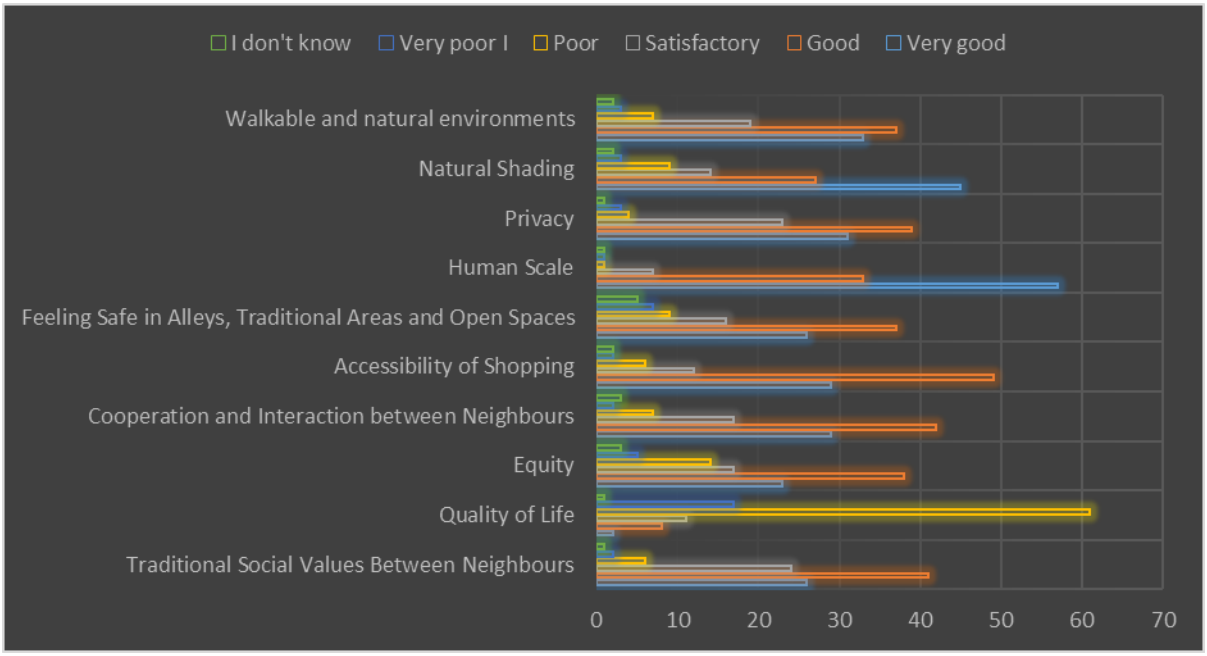


Figure 9.6: The Main Features of Old Rusafa
Source: Author (2017)

9.2.3 Accessibility, Infrastructures and Facilities

9.2.3.1 The accessibility in the historic centre of Baghdad (Old Rusafa)

This question was examining for what the interviewees felt about the different transportation methods in the case study area (How would you rate the accessibility in the historic centre). Strong evidence of poor transport systems was found in Figure 9.7 according to respondents' opinions. From the data in Figure 9.7, it is clear that 72% of the participant believed that the car method was very poor or poor. Moreover, 71% of the participant agreed that the public transportation system was poor or very poor. Cycling was rated as a poor or very poor method with a score 37% and 25 respectively. However, 91% of respondents were satisfied with the motorcycle as a very good or good way of transportation, this is because the motorcycle can carry 6-8 people, cheap, can avoid traffic congestion and reach the destination in the right time. In addition, we can see from the result in Figure 9.7 that the walking method was good or very good with a score of 73%. The assessment of transportation methods according to this investigation shows that the case study area requires a new approach to advancement and this what this research seeks to do.

Figure 9.7: The Accessibility in Old Rusafa
Source: Author (2017)

9.2.3.2 Infrastructures in Old Rusafa

The majority of the participants in this survey asserted that the traditional core was suffering from poor infrastructures when we asked them how you would evaluate infrastructures in Old Rusafa. From figure 9.8, we can see that the digital and energy infrastructures have a high average of very poor conditions with a rate of 66% and 60%. Furthermore, 90% of the responses indicated that sewage is in a very poor and a poor condition. Water supply also was rated as poor and very poor with a score of 48% and 27 respectively. There is strong evidence (42% and 48% of respondents have assessed this aspect in poor and very poor) that the historic centre needs a creative solution to waste management. Transportation was another aspect that the interviewees were asked to evaluate, 53% of the people interviewed answered poor and 26% as a very poor condition. The majority of networks, roads and intersections in Old Rusafa suffer from traffic congestion during peak hours, due to the concentration of many governmental buildings, considering that this part as the central business district of Baghdad and many main roads are utilised for commercial activities. Despite the fact that the majority of answers were divided between the selected options of poor and very poor, a tendency to emphasise the satisfactory option was evident across the minority of the participants. This is because the citizens interviewed felt that the infrastructure situation was impossible to be redeveloped by themselves or even by the Municipality of Baghdad. Therefore, they should cope with what they have.

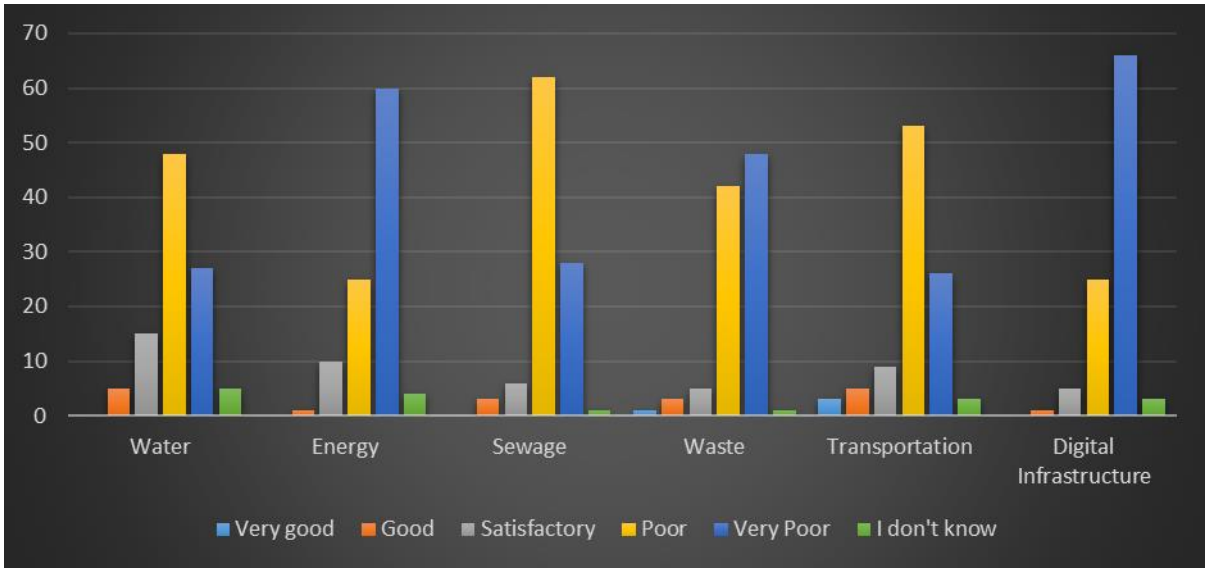


Figure 9.8: Infrastructures in Old Rusafa
Source: Author (2017)

9.2.3.3 Facilities in the Historic Centre of Baghdad

There are many facilities in the old core of Baghdad such as cultural, social and leisure facilities, shopping, religious and educational facilities. These features play a significant role in characterising the identity of its urban form and context. Thus, the goal of this question (How you would assess facilities in the historic centre of Baghdad) was to ascertain the peoples' opinions about these different facilities. The outcomes of this section as it is shown in figure 9.9 were 90% of the citizens interviewed assert that the shopping facility was good or satisfactory. Furthermore, religious facilities were also confirmed by the participants in this survey as good or satisfactory. This satisfaction of these two aspects was the result of the availability of many traditional and modern suqs; moreover, there was also a large number of the historic religious building like mosques and churches. However, 74% of the respondents indicate that cultural facilities were in a poor or a very poor condition. The responses rates (figure9.9) were 76% and 66% for poor or very poor regarding educational and healthcare facilities respectively. The interviewees felt that these aspects were neglected by policy and decision makers, and believe that the traditional centre should reflect its authentic image, cultural identity and urban character by developing these facilities.

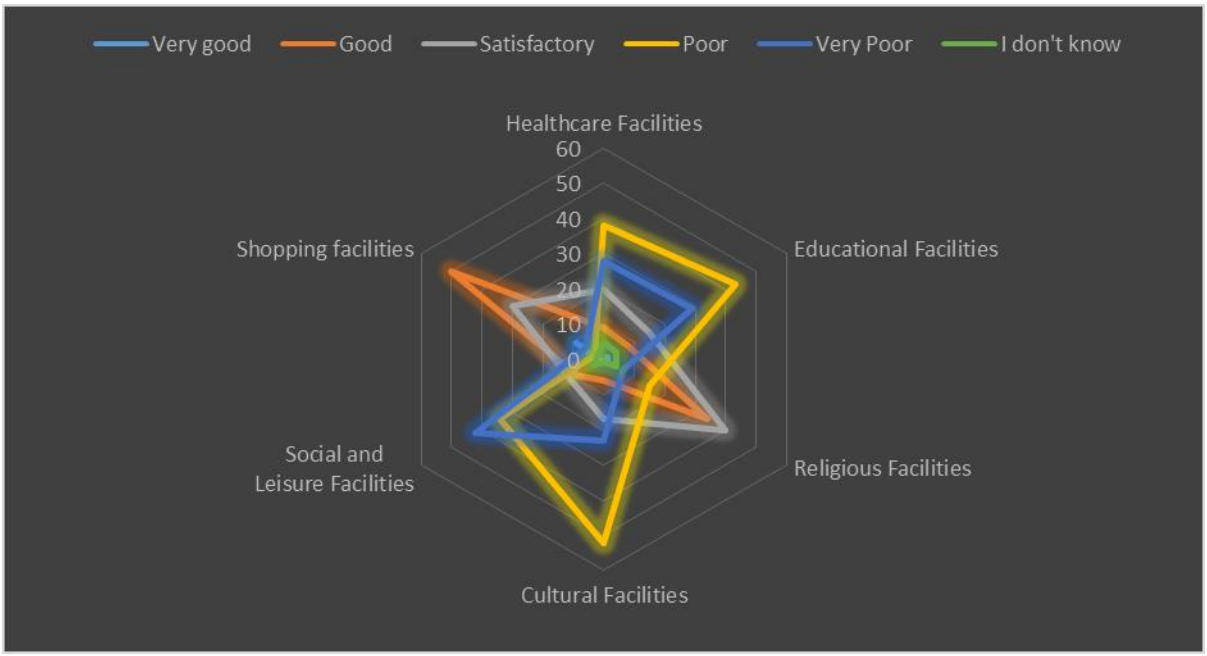


Figure 9.9: Facilities in Old Rusafa
Source: Author (2017)

9.2.4 Deterioration, Pollution and other problems in the Historic Centre

9.2.4.1 The Deterioration Rate in the Main Components of Old Rusafa

Wars, economic situations, lack of conservation plans, lack of new principles to regenerate the traditional urban fabric and other political issues have led to the deterioration in many significant parts of Old Rusafa. Therefore, this section endeavours to explore the rate of the decline of the essential elements of Baghdad historic centre through peoples' views. The vast majority of peoples' opinions emphasise that the deterioration in the historic core components was high or very high (figure 9.10) when we were asking how you would evaluate the deterioration rate in the main components of Old Rusafa. From figure 9.10, we can see that the deterioration of traditional Baghdadi houses have very high and high rates of 51% and 30%, due to the situation that many of these houses were neglected and ignored by government, owners and heritage institutions. In addition, 80% of the interviewees have evaluated the deterioration of the traditional urban fabric as high and very high and 86% of the responses assert that the decline of the physical environment of historical spines was high or very high. They also believe that Rashid Street and squares were suffering from many problems and the deterioration of their traditional buildings was one of these issues with a score of 47% very high and 38% as high. The riverfront of the case study was also assessed by peoples' views with a score of deterioration 77% as high or very high.

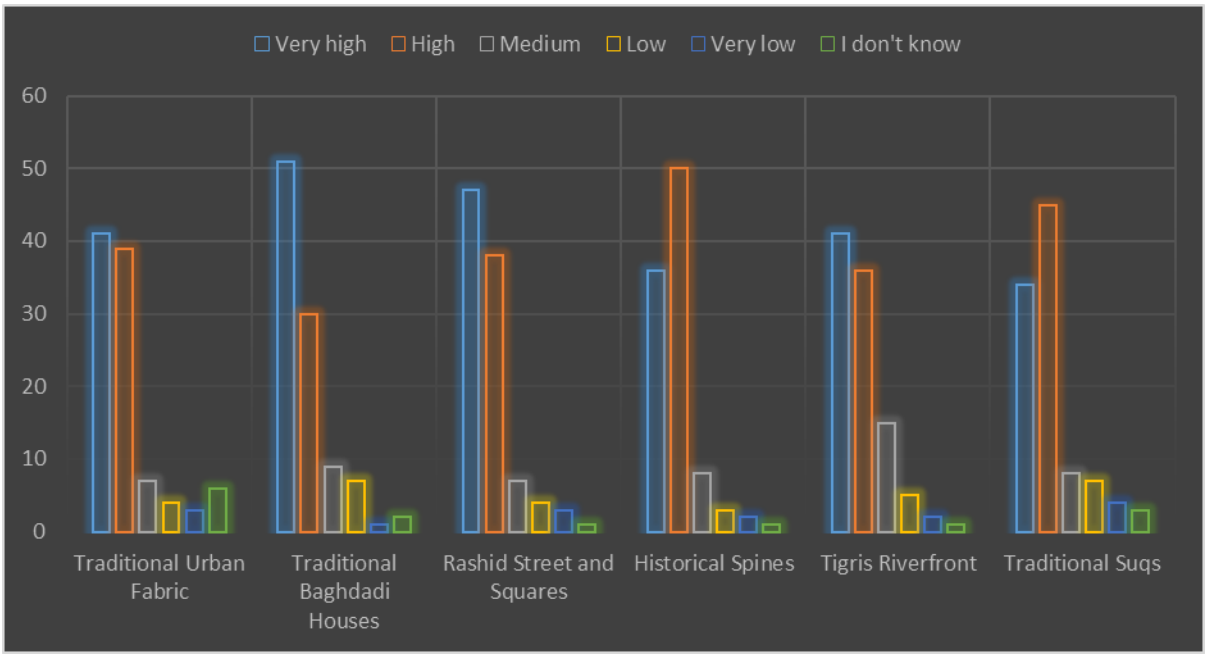


Figure 9.10: The Deterioration in Old Rusafa
Source: Author (2017)

9.2.4.2 The Most Tangible Problems in the Historic Centre of Baghdad

Urban context and form of Old Rusafa have been changed since the opening of four major roads between 1914 and 1945. Therefore, it is an important to understand peoples' views about the most tangible problems in the traditional core such as poverty, safety and land use. To assess the rate of tangible issues of this area we asked a question (How do you evaluate the most tangible problems in the historic centre of Baghdad) and received various responses. From figure 9.11 below, we can see that 94% of the respondents are not satisfied with traffic congestion in the case study area and rated this problem as high or very high. Similarly, household overcrowding issues were rated as very high or high tangible problems with a score of 90%. Moreover, the people interviewed assessed the level of poverty in the case as high with a rate of 64% and very high with a rate of 22%. It is clear also from figure 9.11 that 80% of the interviewees answered that land use problem in this area was high (60%) or very high (20%). Another significant aspect was feeling safe when walking in this area. Improving this element will advance the level of sustainability especially in the fourth main road. It is apparent from the figure below that the majority of participants in this survey answered high or very high (75%), while few people stated that the safety problem was low or very low (11% in total).

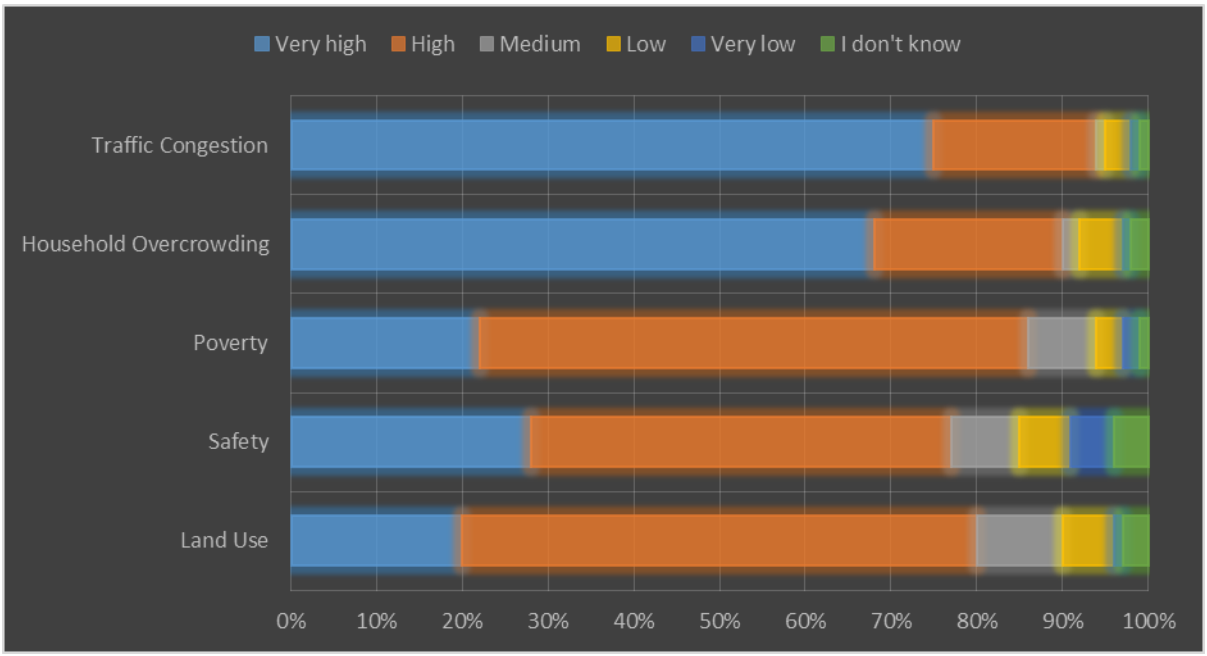


Figure 9.11: The Most Tangible Problems in Old Rusafa
Source: Author (2017)

9.2.4.3 The Rate of Pollution in the Physical Environment of Old Rusafa

For assessment of the level of pollution in the historic core, we asked a question (Would you please indicate the rate of pollution in the physical environment of Old Rusafa?). The results are shown below in figure 9.12. The majority of the respondents have assessed the level of air, noise, water and land pollution in the physical environment of the case study as high or very high. Figure 9.12 shows that most responses to air pollution very high (58%) or high (35%) whereas, few people indicated which asserted that the pollution of the environment was medium (3%). This indicates that participants are not satisfied with the environment of Old Rusafa and believe it requires massive upgrading. As can be seen from the figure below, 59% of the participants have asserted that the noise pollution was very high and 35% of them answered as high while the rest answered (6%) medium, low, very low and I do not know. Strong confirmation of very high or high level of water pollution was found (92%), as can be seen from the information in figure 9.12. In spite of the air, water and noise pollution problems considered by the interviewees to have a high level, they also asserted that land and visual pollutions had a high or very high level with a score of 92% and 86% respectively. The results of this section indicate that the pollution of the physical environment of the case study required new plans and advanced solutions. It also asserts that citizens are looking forward to improving the current situations of this traditional area.

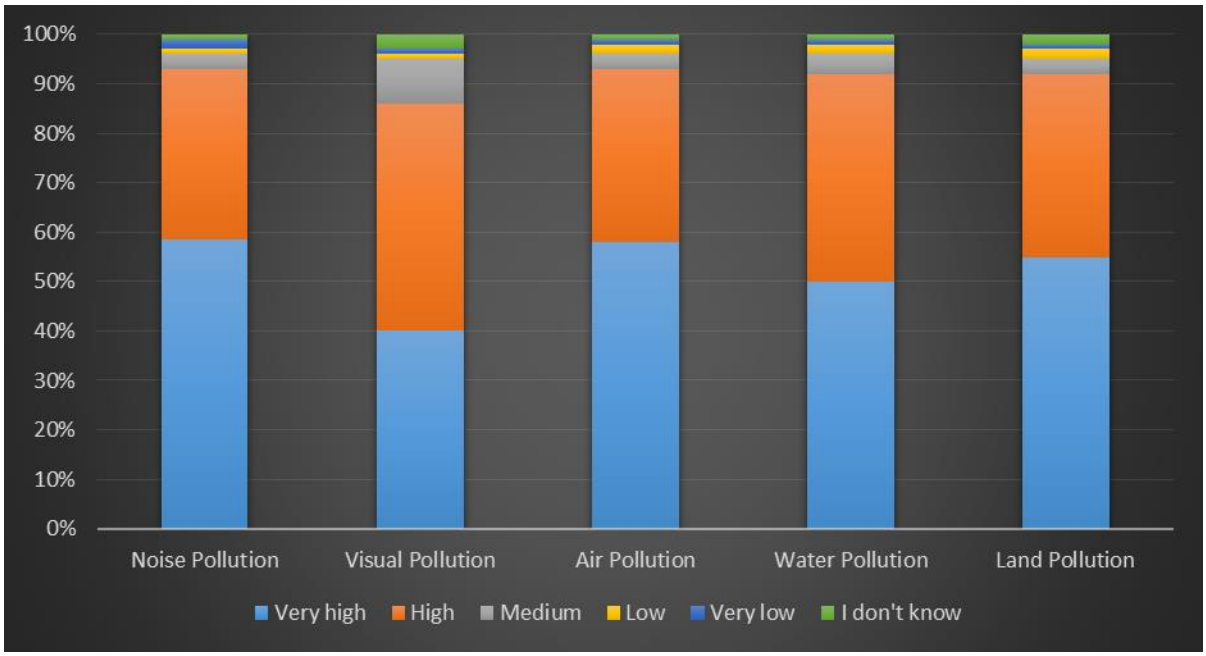


Figure 9.12: The Rate of Pollution in Old Rusafa
Source: Author (2017)

9.2.5 Land Management Problems

9.2.5.1 The Main Land Management Problems in Old Rusafa

In this part, we want to examine the main element that has led to ruin and neglect of many historical monuments and buildings. For this purpose, we asked a question (How would you estimate the main land management problems in Old Rusafa?) with sixth short answers: very high, high, medium, low, very low and I do not know. A variety of responses was seen from figure 9.13. For example, 77% of the people interviewed considered the 'lack of appropriate governmental planning methodologies for conserving heritage values' to be very high and high. Whereas, 72% of participants in this survey asserted that the lack of a maintained register of ownership' was low or very low. Moreover, 65% of the interviewees confirmed that the conflicting ownership of plots was medium or low. The outcomes of this investigation show that the lack of appropriate regulations for conserving heritage values was high or very high with a score of 76%. Similarly, the respondents acknowledged that the lack of maps and plans was low (30%) or medium (24%). While a majority of 46% regarding 'lack of the participation of local communities in the documentation of the cultural heritage' as 'high' with a further 25% viewing such aspects as 'very high' (figure 9.13). From the information in the figure below, it is clear that 70% of those who were interviewed emphasised the appropriate identification of the cultural heritage values was high or very high. In addition, 64% of the responses indicated that the lack of local skilled experts in preserving heritage values was very high and high with a score of 25% and 46% respectively.

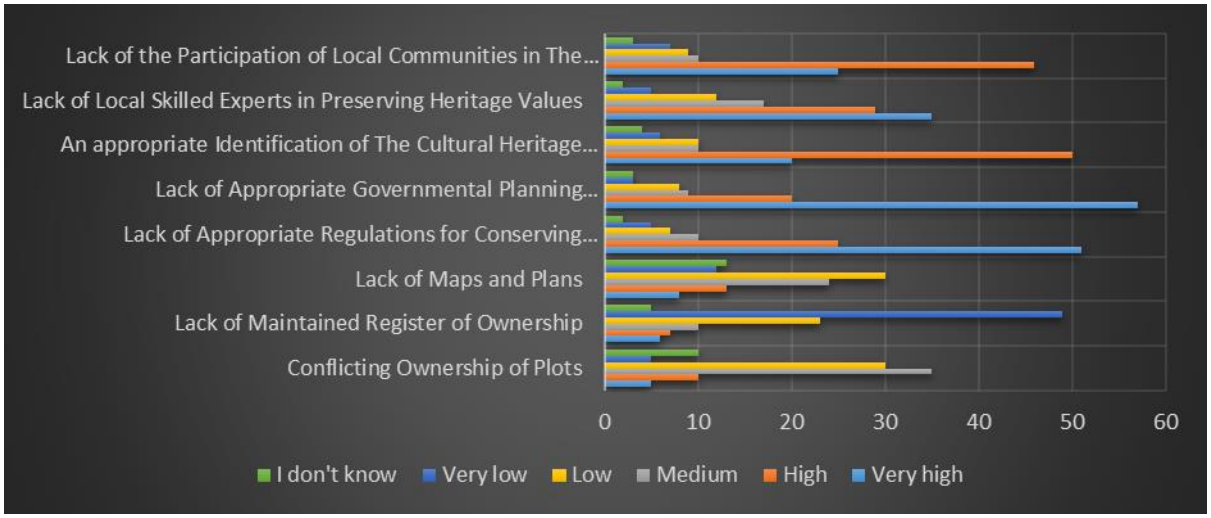


Figure 9.13: The Main Land Management Problems in Old Rusafa
Source: Author (2017)

9.2.5.2 The Attitude of the Government towards Participation of Local Citizens in Conserving Heritage Values of Old Rusafa

In the planning procedure, the participation of local citizen is widely viewed as the main component, and the majority of literature acknowledged that peoples' participation is significant to produce smart sustainable planes. Therefore, we asked the Baghdadi people how do you rate the attitude of the government towards the participation of the local citizen in conserving heritage values of Old Rusafa. The assessment of this section shows that 94% of the answers indicate they belived the attitude of the government was very weak (60%) or weak (34) (figure 9.14).

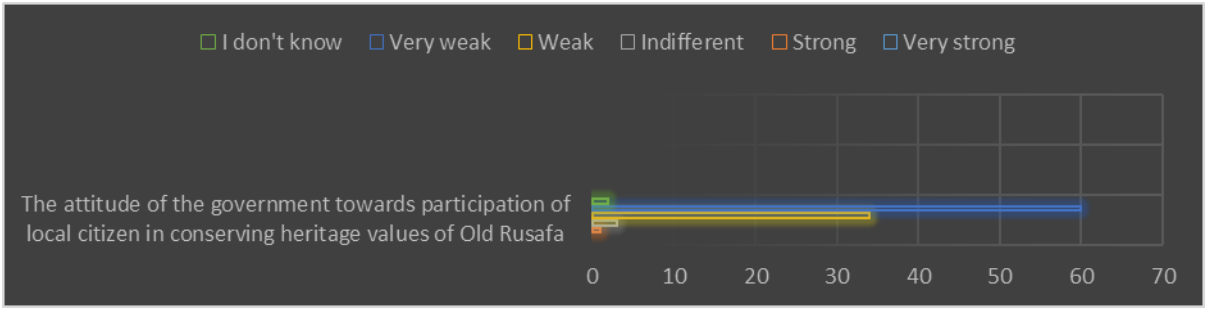


Figure 9.14: The Attitude of the Government Towards Participation of Local Citizen in Conserving Heritage Values of Old Rusafa
Source: Author (2017)

9.2.5.3 The Government Intention towards Promoting A Cultural Heritage Area in Old Rusafa

Old Rusafa is a traditional district with its own cultural identity. In this part, we asked people how you rate the attitude of the government towards the participation of the local citizen in conserving heritage values of Old Rusafa. The vast majority of the response asserts that the promotion of cultural heritage in the historic core was very weak or weak with a score of 92% (figure 9.15).

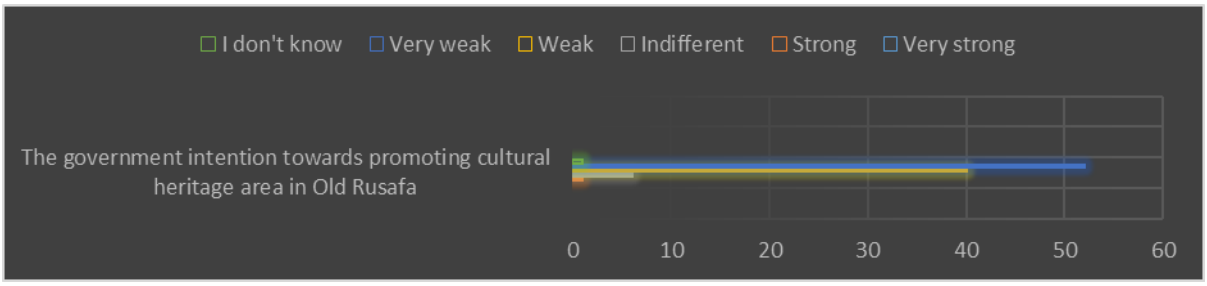


Figure 9.15: The Government Intention towards Promoting Cultural Heritage Area
Source: Author (2017)

9.2.6 Sustainability Indicators

9.2.6.1 The Importance of Quality of Natural Environment in the Historic Centre (Old Rusafa)

One of the main aims of this thesis is to find out the most relevant urban sustainability indicators for the traditional core of Baghdad. The quality of the natural environment is one of these criteria that should be examined to assess the importance of increasing greenery and open spaces, improving air quality, lowering gasoline consumption and resource efficiency for example. A question asked Baghdadi citizens how they rate the importance of quality of the natural environment in the historic centre. According to the survey, 89% of the interviewees asserted that improving air quality was important (20%) or highly important (66%). Furthermore, the respondents agreed that increasing greenery and open spaces were highly important and important with a score of 56% and 24% respectively. It can be observed from the figure 9.16 that over half of those interviewed (52%) confirmed that resource efficiency was highly important. In addition, a minority of responses (10%) asserted that this aspect was moderately important. A vast number of the participants (88%) indicated that promoting opportunities for recycling was highly important (30%) or important (48%). Information from the figure below shows that 82% of the citizens interviewed agreed that lower gasoline consumption was important (40%) or highly important (42%).

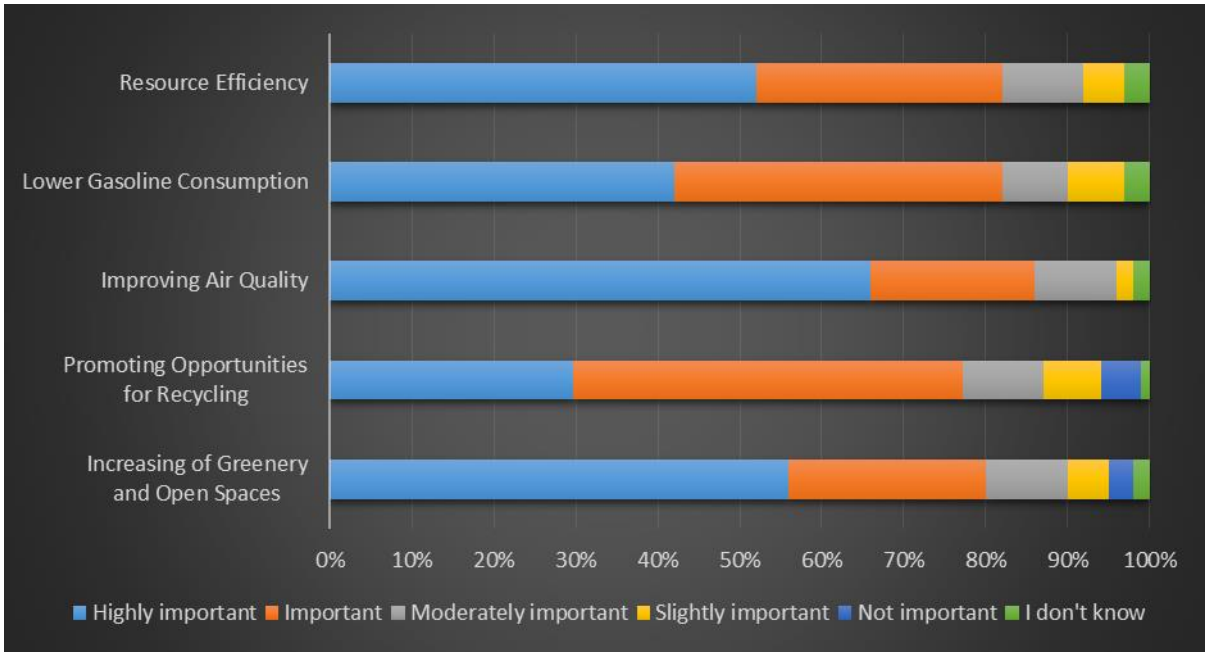


Figure 9.16: The Importance of Quality of Natural Environment in the Historic Core
Source: Author (2017)

9.2.6.2 The Importance of Social Interaction in the Historic Centre

Social interaction is one of the main elements that advance the smart sustainable city concept and one of three key dimensions that form the implementation of urban sustainability methods in cities. How do you rate the importance of social interaction in the historic centre was a question asked to the interviewees in this survey to assess urban sustainability? Equity, the standard of living and social participation, for example, are aspects to be evaluated according to peoples' views to rate the significance of developing social interaction in the case study. It is clear from below that the majority of the participants agreed that all elements of social interaction were highly important and important. The result shows that 91% of the respondents indicate that enhancing the sense of community was highly important (56%) or important (35%). Moreover, a huge number of the people interviewed assert that social participation was important and highly important with an outcome of 20% and 72% respectively. The data from figure 9.17 indicates that equity was highly important (55%) and important (30%) according to peoples' opinions. We can see also from figure 9.17 that 88% of the interviewees confirmed that strengthening social interaction and civic life was another highly important (48%) or important (40%) aspect. In addition, it is obvious from the figure below that almost two-third of the people interviewed (62%) asserted that a better standard of living was a highly important aspect to be achieved in the old city of Baghdad.

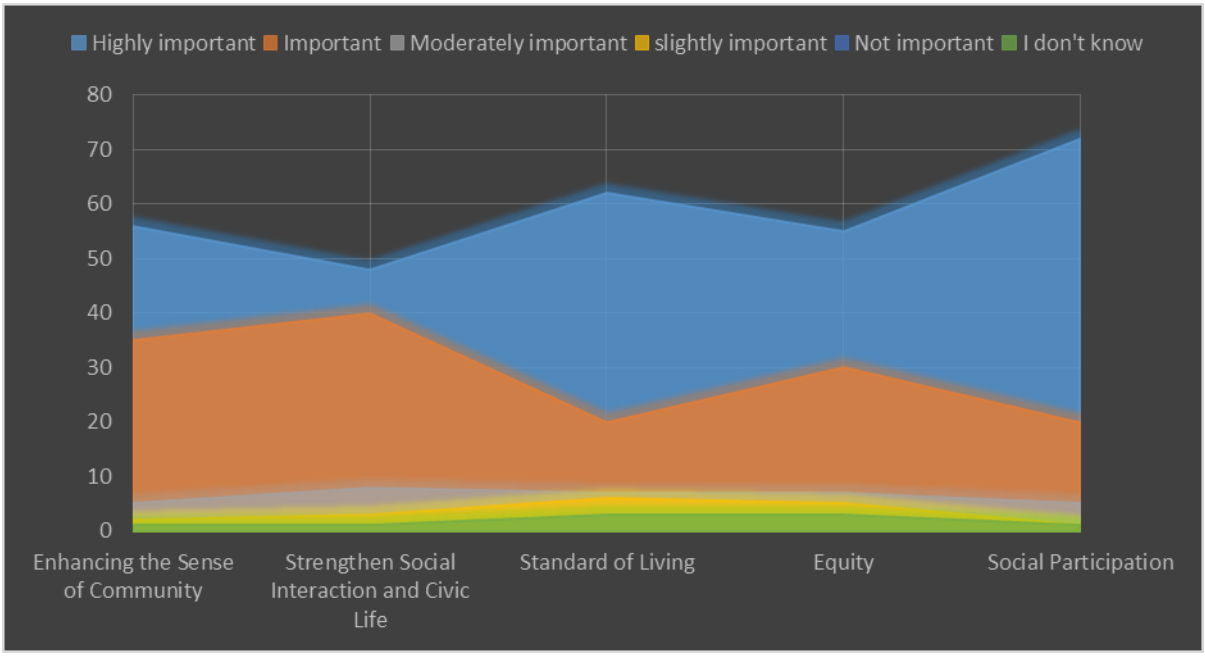


Figure 9.17: The Importance of Social Interaction in the Historic Core
Source: Author (2017)

9.2.6.3 The Importance of a Better Accessibility to Services and Facilities in the Historic Centre

A structured interview has prepared to assess citizens' accessibility to different activities in the traditional core of Baghdad. One of the main sustainable indicators is accessibility to services and facilities; thus, it is important to evaluate how to reduce the need for people to travel, provide socially equitable for services and provide services locally and easy to walk to in Old Rusafa. In spite of the lack of many services that are deeply rooted in the historic core, however, there are, many potentialities may be regarded as a centre for advancement. We asked the participants in this investigation the question (How do you rate the importance of a better accessibility to services and facilities in the historic centre?) with sixth short answers: highly important, important, moderately important, slightly important, not important and I do not know. It can be seen from the information in figure 9.18 the vast number of the people interviewed that the accessibility to services and facilities was an important and highly important aspect of promoting the physical environment in the city centre of Baghdad. The majority of 65% regarded 'provide services locally and easy to walk' as 'highly important', with a further 20% viewing such aspect as 'important' (figure9.18). The vast number of responses regarding 'reducing the need for people to travel' was divided between two options: 'highly important and 'important', which counted for 35% and 60% respectively. Strong evidence from the outcomes of the responses regarded providing socially equitable services in the figure below was 'highly important' and 'important' for 90% of the participants.

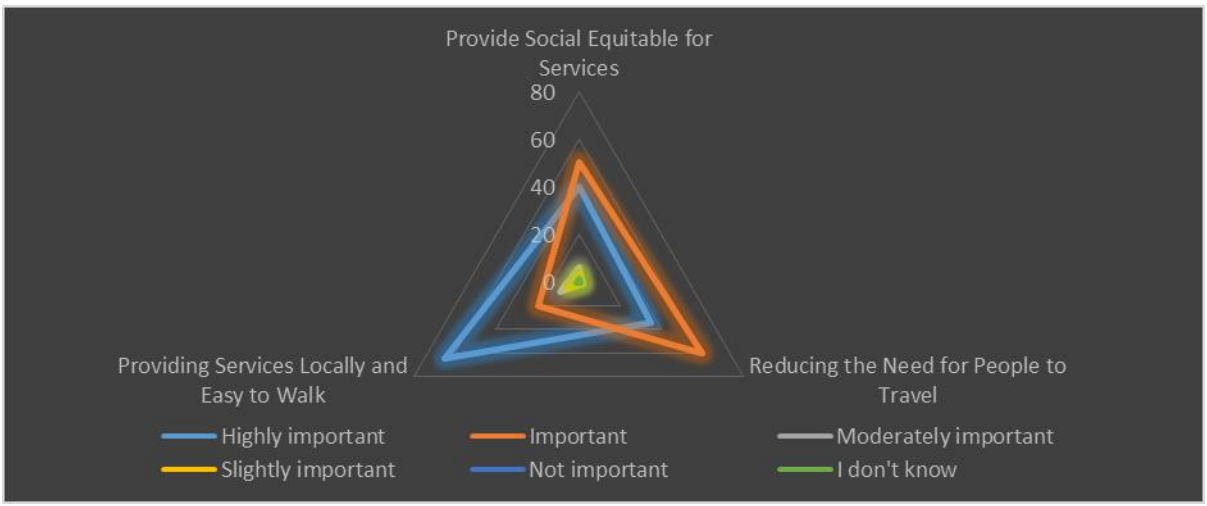


Figure 9.18: The Importance of a Better Accessibility to Services and Facilities in the Historic Core
Source: Author (2017)

9.2.6.4 The importance of public health in the historic centre (Old Rusafa)

Achieving a sustainable environment in the case study of this thesis requires decreasing toxic and nontoxic pollutants. A healthy environment is one of the significant aspects that all cities are seeking when they endeavour to implement urban sustainability or the smart city concept. Therefore, we asked a question (How do you rate the importance of public health in the historic centre?) to assess Baghdadi peoples' opinions about the significance of obtaining clear water, air and land, and reduce individuals' stress. In this section, the majority of the respondents were divided between the two favoured options, 'highly important' and 'important'. Whereas, there was a minority of those who answered moderately important. It can be seen from the figure below that 89% of the citizens interviewed asserted that decreasing toxic and non-toxic pollutants were highly important (67%) or important (22%). Furthermore, 92% of the interviewees agreed that obtaining clear water, air and land in the old city of Baghdad were either highly important and important issues with a score of 75% and 17 respectively (figure9.19). It is clear from the data in figure 9.19 that over a half of the participants (52%) indicates reducing the stress for individuals was a highly important issue and 25% of the respondents answered it as 'important'. The participants in this survey agreed that reducing the intensity of existing life stresses was either a highly important or important issue, accounting for 35% and 40% respectively.

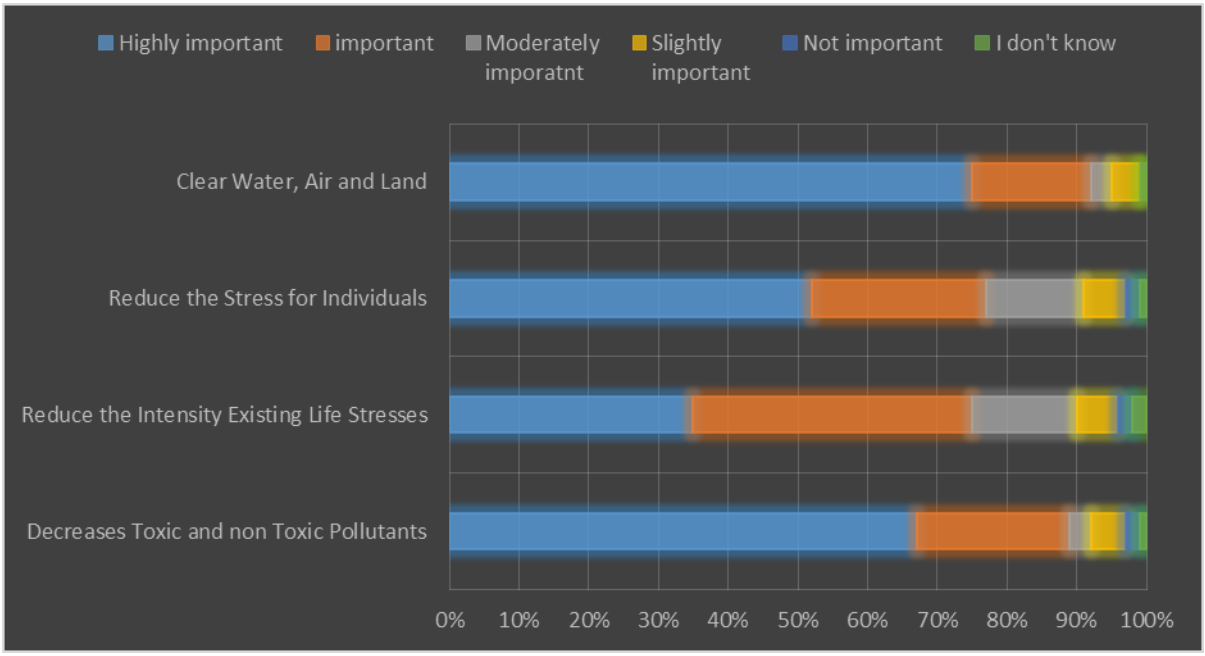


Figure 9.19: The Importance of Public Health in the Historic Core
Source: Author (2017)

9.2.6.5 The importance of economic viability in the historic centre (Old Rusafa)

We prepared a question (How do you rate the importance of economic viability in the historic centre) to assess the importance of economic dimension in the heritage core of Baghdad that represent the major part of the Central Business District. Therefore, this dimension is an important element in advancing the traditional urban context of Old Rusafa to be smart and sustainable. In addition, it is a significant aspect to find out and assess how might decrease poverty and the cost of infrastructure. From the data in the figure below, it is obvious that 90% of those who were interviewed asserted that decreasing the cost of infrastructure was either a highly important (53%) or an important (37%) issue to be considered in the development of Old Rusafa. It can be seen that the responses rate for the reducing poverty issue was rate by 50% as 'highly important' and 30% as important (figure 9.20). The outcomes of this survey show that urban maintenance was highly important and important with a score of 48% and 44% respectively. A vast number of the respondents (81%) considered increasing land values for residential neighbourhoods as a highly important issue (34%) or important (46%).

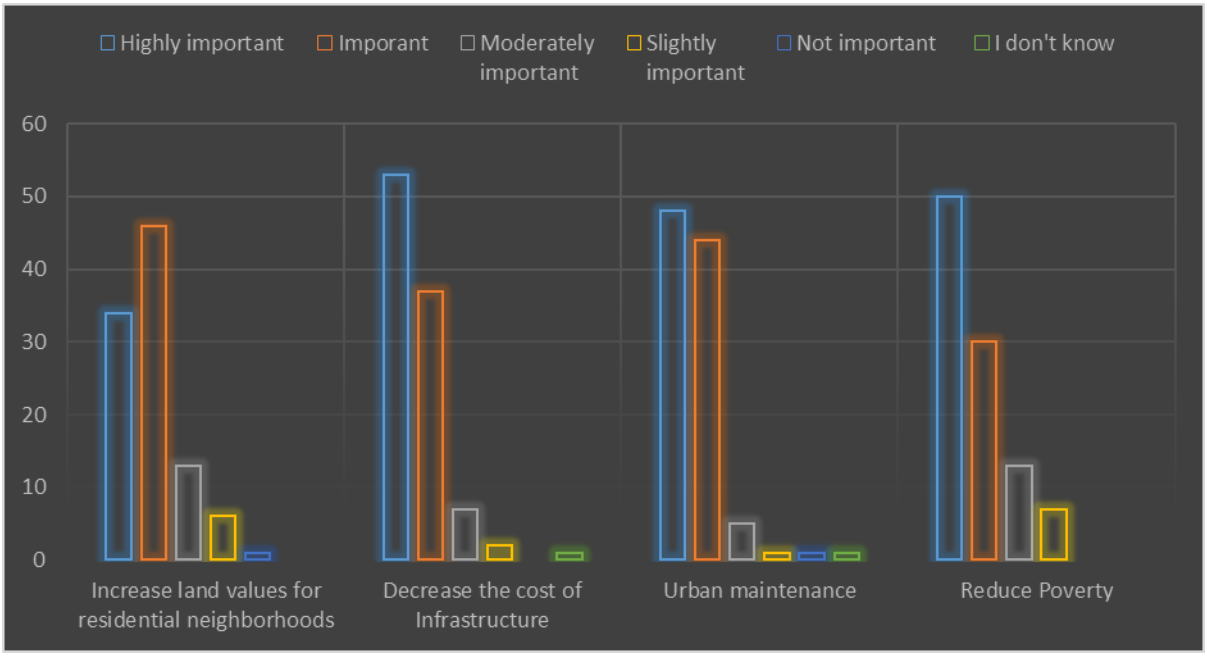


Figure 9.20: The Importance of Economic Viability in the Historic Core
Source: Author (2017)

9.2.7 Smart City characteristics

9.2.7.1 The importance of smart governance in Old Rusafa

The smart governance dimension is one of the essential elements in advancing the smart city concept to play a fundamental role in creating an open service and data platform for their citizens to participate. As this thesis is endeavouring to create a framework to develop the physical environment of Old Rusafa by using new smart sustainable methods. Therefore, three key elements have been evaluated (e-services, interaction and collaboration with public and open data by using ICT) in order to understand peoples' view on how they would evaluate the importance of smart governance and its aspects. From the figure below, it can be seen that a vast number of answers (91%) indicated that interaction and collaboration with the public were highly important (32%) or important (57%). Moreover, the data in figure 9.21 asserts that 80% of the participants in this investigation agreed that open data by using ICT was important or highly important with a score of 28% and 52% respectively. As can be seen from the figure below, less of the people interviewed (10%) answered that e-services were moderately important, whereas, the majority (81%) confirmed that e-services were highly important (46%) or important (34%). This section according to Baghdadi participants' opinion asserts that the smart governance dimension is a significant element to be considered in evolving the traditional urban context of Old Rusafa.

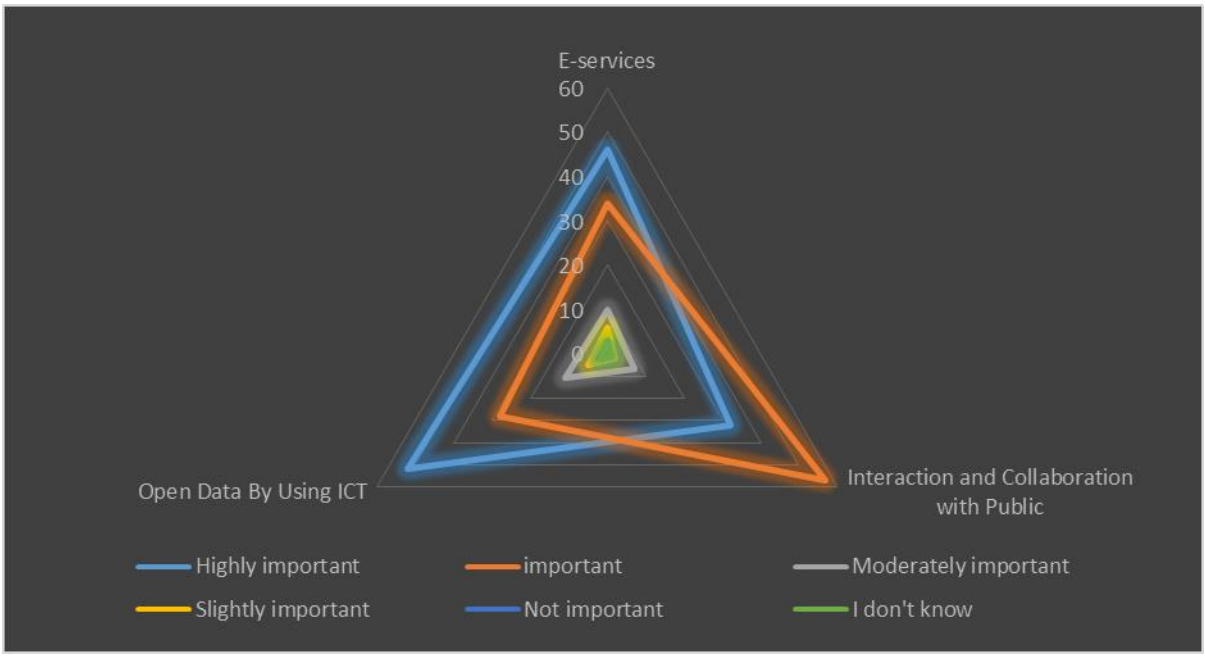


Figure 9.21: The Importance of Smart Governance in the Historic Core
Source: Author (2017)

9.2.7.2 The importance of smart economy in Old Rusafa

This part looked at how many of the interviewed Baghdadi citizens evaluated the importance of smart economy in the historic centre. For an assessment of the importance level of the smart economic dimension, we asked people about the significance of three elements (e-business, e-commerce, increased productivity) that might play a crucial role in characterizing the traditional core with a smart industry that utilizes ICT in their procedures, advancing the competitiveness in its urban contexts and increasing innovation, productivity and flexibility. It is clear from the figure below that two-thirds (63%) of the respondents agreed that e-business was highly important and 32% of the people interviewed asserted that this aspect was important, whereas, fewer people indicated that e-business was moderately important. Furthermore, a majority of participants (84%) asserted that the increase productivity aspects in Old Rusafa were highly important or important with a rate of (44%) and (40%) respectively (figure 9.22). It is obvious from figure 9.22 that the majority of respondents (84%) confirmed e-commerce as a highly important or important element. Thus, the smart economic dimension is an essential aspect to be considered in developing the urban context of Old Rusafa and promoting the smart sustainable framework of the case study.

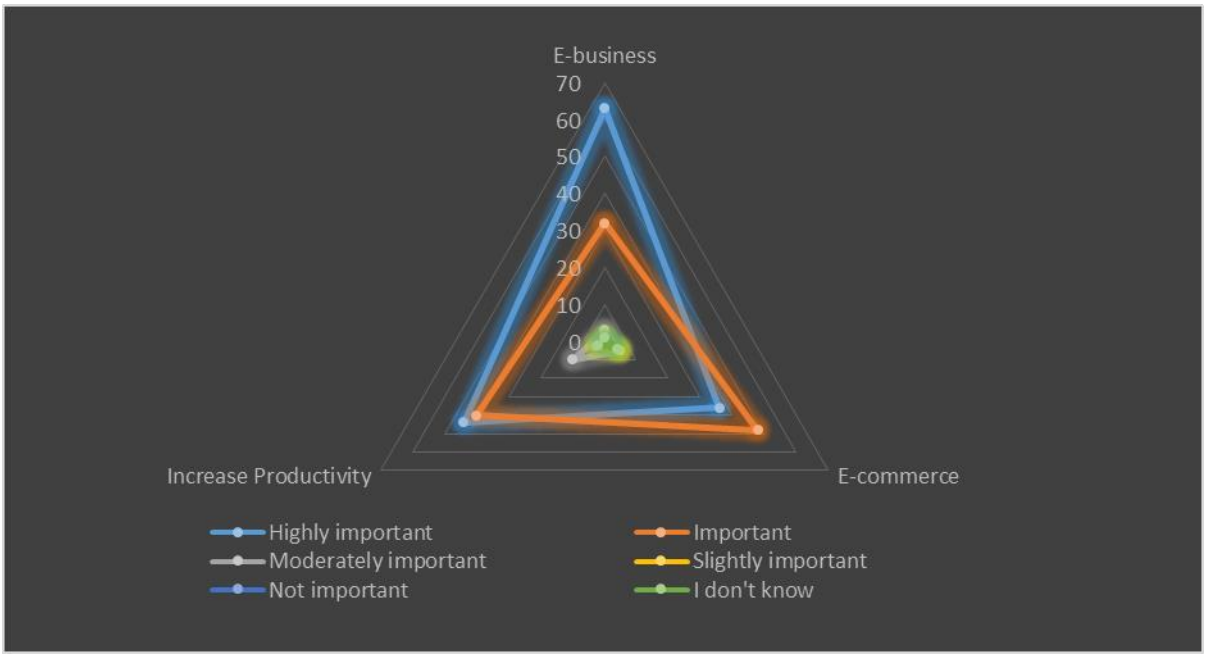


Figure 9.22: The Importance of Smart Economy in the Historic Core
Source: Author (2017)

9.2.7.3 The importance of smart mobility in Old Rusafa

Traffic congestion, poor public transportation and lack of good transportation systems are some of the main problems in the case study area of this research. Therefore, we asked a question (How do you evaluate the importance of smart mobility in the historic centre) to Baghdadi people to assess the importance of smart mobility dimension that might reduce CO2 emission, and find an efficient method of commuting in the historic centre of Baghdad. This question in the survey examined four main aspects (Integrated Transport, Clean and Often Nonmotorised Options, Efficient Commuting, Reducing CO2 Emissions) that would help the research framework to find appropriate smart sustainable methods that could improve accessibility in Old Rusafa. It is evident from the figure below that the majority of the people interviewed (90%) asserted that reducing CO2 emissions in the traditional centre were highly important (65%) or important issues (25%). Moreover, clean and often nonmotorised options were assessed by the majority of respondents (84%) as highly important or important methods that should be implemented in the promotion of the urban context. Information from figure 9.23 shows that a vast number of interviewees (88%) indicate that efficient commuting was an important (28%) or highly important (60%) issue to be considered in the development of the case study area, whereas, fewer participants (6%) assert this aspect as moderately important. We can see from the data in figure 9.23 that the majority of people interviewed in this survey (85%) confirmed that integrated transport was highly important (46%) or important (38%).

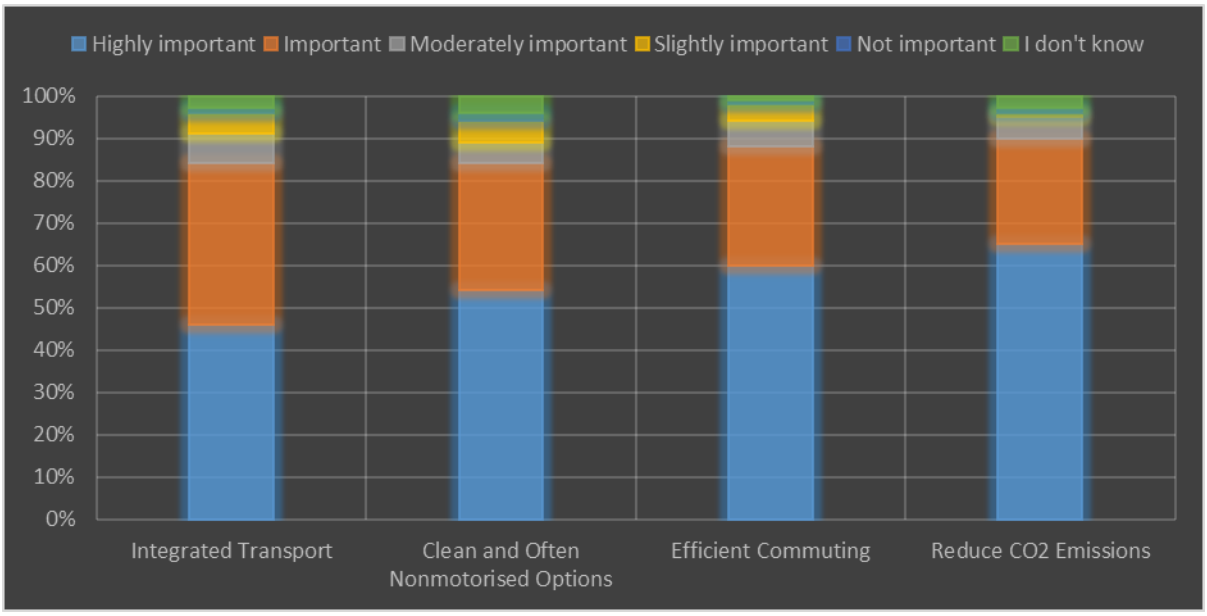


Figure 9.23: The Importance of Smart Mobility in the Historic Core
Source: Author (2017)

9.2.7.4 The importance of smart environment in Old Rusafa

To gain well-being and increase the availability of green spaces in Old Rusafa we need to assess the importance of the smart environment dimension. Thus, we asked people (How do you evaluate the importance of smart environment in the historic centre) with six short answers (highly important, important, moderately important, slightly important, not important and I do not know). The majority of respondents (94%) were divided between the two favoured options, 'highly important' and 'important' when they assessed the significance of green buildings aspects. Moreover, a vast number of the interviewees (90%) asserted that improving water quality was highly important or important with a score of (64%) and (26%) respectively. We can see from the data in Figure 9.24 that 80% of the responses indicate smart energy was important (32%) or highly important (48%). It is clear from the figure below that the majority of the participants (86%) agreed that pollution control and monitoring were a highly important (58%) or important issue (28%) to be considered in the smart sustainable framework of Old Rusafa. Figure 9.24 provides the results of people interviewed and it can be seen that the green urban planning was assessed as highly important (56%) or important (36). Furthermore, the majority of responses (82%) confirm that resource use efficiency was either highly important or important, which counted for 50% and 32% respectively (figure 9.24).

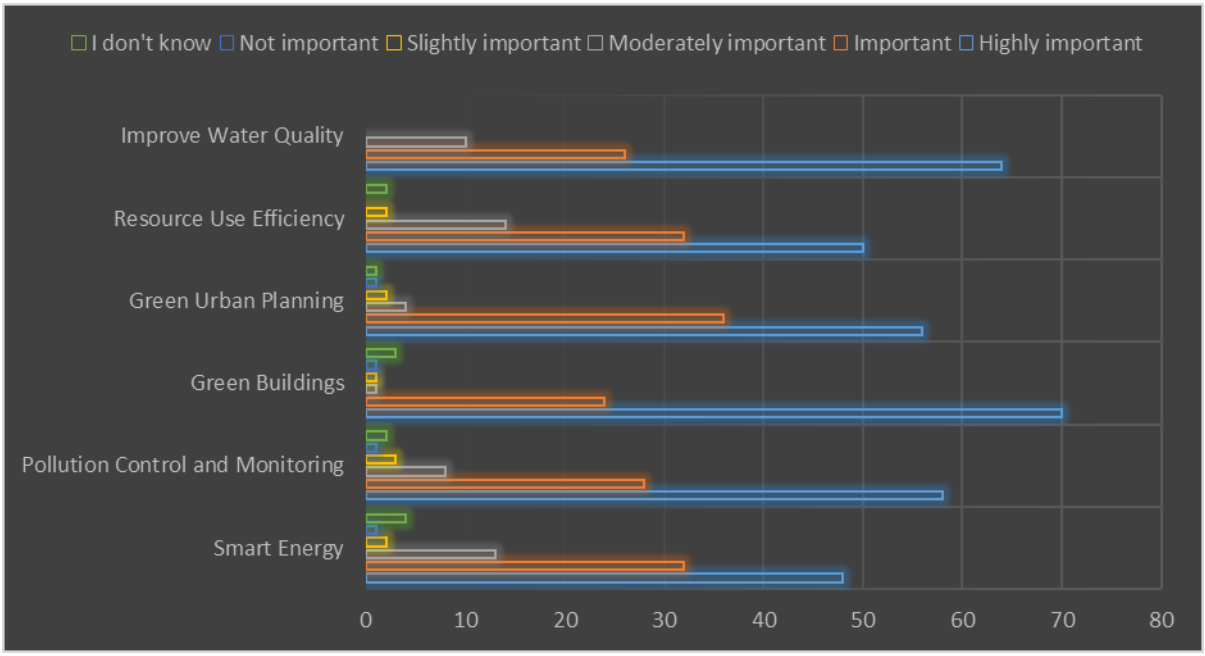


Figure 9.24: The Importance of Smart Environment in the Historic Core
Source: Author (2017)

9.2.7.5 The importance of smart people in Old Rusafa

Educating a city's people and developing their educational level in using advanced technologies is one of the essential elements in the implementation of the smart city concept in the case study area; thus, citizens will have the capability to share their data and opinions in evolving their city. Therefore, we asked people (How do you evaluate the importance of smart people in the historic centre regarding E-skills, E-working, E-education?) with six short answers (highly important, important, moderately important, slightly important, not important and I do not know). A vast number of the people interviewed (89%) emphasized that e-education was highly important or important with a score of (38%) and (51%) respectively. Furthermore, the majority of the interviewees (86%) agreed that e-skills were important (56%) or highly important (30%). We can see from the data in the figure below that the majority of respondents (81%) asserted that e-working was important (28%) or highly important (53%), whereas, fewer participants (14%) in this investigation confirm that this aspect was moderately important (figure 9.25). These aspects will play a significant role in promoting the interactions between people and physical environment in the city; it will also be the key element to advance the quality of life of a city's citizens. Smart people or community will promote the bottom-up method in old Rusafa that will increase the involvement of citizens in making a decision, sharing and managing data, and optimising big data in real time.

Figure 9.25: The Importance of Smart People in the Historic Core
Source: Author (2017)

9.2.7.6 The importance of smart living in Old Rusafa

Improving the quality of life in Old Rusafa is one of the main aims of this research. Therefore, we asked a question (How do you evaluate the importance of smart living in the historic centre?) to Baghdadi people to assess the importance of smart living dimension that might improve ICT and its applications, efficient use of natural resources, safety and advancing urban quality in the case study area. The majority of participants (98%) were divided between the two favoured options, 'highly important' and 'important' when they assessed the significance of safe living aspects. Moreover, a vast number of the interviewees (94%) asserted that healthy living was highly important or important with a score of (66%) and (28%) respectively. It can be seen from the figure below that the majority of responses (85%) agreed that the ICT-enabled lifestyles aspect was highly important (55%) or important (35%). Figure 9.26 shows that a vast number of citizens interviewed (93%) confirm that good quality housing and accommodation aspects was important (28%) or highly important (65%). Moreover, the data in figure 9.26 asserts that 88% of the participants in this survey emphasized that diverse cultural facilities were important or highly important with a score of 52% and 63% respectively. The smart living dimension is an important element to achieve a good quality of life in Old Rusafa through implementing zero-energy building (ZEB) in the historic centre and a better generation of renewable energy.

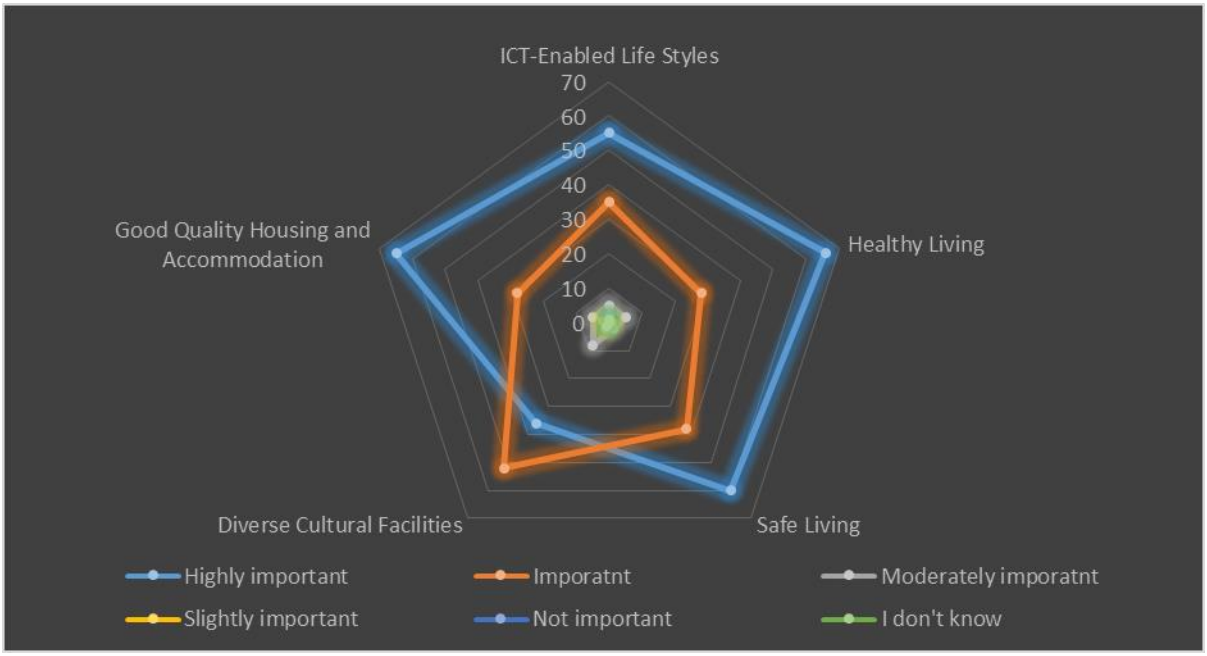


Figure 9.26: The Importance of Smart Living in the Historic Core
Source: Author (2017)

9.3 Discussion and Conclusion

Traditional buildings and areas in Old Rusafa are threatened by excessive official concentration on expansion, without appropriate care to its unique sets of cultural and community features, which has led to an inadequate government method towards conserving cultural identity and supporting the socio-economic and environmental requirements of local communities. Therefore, the majority of the participants in this survey believe that this heritage area (Old Rusafa) should reflect its authentic image, in terms of urban features, residential areas and cultural identity, at the same time modern development should be controlled by the government.

9.4 Chapter Summary

This chapter has clarified the relatively high awareness of the interviewees to the issues facing Old Rusafa. Participants have given many recommendations that hold important weight in suggesting design guidelines and smart sustainable framework for the advancement of the historic area of Baghdad. The quantitative information of the seven parts presented from the interviews with the Baghdadi citizens was assessed and analysed. In the first part of this survey, the responses show that the majority of participants, their age between 31 and 50 and 94% of them hold a university degree. In the second part, the citizens' opinion was assessed, and poor or very poor options were the most regarded options in the question of how they consider the traditional area as a place for living. Whereas, other activities showed as good or very good among the responses because there are many opportunities for jobs and work as Old Rusafa represents the major part of the CBD of Baghdad. In addition, the second section showed that the majority of answers indicated that the key characteristics of the traditional core were very good or good and had influenced the relationship between neighbours and played an important role in creating the livable and sustainable environment. In the third part of this investigation, after assessing the accessibility, infrastructures and facilities, it was asserted by this survey that a vast number of participants confirmed that the case study required a new approach to advancement in their transportation systems, infrastructures and facilities. The fourth section indicated that Old Rusafa is suffering from a very high or high rate of the deterioration of its main components. Moreover, the tangible problems and the level of pollution in the historic core were evaluated by the people interviewed, and the high or very high level was apparent in the case study area. Land management problems assessed

in the fifth part, which asserted that the historic centre is facing a high or very high rate of lack of appropriate governmental planning methodologies for conserving heritage values'. Furthermore, in the fourth section, it was revealed that both attitudes of the government towards promoting cultural heritage area in the historic core and towards the participation of the local citizen in conserving heritage values of Old Rusafa were perceived at a weak or very weak level.

Urban sustainability indicators were evaluated in the sixth part of this survey, which comprised five questions. The first one highlighted the most relevant urban sustainability indicators to the traditional core of Baghdad, the majority of responses asserted the importance of increasing greenery and open spaces, improving air quality, lowering gasoline consumption and resource efficiency in the Old City. Equity, the standard of living and social participation for example, are aspects that are evaluated in the second question of this part according to peoples' views to rate the significance of developing social interaction in the case study, which indicated that a vast number of the participants agreed that all elements of social interaction were either highly important or important. The third question in this part displayed that the old city requires new methods to reduce the need for people to travel, provide socially equitable services and provide services locally and easy to walk to. Therefore, the majority interviewees evaluated accessibility to services and facilities as an important and highly important issue to be considered in the development of Old Rusafa. This research endeavours to implement the smart sustainability city concept in the case study. Thus, a healthy environment and economic dimension were the fourth and fifth aspects discussed in the sixth section that revealed that the majority of the respondents were divided between the two favoured options, 'highly important' and 'important' in the assessment of these two aspects.

Smart city characteristics were assessed in the seventh part of this investigation. This section involved six questions in evaluating the importance and amenability of the six dimensions of the smart city concept in the traditional core of Baghdad. According to participants' view in the first question, smart governance dimension is an important or highly important aspect of creating an open service and data platforms for their citizens to participate. Moreover, the majority of responses asserted that the smart economy dimension is a highly important or important aspect in characterising the traditional core

with a smart industry that utilises ICT in their procedures, advancing the competitiveness in its urban contexts and increases innovation, productivity and flexibility. The third section of this part debated the assessment of advancing transportation systems and using a smart clean method of transportation in the case study area. Consequently, smart mobility was evaluated as an important and highly important dimension to reduce CO2 emission, and find an efficient method of commuting in the historic centre of Baghdad. The fourth section in the seventh part assesses the smart environment dimension, which showed that a vast number of respondents indicated that this aspect was highly important to gain well-being and increase the availability of green spaces in Old Rusafa. Educating citizens and promoting their educational level in utilising advanced technologies showed the highly important level in the assessment of the smart people dimension, it was also considered as an essential element in the implementation of e-skills, e-working and e-education in the historic centre. Improving the quality of life (smart living dimension) in Old Rusafa was the final issue evaluated in this survey. The last section in this part demonstrated that the smart living aspect is a highly important dimension in improving ICT and its applications, efficient use of natural resources, safety and advancing urban quality in the case study area.

This questionnaire survey has endeavoured to participate citizens in determining the potentialities and constraints of Old Rusafa. Therefore, a framework for the design guidelines will be suggested in the following chapter.

The outline of key strategies that have been highlighted and determined to involve smart sustainable framework will be according to the following indicators:

1. Factors that represent the historic centre of Baghdad (Old Rusafa)

A. The survey in Old Rusafa (the area between Al-Rashid Street and the Tigris Riverfront) asserts that the urban sense in the historic center is one of the essential potentialities that should be conserved and developed.

B. The participants in this survey indicate that the traditional core is a good district for tourion and goverment activities.

C. The respondent agreed that the main characteristics of the traditional core have influenced the relationship between neighbours and played an important role in creating the livable and sustainable environment.

D. The assessment of transportation methods according to this investigation shows that the case study area requires a new approach to advancement and this is what this research seeks to do.

2. Accessibility, Infrastructures and Facilities

A. The majority of the participants in this survey asserted that the traditional core was suffering from poor infrastructures such as water supply, sewage and energy. This has brought into focus that the traditional core requires smart sustainable systems to be implemented to solve these problems.

B. Cultural facilities, social and leisure facilities, shopping facilities, religious and educational facilities were neglected by policy and decision makers, there is the belief that the traditional centre should reflect its authentic image, cultural identity and urban character by developing these facilities.

3. Deterioration, Pollution and other problems in the Historic Centre

A. Wars, economic situations, lack of conservation plans, lack of new principles to regenerate the traditional urban fabric and other political issues have led to the deterioration in many significant parts of Old Rusafa, leading to the urgent need for the fulfillment of smart sustainable design guidelines that control the deterioration issues.

B. The results of this investigation indicate that the pollution of the physical environment of the case study required new plans and advanced solutions. It also asserts that citizens are looking forward to improving the current situations of this traditional area.

4. Land Management Problems

A. In the development procedure of our case study area, the participation of local citizen should be considered as the main component and as the main method to produce smart sustainable planes.

5. Sustainable City Indicators

A. The results of this survey confirm that the quality of the natural environment is one of the essential criteria that should be examined in order to assess the importance of increasing greenery and open spaces, improving air quality, lowering gasoline consumption and resource efficiency for example.
B. Social interaction has been considered according to the out comes of this examnation is one of the main elements that advances the smart sustainable city concept and one of three key dimensions that forms the implementation of urban sustainability methods in the case study area.
C. One of the main sustainable indicators is accessibility to services and facilities. Thus, this survey asserts the importance of reducing the need for people to travel, providing socially equitable services and providing services locally and easy to walk to in Old Rusafa.
D. A healthy environment is one of the significant aspects that all cities are seeking when they endeavour to implement urban sustainability or the smart city concept. Therefore, achieving a sustainable environment in the case study of this thesis requires decreasing toxic and nontoxic pollutants.
E. The economic dimension should be considered as an important element in advancing the traditional urban context of Old Rusafa to be smart and sustainable.

6. Smart City characteristics

A. In terms of smart city indicators, the results show that the smart governance dimension is one of the essential elements in advancing the smart city concept in our historic centre and plays a fundamental role in creating an open service and data platform for their citizens to participate in the development of Old Rusafa.
B. The outcomes of this survey emphasize that the smart economic dimension is an essential aspect to be considered in developing the urban context of Old Rusafa and promoting the smart sustainable framework of the case study.

C. The smart mobility dimension should be considered as an important aspect to reduce CO2 emission, and find an efficient method of commuting in the historic centre of Baghdad in thesis framework for resolving traffic congestion and poor public transportation.

D. To gain well-being and increase the availability of green spaces in Old Rusafa we need to consider the importance of the smart environment dimension.

E. Educating a city's people and developing their educational level in using advanced technologies is one of the essential elements in the implementation of the smart city concept in the case study area, thus, citizens will have the capability to share their data and opinions in evolving their city. E-skills, e-working, e-education will play a significant role in promoting the interactions between people and physical environment in the city; it will also be the key element to advance the quality of life of a city's citizens. Smart people or community will promote the bottom-up method in old Rusafa that will increase the involvement of citizens in making a decision, sharing and managing data, and optimizing big data in real time.

F. This survey indicates that the smart living dimension is a significant element to improve a good quality of life in Old Rusafa through implementing zero-energy building (ZEB) in the historic centre and a better generation of renewable energy.

CHAPTER 10: TOWARDS SMART AND SUSTAINABLE URBANISM FRAMEWORK IN OLD RUSAFA

10 Introduction

The case study area has witnessed many initiatives to develop its urban context like the development plan by JCP 1984; however, there is still an absence of understanding about a suitable framework of a smart sustainable urbanism in Old Rusafa. Therefore, this chapter will aim to produce an effective framework and guidelines for the controlled development for the future of Old Rusafa taking into account the new principles and criteria of the smart sustainable cities concept. Furthermore, the ultimate objective of this thesis is the happiness of the city's stakeholders by improving the quality of life, optimising the utilisation use of city resources, preservation and rehabilitation of the historic urban context, providing efficient services, creating a safe life for city's people and secure their information, developing the economic situation and creating new job opportunities in the case study area. This section of our research will respond to thesis aim one and question three-part A and B (page 3).

To understand what new techniques that could reconstruct Baghdad and especially the case study area (the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa) regarding smart sustainable cities, we should consider significant aspects. The main one is the limitations of the smart sustainable cities concept such as technology, communication, infrastructure, people, governance, environment, transport, economy, quality of living. Moreover, the role of culture, history, political, and socio-economic aspects that can play an important role to shape and form the new image for the city, and the influence of ICT that might reduce the lack of standardised terminologies for a "smart sustainable city".

10.1 Comprehensive Smart Sustainable Urbanism Framework

- To produce a smart and sustainable urbanism framework, which provides conceptual solutions to shape the future of Baghdad city centre. These solutions will address the fundamental issues that shape urban form, land use, transportation, open space and the capital city image.
- To create a balance between urban conservation and the criteria of modern urban design (smart sustainable urban design).

The implementation of the rehabilitation the historic centre and preserving its identity and its historical values, the implementation of the comprehensive smart sustainable urban design framework will require a long-term policy mastering a larger set of variables to achieve the aims of this study. The comprehensive smart sustainable urbanism framework will provide a systematic exploration of smart sustainable advancement and implementation. This chapter will try to show how to counter the smart sustainable cities concept challenges by creating new business models, integrating different advanced technologies in an efficient system and promoting the role of government in engaging stockholders in making decisions.

10.1.1 Urban Structure Framework Plan: The Main characteristics, Activities of Old Rusafa, Land Use, Accessibility, Infrastructures and Facilities, Deterioration, Pollution and other problems in the Historic Centre

The main aim of this thesis is to advance the historical physical urban environment of the city centre of Baghdad that is going back to the Abbasid period. There are several aspects should be considered in Old Rusafa advancement such the significance of the Tigris River for the life of the city. This framework endeavours to develop the case study area to be modern, smart and sustainable with preservation to its traditional form that reflect the city heritage identity. This will require cooperation between policy, practice and community. The urban structure framework plan endeavours to implement the broad aims and objectives of this research. Thus, the future vision for the case study area attempts to gain balance between the need to preserve and promote the traditional urban fabric, buildings and areas, and introducing new principles of the smart sustainable concept. It also aims to

develop the historic core by producing diverse and modern social and public facilities. This urban structure framework plan should consider the wider urban context of the old city within the Baghdad, and incorporate substantial strategic steps that are essential to balance the competing requirements forming the old city (figure 10.1).

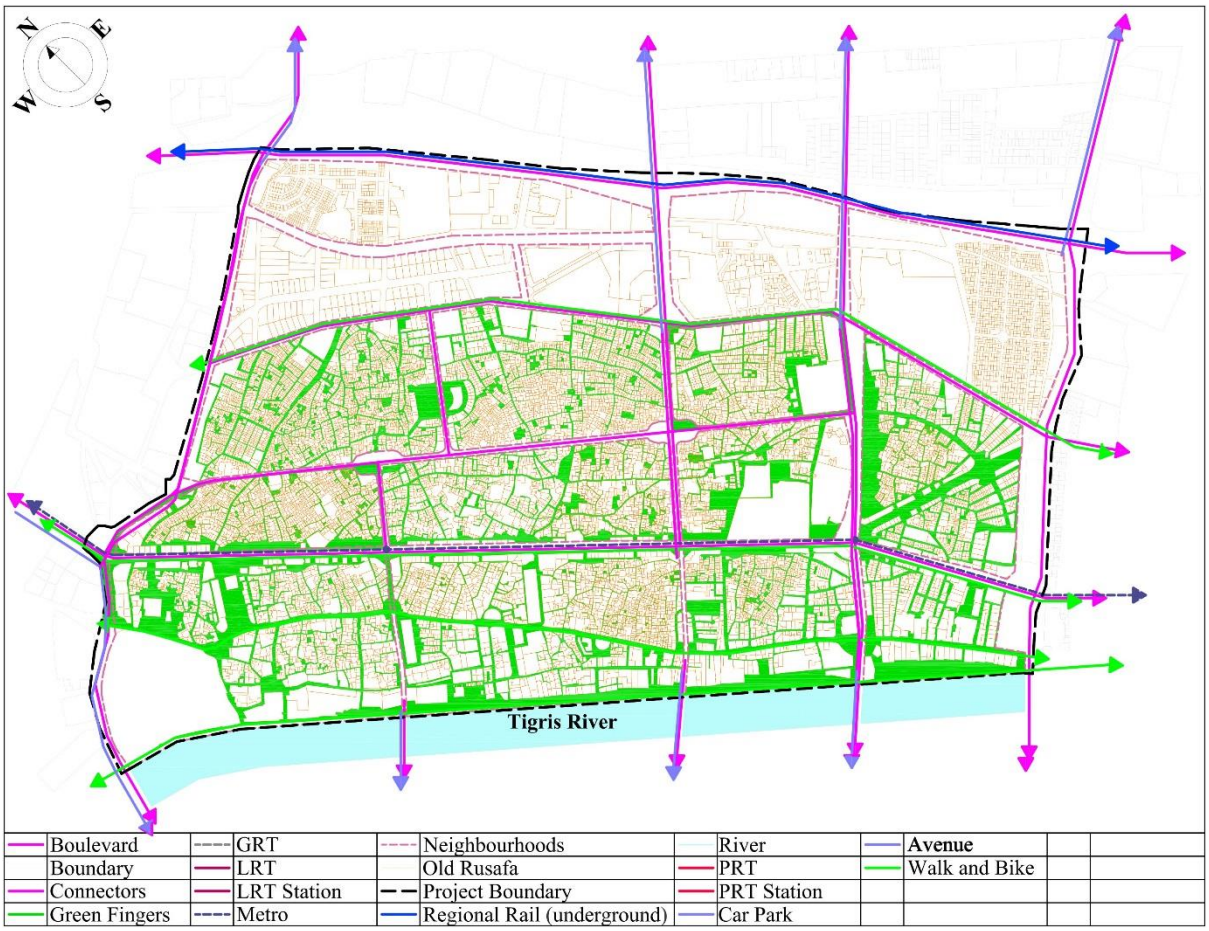


Figure 10.1: Urban Structure
Source: Author (2017)

The case study area has been faced a diverse array of challenges in recent decades, and all development plans were not implemented for political and wars reasons. This research has analysed the existing physical urban conditions of the case study area, which has led to the formulation of definite aims that affected the urban designing and planning strategies framework. These objectives are first, developing Old Rusafa that represent the historic capital of Iraq, recombining the broken physical urban structure of the historic core, preserving the traditional urban fabric and buildings, controlling the new urban development according to new principles that maintain the old city identity and heritage

values. Moreover, balancing and integrating between the new development (especially in Sheikh Omar zone that has a good potential for large-scale advancement) and conservation traditional areas within the old city. There are many elements which emphasise a unique urban fabric that makes the Old Rusafa so special such as traditional suqs, Rashid Street, khans, churches and significant mosques. Conserving these archaeological and cultural features will promote heritage values in Baghdad. Rescuing Old Rusafa by regenerating its urban fabric, the five historical spines and Baghdadi courtyard houses will enhance the quality of life and achieve equity. Traditional urban fabric needs a green and new urban infrastructure that helps to reach the environmental and health standard. As a result, urban sustainability would be measured regarding the long-term environmental and resources protection, including built environment.

One of the main objectives of this research is preserving the traditional city identity and its heritage values. It determines, by the case study analysis in previous chapters, that Old Rusafa represented a significant part of the CBD; thus, this area has the opportunities for redevelopment of its physical urban context and conserving its important traditional places and building. Our framework seeks to enhance the traditional areas and historic pedestrian spines by promoting its features such as narrow streets, human scale, natural shading, high density/low rise living, public spaces, mixed-use, walkable. In addition, produces a more gradual transition between these two (traditional areas and the modern development) contrasting physical urban environments. The urban structure framework plan proposes a well-defined distinction between preservation places and modern places. Al-Rashid Street is to be reserved for cycling, pedestrians and smart mobility, and its traditional character preserved and promoted by enhanced connections with the river and its proposed walkways (figure 10.2). The already heavily deteriorated traditional urban fabrics in the case study area is sacrificed for advancement at these strategic areas of the new city centre.

To make the old centre vital, the urban structure framework plan suggests increasing the main city functions such as residential, public facilities and open spaces. It also proposes to reduce or even move all industrial facilities from the case study area to the outside of the city. Regarding the Riverfront area, our framework plan suggests a pedestrian and cycling path along the Riverfront, increasing entertainment and cultural facilities and creating a landscaped river walks with tourist facilities and boat stops. In terms of Al-Rashid Street,

Figure 10.2: Pedestrians and Smart Mobility in Rashid Street
Source: Author (2017)

we are suggesting to preserve the traditional identity of this main road and allocate it just for pedestrian, cycling and smart sustainable mobility. Furthermore, increasing residential areas between Al-Rashid Street and the Riverfront with more long-term development projects.

The implementation of the proposed urban structure framework plan will be essential to the fulfilment of the objectives of this research. This study suggests that the implementation of this framework should occur through long-term levels of actions up to the year 2030. These actions are:

- Preservation and advancement of cultural heritage.
- Renewal and conserving of historical buildings, areas and monuments.
- Conservation of the historical urban fabric.
- Enhancement of Al-Rashid Street and Tigris riverfront.
- Restoration of traditional spines.
- Improvement of the city centre stockholders.
- Advancement of social and educational facilities.
- Redevelopment of the main areas at Rashid Street and improvement of sug area.
- Development of urban infrastructure.
- Advancement of transportation nodes.

10.1.2 The Case Study Urban Control System Framework

To manage the development framework an efficient way within the boundaries of the case study area, this research requires proposing an urban control system for the area between Al-Rashid Street and the Riverfront. Thus, five efficient stages are proposed urban development, urban form, urban design, land use, and traffic controls. These levels will ensure that preservation and advancement are implemented and guided according to the broad aims of this research. The Case Study Urban Control System consists of conservation and advancement the case study area that includes maintenance of cultural heritage and historical monuments, preservation of the traditional urban fabric. Furthermore, the system should deal with zoning heights and capacity ratios of buildings, building regulations, acceptable and unacceptable land uses in various zones; and traffic controls such as accessibility, time limits and car parking.

10.1.3 Revitalization of Tigris Riverfront Framework

The framework of this research aims to create an environmental walkway along the riverfront of the case study area and determines principles that might revitalise Tigris Riverfront. Design criteria have been embraced in this study to produce a basis for any future design scheme. These guidelines are:

1. An environmental pedestrian walkway should be implemented along Tigris Riverfront started from the Citadel (Zone A, Ministry of Defence) to the end of Zone D. This walkway should reflect the identity of Old Rusafa characteristics and interconnected with the features of the adjacent places of the old city. The pedestrian walkway should also consider the relation and interconnection with the inner part of the historic city; it should examine the pedestrian paths leading from the traditional area towards riverfront (figure 10.3).
2. Various levels should be implemented along the waterfront that realises the urban physical requirements of the case study area. These levels should also achieve the requirements of environmental aspects, planted to provide shades and protected gathering areas. Furthermore, the waterfront levels should cope with changing in Tigris River level and provide suitable areas to get a river transport.
3. Redevelop the edge of the Tigris River by vertical walls especially in constructing these different levels.
4. The framework aims to enhance and promote different functions that overlook the waterfront such as entertainment and social facilities. These entertainment and social functions will promote social interaction in the case study area.
5. Improve the visual aspect of the riverfront by replacing the poor condition and modern structures with smart sustainable buildings that reflect the cultural value of the old core. These new infill buildings also should integrate with traditional riverfront elevation, have brick and timber facing materials and not exceed 2-3 storeys.
6. The traditional and historical buildings should be preserved and enhance their function that associate with the cultural and entertainment features of the new waterfront.
7. Advances the empty spaces with new development that integrates the present of Tigris Riverfront.

8. Tigris Riverfront should be developed according to the new principles of the smart sustainable cities concept.

Figure 10.3: An Environmental Pedestrian Walkway along Tigris Riverfront
Source: Author (2017)

10.1.4 Revitalization of Al-Rashid Street Framework

1. Al-Rashid Street requires new methods of rehabilitation its heritage identity and historical value. According to the research analysis, this traditional street suffers from many problems such as traffic congestion, deterioration many of its traditional buildings and poor infrastructures. Thus, this research framework proposes appropriate measures that might have the ability to preserve and develop the street physical environment (figure 10.4).

2. Infill new buildings in empty areas should integrate with traditional street elevation by using brick and timber facing materials and not exceed 2-3 storeys.

3. Advance the visual aspect of Al-Rashid Street through improving and preserving its traditional buildings and promoting its urban spaces with green open areas.

4. The continuity of collonaded arcades with a rich diversity in their details is the aspect that characterizes the traditional street. Each traditional building located in the main elevation of Al-Rashid Street has columns with a particular design. Therefore, we should enhance the continuity of colonnaded arcades to preserve the streetscape of the traditional street. Conserving the colonnaded arcade and column in the development places will lead to regulate and promote the unity of the physical urban structure into the appearances of the new and old townscape.

5. Al-Rashid Street has several strategic nodes that play a significant role in characterising its cultural value. Therefore, it is important to pay particular attention in the development of the physical urban environment along this street, further, should create a more public character in these influential nodes, and even in the places that are not targets of direct preservation measures.

Figure 10.4: Development of Al-Rashid Street Physical Environment
Source: Author (2017)

6. One of the main element in the development of Al-Rashid Street is respecting the physical historical urban environment through improving the functions and environment of the old city and particularly of the present social activities of the surrounding areas.

7. The promotion of Al-Rashid Street will participate in the future development vision of Old Rusafa. Consequently, it is essential to consider smart, sustainable strategies in the development framework of the historical city centre that conserve its traditional appearance.

8. It is also fundamental to advance and promote the configuration of the physical urban functions and environment in harmony with the traditional environment (figure 10.5). This arrangement will play the role of a plugin that will interconnect and resuscitate the places at both sides of the traditional street.

9. Constructing new buildings instead of the poor modern structures and especially in the focal area that respects the form of the traditional street and integrating with the preservation of historical buildings, and the traditional alleys form under an environment with renewed appearance.

10. This framework proposes to create new open spaces in the form of a plaza along Al-Rashid Street that will shape the amenity core of the advancement place.

11. It is important to manage and control the skyline of the old city and respect the height of the historical buildings, which play an essential role in the creation of the locational identity.

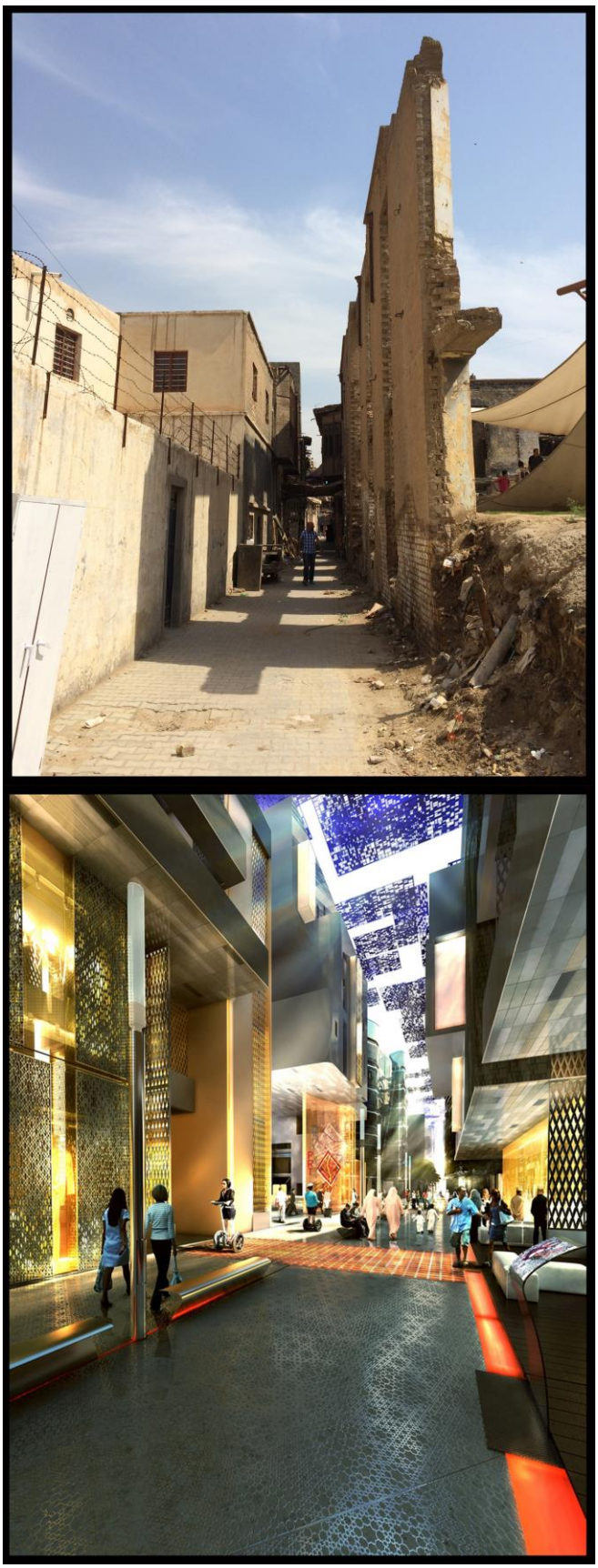


Figure 10.5: the Configuration of the Physical Urban Functions and Environment
Source: Author (2017)

10.1.5 Smart Sustainable City characteristics

A smart sustainable urbanism framework in Old Rusafa aims to provide an efficient quality of life for the old city stockholders with the lowest environmental footprint, zero waste, clean-tech cluster, renewable energy and rehabilitation the traditional urban fabric with its historical buildings. This framework seeks to create a modern city in the historical environment with less impact on the environment. This will require a huge investment in different aspects, develop the city economy and relationship and collaboration with various institutes that have expenses in advanced technology.

10.1.5.1 Smart Sustainable Governance in Old Rusafa

Nowadays the Iraqi government is facing significant challenges to moving toward the new age of sharing information with its stakeholders and using ICT, IoT, advanced technology and smart sustainable principles. These new concepts will play an important role in promoting the relationships between the Municipality of Baghdad and its stakeholders, and they will also play an essential role in creating a new thinking of urban management in the information age. This framework endeavours to employ these methods to achieve jobs-friendly, healthy environment, better quality of life and smart sustainable education. Smart sustainable governance framework in Old Rusafa also seeks to invest in human and social capital and promote the participation of governance in creating a smart sustainable platform of sharing information in real time with its people. Moreover, this framework purposes to implement ICT infrastructure in the urban context of Old Rusafa that enhance smart sustainable economic growth and gain a high quality of life. In addition, one of the main framework objectives is to create a holistic method that allows stakeholders in Baghdad go online through their smartphones, computers and advanced technologies to contact to citizens, hospitals, local government, public transportation, schools and socio-economic and cultural services to develop collective skills and capacities. Smart sustainable governance in Old Rusafa should:

- Integrate city governance, organizations, services with public, private, civil, and community organizations in order to create efficient, effective and green city functions working as one organism.

- Utilize ICT infrastructures, hardware and software and e-government will participate in promoting transparency, open data, decision-making and e-services.

- Combine with other cities national and international, which could be described as quintessentially a globally networked hub.

- Enhance stakeholders' participation in urban decision-making procedures, advancing new services, improving the quality of life, and the accomplishment of diverse instruments for participation, service combination, and information exchange.

- Create an open information platform for their citizens to collaborate in improving job opportunities, business creation, services, environmental aspects, and minimize CO2 emission.

- Balance both top-down and bottom-up governance approaches to implement a dynamic smart sustainable city management.

- Develop a new relationship between governments and their stakeholders, and share challenges and aims with general electronic governance goals to improve different aspects in the case study area such as traffic management, urban planning, and public transport.

10.1.5.2 Smart Sustainable Economy in the historic centre (Old Rusafa)

The major part of CBD is located in this historic core of Baghdad. Therefore, it is essential to integrate industry, economy and commerce by introducing big data as the core to manage the old city. The smart sustainable economy in Old Rusafa will aim to implement an active economy by investing in the quality of life that will lead to attracting knowledge workers and best talent to live and work in the case study area. It will also seek to attain e-business, e-commerce and increased productivity. The economy framework endeavours to utilise ICT and advance technology in manufacturing operations and delivering services, and in creating new services and smart sustainable business models. Establishing smart

sustainable clusters and ecosystems in the historic centre will increase innovation, productivity, entrepreneurship, and flexibility of the labour market. It will lead to integrate local and global interconnection and international embeddedness with physical and virtual flows of goods, services and knowledge.

The success of this framework associated with the gross domestic product, local economic situations and growth ratio of the case study area and its development. The excellent economic development in the old core will lead to improving the financial resources that play a significant role in investing in new projects such as health and culture, water and waste infrastructures, energy, and ICTs infrastructures. Smart sustainable economic growth in Old Rusafa will attract stakeholders who want to develop their quality of life and enhancing their human capital. It will also create new dynamic generation and advance outputs. This framework will seek to implement integrative ecosystems that are improved by the highest level of advanced technology and engagement of private associates and feasible business patterns that lead to developing the competitiveness of urban physical contexts in the global knowledge economy.

10.1.5.3 Smart Sustainable Mobility in the historic centre (Old Rusafa)

The main problem in the historic centre is traffic congestion, by spreading traffic loads evenly through the roadway system, starts with a good land use plan. Creating a comfortable and efficient transportation scheme is the first stage of formulating efficient and environmentally sound transportation systems. Walking and cycling are keys to the Transportation Framework (figure10.6). Most journeys begin and end with a walk, so no matter what form of transportation people ultimately will choose. This will demand to increase the width of sidewalks, adding the shade of trees and shading devices, and comprehensively designing the entire public realm. Encouraging people to walk or to cycle, providing suitable ways to access to the centre and secondary centres and reducing the need for a car will reduce the impact on the environment and minimise air pollution. Promote movement linkages between two sides of Tigris River by using river transportation as a part of Transportation Framework of metropolitan Baghdad. A well-conceived transit network will help guide and phase development as Baghdad’s population increases.

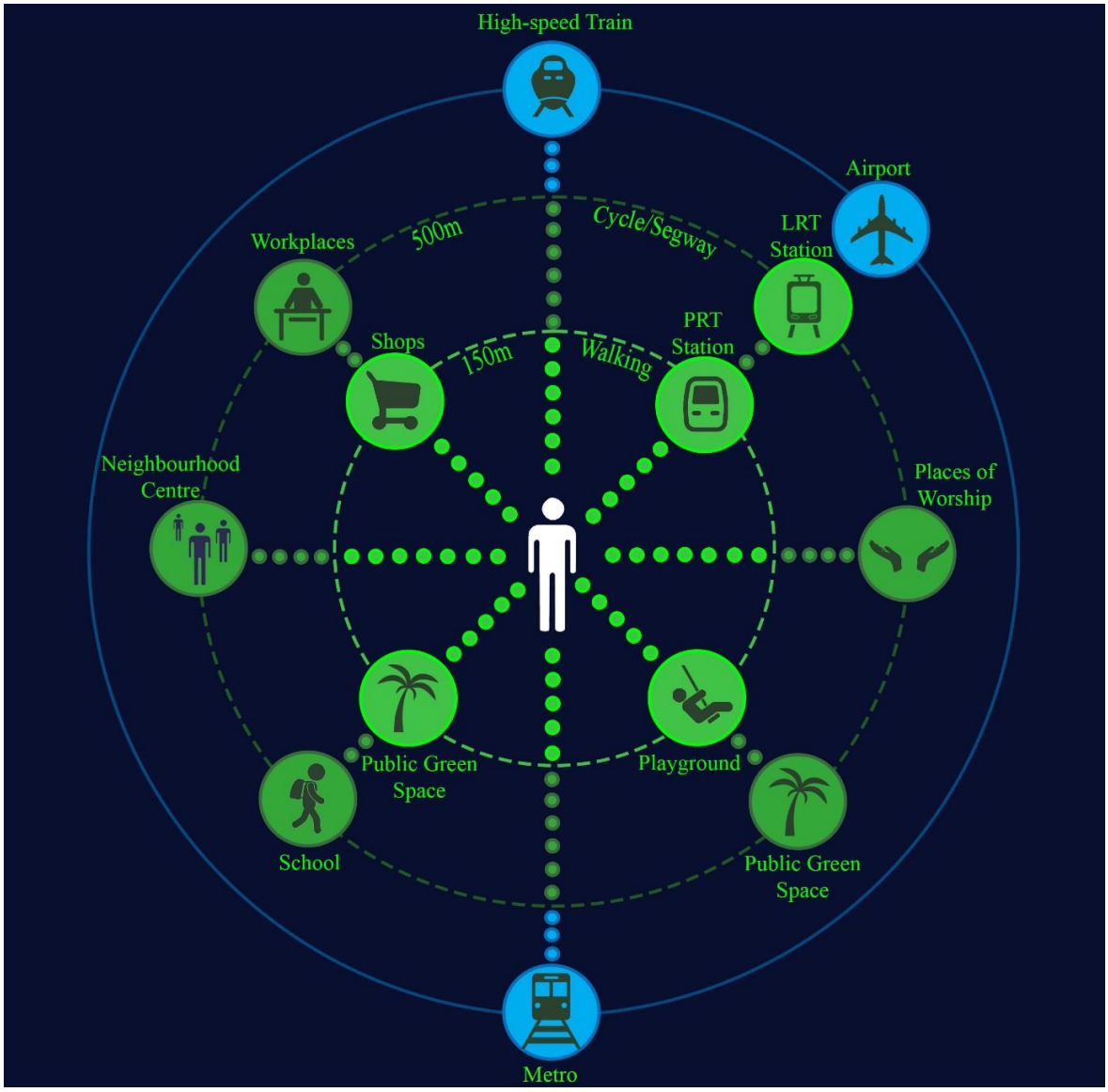


Figure 10.6: Integrated Mobility for Old Rusafa Walking, Cycling, Personal rapid transit (PRT) and Light Rail Transit (LRT)
Source: Author (2017)

A smart sustainable mobility framework proposes organised aspects of interventions with the objective to develop the quality of life and urban services through implementing information communication technologies in the case study infrastructures. In another aspect, ICT will support and integrate different transport systems such as trams, personal rapid transit (PRT), and light rail transit (LRT), buses, trains, metros, cars, cycles and pedestrians to be safe and interconnected transportation systems (figure10.7).

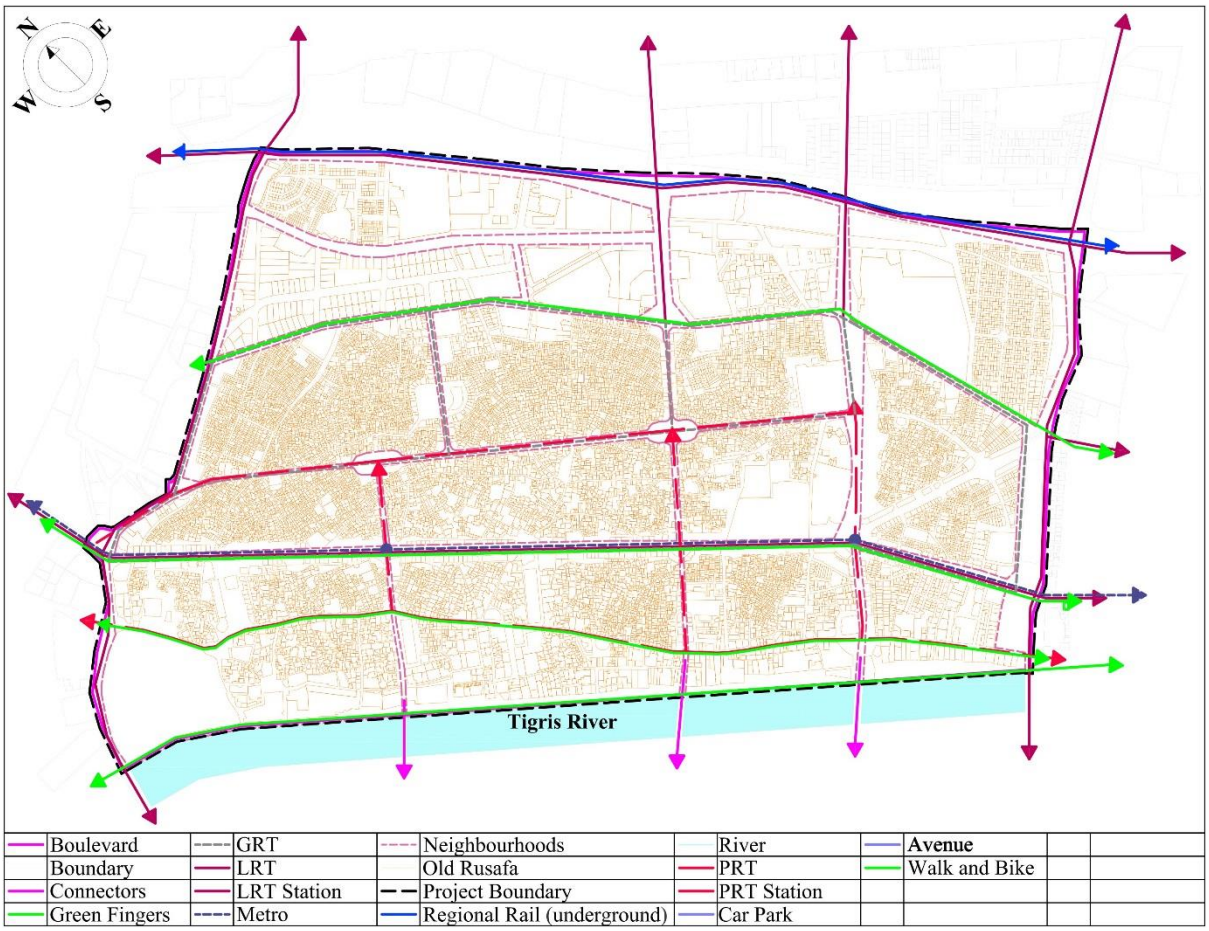


Figure 10.7: Integrated Mobility for Old Rusafa
Source: Author (2017)

This framework endeavours to implement clean efficient and non-motorised transportation options in the old core that might reduce CO2 emissions. These smart sustainable models of transportation will develop services and provide feedback to stakeholders, create their real-time information and participate in long-term planning. These new models of mobility that employ ICT will advance traffic in the urban context of the case study area and offer safe, efficient and secure conditions of transport. This framework aims to integrate different modes of transport choices in Old Rusafa including both individual and mass transit, in a suitable method. It also proposes to implement sensors, automatic vehicle registration plate readers, dynamic traffic lights, passenger information panels and the capability of integrating live data from most of these sources that will advance network management, safety, environmental performance, accessibility, convenience, public perception and reduce traffic congestion (figure10.8).

Figure 10.8: Integrated Mobility for Old Rusafa
Source: Author (2017)

10.1.5.4 Smart Sustainable Environment in the historic centre (Old Rusafa)

The Municipality of Baghdad encounters much more challenge in developing the physical urban environment of the case study area; thus, one of the main framework goals is to restore the traditional built environment particularly the historic urban fabric to meet collective needs. Many elements are integrated to give the historic part of Baghdad one of the most extraordinary ecological contexts in the world. Fundamentally, it is a river city and the traditional urban fabric that gives Old Rusafa the most important economic resources in the entire city. This framework is predicated on the concept that this vital environment in the traditional urban fabric must be preserved. The best way to implement that is through redeveloping the traditional principle in the organic traditional core and the environmental standard. High performance green urban fabric and buildings will maximise resource efficiency and human comfort in the hot and dry climate. The level of land use allocation, green open spaces, riverfront, and the traditional urban fabric provide a framework that can accommodate both the needs of economic development and the needs of environmental preservation. A smart sustainable urbanism framework in the case study area should be achieved by promoting environmental awareness and a sense of responsibility. Furthermore, we can achieve it by using energy from renewable resources, green infrastructure, reducing waste by improving the way to recycle products and green transportation to minimise air pollution (figure10.9).

Figure 10.9: Green Transportation to Minimise Air Pollution
Source: Author (2017)

Smart sustainable environment framework in the historic core aims to gain green urban infrastructure that utilising ICT, IoT and cloud computing that concern for sustainability, protect the environment and reduce CO2 emission. It produces an urban area where smart sustainable solutions are achieved to promote smart sustainable urban growth. These new solutions will employ smart sustainable renewables energy, smart metering, pollution control and monitoring, green buildings, green urban design and planning and resource utilisation efficiency that serve the smart sustainable environment framework. This framework will produce a green urban area in Old Rusafa with key goals to develop the quality of life for their stakeholders through integrating ICT infrastructures into socio-economic, cultural and physical infrastructures in different urban environments. Moreover, this framework suggests considering pollution reduction and natural resource control to reach smart sustainability goals.

10.1.5.5 Smart Sustainable People in the historic centre (Old Rusafa)

Baghdadi citizens are the key element in determining the old city advancement, prosperity, form of the physical urban context and spatial configuration. These stakeholders will also determine the success of the implementation of the smart sustainable cities methods in the historic part of Baghdad. The smart sustainable people framework considers city citizens as the main aspect that has opportunities to build a humane city centre by employing advanced technologies, ICT and IoT and create a new platform of socio-economic and cultural infrastructures integrations, which result to a prosperous and healthy life. The framework proposes an efficient incorporation of human systems, digital and physical in the historic built environment of the case study area to achieve smart sustainable principles and realize a good quality of life for the old city people. It also suggests that the city centre citizens should have the right to an improved educational level in a way to ensure that smart sustainable cities methods are achieved.

There are various aspects which should be considered in the implementation of the smart sustainable cities concept in Old Rusafa such as the quality of social interactions, the growth of human capital, the role of ICT and IoT and openness towards other cultures. In another ward, stakeholders in the case study area should have the ability to engage with others, home, work, government, other communities, companies, business, and health and education systems through their advanced technologies to generate digital information that might help to improve the urban services they perform. The framework seeks to give

Baghdadi citizens the opportunity in making decisions (bottom-up method) through their smart behaviours in e-governance. This will assist local government and particularly the Municipality of Baghdad (top-down method) producing new services to their societies. Allowing people to participate their ideas and data through the utilisation of ICT and IoT will improve public services and quality of life and will develop interactions between stakeholders and physical urban environment in the old city.

10.1.5.6 Smart Sustainable Living in the historic centre (Old Rusafa)

The smart sustainable living framework addresses the critical issues facing the traditional area of Old Rusafa through several strategic moves. Firstly, it is necessary to define the limits of growth for the city centre of Baghdad by providing a clear spatial identification for the activities, and minimise the horizontal extension of the city centre. Secondly, we need to organise new strategies for land use within the smart sustainable urbanism framework of greater Baghdad, transfer functions and replace them with other green facilities that promote the traditional values and healthy environment. Most important they resolve the conflict between traditional principles and modern design model through identifying the policies and strategies that will conserve the traditional urban fabric under the light of urban sustainability. Also, we should correct the balance of spatial distribution in Old Rusafa, and try to create livable and competitive historic centre.

The smart sustainable living framework proposes to integrate the old core with other centres, open areas and public areas, which altogether will produce an open public domain in Baghdad. Mixed use will be one of the main aims in this framework that seeks to connect government institutions, health, education and economic activities and ICT-enabled lifestyles that will play a significant role in developing the quality of life. This framework aims to create a safe environment for living in a culturally vibrant historic area with various cultural activities.

It also endeavours to support the historical physical urban environment by sensors, ICT and IoT systems and smart sustainable infrastructures that can advance and innovate services to stakeholders and improve the quality of life in the case study area. Moreover, it will seek to utilise renewable energy, appropriate technologies and build zero-energy

building in the old core that might reduce CO2 emissions and create a healthy urban environment.

10.1.5.7 Smart Sustainable Infrastructure in the historic centre

This framework aims to advance the historical environment of the case study area by building smart sustainable traditional buildings that can reduce waste, efficiently use water and energy, manage smart systems. Regarding mobility, it will seek to manage new methods of transportation and traffic congestion through the utilisation of ICT and automated sensing and management of traffic that operate and analyse data gathered form different mobility styles and community participation (figure10.10). As the old centre is suffering from water and energy supply problems, smart sustainable management systems that employ renewable energy sources, sensors, digital controls, smart meters, manage and optimise energy and water usage are required. To achieve a good quality of life in the traditional part of Baghdad, smart sustainable health-care systems are very important to ensure the success of the implementation of the smart sustainable cities concept in Old Rusafa.

One of the main elements to the redevelopment the historic centre is creating modern social facilities and enhancing the existing ones. These facilities such as schools, playgrounds and local centres should apply according to the stakeholders' levels; thus, their size and location vary accordingly. Moreover, social facilities had to be either advanced to suit the scale and character of the traditional urban fabric and the old city identity and to integrate within the new development. The smart sustainable infrastructure framework plan asserts to create additional social facilities like nurseries, primary schools, secondary schools, high schools, local and cultural centres that fulfil the basic and developing requirements of Old Rusafa. It will propose to use ICT and its infrastructures to monitor smart sustainable transportation models (include roads, bridges, tunnels, rails, subways), manage and analyse the real-time data, manage and optimise buildings and maximising services to its stakeholders. This framework aims to achieve smart sustainable buildings, smart sustainable mobility, smart sustainable energy and water, smart waste management, smart health, smart digital layers (table10.1).

Figure 10.10: Smart Sustainable Infrastructure in the historic centre
Source: Author (2017) According to The Municipality of Baghdad

Smart Sustainable Infrastructure			
1	Challenge	Solution	Description
2	**Healthcare**	1. Smart Sustainable Hospitals 2. Real Time Healthcare including Analytics 3. Home and Remote HealthCare incl. Monitoring 4. Electronic Records Management	- Products and services for remote access to health services.
3	**Education**	1. Flexible learning in an interactive learning environment	- Accessing world class digital content online using collaborative technologies
4	**Air, Water and Waste Management**	1. Smart Meters 2 Renewable energy 3. Water Information Systems (WIS) 4. Integrated Water, Waste and Energy Savings Optimization Schema 5. Sensor Networks for Water and Air Systems	- Metering of power, water and gas that can provide real time measurement of energy consumption. - Generation of power including solar, hydro, thermal and fuel cell technology.
5	**Safety and Security**	1. Video Surveillance and Video Analytics 2. Seamless Communication during Natural & Man Made Disasters	- Public safety, crowd management and people counting.
6	**Utilities Infrastructure Development**	1. Smart Grid and Smart Metering (Generation, Distribution, Measurement) 2. Wireless Communications 3.Analytics and Policies 4.Load Balancing, Decentralized and Co-generation	Mobile Internet access in public locations.
7	**Smart Buildings**	1. Synergies between energy efficiency, comfort and safety and security …. 2. Building as a Network – Integration of Multiple Technologies (HVAC, Lighting, Plug Loads, Fire, Safety, Mobility, Renewable, Storage, Materials, IAQ etc) 3. Software – Efficiency, Automation & Control , Analytics & Big Data Management	Array of sensors and technologies that improve safety, security, energy efficiency and usability.
8	**Mobility and Transportation**	1. Intelligent Transportation Technologies in the Age of Smart Cities: 2. Traffic Management – Monitoring & Routing 3. Real Time Linkage to Emissions, Traffic Patterns, Reduced Fuel Consumption.	- Cars, which operate on electricity/batteries with appropriate infrastructure for charging stations throughout the metropolis. - Car parks and street parking locations. - Automated sensing and management of traffic.
9	**Improvement of environmental conditions**	Environmental Sensors	Data collection about the condition of air, water and soil.

Table 10.1: Smart Sustainable Infrastructure framework for Old Rusafa
Source: Author 2016 according (Kondepudi, 2015) and (ITU-T, 2014b)

10.1.6 Smart Sustainable Old Rusafa Indicators (SSCIs)

Smart sustainable Old Rusafa indicators will be an applicable collection of indicators that will determine the implementations of smart sustainable urbanism framework in the historic centre of Baghdad and illustrate future development opportunities. The research proposes the Index Wheel for the case study area according to previous studies, literature review, smart sustainable cities examples. This Index-Wheel has considered the historical physical environment that requires particular solutions to produce suitable facilities and services for the case study stakeholders and participate in drawing the future vision of Baghdad and the old core development in particular.

The Index Wheel has been divided into ten parts following the dimension of smart sustainable urbanism framework (figure10.11). Various tangible performance measurement systems have been determined that will help to show the success of development of smart sustainable initiatives, concept, products and services in the case study area. This innovative Index Wheel for the historical physical environment contains a combination of the main performance indicators for smart sustainable urbanism that might be implemented in other historical places that seek to be developed in the smart sustainable way (figure10.12). Moreover, it will be the guide and the basis for Baghdad's future advancement and will assist the Municipality of Baghdad, policy makers, planners, urban designers, and architects to prioritise goals and allocate resources that promote the implementation of the smart sustainable urbanism in the traditional centre.

These indicators play an essential role in the assessment of the implementation of smart sustainable cities methods in the case study area based on various aspects such as innovation on urban performance, socio-economic and environmental cases, mobility, health care, education, ICT infrastructures, quality of life and energy. The case study area indicators should enhance an integrated advancement of these diverse elements in the evaluation of smart sustainable urbanism.

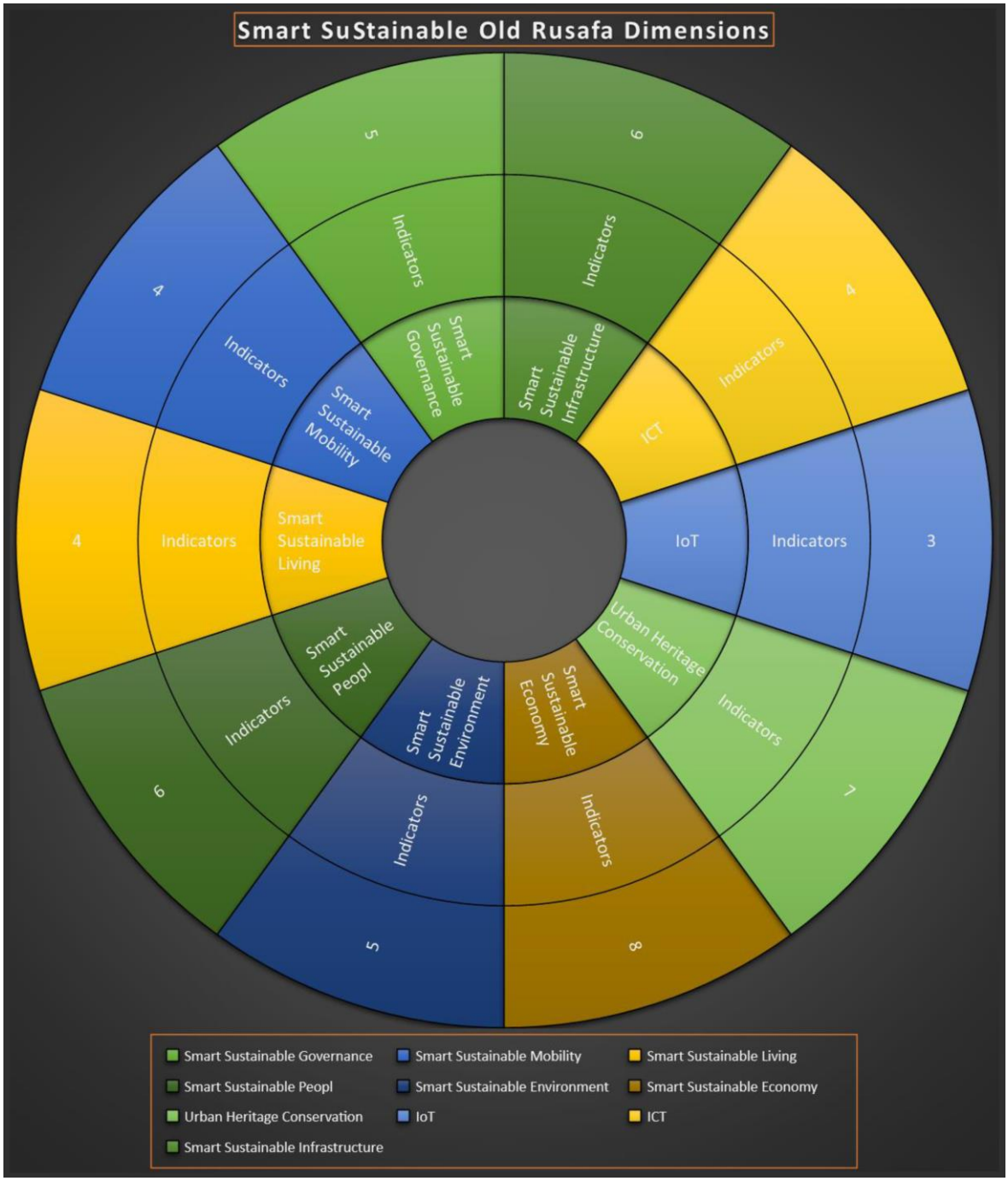


Figure 10.11: Smart Sustainable Old Rusafa Dimensions
Source: Author (2017)

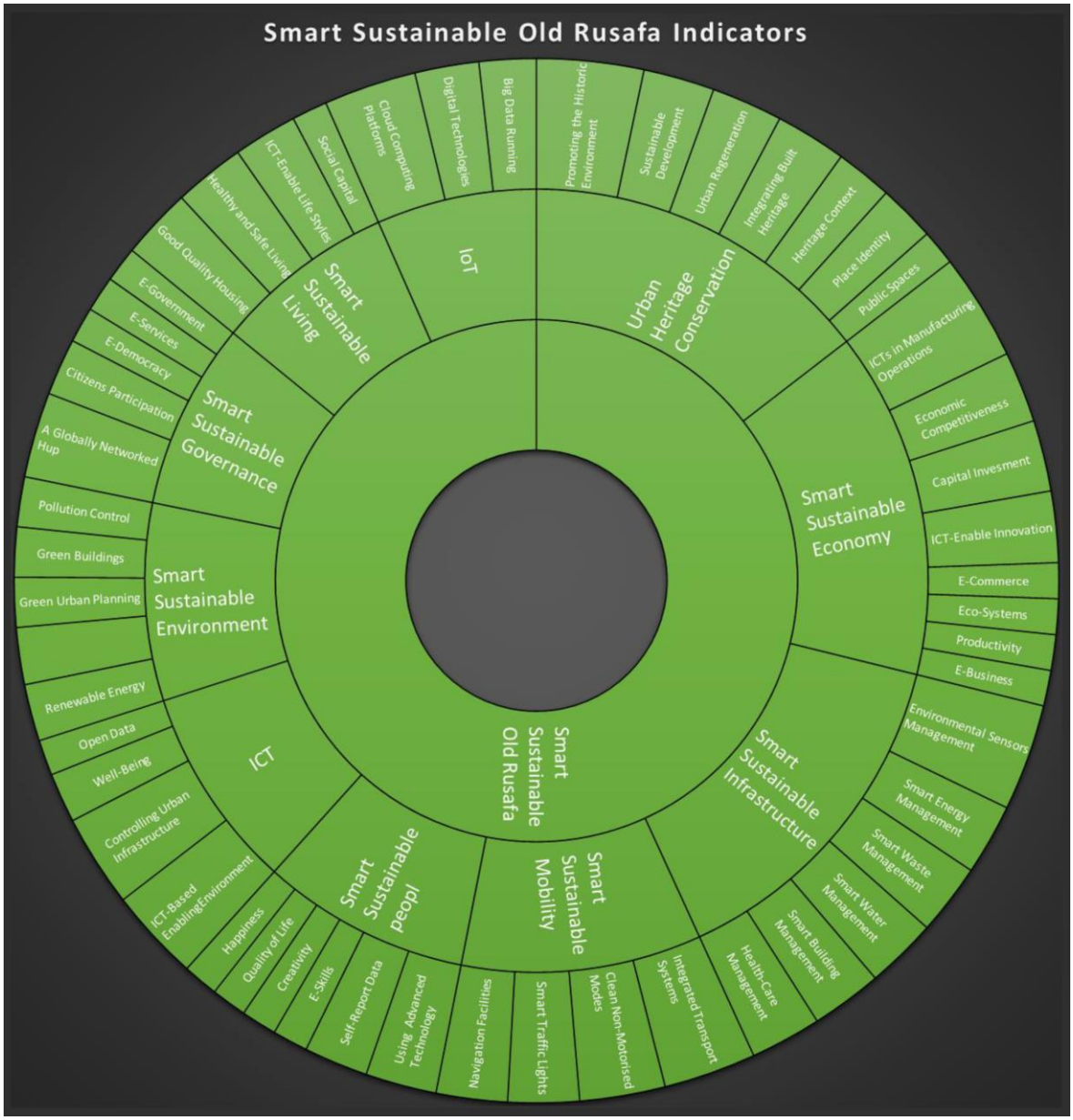


Figure 10.12: Smart Sustainable Old Rusafa Indicators
Source: Author (2017)

10.2 Discussion and Conclusion

The implementation of the smart sustainable city concept in the historical environment of the case study area faces a big challenge on how to integrate various advanced technologies and infrastructures to minimize the environmental impacts and the deterioration of the traditional urban context. Moreover, the old centre is suffering different problems such as pollution, traffic congestion, socio-economic and cultural issues. These challenges require producing smart sustainable methods to control these challenges, furthermore, will demand the engagement of different disciplines using ICT, sensors and advanced technologies to attain a smart sustainable city environment and to provide our stakeholders with a better quality of life in their urban area. Therefore, this chapter has proposed a number of core systems such as infrastructures, networks and environments, transportation, communication, water and energy to be implemented or considered in the future development of the case study area (Old Rusafa). The capability of these systems, dimensions and indicators will determine how the old core works, develops and the ability to deliver its future advancement goals.

10.3 Chapter Summary

This chapter has produced a smart sustainable urbanism framework for the historic centre of Bagdad. It has taken into account the new principles and criteria of the smart sustainable cities concept. It asserts that the successful implementation of the smart sustainable cities methods in the historic part requires investment in various sectors, creates new job opportunities and a tremendous amount of money to achieve smart sustainable cities goals. This section indicates it is very important to achieve renewable energy, efficient use of natural resources, good waste management to attain smart sustainable urban context in the traditional centre of Baghdad. Citizens' participation in making decisions and urban development is an essential aspect to be considered by the Municipality of Baghdad in the advancement of the historical physical urban environment. Moreover, this part of the thesis emphasises that the case study area requires new methods of implementing smart sustainable infrastructures, ICT, IoT, smart sustainable mobility, new health and education systems to achieve the requirements of the smart sustainable urbanism framework in the historical physical urban environment of Old Rusafa.

CHAPTER 11: RESULTS AND DISCUSSIONS

11 Introduction

Chapter 11 is the final chapter of this research, which involves a summary of the significant contributions made to knowledge in this study throughout its chapters, with the consideration of how the research questions and aims are answered and achieved. Each section of this chapter will clarify how each chapter was examined during this study and where within this thesis it is adduced, authenticated, attain thesis aims and answered the research question.

There are different methods of looking at case study physical urban problems and addressing them in an appropriate context. The suitable and efficient approach is to address these cases in their urban context and most importantly to avoid considering the global view without engaging stakeholders' views on these issues. Citizens in Baghdad city have endured from ignoring their opinion throughout top-down systems. Consequently, this research has looked at the physical urban context of Old Rusafa from its wider local view taking into account the new principles of the smart sustainable cities concept. It also has endeavoured to advance the quality of life in the case study area by participating Baghdadi citizens in the urban development process, making decisions, implementing the new methods of city improvement and draw the define vision of the old core.

The essence of the debate in this research is the identification of the new principles and criteria of the smart sustainable cities concept such as the use of ICT, IoT and advance technology to fill a gap related to implementing these methods in a historic environment. Furthermore, the main challenges recognised of this research is to explore how the conservation, smart and sustainable strategies will lead to regenerate the historic area of Baghdad and how it could be carried out in a way that promotes social, economic and environmental sustainability, as well as the full participation of all stakeholders. Therefore, this thesis has developed a methodology, which can form urban planning, design and advancement of such a historic area.

The methodology that has been utilized to fill the gap and face different challenges in the case study area is a mixed research method that uses both techniques, qualitative and quantitative. This thesis has classified various levels of action that started from critical

literature reviews to the use of a multi-strategy such as structured interview, walking tool, serial vision method to assess the condition of the traditional urban fabric in Old Rusafa. The research method of this thesis has also adopted stakeholders' participation in the development of the physical urban context of the traditional centre of Baghdad that indicates the importance of citizens' engagement in the success of the implementation of the smart sustainable methods. The consequences are a guide-based and theoretically shaped methodology for smart sustainable urbanism in Old Rusafa.

11.1 Contribution to Knowledge

The key goal of this thesis is to fill a gap related to the implementation of the smart sustainable cities principles in the historical physical urban environment of the historic centre of Baghdad. Moreover, it is also intended to complement the general knowledge and global argumentation of smart sustainable cities concepts, methods, indicators and norms, with numerous participation that is informed in this research. The crux of the thesis contribution lies in the debate of implementing smart sustainable cities indicators in the traditional urban fabric to be developed and might be directed towards a smart sustainable urban environment future. It also asserts that the different demands of such an area (Old Rusafa) present unique challenges for which smart, sustainability and digital techniques potentially create new principles of regeneration, and makes a platform to resolve the conflicting values of traditional urban form and modern design models.

This study has proposed a methodology for assessing the success of the implementation of the smart sustainable cities methods in the historic part of Baghdad. This approach might be implemented and become applicable for the local and international historical cities with some advancement required for the socio-economic, cultural and physical speciality of the issue. For the developing countries, this study provides an appropriate test and findings that might have some similarities with the Iraqi issues. Consequently, measuring and assessing the implementation of the smart sustainable cities principles by selecting a city from the developing countries and by using a smart sustainable urbanism framework provides benefits for local, national and international research. Finally, the key contributions made to knowledge in this thesis is how each research aim and question was answered, clarified, and addressed throughout this study.

11.2 City Structure, Urban Transformation, Urban Heritage and Conservation in the Old Core of Baghdad

These subjects were presented in chapters two and three, and associated at length within the following research aim and question of this research:

Research Aim 3: To fill a gap related to the use of 'Smart and Sustainable City' methods in a historic environment by <u>understanding a specific case study of a physical part of an existing city (Old Rusafa)</u> in order to add enough knowledge to the field to inform further study and potential implementation.

Question 1: Are the traditional urban areas of Old Rusafa in Baghdad city amenable to smart sustainable cities processes?

- **Reviewing the literature and <u>identifying the heritage features of the traditional urban fabric in Old Rusafa</u> that improves amenability to create a smart and sustainable urban area.**
- **<u>Identifying urban heritage context and urban conservation in historic cities and assesse the role of historic preservation of Baghdad</u>.**

11.2.1 City Structure and Urban Transformation in the Old Core of Baghdad

The traditional and oldest part in Baghdad faced various transformation processes in the culture and physical urban environment due to socio-economic and political reasons. Therefore, understanding the history of Baghdad and particularly the old core urban development is a significant point to start this research to add knowledge to the field, to inform further studies and potential implementation for cities that require new methods to be developed. Reconfigure and produce new urban typologies within the heritage fabric and create different spatial languages competing with each other were the most fundamental effects that address by this research. This part asserted that the spatial features, structure and identity of Baghdad had been examined throughout the process of the case study urban transformation and growth, and by analysing its physical structures at different stages and periods to achieve a better understanding of the physical part of Old Rusafa. It also explored how Baghdad emerged, and developed a comprehensive

understanding of the history of urban transformation in the context of city change. Illustrating the main components of urban form in the historic centre of Baghdad has resulted to identifying the heritage features and components of the traditional urban fabric in Old Rusafa that improves amenability to create smart and sustainable urban areas.

The complex urban structure and form in Old Rusafa has provided an example of how to create privacy and a healthy environment for its people, especially within the district society. This thesis has identified and built a theoretical background about urban heritage context, conservation and urban conservation. It has determined the relevant principles of urban conservation in historic cities, and has assessed the physical and social conditions of Baghdad and examined the contemporary situation of heritage and conservation there. The examining of these topics in this research has led to sum up that the previous studies have not illustrated a clear vision for dealing with the assets of urban heritage and their relationship with environmental, social and economic issues, especially in an age of such significant transformation. Therefore, an evaluation of urban heritage conservation under the light of the new principles of smart and sustainable design is required to regenerate urban form and fabric. It also indicated that globalization, rapid uncontrolled development, demographic changes, and economic pressures are the main factors driving change in the urban environment, which directly influences the preservation of historic urban environments.

11.2.2 Urban Heritage and Conservation

The understanding and the assessment of the main components and existing physical condition of the historic centre of Baghdad has become a basis for urban designers, policy-makers, architects and governments to consider devising regeneration solutions. The research has clarified that the narrow alley together with the hierarchy of the traditional Baghdadi house, traditional buildings, mosques, traditional suqs provides a series of thresholds of security, visual security between spaces and emphasise the urban fabric identity and its urban form. Furthermore, examining the complex urban structure of the historical area of Baghdad under the light of the smart sustainable cities concept has assisted to integrate traditional principles with contemporary needs and provided a new vision for rethinking the way cities are designed, built, and managed. Therefore, for a

future vision, a significant effort is required in the traditional centre to regenerate urban heritage form under the light of the new principles of contemporary design models.

Investigating and identifying the relevant principles of urban conservation, urban heritage context in historic cities, and assessing the role of historic preservation of Baghdad urban fabric are important subjects to be dealt with in this research. The examination of these issues helped for a better understanding of how to save the structure and history of cities and promote local and place identities. This section also has shown how the traditional compact urban fabric in the old centre has witnessed irreparable damage because of wars, a weak definition of demands and an ambiguous formulation of what to preserve. Therefore, this research suggests that the Municipality of Baghdad with the other heritage institutions should work and produce new urban regulations and a clear vision regarding urban conservation to avoid obstacles that might be faced when preparing a plan for conserving traditional areas. This part of our thesis has suggested employing Cohen's tools and methods from his book *Urban Conservation* to preserve the structure and history of cities and to promote local and place identities. Due to globalisation, rapid uncontrolled development, demographic changes, and economic pressures are the main factors driving change in the urban environment, which directly influences the preservation of historic urban environments. Consequently, this study has promoted the role of socio-economic and environmental aspects in the process of revitalising urban components of the urban system in the city centre of Baghdad.

11.3 Urban Sustainability, Smart Cities and Smart Sustainable Cities

These topics were presented in chapters four, five and six, and related at length within the following research goal and question of this research:

Research Aim 2: The second aim of this research is to provide a greater view and better <u>understanding of what smart sustainable cities indicators could implement in an urban core of the Iraqi traditional urban areas</u> as a base to resolve the conflicting values of the traditional urban form and modern design models.

Question 2: What are new alternative methods (smart sustainable principles) which could integrate traditional principles with contemporary needs and provide a new vision for reconstructing the historic areas in Baghdad?

- **Identifying the criteria for smart sustainable cities, which are most relevant to urban design, urban forms on the traditional urban fabric scale.**

11.3.1 Urban Sustainability

In chapter four, the sustainability concept has been identified and investigated as a worldwide concern for the last decades. It also has been debated on its definitions, aims, and dimensions. It provided a review of the origins of these subjects, along with different definitions of each that are commonly cited in the literature. It concentrated on urban sustainability and the evolution of cities, along with a review of common challenges and barriers. This study has determined the main relevant criteria to the historic centre of Baghdad by defining a set of urban sustainability indicators that can be assessed in the traditional fabric such as socioeconomic development, and environmental management, which played an essential role in developing thesis framework for investigating urban sustainability in Old Rusafa.

This thesis has argued that urban designers need to rethink land use and the horizontal division of functions and design productive and active cities. This study has explored various definitions of urban sustainability and asserted the necessity to implement urban sustainability in our cities. The research confirmed that achieving sustainable urbanism in Old Rusafa would contribute significantly to develop the urban environment and produce livable, efficient city, to accomplish that, we need firstly to consider urban morphology and how it will participate in the city's long-term economic growth. Secondly, to produce new creative strategies that can move from sustainability to regeneration. Thirdly, the old core must be economically effective, to reduce poverty and must deal with the issue of equity. Fourthly, the traditional centre needs to minimise the impact on the environment and face pollution and extreme weather events. Fifthly, the education system is an essential aspect of sustainable urban advancement and citizens must have the right to gain the right education to elevate them out of extreme poverty and stagnation. Finally, to employ intelligent methods to administer this massive change, creating new systems of gain (zero

carbon, zero waste, green transportation, sustainable food, equity, happiness, health and culture) and implement green infrastructure in terms of green space, parks, gardens, civic space, water, waste, transportation and energy.

This research emphasised that the historic core should meet the business requirements of the new economic paradigm by increasing interaction and communication between citizens and government, promoting access to services, achieving flexibility of urban development process. This study asserted that achieving a high quality of life for the whole society within a socio-economic and cultural framework might reduce the influence of the old city on the local and global environment. It also discusses that governments and international organisations at different levels look for the optimum urban sustainability value. Moreover, practices of a sustainable urbanisation will play a substantial role in obtaining local sustainability aims. This research asserted that cities are active complex open systems with associated socio-economic and environmental systems. Consequently, sustainable advancement in the historic centre of Bagdad cannot be attained without integrating sustainable development indicators that address socio-economic and environmental dimensions. Moreover, as every city is different, these indicators must be different. The study has endeavoured to associate the three elements into a significant and dynamic framework. It also has displayed significant opportunities and environmental challenges such as low levels of infrastructure, weak urban governance, poor urban planning and poor provision of green and public spaces.

This research has concentrated on sustainable urbanism and explored various aspects that have a direct or indirect impact on the sustainable urban form by analysing a range of policy and strategies to achieve urban sustainability. It has examined the principles of sustainable urbanism and investigates how to assess a sustainable city by discussing, and gave examples of comparative analysis of a number of cities in using urban sustainability indicators. The primary implications of this study are summarised in two outcomes, the implementation of the sustainable urban design in a historic environment and the degree of amenability of the historic centre (Old Rusafa) for sustainable regeneration. Traditional urban fabric in Old Rusafa can achieve urban sustainability through the following points:

1. Implementing natural environment through compact urban planning, narrow alleys and their orientation, shading passageways and attached buildings.

2. Utilising natural materials that have the ability for reuse, using renewable energy and natural ventilation.
3. Significant buildings, mosques, traditional suqs and private houses that emphasise the urban fabric identity and its urban sustainability.
4. People participation in decision-making and increasing public awareness about urban sustainability.
5. Governments, planners, architects, urban designers, companies and professionals should improve urban design strategies, qualities codes, and building regulations towards urban sustainability, heritage values, and cultural environment.
6. Advancing sustainable urban indicator variables spanning all the relevant Baghdad city aspects.
7. Developing sustainability environmental measurement method appropriate to Baghdad city.
8. Proposing effective policy measures and implementation plans to bridge the identified gaps to achieve aims of urban sustainability.

11.3.2 Smart Cities

The smart city concept has been identified and investigated in chapter five that provided a greater view and better understanding of what smart cities indicators could implement in the historic centre as a base to resolve the conflicting values of the traditional urban form and modern design models. This research has described the main elements of the smart city concept and elaborated on some challenges faced the smart cities projects and the role of ICT and IoT in addressing them. It has explored the smart city concept both analytically and philosophically that has led to advance and support this thesis to create an appropriate smart sustainable framework for Old Rusafa. The research has defined the smart city concept in different ways; some of them focus on ICTs and their infrastructure as advanced technologies that enable citizens to communicate in smart methods, while other definitions considered socio-economic and environmental elements that seek to advance the quality of life, urban well-being, e-government, citizens' participation, and improve the sustainability in cities. The smart cities concept defined by this study as a future notion that will permit their citizens governments, businesses, urban designers, planners, architects and professionals to contribute their opinion through complex system or systems in terms of

making decisions, sharing big data, promoting urban environment, implementing equity, promoting efficient energy resources, constructing intelligent infrastructures and administrating complex information through utilizing ICT.

This thesis has discussed and examined the dimensions of the smart cities concept such as smart people, smart mobility, smart economy, smart living, smart governance and smart environment that developed the research framework knowledge. The determination of these six dimensions has played an important role to allocate the efficient indicators that can develop the physical urban environment, create new systems and modern digital layers and solve the current problems of the Old Rusafa infrastructure. This research has defined and considered ICT and IoT as a platform for communication between citizens and government, as an efficient method of running the machines and big data and about the use of advanced technologies in a collaborative way in the old centre. The future vision of citizen's participation in Baghdad and especially in Old Rusafa will engage citizenry with experts from many fields in producing scenarios for promoting the quality of urban life. This will require a massive mobilisation of data, serious progress in models, policy integration and the most important thing is to educate citizens to enable them to use intelligent devices in traditional environments. Participation will be the main element to build a global knowledge resource that will clarify the accessibility to individuals, organisations and businesses. Traditional urban fabric in Old Rusafa can achieve the goals of the smart cities concept through the following points:

1. The implementation of smart people dimension, which contains different aspects such as education, affinity to lifelong learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism or open-mindedness, and participation in public life can play important part in improving the quality of life in the urban context of Old Rusafa.
2. Mentioning and generate digital data in real-time through the utilisation of ICT and IoT by the city and local government in interacting with their people will advance the performance of urban activities in the traditional core.
3. The Municipality of Baghdad should produce an open service and data platforms for their stakeholders to participate to improving services, traffic management, public transport, the physical urban environment, urban planning and promote socio-economic and cultural aspects.

4. The implementation of sophisticated technologies in the physical urban context of the case study area of this research can develop the quality of life, mobility, efficient use of natural resources, safety and advancing urban quality.
5. Increases the availability of green spaces and integrating ICTs infrastructures into socio-physical infrastructures in various urban environments of Baghdad can lead to achieve a sustainable environment and achieve the aim of the smart sustainable cities concept.
6. The employment of ICT, IoT and advance technologies in the case study area can create contemporary transport, advance traffic in urban places and produce dynamic traffic lights. Moreover, can lead to better traffic congestion, environmental performance, accessibility, safety, network management, convenience and public perception.
7. The use of ICT, IoT and advance technologies in the case study area can create smart industry and develop the competitiveness of urban contexts in the local and global knowledge economy.
8. The Iraqi government should consider using smart economy dimension, which is associated with the growth of industries that employ ICT in manufacturing operations. This might lead to more innovation, productivity, and flexibility of the labour market, as well as the international expansion of the local economy.
9. The Municipality of Baghdad should produce new approaches to assess the implementation of the smart sustainable city concept to advanced and measure the performance of the physical urban area of Old Rusafa.
10. The Index Wheel provided by this research should assist the Municipality of Baghdad urban designers, planners and decision makers to advance the quality of life in the heritage urban context, achieve the aim of the smart sustainable cities concept and enable cooperation and connectivity between the stakeholders of the smart sustainable cities initiatives.
11. Smart sustainable infrastructure is a significant aspect to be implemented, which can enhance the old core advancement, increase collaboration between various economic actors and generate big information.

11.3.3 Smart Sustainable Cities

This research conceptualised and defined the aspects and implementation domains that constitute smart sustainable cities. It illustrated how the International Telecommunication Union (ITU-T) had analysed ICT solutions and projects that promote environmental sustainability in cities. Moreover, how they played as an open platform for smart-city stakeholders such as academic, research institutes, non-governmental organisations, ICT organisations and others to exchange knowledge in the interests of identifying the standardised frameworks needed to support the integration of ICT services in smart sustainable cities. This study displayed and examined the new vision "a system of systems" of the physical infrastructure elements of a city that can enhance the management processes within Old Rusafa. Furthermore, it asserted that cities and specifically the old city of Baghdad require employing ICT and IoT infrastructures in an adaptable, efficient, reliable, scalable, accessible, flexible, secure, safe and resilient way to promote the quality of life of its citizens and fulfil equity. The research emphasises that urban designers and planners should use smart sustainable methods that meet the requirements of the present without sacrificing the ability to meet the requirements of future generations.

This thesis according to ITU-T (2014) determined eight categories to be the main elements of the smart sustainable city (SSC), these categories are the quality of life and lifestyle, infrastructure and services, ICT, communications, intelligence and information, people, citizen and society, environment and sustainability, governance, management and administration, economy and Finance and mobility. We examine and clarify in this research various definitions for the smart sustainable city (SSC) according to different literature that has provided us with a platform for understanding the most common elements, improving essential indicators and establishing an ICT infrastructure for smart sustainable cities. This research discussed the influence of the smart city on sustainable behaviour and planning, further argued that the implementation of the multi-dimensional of smart sustainable cities concept, both top-down government decision-making and bottom-up people attitude will require being sustainable, effective and dynamic. The study asserted that bottom-up system citizens should have a significant role in decision-making and embrace the sustainable style of living to promote socio-economic and environmental aspects of urban sustainability. It also illustrated that the smart city concept advanced the

relationship between governmental and non-governmental actors by utilising ICTs in different sectors and create smart methods of city management such as e-governance and e-democracy. The study asserted that the association between stakeholders and policymakers should be sustainable and dynamic to implement the various aspects of smart sustainable urbanism. The success of the implementation of smart sustainable cities concept in Old Rusafa will depend on motivating people towards sustainable attitudes by using advanced technologies in their mobility, natural resources consumption and waste behaviours.

The thesis asserted that the assessment of sustainability should be integrated with the concept of smart city growth and hence it is significant to combine sustainability and smart city frameworks so that both methods are accounted for in performance assessment systems. The research confirms that there are different methods to achieve the aim of the smart sustainable cities concept, depending on the city needs, features, cultural aspects and socio-economic and environmental issues. It also argued by this study that the implementation of smart sustainable cities in Old Rusafa would face many challenges such as economic challenges, low levels of people engagement, technological challenges, scarcity of natural resources, environmental administration challenges, climate change challenges, shortage of smart sustainable cities expertise and growing inequality. Moreover, it emphasised that the concept of smart cities in the traditional core should have the ability to advance its method of management and operation different infrastructures to cope with the future need for its stakeholders. One of the main significant issue debated by this thesis is that cities cannot be smart if they are not sustainable.

To obtain the objectives of the smart sustainable cities concept in the historic centre of Baghdad should follow the following points:

1. The Municipality of Baghdad should implement advanced technologies as the main aspect of reducing greenhouse gas emissions and promoting energy efficiency of the city centre. These advanced technologies should be elegant, effective, use resources efficiently, create a sustainable environment, enhance the quality of life of citizens, and have financial sustainability.

2. Smart sustainable urbanism in Old Rusafa should promote the method of the sustainable environment as its key objective is decreasing CO2 emissions in urban places by the deployment of advanced technologies.
3. Smart Sustainable urbanism in the old centre should use ICT, IoT and advance technologies to be more smart and effective in the use of resources, resulting in cost and energy savings, improved service delivery and quality of life, and reduced environmental footprint. Utilising ICT, IoT and advance technologies in the core of the old city development will lead to improving the lifestyle of citizens, create opportunities for urban development and renewal, support eco-sustainability initiatives, improve the political and representative process, and provide access to advanced financial services. It also will affect the way each urban area will be made and developed.
4. The Municipality of Baghdad should ensure the traditional city is a city well performing in six characteristics to maintain the success of the implementation of smart sustainable cities concept. These features Economy, Mobility, Environment, People, Living, Governance.
5. The smart sustainable urbanism in Old Rusafa should be made clear, simple and responsive. Stakeholders in Baghdad city should participate and inform in the relationship between their services, local area and the wider urban ecosystems.
6. The Municipality of Baghdad should seek to integrate technology into a strategic method to sustainability, people prosperity, and socio-economic and environmental growth.
7. The method of the implementation of the smart sustainable city in the traditional city should be effective, flexible and variable, and endeavoured to gain zero-carbon, eco-city and smart-eco.
8. Smart sustainable city indicators in Old Rusafa should be utilized as a tool to observe cities' advancement towards sustainable urban development in the local and global framework of the Sustainable Development Goals. These indicators are a good controlling tool to assess the changes in the city's achievement over a particular period and after various actions have been obtained.
9. The city centre requires indicators to set aims and track and monitor progress on performance.

11.4 The Case Study Area Data (Old Rusafa) Analysis and Examination

These topics were presented in chapters eight and nine, and related at length within the following research goal and question of this research:

Research Aim 3: The third aim of this research is to fill a gap related to the use of 'Smart and Sustainable City' methods in a historic environment by understanding a specific case study of a physical part of an existing city (Old Rusafa) in order to add enough knowledge to the field to inform further study and potential implementation..

Question 1: Are the traditional urban area of Old Rusafa in Baghdad city amenable to smart sustainable cities processes?

• Appraisal of the situation of the historic centre to find which sustainability and digital techniques potentially provide new methods to regenerate the broken urban structure of the old city.

Question 2: What are new alternative methods (smart sustainable principles) which could integrate traditional principles with contemporary needs and provide a new vision for reconstructing the historic areas in Baghdad?

• Assessing the criteria for smart sustainable cities concepts in the historic centre of Baghdad.

11.4.1 The Case Study Area (Old Rusafa) Analysis and Examination

This research examined the historic core of Baghdad as a pragmatic case study area, which might produce a comprehensive understanding of the particular needs for smart sustainable urban development in one of the significant traditional area. The old centre is a unique physical urban context going back a thousand years and its components that survive to this day consist of important traditional buildings, spines and monumental clusters that show the traditional urban sense of the city. One of the main challenges in the case study of this research was how to find a platform that could solve the battlefield between various architectural styles and ideologies. This conflict between, on the one hand, the modern development that shows no consideration for the traditional urban context and, on the

other, the large stock of abandoned, decaying or misused traditional buildings has led to the confusion and chaos in the case study area. The area between Rashid Street and the Riverfront is a very important part of Old Rusafa that might pose both conservation and development problems. Therefore, this area was selected as a case study area and a mixed research method (quantitative and qualitative) was adopted for the evaluation of the physical urban context of the case study area and the amenability of this area to smart sustainable cities concept.

The analysis of the research case study has been designed in a way that examines the determination of the work on the local context of Old Rusafa. These determinations contain the availability and type of the information that might be gained, the current and the available literature on Old Rusafa, the availability of techniques for fieldwork, time determination etc. This thesis examines the case study information and develops a comprehensive understanding of the existing physical condition. It brought to particular light aspects of the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa, which has been chosen as the case study area of this thesis. Furthermore, it clarified the information gathering method and exemplified the analytical stage of the gathering data. It also utilised the methodological approaches and tools that analyse the fieldwork to answer and elaborate the research aims and questions. The field survey aims to assess the current situations of the social and urban contexts of traditional areas (the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa) to facilitate successful advances and improvement of the historic core.

This research examined the research strategies that were embraced for gathering and analysing the information. The methodology that has evolved for this empirical thesis is a sectional comparison conducted as an integration of qualitative and quantitative research approaches. The field investigation illustrated the historical and architectural value, buildings use, historic and traditional buildings, building height and the structural condition of historical and traditional buildings in the case study area. It also took photos and gathered maps as a part of fieldwork methods. Also, in this research, we utilised a combination of the walking and the serial vision method as a qualitative approach to gathering information. We asserted in this thesis two main concerns in the development of the historic core.

1. The first concerned is the type of potential conservation project, such as renewal the traditional buildings, preservation of the physical urban fabric.
2. The second concerned is the use of the new methods in the advancement of the historic centre, such as the smart sustainable cities concept.

The study debated the data gathered by the field survey of the area between Al-Rashid Street and Tigris Riverfront in Old Rusafa. It also assessed the current situation of the existing physical urban context and urban form of the case study area. **The outcomes of this investigation in terms of historical and architectural value (figure 11.1):**

1. Vast majority of buildings have no architectural style, which was recorded 70% and 45% of buildings in Zone B and A respectively.
2. Historical buildings recorded the highest in the Zone A (10%).
3. The highest number of traditional buildings were found in Zone D that accounted 25% of its buildings.
4. The majority of modern buildings were found in Zone D, which recorded 45% of its buildings.
5. The majority of buildings that have Art Nouveau architectural style were found in Zone C that accounted 18% of its buildings.
6. The Art Déco category recorded the highest number in Zone B that accounted 8% of its buildings.

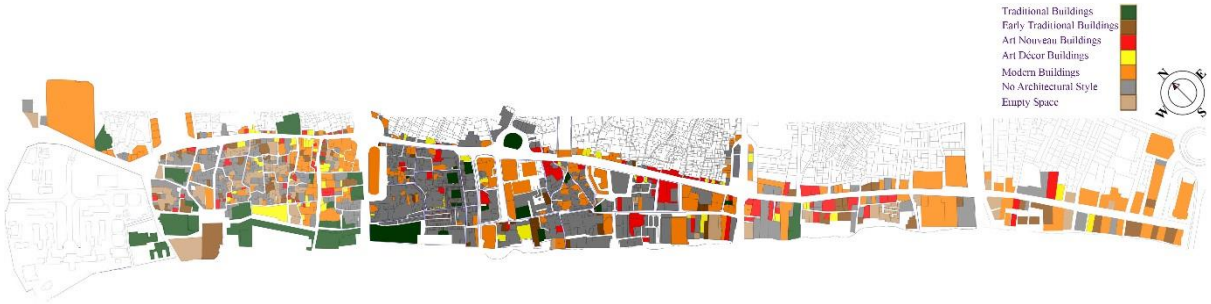


Figure 11.1: Historic and Architectural Value in the Area between Al-Rashid Street and Tigris Riverfront in Old Rusafa (Architectural Types)
Source: Author (2017) According to The Municipality of Baghdad

The case study area has shown diversity on its buildings uses such as commercial, administrative, residential, mixed-use, parking, entertainment, industrial and religious activities. There are diverse building uses in the case study area that asserted the significance of the need of finding new smart sustainable methods to develop Old Rusafa. **The outcomes of this investigation in terms of buildings use (figure 11.2):**

1. Mixed-use commercial and administrative represents the majority of building uses in the case study area; Zone B was recorded the highest number (70%) of mixed-use buildings according to the field survey.
2. The highest figure of another mixed-use category (commercial and residential or industrial) was recorded 25% in Zone A.
3. The open space category was only recorded 2% in this field survey of Zone C.
4. Industrial categories accounted in Zone A and C for a similar rate of 2% each of them.
5. 2% of building uses in Zone A and B of the traditional street were residential categories.

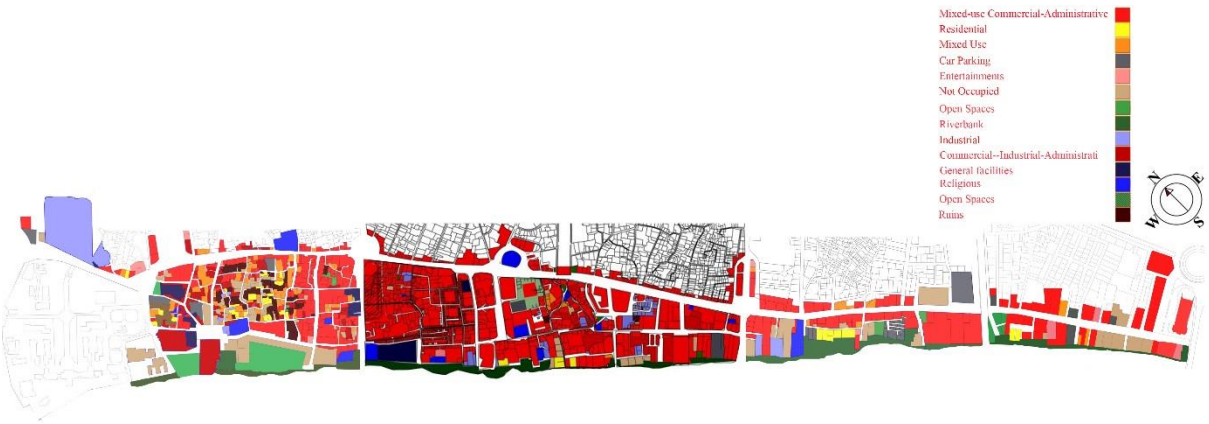


Figure 11.2: Buildings Uses in the Area Between Al-Rashid Street and Tigris Riverfront in Old Rusafa
Source: Author (2017) According to The Municipality of Baghdad

This area was considered as representing the main part of the CBD area of Baghdad, therefore, we can observe that there were variations in building height in the area between Al-Rashid Street and Tigris Riverfront in Old Rusafa starting from zero storeys up to thirty. The skyline of the area between Al-Rashid Street and Tigris Riverfront in Old Rusafa is a very important issue to be clarified in the urban design processes, thus, buildings height of the case study is very significant to be considered to realize what concepts should be utilised to fulfil the requirements of the case study development. **The outcomes of this investigation in terms of building height (figure 11.3):**

1. The outcomes show that 47% of the buildings in Zone A have two storeys, whereas, 17% of buildings in the Zone D was considered to have just two floors.
2. Strong evidence from Figure 11.3, 23% of buildings in the Zone A have just a ground floor.
3. Buildings that have three storeys were accounted 15% in Zone B and C according to the field investigation of the case study area.
4. Buildings with ten to thirty storeys were recorded 1% in each of Zone A, B and D buildings.
5. The majority of buildings (36%) have ground, and first floor was founded in Zone B.

Figure 11.3: Buildings Height in the Area Between Al-Rashid Street and Tigris Riverfront in Old Rusafa
Source: Author (2017) According to The Municipality of Baghdad

The development of the physical urban context of the case study area and the preservation of its identity will require an evaluation of the structural condition of historical and traditional buildings. It can be observed from the field investigation that there are no buildings under construction or in an excellent condition found in this case study area. **The outcomes of this investigation in terms of building height (figure 11.4):**

1. Very good structural condition buildings in Zone B and C were accounted 7% for each of them of all of their buildings.
2. Buildings in a good structural situation in Zone D and C have accounted 34% and 32% respectively.
3. The majority of buildings in the case study area Zone B were found in a poor situation, which recorded 45% of its buildings.
4. Zone A buildings that were in the deteriorating category have been recorded as 23% of its buildings.
5. Buildings in an acceptable structural situation accounted for 20% in each of Zone A and B and these buildings require an urgent need to be preserved.

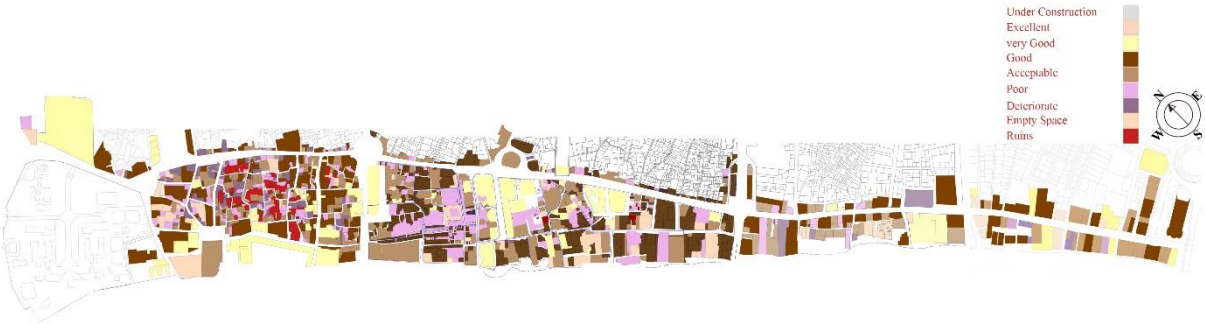


Figure 11.4: Structural Condition Assessment of Buildings in the Area Between Al-Rashid Street and Tigris Riverfront in Old Rusafa
Source: Author (2017) According to The Municipality of Baghdad

One of the significant elements in the examining of the case study area to achieve smart and sustainable indicators is historic and traditional buildings. The four zones of the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa have been examined by historic and traditional buildings category denoting a particular use or date according to this field examination. The conflict between heritage and modern life in the traditional area

has led to both pros and cons results. This study utilized the historic and traditional buildings category to evaluate and assess the physical environment in the historic centre. **The outcomes of this investigation in terms of historic and traditional buildings (figure 11.5):**

1. The Zone A contains several significant suqs such as Mutanabi Street that includes the book market and Saray suq for selling stationery.

2. Zone A has embraced many traditional mosques such as Ahmadiya mosque which was built by Ahmad Pasha in 1769, Numaniya mosque which was built in 1772 by Fatima Biktash al-Sayid Wali to memorialize her husband, Numan Agha lbrahim and Saray mosque that was built in 1704 by Hasan Pasha.

3. The Zone A district as it was asserted by this survey contained some of the significant traditional buildings such as the Baghdadi Museum that was built in 1910.

4. The field investigation of Al-Rashid Street Zone B in Old Rusafa displayed that there were 44 buildings identified as historical and heritage buildings within zone B, denoting a particular use (Khan of Shah Bandar and Khan Yassin Khudairi).

5. The investigation displayed that there were 22 buildings identified as heritage buildings within Zone C, denoting a specific character like Al-Naqeeb House or denoting a particular use (Brazilian Café, Alaa Al-Deen Cinema, British Resident House).

6. The survey revealed that there were 12 buildings identified as heritage buildings within Zone D, denoting a certain period of time (Dar al-Khudairi) or denoting a specific character (Dar Khalil Pasha, House of the British delegate and others).

Figure 11.5: Historic and Traditional Buildings in the Area Between Al-Rashid Street and Tigris Riverfront in Old Rusafa
Source: Author (2017) According to The Municipality of Baghdad

11.4.2 The Case Study Data Analysis and Examination

Citizens' participation in making decisions is one of the most important elements in developing cities to become smart and sustainable and to find an appropriate way to preserve the historic physical environment. The answers gathered from the research investigation produced a huge amount of information that has been analysed according to the study methodology. Beneficial outcomes and recommendations have been identified throughout the questionnaire survey of this thesis. The study clarified the relatively high awareness of the interviewees to the issues facing Old Rusafa. **The outcomes of this investigation in terms of the historic centre (Old Rusafa) Activities:**

1. Poor and very poor options were the most regarded choices in the question of how they consider the traditional area as a place for living, which accounted for 39% and 24% respectively.
2. The outcomes show that 42% of the responses agree that this area is a good place for working and 26% are very good.
3. Fifty percent of the participants believe that Old Rusafa is a very good place for shopping and covers the majority of their requirements.
4. Seventy percent of the respondents have agreed that this area is a very good and a good place for investing.
5. About half of the participants also indicate that the traditional core is a good district for touring and governing activities.

The outcomes of this investigation in terms of the main features of the old centre:

1. The human scale was one of the features that 90% of the respondents have agreed is a very good and a good aspect that has promoted the traditional social values in Old Rusafa.
2. Seventy-eight percent of participants have indicated that quality of life was in a poor or a very poor condition due to the deterioration of the built environment and this aspect is what this thesis seek to improve.
3. Ninety percent of the interviewees considered the accessibility of shopping was good, very good and satisfactory as there are many elements that have promoted this aspect such as walkable and natural environments (70% of the respondents felt

that these characteristics are good and very good) and traditional suqs that are located near them.

4. Sixty percent of the responses indicated that the privacy feature was a very good and a good aspect, and this is due to characteristics of the traditional urban form of the old city

The outcomes of this investigation in terms of the accessibility in the historic centre:

1. Seventy-two percent of the participant believed that the car method was very poor or poor.
2. Seventy-one percent of the participant agreed that public transportation system was poor or very poor.
3. Cycling was rated as a poor or very poor method with a score 37% and 25 respectively.
4. Ninety-one percent of respondents were satisfied with the motorcycle as a very good or good way of transportation, this is because that this motorcycle can carry 6-8 people, cheap, can avoid traffic congestion and reach the destination in the right time.
5. The walking method was good or very good with a score of 73%.

The majority of the participants in this survey asserted that the traditional core was suffering from poor infrastructures when we asked them how you would evaluate infrastructures in Old Rusafa. **The outcomes of this investigation in terms of infrastructures in the historic centre:**

1. The digital and energy infrastructures have a high average of very poor conditions with a rate of 66% and 60%.
2. Ninety percent of the responses indicated that sewage is in a very poor and a poor condition.
3. Water supply also was rated as poor and very poor with a score of 48% and 27 respectively.
4. There is strong evidence (42% and 48% of respondents have assessed this aspect in poor and very poor) that the historic centre needs a creative solution to waste management.

5. Transportation was another aspect that the interviewees were asked to evaluate, 53% of the people interviewed answered poor and 26% as a very poor condition.

There are many facilities in the old core of Baghdad such as cultural, social and leisure facilities, shopping, religious and educational facilities. These features play a significant role in characterizing the identity of its urban form and context. **The outcomes of this investigation in terms of facilities in the historic centre:**

1. Ninety percent of the citizens interviewed assert that the shopping facility was good or satisfactory.
2. religious facilities were also confirmed by the participants in this survey as good or satisfactory.
3. Seventy-four percent of the respondents indicate that cultural facilities were in a poor or a very poor condition.
4. The responses rates were 76% and 66% for poor or very poor in terms of educational and healthcare facilities respectively.

Wars, economic situations, lack of conservation plans, lack of new principles to regenerate the traditional urban fabric and other political issues have led to deterioration in many significant parts of Old Rusafa. **The outcomes of this investigation in terms of deterioration of the essential elements in the historic centre:**

1. the deterioration of traditional Baghdadi houses have very high and high rates of 51% and 30%, due to the situation that many of these houses were neglected and ignored by government, owners and heritage institutions.
2. Eighty percent of the interviewees have evaluated the deterioration of the traditional urban fabric as high and very high and 86% of the responses assert that the decline of the physical environment of historical spines was high or very high.
3. They also believe that Rashid Street and squares were suffering from many problems and the deterioration of their traditional buildings was one of these issues with a score of 47% very high and 38% as high. The riverfront of the case study was also assessed by peoples' views with a score of deterioration 77% as high or very high.

Urban context and form of Old Rusafa have been changed since the opening of four major roads between 1914 and 1945. **The outcomes of this investigation in terms of the most tangible problems in the historic centre:**

1. Ninety-four percent of the respondents are not satisfied with traffic congestion in the case study area and rated this problem as high or very high.
2. Household overcrowding issues were rated as very high or high tangible problems with a score of 90%.
3. The people interviewed assessed the level of poverty in the case as high with a rate of 64% and very high with a rate of 22%.
4. Eighty percent of the interviewees answered that land use problem in this area was high (60%) or very high (20%).
5. The majority of participants in this survey answered high or very high (75%), while few people stated that the safety problem was low or very low (11% in total).

The outcomes of this investigation in terms of the level of pollution in the historic centre:

1. Most responses to air pollution very high (58%) or high (35%) whereas, few people indicated which asserted that the pollution of the environment were medium (3%).
2. Fifty-nine percent of the participants have asserted that the noise pollution was very high and 35% of them answered as high while the rest answered (6%) medium, low, very low and I do not know.
3. Strong confirmation of very high or high level of water pollution was found (92%).
4. Land and visual pollutions had a high or very high level with a score of 92% and 86% respectively.

The outcomes of this investigation in terms of the main land management problems in the historic centre:

1. Seventy-seven percent of the people interviewed considered the 'lack of appropriate governmental planning methodologies for conserving heritage values' to be very high and high.
2. Seventy-two percent of participants in this survey asserted that the lack of a maintained register of ownership' was low or very low.

3. Sixty-five percent of the interviewees confirmed that the conflicting ownership of plots was medium or low.
4. The lack of appropriate regulations for conserving heritage values was high or very high with a score of 76%.
5. The lack of maps and plans was low (30%) or medium (24%).
6. A majority of 46% regarded 'lack of the participation of local communities in the documentation of the cultural heritage' as 'high' with a further 25% viewing such aspects as 'very high'.
7. Seventy percent of those who were interviewed emphasized the appropriate identification of the cultural heritage values was high or very high.
8. Sixty-four percent of the responses indicated that the lack of local skilled experts in preserving heritage values was very high and high with a score of 25% and 46% respectively.

The outcomes of this investigation in terms of the attitude of the government towards the participation of local citizens in conserving heritage values of Old Rusafa:

1. Ninety-four percent of the answers indicate the attitude of the government was very weak (60%) or weak (34%).

The outcomes of this investigation in terms of the government intention towards promoting a cultural heritage area in Old Rusafa:

1. Vast of response asserts that the promotion of cultural heritage in the historic core was very weak or weak with a score of 92%.

The outcomes of data analyses in terms of the quality of the natural environment in Old Rusafa:

1. Eighty-nine percent of the interviewees asserted that improving air quality was important (20%) or highly important (66%).
2. Increasing greenery and open spaces were highly important and important with a score of 56% and 24% respectively.
3. Over half of those interviewed (52%) confirmed that resource efficiency was highly important.
4. A minority of responses (10%) asserted that this aspect was moderately important.

5. A vast number of the participants (88%) indicated that promoting opportunities for recycling was highly important (30%) or important (48%).
6. Eighty-two percent of the citizens interviewed agreed that lower gasoline consumption was important (40%) or highly important (42%).

Social interaction is one of the main elements that advance the smart sustainable city concept and one of three key dimensions that form the implementation of urban sustainability methods in cities. **The outcomes of data analyses in terms of social interaction in Old Rusafa:**

1. Ninety-one percent of the respondents indicate that enhancing the sense of community was highly important (56%) or important (35%).
2. social participation was important and highly important with an outcome of 20% and 72% respectively.
3. Equity was highly important (55%) and important (30%) according to peoples' opinions.
4. Eighty-eight percent of the interviewees confirmed that strengthening social interaction and civic life was another highly important (48%) or important (40%) aspect.
5. Two-third of the people interviewed (62%) asserted that a better standard of living was a highly important aspect to be achieved in the old city of Baghdad.

The accessibility to services and facilities was an important and highly important aspect of promoting the physical environment in the city centre of Baghdad. **The outcomes of data analyses in terms of citizens' accessibility to different activities in Old Rusafa:**

1. The majority of 65% regarded 'provide services locally and easy to walk' as 'highly important', with a further 20% viewing such aspect as 'important'.
2. The vast number of responses regarding 'reducing the need for people to travel' were divided between two options: 'highly important and 'important', which counted for 35% and 60% respectively.
3. The outcomes of the responses regarded providing socially equitable services in the figure below was 'highly important' and 'important' for 90% of the participants.

Achieving a sustainable environment in the case study of this thesis requires decreasing toxic and nontoxic pollutants. **The outcomes of data analyses in terms of public health in Old Rusafa:**

1. Eighty-nine percent of the citizens interviewed asserted that decreasing toxic and non-toxic pollutants were highly important (67%) or important (22%).
2. Ninety-two percent of the interviewees agreed that obtaining clear water, air and land in the old city of Baghdad were either highly important and important issues with a score of 75% and 17 respectively.
3. Over a half of the participants (52%) indicates reducing the stress for individuals was highly important issue and 25% of the respondents answered it as 'important'.
4. Reducing the intensity of existing life stresses was either a highly important or important issue, accounting for 35% and 40% respectively.

The outcomes of data analyses in terms of economic viability in Old Rusafa:

1. Ninety percent of those who were interviewed asserted that decreasing the cost of infrastructure was either a highly important (53%) or an important (37%) issue to be considered in the development of Old Rusafa.
2. The reducing poverty issue was rate by 50% as 'highly important' and 30% as important.
3. Urban maintenance was highly important and important with a score of 48% and 44% respectively.
4. A vast number of the respondents (81%) considered increasing land values for residential neighbourhoods as a highly important issue (34%) or important (46%).

The smart governance dimension is one of the essential elements in advancing the smart city concept to play a fundamental role in creating an open service and data platform for their citizens to participate. **The outcomes of data analyses in terms of smart governance in Old Rusafa:**

1. A vast number of answers (91%) indicated that interaction and collaboration with the public were highly important (32%) or important (57%).
2. Eighty percent of the participants in this investigation agreed that open data by using ICT was important or highly important with a score of 28% and 52% respectively.

3. Less of the people interviewed (10%) answered that e-services were moderately important, whereas, the majority (81%) confirmed that e-services were highly important (46%) or important (34%).

The outcomes of data analyses in terms of smart economy in Old Rusafa:

1. Two-third (63%) of the respondents agreed that e-business was highly important and 32% of the people interviewed asserted that this aspect was important, whereas, fewer people indicated that e-business was moderately important.
2. Eighty-four percent of participants asserted that the increase productivity aspects in Old Rusafa were highly important or important with a rate of (44%) and (40%) respectively.
3. Eighty-four percent of participants confirmed e-commerce as a highly important or important element.

The outcomes of data analyses in terms of smart mobility in Old Rusafa:

1. Ninety percent of participants asserted that reducing CO2 emissions in the traditional centre were highly important (65%) or important issues (25%).
2. The majority of respondents (84%) as highly important or important methods that should be implemented in the promotion of the urban context.
3. A vast number of interviewees (88%) indicate that efficient commuting was an important (28%) or highly important (60%) issue to be considered in the development of the case study area, whereas, fewer participants (6%) assert this aspect as moderately important.
4. The majority of people interviewed in this survey (85%) confirmed that integrated transport was highly important (46%) or important (38%).

The outcomes of data analyses in terms of the smart environment in Old Rusafa:

1. The majority of respondents (94%) were divided between the two favoured options, ‘highly important’ and ‘important’ when they assessed the significance of green buildings aspects.
2. A vast number of the interviewees (90%) asserted that improving water quality was highly important or important with a score of (64%) and (26%) respectively.

3. Eighty percent of the responses indicate smart energy was important (32%) or highly important (48%).
4. The majority of the participants (86%) agreed that pollution control and monitoring were a highly important (58%) or important issue (28%) to be considered in the smart sustainable framework of Old Rusafa.
5. The green urban planning was assessed as highly important (56%) or important (36).
6. The majority of responses (82%) confirm that resource use efficiency was either highly important or important, which counted for 50% and 32% respectively.

The outcomes of data analyses in terms of smart people in Old Rusafa:

1. A vast number of the people interviewed (89%) emphasized that e-education was highly important or important with a score of (38%) and (51%) respectively.
2. The majority of the interviewees (86%) agreed that e-skills were important (56%) or highly important (30%).
3. The majority of respondents (81%) asserted that e-working was important (28%) or highly important (53%), whereas, fewer participants (14%) in this investigation confirm that this aspect was moderately important.

The outcomes of data analyses in terms of smart living in Old Rusafa:

1. The majority of participants (98%) were divided between the two favoured options, 'highly important' and 'important' when they assessed the significance of safe living aspects.
2. A vast number of the interviewees (94%) asserted that healthy living was highly important or important with a score of (66%) and (28%) respectively.
3. The majority of responses (85%) agreed that the ICT-enabled lifestyles aspect was highly important (55%) or important (35%).
4. A vast number of citizens interviewed (93%) confirm that good quality housing and accommodation aspects was important (28%) or highly important (65%).
5. Eighty-eight percent of the participants in this survey emphasised that diverse cultural facilities were important or highly important with a score of 52% and 63% respectively.

11.5 Smart and Sustainable Urbanism Framework in Old Rusafa

This topic was presented in chapters ten, and related at length within the following research goal and question of this research:

Research Aim 1: The first aim of this research is to produce <u>a smart sustainable urbanism framework and design proposal</u> that provides conceptual solutions to shape the future of the historic centre of Baghdad, which may be applicable to other historic cities.

Question 1: <u>How can smart sustainable methods affect and develop the traditional urban fabric?</u>

<u>• Producing smart sustainable urbanism strategies that seek an efficient quality of life for the old city stockholders with the lowest environmental footprint, renewable energy and rehabilitation the traditional urban fabric with its historical buildings.</u>

• <u>Suggesting guidelines for the future development that shape urban form, urban fabric and advance urban components of the traditional city.</u>

A smart sustainable urbanism framework in Old Rusafa proposed guides to produce an efficient quality of life for the old city stockholders with the lowest environmental footprint, clean-tech cluster, renewable energy and rehabilitation the traditional urban fabric with its historical buildings. **These strategies and guides are:**

1. The implementation of this framework should be through long term levels of actions up to the year 2030.
2. Renewal and conserving of historical buildings, areas and monuments, urban fabric, enhancement of Al-Rashid Street and Tigris riverfront, advancement social and educational facilities, development urban infrastructure and advancement transportation models.
3. Designing an environmental pedestrian walkway should be implemented along Tigris Riverfront.
4. Enhancing and promoting different functions that overlooking on the waterfront such as entertainment and social facilities.
5. Tigris Riverfront should be developed according to the new principles of the smart sustainable cities concept.

6. Infilling new buildings in empty areas that should integrate with traditional street elevation by using brick and timber facing materials and not exceed 2-3 storeys.
7. Advancing the configuration of the physical urban functions and environment in harmony with the traditional environment.
8. Create new open spaces in the form of a plaza along Al-Rashid Street that will shape the amenity core of the advancement place.
9. Controlling the skyline of the old city and respect the height of the historical buildings, which play an essential role in the creation of the locational identity.
10. Integrating city governance, organizations, services with public, private, civil, and community organizations to create efficient, effective and green city functions working as one organism.
11. Promoting the relationships between the Municipality of Baghdad and its stakeholders, and creating a new thinking of urban management in the information age.
12. Investing in the human and social capital and promote the participatory of governance in creating smart sustainable platform of sharing information in real time with its people.
13. Producing a holistic method that allows stakeholders in Baghdad go online through their smartphones, computers and advanced technologies to contact to citizens, hospitals, local government, public transportation, schools and socio-economic and cultural services to develop collective skills and capacities.
14. Integrating industry, economy and commerce by introducing big data as the core to manage the old city.
15. Implementing an effective economy by investing in the quality of life that will lead to attracting knowledge workers and best talent to live and work in the case study area, further, attain e-business, e-commerce and increased productivity
16. Establishing smart sustainable clusters and ecosystems in the historic centre that increase innovation, productivity, entrepreneurship, and flexibility of the labour market.
17. Implementing integrative ecosystems that enhanced the highest level of advance technology and engagement of private associates and feasible business patterns that lead to developing the competitiveness of urban physical contexts in the global knowledge economy.

18. Creating a comfortable and efficient transportation scheme for formulating effective and environmentally sound transportation systems.
19. Increasing the width of sidewalks, adding the shade of trees and shading devices, and comprehensively designing the entire public realm.
20. Promote movement linkages between two sides of Tigris River by using river transportation as a part of Transportation Framework of metropolitan Baghdad.
21. Implementing clean efficient and non-motorised transportation options in the old core that might reduce CO2 emissions.
22. Utilising smart sustainable models of transportation (personal rapid transit (PRT) and light rail transit (LRT)) that use ICT can develop services and provide feedback to stakeholders, create their own real-time information and participate in long-term planning.
23. Implementing sensors, automatic vehicle registration plate readers, dynamic traffic lights, passenger information panels and the capability of integrating live data from most of these sources that advance network management, safety, environmental performance, accessibility, convenience, public perception and reduce traffic congestion.
24. Restoring the traditional built environment particularly the historic urban fabric to meet collective needs.
25. Redeveloping the traditional principle in the organic traditional core and the environmental standard.
26. High performance green urban fabric and buildings will maximize resource efficiency and human comfort in the hot and dry climate.
27. Promoting environmental awareness and sense of responsibility throughout using energy from renewable resources, green infrastructure, reducing waste by improving the way to recycle products and green transportation to minimize air pollution.
28. Gaining green urban infrastructure by utilizing ICT, IoT and cloud computing that concern for sustainability, protect environment and reduce CO2 emission.
29. Producing an urban area where smart sustainable solutions are achieved to promote smart sustainable urban growth.

30. Employing smart sustainable renewables energy, smart metering, pollution control and monitoring, green buildings, green urban design and planning and resource utilization efficiency that serve the smart sustainable environment framework.
31. Producing a green urban area in Old Rusafa that its key goals is to develop the quality of life for their stakeholders through integrating ICT infrastructures into socio-economic, cultural and physical infrastructures in different urban environments.
32. Defining the limits of growth for the city centre of Baghdad by providing a clear spatial identification for the activities, and minimize the horizontal extension of the city centre.
33. Organising new strategies of land use within the smart sustainable urbanism framework of greater Baghdad, transfer functions and replace them with other green facilities that promote the traditional values and health environment.
34. Resolving the conflict between traditional principles and modern design model through identifying the policies and strategies that will conserve the traditional urban fabric under the light of urban sustainability.
35. Correcting the balance of spatial distribution in Old Rusafa, and try to create livable and competitive historic centre.
36. Integrating the old core with other centres, open areas and public areas, which altogether will produce an accessible public domain in Baghdad.
37. Mixed use development that seeks to connect government institutions, health, education and economic activities and ICT-enabled life styles that will play significant role in developing the quality of life.
38. Creating a safe environment for living in a culturally vibrant historic area with various cultural activities.
39. Supporting the historic physical urban environment by sensors, ICT and IoT systems and smart sustainable infrastructures that have the ability to advance and innovate services to stakeholders and improve the quality of life in the case study area.
40. Utilizing renewable energy, appropriate technologies and build zero-energy building in the old core that might reduce CO2 emissions and create healthy urban environment.

41. Creating modern social facilities and enhancing the existing ones. These facilities such as schools, playgrounds and local centres should apply according to the stockholders' levels, thus, their size and location vary accordingly.
42. Proposing to use ICT and its infrastructures to monitor smart sustainable transportation models (include roads, bridges, tunnels, rails, subways), manage and analyse the real-time data, manage and optimise buildings and maximizing services to its stakeholders.
43. Advancing the historical environment of the case study area by building smart sustainable traditional buildings that can reduce waste, use water and energy in an efficient way, manage smart systems.
44. Managing new methods of transportation and traffic congestion through the utilisation of ICT and automated sensing and management of traffic that operate and analyse data gathered from different mobility styles and community participation.
45. Achieving a good quality of life in the traditional part of Baghdad, smart sustainable health-care systems.

11.6 Limitations of the Research

Despite the importance of the outcomes displayed in this chapter, there are some limitations throughout conducting this research:

1. The information that has been collected from diverse sources and Iraqi institutions such as comprehensive plans prepared for the historic centre has required a consent to gather these maps and data.
2. A security permits for taking photographs and site visits to update and assess the area between Al-Rashid Street and the Tigris Riverfront in Old Rusafa was required.
3. The time available and the limitation of this research, it has not been possible to propose a complete urban design solution for the whole of Old Rusafa, nor to address all chosen action places with the same degree of detail.
4. The size and time available of this research, it has not been possible to conduct and address a complete field survey for the whole area of Old Rusafa.
5. The difficulty of taking photos in some place of Old Rusafa due to the concentration of many Iraqi government buildings such the Ministry of Defence,

the Municipality of Baghdad and the Central Iraqi Bank that were surrounded by a concrete wall.

6. The limitation of interview participant from the case study area, as they were afraid to be evacuated from their houses and some security reasons.
7. The communal effects have led to the difficulty to conduct some of the traditional urban fabric and buildings.

11.7 Further Research

This thesis endeavour to develop the urban physical urban environment of Old Rusafa by implementing new smart sustainable urbanism methods. The following are some potential ways to advance this research further and to promote the knowledge around other aspects of smart sustainable methods in Baghdad city:

1. The success of the implementation of smart sustainable cities principles depends on long term designing measures and assessment. Therefore, future work could embark on developing and advancing smart sustainable indicators that are proposed to assess the implantation of new methods in the historical physical environment.
2. There is a need to conduct a comprehensive field survey for the entire historic centre of Baghdad.
3. The substantial thing is to realize what we need for our future vision of Baghdad, and put in place systems now that serve those future requirements in a smart sustainable and integrated way.
4. Reduce the gap between what governments, decision-makers requirements and citizens need.
5. Examining the role of cities in leading economic growth, while sustaining natural resources, reducing greenhouse gas emissions and developing the quality of life.
6. The method of the implementation of smart sustainable cities in Old Rusafa is a complex and multidisciplinary decision-making process, which requires management of a huge amount of data within the built and natural environment. These data contain rich information about socio-economic and environmental aspects that can be used in smart sustainability analysis, thus, the Municipality of Baghdad requires new approaches and knowledge to manage and steer these big data in the development processes.

7. Examining and researching the appropriate way to balance between top-down that demand powerful leadership and large-scale investment programs and bottom-up and that depend on shifts in actions.
8. The incorporation between governments, individuals, businesses, and organizations in terms of producing smart sustainable options that enable us to be more aware of the processes of smart sustainable urban advancement.
9. The smart sustainable cities concept is relatively new, and due to that, smart sustainable cities come in many alternatives, sizes and models. In addition, each city has its unique history, features and future dynamic, thus, searching for new models of smart sustainable cities concept will advance this new concept.
10. One of the significant element that promotes the implementation of the smart sustainable city concept is ICT and their infrastructure, therefore, further research on how these advanced technologies can enhance citizens' participation to communicate in smart methods.
11. Cities and especially Baghdad should determine their socio-economic and environmental aspects that seek to improve the quality of life, urban well-being, e-government, citizens' participation, and advance the sustainability in their urban areas.
12. Cities have gained many benefits and solved various problems by using IoT in real-time systems assessment to analyse their information obtained from diverse aspects such as water, electricity, traffic, and gas. However, more research is required on how to build a holistic approach or model that can combine all systems to assess big data, and how we can create a smart sustainable way to produce back all this information transformed into knowledge to the people to promote their attitudes and assist them to advance their prosperity.
13. A 'system of systems' concept that comprising socio-economic and environmental aspects as subsystems require further research on how this idea can produce efficient urban systems and active urban life that can deal with contemporary challenges and complex urban problems in real time. Furthermore, how this new approach of complex systems will bring the heritage conservation of historic areas such as Baghdad to a new vision that connects tradition and modernization and might manage the new change in a dynamic perspective, to preserve cultural identity and the sense of place.

BIBLIOGRAPHY

Adinyira, E., Oteng-Seifah, S. and Adjei-Kumi, T. (2007) 'A review of urban sustainability assessment methodologies.' In International conference on whole life urban sustainability and its assessment. Glasgow:

Ahmadi, V., Chi-Ani, A. I., Farkisch, H. and Surat, M. (2012) 'MORPHOLOGICAL STUDY OF URBAN HIERARCHY IN BOSHROOYEH CITY OF IRAN.' International Journal of Architectural Research, 6(3) p. 56.

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I. and Airaksinen, M. (2017) 'What are the differences between sustainable and smart cities?' Cities, 60 pp. 234-245.

Akkar Ercan, M. (2011) 'Challenges and conflicts in achieving sustainable communities in historic neighbourhoods of Istanbul.' Habitat International, 35(2) pp. 295-306.

Al Sayyed, W. (2012). THE MORPHOLOGY OF THE TRADITIONAL ARAB HOUSE. Lonaard 2, 9-27.

Al-Akkam, A. (2012a) 'Towards Environmentally Sustainable Urban Regeneration: A Framework for Baghdad City Centre.' Journal of Sustainable
Development, 5, [Online] 9. [Accessed

Al-Akkam, A. (2012b) 'Towards Environmentally Sustainable Urban Regeneration: A Framework for Baghdad City Centre.' Journal of Sustainable Development, 5(9)

Al-Akkam, A. (2013a) 'Urban Heritage in Baghdad: Toward a Comprehensive Sustainable Framework.' Journal of Sustainable Development, 6(2) pp. 39-55.

Al-Akkam, A. (2013b) 'Urban Heritage in Baghdad: Toward a Comprehensive Sustainable Framework.' [Online] [Accessed

Al-Ani, M. (2012) 'Urban Types and Transformation of the City.' In SCHRENK, M., V. POPOVICH, V., ZEILE, P. and ELISEI, P. (eds.) RE-MIXING THE CITY — Towards Sustainability and Resilience? : REAL CORP 2012 - Proceedings/Tagungsband, pp. 1041-1054.

Al-Hasani, M. (2012) 'Urban space transformation in old city of Baghdad--integration and management.' Megaron Architecture, 7(3) p. 79.

Al-Silq, G. (2008) 'Baghdad - Image and Memories.' DC PAPERS: Revista de Crítica y Teoría de la Arquitectura, (1139-5559) pp. 46-65.

Al-Zubaidi, M. (2007) *The Sustainability Potential of Traditional Architecture in the Arab World With-Reference to Domestic Buildings in the UAE.* PhD. University of Huddersfield.

Al-Zubaidi, M. and Shahin, B. (2008) 'Sustainability Principals of Traditional Architecture in the Islamic Perception.' The Iraqi journal of architecture, 4A, pp. 74-91. [Online] 12-13. Accessed http://iasj.net/iasj?func=fulltext&aId=11535

Albayati, D., Sipe, N., Alizadeh, T. and Tomerini, D. (2015) 'The impact of urban form on travel behavior in three Baghdad neighborhoods affected by terrorism.' 3, [Online] 1. Accessed http://dx.doi.org/10.1080/21650020.2014.984080

Alberti, M. (1996) 'Measuring urban sustainability.' Environmental Impact Assessment Review, 16(4) pp. 381-424.

Albino, V., Berardi, U. and Dangelico, R. M. (2015) 'Smart Cities: Definitions, Dimensions, Performance, and Initiatives.' JOURNAL OF URBAN TECHNOLOGY, 22(1) pp. 3-21.

Albrecht, H. (2013) URBAN CONSERVATION PRACTICES IN CANADA. Canada: THE STANDING COMMITTEE ON ENVIRONMENT AND SUSTAINABLE DEVELOPMENT.

Alfonso Piña, W. H. and Pardo Martínez, C. I. (2016) 'Development and urban sustainability: An analysis of efficiency using data envelopment analysis.' Sustainability (Switzerland), 8(2) p. 148.

Alobaydi, D., Rashid and Mahbub. (2015) 'Evolving syntactic structures of Baghdad: Introducing ‘transect’ as a way to study morphological evolution.' In SSS10 Proceedings of the 10th International Space Syntax Symposium. London: pp. 40:41-40:14.

Alsalloum, A. (2011) Heritage-led sustainable urban regeneration: the development of an assessment model for World Heritage Sites cities. University of Liverpool.

Angelidou, M. (2015) 'Smart cities: A conjuncture of four forces.' CITIES, 47 pp. 95-106.

Anthopoulos, L., Janssen, M. and Weerakkody, V. (2015) Comparing Smart Cities with different modeling approaches. 2015. ACM.

Ardakani, M. K. and Oloonabadi, S. S. A. (2011) 'Collective memory as an efficient agent in sustainable urban conservation.' Procedia Engineering, 21 pp. 985-988.

Assi, E. (2002) 'Limitations to community involvement in rehabilitation of historic areas.' Advances in Architecture Series, 14 pp. 439-447.

Auclair, E. and Fairclough, G. J. (2015) Theory and practice in heritage and sustainability: between past and future. Routledge studies in culture and sustainable development. London: Routledge.

Axinn, W. G. and Pearce, L. D. (2006) Mixed method data collection strategies. Cambridge; New York; Cambridge University Press.

Barnaghi, P., Bermudez-Edo, M. and Tönjes, R. (2015) 'Challenges for Quality of Data in Smart Cities.' Journal of Data and Information Quality (JDIQ), 6(2-3) pp. 1-4.

Bassett, K. (2004) 'Walking as an Aesthetic Practice and a Critical Tool: Some Psychogeographic Experiments.' Journal of Geography in Higher Education, 28(3) pp. 397-410.

Battista, G., Evangelisti, L., Guattari, C., Basilicata, C. and Vollaro, R. D. (2014) 'Buildings Energy Efficiency: Interventions Analysis under a Smart Cities Approach.' SUSTAINABILITY, 6(8) pp. 4694-4705.

Batty, M. (2008) 'The Size, Scale, and Shape of Cities.' Science, 319(5864) pp. 769-771.

Batty, M. (2012) 'Building a science of cities.' Cities, 29 pp. S9-S16.

Batty, M. (2013) The new science of cities. London: The MIT Press.

Batty, M., Barros, J. and Júnior, S. A. (2006) Cities: continuity, transformation and emergence. In: Garnsey, E. and McGlade, J. Complexity and Co-Evolution Continuity and Change in Socio-Economic Systems. pp. 61-75. UK: Edward Elgar Publishers.

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G. and Portugali, Y. (2012) 'Smart cities of the future.' The European Physical Journal Special Topics, 214(1) pp. 481-518.

Berehinejad, M., Chelongar, M. and Jamalli, M. (2014) 'Comparison of Baghdad and Cordoba Urban Planning.' World of Sciences Journal 2(4) pp. 48-55.

Bianca, S. (2000) Urban form in the Arab world: past and present. London: Thames & Hudson.

Bicocchi, N., Cecaj, A., Fontana, D., Mamei, M., Sassi, A. and Zambonelli, F. (2013) Collective Awareness for Human-ICT Collaboration in Smart Cities. 2013. IEEE.

Bifulco, F., Tregua, M., Amitrano, C. C. and D'Auria, A. (2016) 'ICT and sustainability in smart cities management.' International Journal of Public Sector Management, 29(2) pp. 132-147.

BOUSSAA, D. (2017) 'ISLAMIC URBAN HERITAGE: BLIGHT OR BLESSING?' In The International Conference on Islamic Heritage Architecture and Art (Islamic Heritage Architecture 2016) Vol. 1, 3: WIT Press, pp. 344–354.

Branchi, P. E., Fernandez-Valdivielso, C. and Matias, I. R. (2014) 'Analysis Matrix for Smart Cities.' Future Internet, 6(1) pp. 61-75.

Bryman, A. (2006) 'Integrating quantitative and qualitative research: how is it done?' Qualitative Research, 6(1) pp. 97-113.

Careri, F. (2002) Walkscapes: walking as an aesthetic practice. Vol. 1. Barcelona: GG.

Cassandras, C. G. (2016) 'Smart Cities as Cyber-Physical Social Systems.' 中国工程科学：英文版, 2(2) pp. 156-158.

Charehjoo, F. and Siong, H. C. (2013) 'Applying quantitative techniques to evaluate the level of sustainability for physical dimension of urban form in Sanandaj city, Iran.' International Journal of Sustainable Development and Planning, 8(3) pp. 275-287.

Chourabi, H., Nam, Taewoo, Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., A., Pardo, T. and Jochen Scholl, H. (2012) 'Understanding Smart Cities: An Integrative Framework.' Hawaii International Conference on System Sciences, pp. 2289 - 2297. [Online] Accessed 10.1109/HICSS.2012.615

Clark, G., Moonen, T. and Moir, E. (2014) What are Future Cities. The Business of Cities for
the Foresight Future of Cities Project and the Future Cities Catapult.

Cohen, B. (2014) The Smartest Cities In The World 2015: Methodology. [Online] [Accessed https://www.fastcoexist.com/3038818/the-smartest-cities-in-the-world-2015-methodology

Cohen, N. (1999) Urban conservation. Cambridge, Mass; London; MIT.

Cooper, R., Evans, G. and Boyko, C. (2009) Designing sustainable cities. Oxford: Blackwell Publishing Ltd.

Creswell, J. W. (2013) Qualitative inquiry and research design: choosing among five approaches.

Creswell, J. W. and Plano Clark, V. L. (2011) Designing and conducting mixed methods research. 2nd ed., London; Los Angeles; SAGE.

Cullen, G. (1961) The concise townscape.

Cullen, G. (1996) The concise townscape. Oxford; Boston: Butter Worth-Heinemann.

Daher, R. (1996) 'Conservation in Jordan: acomprehensive methodology for historical and cultural resources.' Journal of ArchitecturalConservation, 2(3) pp. 65-80.

Danar Sunindyo, W., Akbar, S. and Iqbal, M. (2013) Towards a smart world class city: Case: Building bandung ICT master plan. 2013. IEEE.

Denzin, N. (2007) 21st Century Sociology Peck, C. D. B. D. L. (ed.) Thousand Oaks: SAGE Publications, Inc.

Dey, I. (1993) Qualitative data analysis: a user-friendly guide for social scientists. London: Routledge.

Ebrahimi, A. N. (2015) 'Effective Urban Values on Conservation of Historical Contexts: The Case of Isfahan - Iran.' ArchNet-IJAR: International Journal of Architectural Research, 9(1) p. 181.

Edjossan-Sossou, A. M., Deck, O., Al Heib, M. and Verdel, T. (2014) 'A decision-support methodology for assessing the sustainability of natural risk management strategies in urban areas.' NATURAL HAZARDS AND EARTH SYSTEM SCIENCES, 14(12) pp. 3207-3230.

EH, E. H. (2004) Heritage counts 2004: the state of England's historic environment.

Elmaghraby, A. S. and Losavio, M. M. (2014) 'Cyber security challenges in Smart Cities: Safety, security and privacy.' Journal of advanced research, 5(4) pp. 491-497.

Ericsson. (2013) Networked Society City Index. SE-126 25 Stockholm, Sweden.

Everard, A. J. and Pickard, R. D. (1997) 'Can urban conservation be left to the market? The value of partnership-led conservation regeneration strategies.' In. Vol. 26 1997. pp. 619-632.

Fathy, H., Shearer, W. and Sultān, A. a.-r. n. (1986) Natural energy and vernacular architecture: principles and examples with reference to hot arid climates. Shearer, W. and Sulṭān, ‘. a.-R. m. n. (eds.) Chicago: University of Chicago Press.

Ferro, E., Caroleo, Brunella, Leo, M., Osella, M. and Pautasso, E. (2013) 'The Role of ICT in Smart Cities Governance.' In Conference for Democracy & Open Government:

Fethi, I. (1977) URBAN CONSERVATION IN IRAQ. PHD. University of Sheffield

Gabrys, J. (2014) 'Programming environments: environmentality and citizen sensing in the smart city.' ENVIRONMENT AND PLANNING D-SOCIETY & SPACE, 32(1) pp. 30-48.

Gazi, H., Mikhail, Salwa and Estamboli, M. J. (2012) 'The position of Mosques in Islamic cities and its location design in new cities.' Damascus University Journal, 28(1)

GHF, G. H. F. (2012) 'Iraqi Heritage Experts Call on Government to Preserve Heritage Sites.' 7, [Online] Accessed http://popular-archaeology.com/issue/june-2012/article/iraqi-heritage-experts-call-on-government-to-preserve-heritage-sites

Girard, L. F. (2013) 'Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the "Historic Urban Landscape" Approach.' SUSTAINABILITY, 5(10) pp. 4329-4348.

Glendinning, M. (2013) The conservation movement: a history of architectural preservation: antiquity to modernity. London: Routledge.

Grafakos, S., Gianoli, A. and Tsatsou, A. (2016) 'Towards the Development of an Integrated Sustainability and Resilience Benefits Assessment Framework of Urban Green Growth Interventions.' Sustainability, 8(5) p. 461.

Granier, B. and Kudo, H. (2016) 'How are citizens involved in smart cities? Analysing citizen participation in Japanese "Smart Communities".' Information Polity, 21(1) pp. 61-76.

Grierson, D. (2007) 'The Urban Environment: Agendas and Problems.' 3 pp. 1-8.

Guo, M., Liu, Y., Yu, H., Hu, B. and Sang, Z. (2016) 'An overview of smart city in China.' China Communications, 13(5) pp. 203-211.

Hajduk, S. (2016) 'The Concept Of A Smart City In Urban Management.' Business, Management and Education, 14(1) p. 34.

Hara, M., Nagao, T., Hannoe, S. and Nakamura, J. (2016) 'New Key Performance Indicators for a Smart Sustainable City.' Sustainability, 8(3) p. 206.

HCF, H. C. F. (1983) Heritage conservation terminology, Definition of terms from various sources. [Online] [Accessed http://ip51.icomos.org/~fleblanc/documents/terminology/doc_terminology_e.html

Hiremath, R. B., Balachandra, P., Kumar, B., Bansode, S. S. and Murali, J. (2013) 'Indicator-based urban sustainability-A review.' ENERGY FOR SUSTAINABLE DEVELOPMENT, 17(6) pp. 555-563.

Hiu, Y. and Hon, C. (2012) 'Critical social sustainability factors in urban conservation: The case of the central police station compound in Hong Kong.' Facilities, 30(9/10) pp. 396-416.

Huang, J., Seck, M. D. and Gheorghe, A. (2016) Towards trustworthy smart cyber-physical-social systems in the era of Internet of Things. 2016. IEEE.

Huang, L., Wu, J. and Yan, L. (2015) 'Defining and measuring urban sustainability: a review of indicators.' Landscape Ecology, 30(7) pp. 1175-1193.

Höjer, M. and Wangel, J. (2014) 'Smart sustainable cities: Definition and challenges.' Advances in Intelligent Systems and Computing, 310 pp. 333-349.

Ibrahim, F. I., Omar, D. and Mohamad, N. H. N. (2015) 'Theoretical Review on Sustainable City Indicators in Malaysia.' Procedia - Social and Behavioral Sciences, 202 pp. 322-329.

ICOMOS. (1982) Charter for the Preservation of Quebec's Heritage (Deschambault Declaration). Canada Association for the Interpretation of the National Heritage.

ITU-T. (2014a) SG5 Last Meeting Executive Summary. [Online] Accessed http://www.itu.int/en/ITU-T/studygroups/2013-2016/05/Pages/exec-sum-201412.aspx

ITU-T. (2014b) Smart Sustainable Cities - An Analysis of Definitions.

ITU-T. (2015) Setting the stage for stakeholders' engagement in smart sustainable cities.

Jabareen, Y. R. (2006) 'Sustainable Urban Forms, Their Typologies, Models, and Concepts.' Journal of Planning Education and Research, 26(1) pp. 26- 38.

Jara, A. J., Genoud, D. and Bocchi, Y. (2015) 'Big data for smart cities with KNIME a real experience in the SmartSantander testbed: BIG DATA FOR SMART CITIES.' Software: Practice and Experience, 45(8) pp. 1145-1160.

JCCF. (1987) Integrated capital development plan of Baghdad 2001. Baghdad, Iraq: Municipality of Baghdad.

JCP. (1984) Study on Conservation and Redevelopment of Historical Center of Baghdad City. Republic of Iraq, Amanat Al Assima.

Jenks, M. and Dempsey, N. (2005) Future forms and design for sustainable cities. Oxford: Architectural Press.

Jenks, M. and Jones, C. (2010) Dimensions of the Sustainable City. London: Springer.

Jenks, M., Dempsey, N., Jones, C., Brown, C., Raman, S., Porta, S. and Bramley, G. (2010) Elements of urban form. Vol. 2. Dimensions of the Sustainable City. Springer Netherlands.

Jensenius, F. R. (2014) 'The Fieldwork of Quantitative Data Collection.' PS-POLITICAL SCIENCE & POLITICS, 47(2) pp. 402-404.

Johansson, T., Segerstedt, E., Olofsson, T., Jakobsson, M., Human Work, S., Department of Civil, E. a. N. R. E., Construction Engineering and, M., Industrial Work, E., Structural and Construction, E., Luleå University of, T., Industrilized and sustainable, c. and Department of Business Administration, T. a. S. S. (2016) 'Revealing social values by 3D city Visualization in city transformations.' Sustainability (Switzerland), 8(2) p. 195.

Johnson, R. B. and Onwuegbuzie, A. J. (2004) 'Mixed Methods Research: A Research Paradigm Whose Time Has Come.' Educational Researcher, 33(7) pp. 14-26.

Johnson, R. B., Onwuegbuzie, A. J. and Turner, L. A. (2007) 'Toward a Definition of Mixed Methods Research.' Journal of Mixed Methods Research, 1(2) pp. 112-133.

Jokilehto, J. (1999) A history of architectural conservation. Oxford: Butterworth-Heinemann.

Jones, H. and Jones, P. (2007) 'Cities and sustainability.' Landscape and Urban Planning, 83(1) pp. 1-1.

Kasparek, M. and Dimashki, M. (2009) Towards a Syrian Urban Development Policy.

Kennedy, J. F. (2004) Building without borders: sustainable construction for the global village. Natural building. Gabriola Island: New Society Publishers.

Khalifehei, H. (2014) Social sustainability and the future in the Iranian historic neighbourhoods' townscape. PHD. University of Sheffield.

Khansari, N., Mostashari, A. and Mansouri, M. (2013) 'Impacting Sustainable Behaviour and Planning in Smart City.' International Journal of Sustainable Land Use and Urban Planning, 1(2) pp. 46-61.

Khatoun, R. and Zeadally, S. (2016) Smart cities: concepts, architectures, research opportunities. Vol. 59, pp. 46-57. NEW YORK: ACM.

Kiet, A. (2010) 'Arab Culture and urban form.' focus, 8(1) pp. 36-45.

King, L. O. (2016) 'Functional sustainability indicators.' Ecological Indicators, 66 pp. 121-131.

Kirtikar, M. (2011) Once upon a time in Baghdad: the two golden decades: the 1940s and 1950s.

Kondepudi, S. (2015) Smart sustainable cities: An analysis of definitions.

Koramaz, T. K. and Gulersoy, N. Z. (2011) Users' Responses to 2D and 3D Visualization Techniques in Urban Conservation Process. 2011.

Kraus, S., Richter, C., Papagiannidis, S. and Durst, S. (2015) 'Innovating and Exploiting Entrepreneurial Opportunities in Smart Cities: Evidence from Germany: ENTREPRENEURIAL OPPORTUNITIES IN SMART CITIES.' Creativity and Innovation Management, 24(4) pp. 601-616.

Kuo, H. F. and Tsou, K. W. (2015) 'Application of Environmental Change Efficiency to the Sustainability of Urban Development at the Neighborhood Level.' SUSTAINABILITY, 7(8) pp. 10479-10498.

Kylili, A. and Fokaides, P. A. (2015) 'European smart cities: The role of zero energy buildings.' Sustainable Cities and Society, 15 pp. 86-95.

Larco, N. (2016) 'Sustainable urban design - a (draft) framework.' Journal of Urban Design, 21(1) pp. 1-29.

Lazaroiu, G. C. and Roscia, M. (2012) 'Definition methodology for the smart cities model.' Energy, 47(1) pp. 326-332.

Lee, S. E., Quinn, A. D. and Rogers, C. D. F. (2016) 'Advancing City Sustainability via Its Systems of Flows: The Urban Metabolism of Birmingham and Its Hinterland.' Sustainability, 8(3) p. 220.

Leech, N. L. and Onwuegbuzie, A. J. (2009) 'A typology of mixed methods research designs.' Quality & Quantity, 43(2) pp. 265-275.

Lewis, S. (2015) Qualitative Inquiry and Research Design: Choosing Among Five Approaches. Vol. 16, pp. 473-475. Los Angeles, CA: SAGE Publications.

Li, X., Lv, Z., Hijazi, I. H., Jiao, H., Li, L. and Li, K. (2016) 'Assessment of Urban Fabric for Smart Cities.' IEEE Access, 4 pp. 373-382.

Lim, C.-K. (2010) 'Future Cities, A Preliminary Study for a Teaching Framework that Incorporates CAD/CAM Media into the Basic Design Studio.' In Conference, E., Schmitt, G. and Ecaade (eds.) Future cities : eCAADe 2010 conference.

Lombardi, P., Giordano, S., Farouh, H. and Yousef, W. (2012) 'Modelling the smart city performance.' Innovation: The European Journal of Social Science Research, 25(2) pp. 137-149.

Luque-Ayala, A. and Marvin, S. (2015) 'Developing a critical understanding of smart urbanism?' URBAN STUDIES, 52(12) pp. 2105-2116.

Lynch, K. (1984) Good city form. London: Massachusetts Institute of Technology.

Malapile, S. and Keengwe, J. (2014) 'Information Communication Technology planning in developing countries.' Education and Information Technologies, 19(4) pp. 691-701.

Manville, C., Cochrane, G., Cave, J., Millard, J., Kevin, J., Rasmus Kåre and Andrea. (2014) Mapping Smart Cities in the EU. Policy Department A: Economic and Scientific Policy.

Marozzi, J. (2014) Baghdad : city of peace, city of blood. London: Penguin Group.

Marsal-Llacuna, M. L., Colomer-Llinas, J. and Melendez-Frigola, J. (2015) 'Lessons in urban monitoring taken from sustainable and livable cities to better address the Smart Cities initiative.' TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE, 90 pp. 611-622.

Matos Wunderlich, F. (2008) 'Walking and Rhythmicity: Sensing Urban Space.' Journal of Urban Design, 13(1) pp. 125-139.

Mersal, A. (2016) 'Sustainable Urban Futures: Environmental Planning for Sustainable Urban Development.' Procedia Environmental Sciences, 34 pp. 49-61.

Michael, F. L., Noor, Z. Z. and Figueroa, M. J. (2014) 'Review of urban sustainability indicators assessment - Case study between Asian countries.' HABITAT INTERNATIONAL, 44 pp. 491-500.

Mori, K. and Yamashita, T. (2015) 'Methodological framework of sustainability assessment in City Sustainability Index (CSI): A concept of constraint and maximisation indicators.' HABITAT INTERNATIONAL, 45(1) pp. 10-14.

Mortada, H. (2003) Traditional Islamic principles of built environment.

Naguib, D., Afifi, M. and Wahba, S. (2016) 'Towards Sustainability in Eco-cities; TDR and Possibilities of Application on Urban Areas.' Procedia Environmental Sciences, 34 pp. 94-103.

Nam, T. and Pardo, T. (2011) Conceptualizing smart city with dimensions of technology, people, and institutions. 2011. ACM.

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G. and Scorrano, F. (2014) 'Current trends in Smart City initiatives: Some stylised facts.' CITIES, 38 pp. 25-36.

Newman, P. W. G. (1999) 'Sustainability and cities: extending the metabolism model.' Landscape and Urban Planning, 44(4) pp. 219-226.

Normisur International. (2014) Sustainable Cities of the Future. [Online] [Accessed http://normisur.com/blog/sustainable-cities-of-the-future-%E2%80%93-october-2014

Olascoaga, J. (2003) DEVELOPMENT OF A NEW APPROACH FOR APPRAISING THE AESTHETIC QUALITY OF CITIES. PHD. Texas Tech University.

Palacio, F. (2015) 'Urban quality and the sustainable city in Norway: the challenge of density.' WIT Transactions on Ecology and The Environment, 193 pp. 677-687.

Patton, M. Q. (2002) Qualitative research & evaluation methods. Vol. 3rd. Thousand Oaks, Calif; London; Sage.

Paul, J. (2010) Historic Urban Environment Conservation Challenges and Priorities for Action. USA: The Getty Conservation Institute.

Paulin, A. (2016) 'Informating Smart Cities Governance? Let Us First Understand the Atoms.' Journal of the Knowledge Economy, 7(2) pp. 329-343.

Peerapun, W. (2012) 'Participatory Planning in Urban Conservation and Regeneration: A Case Study of Amphawa Community.' Procedia - Social and Behavioral Sciences, 36 pp. 243-252.

Pendlebury, J. (2002) 'Conservation and Regeneration: Complementary or Conflicting Processes? The Case of Grainger Town, Newcastle upon Tyne.' Planning Practice & Research, 17(2) pp. 145-158.

Pendlebury, J. and Strange, I. (2011) 'Urban conservation and the shaping of the English city.' The Town Planning Review, 82(4) p. 361.

Peng, C. and Park, A. (2013) 'Mapping Interstitial Urban Spaces through Performing the City.' Leonardo, 46(5) pp. 490-491.

Pieri, C. (2014) 'Baghdad 1921-1958. Reflections on history as a" strategy of vigilance".' 8, pp. 69-93. [Online] 1-2. [Accessed https://hal.archives-ouvertes.fr/halshs-00941214/document

Polsevice. (1973) Comprehensive development plan for Baghdad -2000. Warsaw, Poland: Municipality of Baghdad.

Popescu, G. H. (2015) 'THE ECONOMIC VALUE OF SMART CITY TECHNOLOGY.' Economics, Management and Financial Markets, 10(4) p. 76.

Popescul, D. and Radu, L. D. (2016) 'Data Security in Smart Cities: Challenges and Solutions.' Informatica Economica, 20(1/2016) pp. 29-38.

Pouryazdan, M. and Kantarci, B. (2016) 'The Smart Citizen Factor in Trustworthy Smart City Crowdsensing.' IT Professional Magazine, 18(4) pp. 26-33.

Puren, K. and Jordaan, T. (2014) 'Towards integrating built heritage resources in urban development through spatial planning.' WIT Transactions on Ecology and the Environment, 191 pp. 209-220.

Purnomo, F., Meyliana and Prabowo, H. (2016) 'Smart city indicators: A systematic literature review.' Journal of Telecommunication, Electronic and Computer Engineering, 8(3) pp. 161-164.

Pyla, P. (2008) 'Back to the Future: Doxiadis's Plans for Baghdad.' Journal of Planning History, 7(3) pp. 4-19.

Rabari, C. and Storper, M. (2014) The digital skin of cities: urban theory and research in the age of the sensored and metered city, ubiquitous computing and big data.

Ragette, F. (2003) Traditional domestic architecture of the Arab region. Stuttgart: Axel Menges.

Rashed, H. (2013) SUSTAINABLE URBAN DEVELOPMENT IN HISTORIC CAIRO. PHD. University of Nottingham.

Reiche, D. (2011) 'Renewable Energy Policies in the Gulf countries: A case study of the carbon-neutral “Masdar City” in Abu Dhabi.' [Online] Accessed https://www.aub.edu.lb/ifi/public_policy/climate_change/ifi_cc_texts/Documents/policy_memos/ifi_cc_memo09_masdar_city.pdf

Reutersward, L. (2009) 'Urban Futures: The Challenge of Sustainability.' In Conference report, AGS Annual Meeting. Switzerland: Alliance for Global Sustainability, pp. 1-45.

Rodwell, D. (2008) Conservation and Sustainability in Historic Cities.

Romanos, M. C. and Auffrey, C. (2002) Managing intermediate size cities: sustainable development in a growth region of Thailand. GeoJournal library v. 69. London: Springer.

Ročak, M., Hospers, G.-J. and Reverda, N. (2016) 'Searching for social sustainability: The case of the shrinking city of Heerlen, the Netherlands.' Sustainability (Switzerland), 8(4) p. 382.

Salingaros, N. A. (1998) 'Theory of the urban web.' Journal of Urban Design, 3(1) pp. 53-71.

Sarvarzadeh, S. K. and Abidin, S. Z. (2012) 'Problematic Issues of Citizens’ Participation on Urban Heritage Conservation in the Historic Cities of Iran.' Procedia - Social and Behavioral Sciences, 50 pp. 214-225.

Scholz, R. W. and Tietje, O. (2002) Embedded case study methods: integrating quantitative and qualitative knowledge. Thousand Oaks, [Calif.]; London; SAGE.

Science for Environment Policy. (2015) Indicators for sustainable cities. Bristol: the European Commission DG Environment by the Science Communication.

Scuotto, V., Ferraris, A. and Bresciani, S. (2016) 'Internet of Things: Applications and challenges in smart cities: a case study of IBM smart city projects.' Business Process Management Journal, 22(2) pp. 357-367.

Selim, G. (2017) Unfinished Places. New York: Routledge.

Shaban, R. (2009) 'Robert K. Yin, Case Study Research: Design and Methods, Fourth Edition, Applied Social Research Methods Volume 5, Sage Publications Incorporated (2008) 240 pages, Paperback, RRP AU$ 65.00, ISBN: 9781412960991.' Australasian Emergency Nursing Journal, 12(2) pp. 59-60.

Shahrokni, H., Årman, L., Lazarevic, D., Nilsson, A., Brandt, N., Hållbar utveckling, m. o. t., Kth, Industriell, e. and Skolan för arkitektur och, s. (2015) 'Implementing Smart Urban Metabolism in the Stockholm Royal Seaport: Smart City SRS.' Journal of Industrial Ecology, 19(5) pp. 917-929.

Shen, L., Shuai, C., Jiao, L., Tan, Y. and Song, X. (2016) 'A global perspective on the sustainable performance of urbanization.' Sustainability (Switzerland), 8(8) p. 783.

Shen, L.-Y., Jorge Ochoa, J., Shah, M. N. and Zhang, X. (2011) 'The application of urban sustainability indicators – A comparison between various practices.' Habitat International, 35(1) pp. 17-29.

Shin, H. B. (2010) 'Urban conservation and revalorisation of dilapidated historic quarters: The case of Nanluoguxiang in Beijing.' Cities, 27(1) pp. S43-S54.

Shiwei, L., Pingyu, Z., Zheye, W., Wenxin, L. and Juntao, T. (2016) 'Measuring the sustainable urbanization potential of cities in Northeast China.' 地理学报：英文版, 26(5) pp. 549-567.

Shokry, H. (2012) 'ISLAMIC URBANISM AND ACCESS REGULATION AS A GUIDE TO THE FUTURE THE CASE OF MEDIEVAL CAIRO.' Journal of Engineering Sciences, 40(3) pp. 943-958.

Shwartz, A., Turbé, A., Julliard, R., Simon, L. and Prévot, A.-C. (2014) 'Outstanding challenges for urban conservation research and action.' Global Environmental Change, 28 pp. 39-49.

Sinclair, I. (2003) Lights out for the territory: 9 excursions in the secret history of London. London: Penguin.

Sinemillioglu, M. O., Akin, C. T. and Karacay, N. (2010) 'Relationship Between Green Areas and Urban Conservation in Historical Areas and Its Reflections: Case of Diyarbakir City, Turkey.' European Planning Studies, 18(5) pp. 775-789.

Smart Dubai. (2014) Smart Dubai. Dubai: [Online] [Accessed http://www.smartdubai.ae/index.php

Smedley, T. (2013). Top-down or bottom-up? Two visions of smart cities. New Scientist.

Sousa, A. (1952) Aṭlas Baghdād. Baghdad: Mudiryat Al-Masaha.

Srivastava, M. (2016) 'Framework to Assess City-scale Sustainability.' Procedia Engineering, 145 pp. 1440-1447.

Stenhouse, L. (1975) An introduction to curriculum research and development. London: Heinemann Educational.

Stilwell, B. and Lindabury, S. (2008) MASDAR. USA.

Stonor, T. (2014) A SMART approach to digital planning and design. UK: RIBA

Stossel, Z., Kissinger, M. and Meir, A. (2015) 'Measuring the biophysical dimension of urban sustainability.' ECOLOGICAL ECONOMICS, 120 pp. 153-163.

Su, X. (2010) 'Urban conservation in Lijiang, China: Power structure and funding systems.' Cities, 27(3) pp. 164-171.

Sánchez-Algarra, P. and Anguera, M. T. (2013) 'Qualitative/quantitative integration in the inductive observational study of interactive behaviour: impact of recording and coding among predominating perspectives.' Quality & Quantity, 47(2) pp. 1237-1257.

Tan, Y., Xu, H. and Zhang, X. (2016) 'Sustainable urbanization in China: A comprehensive literature review.' Cities, 55 pp. 82-93.

The Municipality of Baghdad (Cartographer). (2016). Land Uses Plane of Baghdad

Throsby, D. (2014) 'Investment in urban heritage conservation in developing countries: Concepts, methods and data.' City, Culture and Society, 7(2) pp. 81-86.

To, W.-M., Lai, L. S. L. and Chung, A. W. L. (2016) 'Tree MIS: Caring for Ecological Assets in Smart Cities.' IT Professional, 18(4) pp. 50-55.

Townsend, A. M. (2013) Smart cities: big data, civic hackers, and the quest for a new utopia. New York: W. W. Norton and Company.

UN-Habitat. (2016) Urbanization and Development: Emerging Futures. Nairobi, Kenya: United Nations Human Settlements Programme (UN-Habitat).

UNCHS, U. N. C. o. E. a. D. (1992) Press summary of Agenda 21.

UNECE–ITU. (2015) The UNECE–ITU Smart Sustainable Cities Indicators. Geneva.

UNESCO. (2010) Four Dimensions of Sustainable Development. [Online] [Accessed http://www.unesco.org/education/tlsf/mods/theme_a/popups/mod04t01s03.html

United Nations. (2016) Smart cities and infrastructure. Geneva: Economic and Social Council.

Wagle, G. (2014) 'Masdar City: Planning a Sustainable, Smart City - An Integrated Approach.' In 12th International Conference on emerging trends in Sustainable Habitat and Integrated Cities:

Walton, J., EL-Haram, M., Castillo, N., Horner, R., Price, A. and Hard castle, C. (2005) 'Integrated assessment of urban sustainability.' Engineering Sustainability, 158(2) pp. 57-65.

Warren, J. and Fethi, I. (1982) Traditional houses in Baghdad. Horsham: Coach Publishing House.

Webster, H., Williams and P. (2005) Envisioning the Future: Sustainable Models for Rural Communities. In: Jenks, M., Dempsey, N. and MyiLibrary. Future Forms and Design for Sustainable Cities. pp. 263-284. Oxford: Architectural Press.

Wheeler, S. (2013) Planning for sustainability: creating livable, equitable and ecological communities. Vol. Second. London: Routledge.

Whyte, J., Hart, Thomas, Kang, Y., Zang, L., Chen, C., G, e. Y., Li Hao and Cui, Y. (2014) Comparative Study of Smart Cities in Europe and China. Ministry of Industry and Information Technology (MIIT).

Williams, K. (2010) 'Sustainable cities: research and practice challenges.' International Journal of Urban Sustainable Development, 1(1-2) pp. 128-132.

Williams, K., Jenks, M. and Burton, E. (2000) Achieving sustainable urban form. London: E & FN Spon.

Willis, B. (2005) Towards a Sustainable City: Rebuilding Lower Manhattan. In: Jenks, M., Dempsey, N. and MyiLibrary. Future Forms and Design for Sustainable Cities. pp. 185-206. Oxford: Architectural Press.

Wilson, V. (2016) 'Research Methods: Design, Methods, Case Study…oh my.' Evidence Based Library and Information Practice, 11(1) pp. 39-40.

Wissen Hayek, U., Efthymiou, D., Farooq, B., von Wirth, T., Teich, M., Neuenschwander, N. and Grêt-Regamey, A. (2015) 'Quality of urban patterns: Spatially explicit evidence for multiple scales.' Landscape and Urban Planning, 142 pp. 47-62.

World Commission on Environment and, D., Brundtland, G. H., Worcomenvdev and Wced. (1987) Our common future: ["April 1987."]. Oxford paperbacks.

Yigitcanlar, T. and Lee, S. H. (2013) 'Korean ubiquitous-eco-city: A smart-sustainable urban form or a branding hoax?' Technological Forecasting and Social Change, 89 pp. 100-114.

Yigitcanlar, T., Dur, F. and Dizdaroglu, D. (2015) 'Towards prosperous sustainable cities: A multiscalar urban sustainability assessment approach.' HABITAT INTERNATIONAL, 45(1) pp. 36-46.

Zanella, A., Bui, N., Castellani, A., Vangelista, L. and Zorzi, M. (2014) 'Internet of Things for Smart Cities.' IEEE Internet of Things Journal, 1(1) pp. 22-32.

Zoonen, L. v. (2016) 'Privacy concerns in smart cities.' Government Information Quarterly, 33(3) pp. 472-480.

APPENDICES

Appendix 1: The Arabic Version of the Final Questionnaire

المعلومات المتعلقة بالبحث

تصميم حضري متكامل ذكي ومستدام للمركز التاريخي في بغداد. منطقة الدراسة: الرصافة القديمة

انت مدعو للمشاركة في دراسة بحثية. قبل أن تقرر ما إذا كانت ستشارك، من المهم بالنسبة لك أن تفهم لماذا اجري هذا البحث وما هي اهدافه. يرجى أخذ الوقت لقراءة المعلومات التالية بعناية، ولا تردد في طلب المزيد من المعلومات أو إذا كان هناك أي شيء أنت لا تفهمه

يرجى العلم بانه تمت الموافقة على هذا الاستبيان من قبل اللجنة الأخلاقية الاكاديمية في جامعة مانشستر متروبوليتان في 2015/06/08

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أنا ممتن جدا لمشاركتكم في هذا البحث. وسوف أطلعكم على نتائج هذا الاستبيان في الوقت المناسب، إذا كنت ترغب في ذلك. سيتم التعامل مع ردودكم في سرية تامة, وسيتم الاعترف الكامل في ختام هذا العمل، ولكن فقط مع موافقتك. إذا كان لديك أي أسئلة أخرى حول الاستبيان أو طلب توضيحات بشأن أي جوانب أخرى لهذا البحث، لا تترددوا في الاتصال بنا، على العناوين المذكورة أعلاه يرجى

توجز المعلومات التالية اهداف مشروع البحث ومنهجياته الاكاديمية

يقوم بهذا البحث مازن الصفار المرشح لنيل شهادة دكتوراه من كلية مانشستر للعمارة في جامعة مانشستر متروبوليتان، تحت إشراف ايمون كناف مدير الدراسات والبروفيسور توم جيفريز،عميد كلية مانشستر للعمارة

الاهدف الرئيسية من هذا البحث

الهدف الأول من هذا البحث هو وضع إطار تصميم حضري مستدام ذكي وايضا تصميم مقترح يوفر الحلول والمفاهيم اللازمة لتحديد شكل و مستقبل المركز التاريخي لبغداد، والتي يمكن أن تطبق على المناطق التاريخية الأخرى. الهدف الثاني من هذا البحث هو تفسير دور تكنولوجيا المعلومات والاتصالات والتصميم المستدام الذكي التي يمكن أن تنفذ في جوهر المناطق الحضرية التقليدية العراقية وايضا ايجاد قاعدة لحل القيم المتضاربة بين الشكل العمراني التقليدي ونظم التصميم الحديث . الهدف الثالث من هذا البحث هو لملء الفجوة المتعلقة استخدام "المدينة الذكية المستدامة" في البيئة التاريخية من خلال دراسة حالة معينة وهي منطقة الرصافة القديمة وايضا لاضافة ما يكفي من المعرفة إلى الميدان ودراسة إمكانية تطبيقها

منهجية البحث العلمي

الهدف من هذا البحث هو تقييم حالة النسيج العمراني التقليدي في الرصافة القديمة وإيجاد تصميم حضري ذكي ومستدام. لذلك، سوف يستند هذا البحث على مجموعة من البيانات النظرية والتجريبية للتأكد من أن اجوبة الأسئلة البحثية سوف يتم الرد عليها باستخدام المنهجيات المناسبة. ان طبيعة منهجية هذا البحث يمكن أن تسمى أبحاث متعددة الاستراتيجيات، حيث يدمج كل طريقة، ويبني على قوة الآخر. وسيتم استخدام منهجية البحث الكمي من أجل تحقيق الهدف من الدراسة البحثية. وعلاوة على ذلك، سيتم استخدام منهجية دراسة حالة او منطقة معينة كأداة بحثية

المشاركون في هذه الدراسة

ويهدف هذا البحث الى مقابلة عدد من الأكاديميين وصانعي السياسات والمهنيين والسكان المحليين. وسوف تستخدم المعلومات من هذه الدراسة لكتابة أطروحة الدكتوراه وسوف يتم قراءتها من قبل مشرفين وغيرهم من الأشخاص ما يلزم منها للأغراض البحثية. وسوف تصبح ملكا لجامعة مانشستر متروبوليتان بعد التحكيم وفقا للأحكام والشروط

اسئلة عامة

ترتبط الأسئلة العامة التالية بالعمر والجنس والمهنة، والمؤسسات، ومجالات الاهتمام. ستعامل إجاباتك بسرية تامة وسيتم الاعتراف بمشاركتكم تماما في ختام هذا العمل، ولكن فقط مع موافقتك. سيتم استخدام المعلومات التي تم جمعها من هذا القسم العام من أجل تصنيف الفئات المهنية والمؤسسات من المشاركين، عند تحليل البيانات

1.

يرجى اختيار فئتك العمرية؟

- ◯ 20-30 سنة
- ◯ 31-40 سنة
- ◯ 41-50 سنة
- ◯ 51-60 سنة
- ◯ 61 سنة فاكبر

2.

يرجى الإشارة مؤهلاتك؟

- ◯ بكلوريوس
- ◯ ماجستير
- ◯ دكتوراه
- ◯ أخرى يرجى التحديد

3.

يرجى اختيار الجنس؟

- ◯ ذكر
- ◯ انثى

4.

كيف يمكنك أن تصنف الفئة المهنية الخاصة بك؟

- أكاديمي
- مهني
- ساكن محلي
- صانع قرار
- أخرى يرجى التحديد

العوامل الرئيسية التي تمثل المركز التاريخي في بغداد الرصافة القديمة

5.

كيف يمكنك أن تنظر الى المركز التاريخي في بغداد (الرصافة القديمة) كمكان لل

	جيد جدا	جيد	مرض	ضعيف	ضعيف جدا	لا اعرف
السكن	○	○	○	○	○	○
العمل	○	○	○	○	○	○
التسوق	○	○	○	○	○	○
الاستثمار	○	○	○	○	○	○
سياحة	○	○	○	○	○	○
الوصول إلى الخدمات الحكومية والمدنية	○	○	○	○	○	○

6.

كيف تقيم العوامل الرئيسية التي تمثل المركز التاريخي في بغداد (الرصافة القديمة)؟

	جيد جدا	جيد	مرض	ضعيف	ضعيف جدا	لا اعرف
القيم الاجتماعية التقليدية بين الجيران	○	○	○	○	○	○
جودة الحياة	○	○	○	○	○	○
العدالة الاجتماعية	○	○	○	○	○	○
التعاون والتفاعل بين الجيران	○	○	○	○	○	○
إمكانية الوصول إلى التسوق	○	○	○	○	○	○
الشعور بالأمان في الأزقة والمناطق التقليدية والمساحات المفتوحة	○	○	○	○	○	○
المقياس الانساني	○	○	○	○	○	○
الخصوصية	○	○	○	○	○	○
الظل الطبيعي	○	○	○	○	○	○
المشي والتجوال والبيئة الطبيعية	○	○	○	○	○	○

سهولة الوصول، البنى التحتية والخدمات العامة

7.

كيف تقيم سهولة الوصول في المركز التاريخي في بغداد (الرصافة القديمة)

	جيد جدا	جيد	مرض	ضعيف	ضعيف جدا	لا اعرف
النقل العام	○	○	○	○	○	○
سيارة	○	○	○	○	○	○
دراجة نارية	○	○	○	○	○	○
دراجة هوائية	○	○	○	○	○	○
المشي	○	○	○	○	○	○

8.

كيف تقيم البنية التحتية في المركز التاريخي في بغداد (الرصافة القديمة)

	جيد جدا	جيد	مرض	ضعيف	ضعيف جدا	لا اعرف
الماء	○	○	○	○	○	○
الطاقة	○	○	○	○	○	○
التصريف الصحي	○	○	○	○	○	○
التخلص من النفايات	○	○	○	○	○	○
النقل	○	○	○	○	○	○
البنية التحتية الرقمية	○	○	○	○	○	○

9.

كيف يمكنك تقييم المنشئات العامة في المركز التاريخي في بغداد (الرصافة القديمة)

	جيد جدا	جيد	مرض	ضعيف	ضعيف جدا	لا اعرف	
منشئات الرعاية الصحية	○	○	○	○	○	○	○
المنشئات التعليمية	○	○	○	○	○	○	○
المنشئات الدينية	○	○	○	○	○	○	○
المنشئات الثقافية	○	○	○	○	○	○	○
المنشئات الاجتماعية والترفيهية	○	○	○	○	○	○	○
منشئات التسوق	○	○	○	○	○	○	○

مشاكل إدارة الأراضي

10.

كيف تقيم مشاكل إدارة الأراضي في المركز التاريخي في بغداد الرصافة القديمة

	عالي جدا	عالي	متوسط	منخفض	منخفض جدا	لا اعرف
الخلاف على ترسيم الملكية	◯	◯	◯	◯	◯	◯
عدم وجود سجل خاص باصحاب الاملاك	◯	◯	◯	◯	◯	◯
نقص في الخرائط والمخططات	◯	◯	◯	◯	◯	◯
عدم وجود أنظمة مناسبة للحفاظ على قيم التراث	◯	◯	◯	◯	◯	◯
عدم وجود منهجيات التخطيط الحكومية المختصة للحفاظ على قيم التراث	◯	◯	◯	◯	◯	◯
عدم وجود خبراء من ذوي المهارات المحلية في الحفاظ على قيم التراث	◯	◯	◯	◯	◯	◯
عدم وجود مشاركة للمجتمعات المحلية في توثيق التراث الثقافي	◯	◯	◯	◯	◯	◯

11.

كيف تقيم موقف الحكومة تجاه مشاركة المواطنين المحليين في الحفاظ على قيم التراث

- ◯ قوي جدا
- ◯ قوي
- ◯ متوسط
- ◯ ضعيف
- ◯ ضعيف جدا
- ◯ لا اعرف

12.

كيف تقيم عمل الحكومة نحو تعزيز مجال التراث الثقافي

- قوي جدا
- قوي
- متوسط
- ضعيف
- ضعيف جدا
- لا اعرف

مؤشرات الاستدامة

13.

كيف تقيم أهمية جودة البيئة الطبيعية في مركز المدينة التاريخي (الرصافة القديمة) من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
زيادة المساحات الخضراء والمفتوحة	○	○	○	○	○	○
تعزيز فرص إعادة التدوير	○	○	○	○	○	○
تحسين نوعية الهواء	○	○	○	○	○	○
انخفاض استهلاك البنزين	○	○	○	○	○	○
كفاءة استخدام الموارد	○	○	○	○	○	○

14.

كيف تقيم أهمية التفاعل الاجتماعي في المركز التاريخي (الرصافة القديمة) من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
تعزيز الإحساس بالانتماء للمجتمع	○	○	○	○	○	○
تعزيز التفاعل الاجتماعي والحياة المدنية	○	○	○	○	○	○
مستوى المعيشة	○	○	○	○	○	○
العدالة الاجتماعية	○	○	○	○	○	○
المشاركة الاجتماعية	○	○	○	○	○	○

15.

كيف تقيم أهمية وجود سهولة في الوصول بشكل أفضل إلى الخدمات والمرافق في المركز التاريخي الرصافة القديمة من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
توفير العدالة الاجتماعية في توفير للخدمات	○	○	○	○	○	○
تقليل حاجة الناس الى التنقل	○	○	○	○	○	○
تقديم الخدمات محليا والتشجيع السير على الأقدام	○	○	○	○	○	○

16.

كيف تقيم أهمية الصحة العامة في المركز التاريخي من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
تقليل الملوثات السامة وغير السامة	◯	◯	◯	◯	◯	◯
تقليل ضغط متطلبات الحياة اليومية	◯	◯	◯	◯	◯	◯
الحد من الإجهاد للأفراد	◯	◯	◯	◯	◯	◯
تنقية المياه, الهواء والارض	◯	◯	◯	◯	◯	◯

17.

كيف تقيم أهمية الجدوى الاقتصادية في المركز التاريخي من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم
زيادة قيمة الأراضي للأحياء السكنية	◯	◯	◯	◯	◯
خفض تكاليف البنية التحتية	◯	◯	◯	◯	◯
الحفاظ الحضري	◯	◯	◯	◯	◯
الفقر	◯	◯	◯	◯	◯

التدهور العمراني والتلوث وغيرها من المشاكل في الرصافة القديمة

18.

كيف تقيم معدل التدهور في المكونات الرئيسية في المركز التاريخي في بغداد (الرصافة القديمة)

	عالي جدا	عالي	متوسط	منخفض	منخفض جدا	لا اعرف
النسيج الحضري التقليدي	○	○	○	○	○	○
البيوت البغدادية التقليدية	○	○	○	○	○	○
شارع الرشيد والساحات	○	○	○	○	○	○
المحاور التاريخية	○	○	○	○	○	○
الواجهة النهرية	○	○	○	○	○	○
الاسواق التقليدية	○	○	○	○	○	○

19.

كيف تقيم المشاكل الملموسة في المركز التاريخي في بغداد من حيث

	عالي جدا	عالي	متوسط	منخفض	منخفض جدا	لا اعرف
استعمال الاراضي	○	○	○	○	○	○
ألامان	○	○	○	○	○	○
الفقر	○	○	○	○	○	○
الاكتظاظ السكاني	○	○	○	○	○	○
الازدحام المروري	○	○	○	○	○	○

20.

كيف تقيم نسبة التلوث في البيئة الفيزياوية في المركز التاريخي في بغداد الرصافة القديمة

	عالي جدا	عالي	متوسط	منخفض	منخفض جدا	لا اعرف
التلوث الضوضائي	○	○	○	○	○	○
التلوث البصري	○	○	○	○	○	○
تلوث الهواء	○	○	○	○	○	○
تلوث المياه	○	○	○	○	○	○
تلوث الأرض	○	○	○	○	○	○

خصائص المدن الذكية

21.

كيف تقيم اهمية الحوكمة الذكية في الرصافة القديمة من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
الخدمات الالكترونية	○	○	○	○	○	○
التفاعل والتعاون مع الجمهور	○	○	○	○	○	○
البيانات المتاحة والمجانية باستخدام تكنولوجيا المعلومات والاتصالات	○	○	○	○	○	○

22.

كيف تقيم أهمية الاقتصاد الذكي في المركز التاريخي من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
الأعمال الإلكترونية	○	○	○	○	○	○
التجارة الإلكترونية	○	○	○	○	○	○
زيادة الإنتاجية	○	○	○	○	○	○

23.

كيف تقيم أهمية النقل الذكي في المركز التاريخي من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
انظمة نقل متكاملة	○	○	○	○	○	○
خيارات نقل نظيفة وغير مزودة بمحركات	○	○	○	○	○	○
انظمة نقل متطورة وذكية	○	○	○	○	○	○
الحد من انبعاثات غاز CO_2	○	○	○	○	○	○

24.

كيف تقيم أهمية البيئة الذكية في المركز التاريخي من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
الطاقة الذكية	○	○	○	○	○	○
مراقبة ومكافحة التلوث	○	○	○	○	○	○
المباني الخضراء	○	○	○	○	○	○
التخطيط الحضري المستدام	○	○	○	○	○	○
كفاءة استخدام الموارد	○	○	○	○	○	○
تحسين جودة المياه	○	○	○	○	○	○

25.

كيف تقيم أهمية الأشخاص الأذكياء في المركز التاريخي من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
المهارات الالكترونية	○	○	○	○	○	○
العمل عن بعد	○	○	○	○	○	○
التعليم والتدريب الإلكتروني	○	○	○	○	○	○

26.

كيف تقيم أهمية الحياة الذكية في المركز التاريخي من حيث

	مهم للغاية	مهم	معتدل الاهمية	قليل الاهمية	غير مهم	لا اعرف
رفاهية الحياة باستخدم تكنولوجيا المعلومات والاتصالات	○	○	○	○	○	○
الحياة الصحية	○	○	○	○	○	○
العيش الآمن	○	○	○	○	○	○
مرافق ثقافية متنوعة	○	○	○	○	○	○
جودة المسكن	○	○	○	○	○	○

نموذج الموافقة

تتعلق الأسئلة والمتطلبات التالية بمستلزمات الاداب الاكادمية لهذا الاستبيان

27.

أنا أفهم أن مشاركتي طوعية وأنا حر في الانسحاب في أي وقت دون إبداء أي سبب، دون ان تتاثر حقوقي

- نعم
- لا

28.

أؤكد أنني قد قرأت وفهمت ورقة المعلومات المؤرخة [2016/01/04] للدراسة المذكورة أعلاه. وقد أتيحت لي الفرصة للنظر في المعلومات، وطرح الأسئلة، وكانت الإجابات مرضية

- نعم
- لا

29.

أنا على علم وفقا لقانون حماية البيانات، بانه يمكنني في أي وقت طلب الحصول على المعلومات التي قدمتها ويمكنني أيضا طلب اتلاف تلك المعلومات إذا كنت ارغب في ذلك

- نعم
- لا

30.

أنا أوافق على المشاركة في الدراسة المذكورة أعلاه

- نعم
- لا

31.

هل تعطي الإذن لتوثيق اسمك والمؤسسة المهنية التي تتبع لها في هذا البحث؟

- نعم
- لا

32.

هل ترغب في الحصول على النتائج النهائية لتحليل البيانات التي تم جمعها بواسطة هذا الاستبيان؟

- نعم
- لا

33.

هل ترغب في الحصول على النتائج النهائية لهذا المشروع البحثي لرسالة الدكتوراه؟

- نعم
- لا

34.

يرجى كتابة اسمك وعنوان البريد الإلكتروني الخاص بك إذا كنت ترغب في الحصول على النتائج النهائية لهذا المشروع

Appendix 2: Research Ethics Application Form

ETHICS AND YOUR RESEARCH PROPOSAL:
A REFLECTION EXERCISE FOR ART, DESIGN & MEDIA.

Principle 1: Health, Wellbeing and Dignity.
Principle 2: Reputation, Integrity and Dissemination.
Principle 3: Legislation, Regulation and the General Good.

This interactive Acrobat version requires Adobe Acrobat reader.

For optimum view turn off 'show border hover colour' under Menu -Acrobat Reader: Preferences: Forms
Note: Apple Macintosh Preview software doesn't fully support this interactive .PDF (known issue on page 4 with layers).

MIRIAD MANCHESTER SCHOOL OF ART

Project and Researcher Details (Please Complete)

Name of applicant (Principal Investigator):	Mazin Mousa
Date:	30/07/2015
Telephone Number:	07587602260
Email address:	12500256@stu.mmu.ac.uk
Status: Undergraduate student, Postgraduate Student (Taught or Research), Staff	Postgraduate Student Research
Department/School/Research centre Other Unit:	Manchester School of Architecture
Programme of study (if applicable):	
Name of supervisor/mentor/research centre leader (if applicable):	Eamonn Canniffe
Project Title:	THE INFLUENCE OF ICT & SMART SUS

To be used in conjunction with the taught session. J Spencer. PhD Research Study. Version 8. MIRIAD 2014.

Ethical assessment – An introduction

"There are many other areas of activity where ethical issues may have an impact and it is the responsibility of a researcher to draw any potential areas of concern to the attention of the appropriate ethics committee".

MMU Academic Board Research Degrees Committee. October 2002.

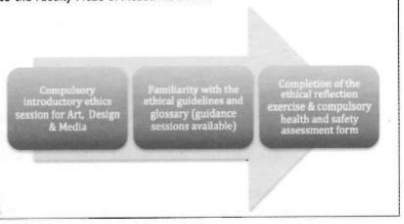
This ethical reflection exercise must be completed for every research project. It is used to identify whether there are any ethical issues associated with your project and **importantly to begin planning a your response to any issues raised.**

It will also help your supervisor or mentor recognise if further consideration is required. A taught introductory ethics session supports the implementation of this excercise and its guidelines. The taught session includes short case study examples and also lists some activities and scenarios that require careful consideration.
Prior to completing the exercise you should refer to the MIRIAD Ethical Guidelines and glossary at the back of this document *(see Appendix).*

The MIRIAD ethical approval process

"Ethical judgments are highly context-sensitive and there are rarely simple right or wrong answers to the dilemmas faced by researchers."
The Ethics project [2006]

The ethics approval process comprises three main preliminary stages. In the case of specific ethical issues or where there is uncertainty, referral will be made to the Faculty Head of Academic Ethics.



Ethical assessment. Encouraging engagement with potential ethical issues.

Six categories of ethical issues pertinent to art and design media are listed overleaf.

The category framework was originally produced in 2006 by a consortium of Universities, as part of the 'Research ethics in art and design media project' funded as part of the Arts and Humanities Research Council Collaborative Research Training Scheme. The 'ethics project' examined the role of ethics within postgraduate art and design media research. The project did not set out to be overly bureaucratic or stifle creative work, rather it stated the belief that ethical awareness leads to better research.
[http://www.biad.bcu.ac.uk/research/rti/ethics/about.html -06/05/14]

At MIRIAD this category framework has been used as a starting point and combined it with the two part evaluative approach, familiar to those involved in physical risk assessment. This resulting three-part process is part of a larger individual ongoing research project.
The aim is to encourage researchers themselves, to evaluate and respond to ethical issues they might encounter.

"It is important that these categories are not seen to prescribe particular approaches. For example, the heading 'communal or general good' does not imply that all research should have an immediate applied value beyond the context of the research; it can clearly be argued that there is a place for research in fine art where no such immediate application can be demonstrated, and no doubt this is true in other disciplines. On the other hand, it is certainly legitimate to ask whether a particular research question is sufficiently interesting and valuable to justify any investment and risk that answering it entails".
[http://www.biad.bcu.ac.uk/research/rti/ethics/guidance.html -06/05/14]

Remember this is also a dynamic process and any significant change in your question, design or conduct over the course of the research will require resubmission of this form to your supervisor, mentor or research area leader and/or the Faculty Head of Academic Ethics.

Completion of this exercise will be supported by bookable one to one sessions aimed at helping you appraise your research project in ethical terms or simply to assist you with completion of the checklist.
(See the Righton building notice board).

2

The five basic steps to completing this ethical reflection exercise:

1. Read the ethical guidelines on page 8 and the glossary of ethical terms on page 11.
2. Complete the short introductory questionnaire - below on this page.
3. Read the list of ethical issues on the form overleaf (page 4 - PART A). Indicate YES or NO to the issues which might apply to your study.
4. Use PART B (on page 5), to describe your ethical response to **all** the issues you have highlighted. (See the example at the top of page 5)
5. Submit this pack together with a completed health and safety assessment form. If you are gathering data from people please also attach examples of your consent form(s) and how you will inform participants about your project and ensure 'active consent'.

Responses (yes/no) which are highlighted in green will require referral to the Faculty Head of Academic Ethics.
Other issues may also be referred to the Faculty Head of Academic Ethics at the discretion of your supervisor.

Introductory questions - Please tick your response and answer all questions.

Have you attached a health and safety risk assessment? From November 2012 all proposals will require a separate health and safety risk assessment.	YES/NO ☐ ☑
Does your project involve NHS Staff or patients or require NHS Trust approval? For example your study will involve the recruitment of patients or staff through the NHS or involve NHS resources.	YES/NO ☐ ☑
Will blood or tissue samples be obtained from participants?	YES/NO ☐ ☑
Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	YES/NO ☐ ☑
Will research take place outside of the UK?	YES/NO ☑ ☐

3

PART A – What ethical issues are there in your research? [Please tick YES OR NO to ALL the issues listed below].

	YES	NO
Communal or General Good		
A1 Potential Applications of Research	[✓]	[ ]
A2 Anticipated and Unanticipated Consequences	[ ]	[✓]
A3 Impact on Third Parties or the Environment	[✓]	[ ]
A5 The Value of Knowledge	[ ]	[✓]
A6 The Problem of Relevance	[ ]	[✓]
Academic Integrity and Responsibility to the Discipline		
B1 The Pursuit of Objectivity	[ ]	[✓]
B2 Integrity in Reporting Data and Findings	[ ]	[✓]
B3 Acknowledging Sources	[ ]	[✓]
B4 Conflicts of Interest	[ ]	[✓]
B5 Supervisory Relationships	[ ]	[✓]
Safeguarding the Well-Being of Participants		
C1 Protection from Physical Harm (Health and Safety)	[ ]	[✓]
C2 Threats to Psychological Well-Being	[ ]	[✓]
C3 Sensitive Issues and Traumatic Experiences	[ ]	[✓]
C4 Intrusiveness	[ ]	[✓]
C5 Sensitivity to the Needs and Expectations of Participants	[ ]	[✓]
C6 Psychological Impact on the Researcher	[ ]	[✓]
Research Participants and Informed Consent		
D1 Collaborators, Participants or Subjects	[ ]	[✓]
D2 Payment of Participants	[ ]	[✓]
D3 Informing Consent	[ ]	[✓]
D4 Active Consent	[✓]	[ ]
D5 Documenting Consent	[ ]	[✓]
D6 Consent as Process not Event	[ ]	[✓]
D7 The Right to Withdraw	[ ]	[✓]
D8 Vulnerable Populations	[ ]	[✓]
D9 Power Relationships and Exploitation	[ ]	[✓]
D10 Neutrality and Maintaining the Role of Researcher	[ ]	[✓]
D11 Participant-Research	[ ]	[✓]
D12 Gatekeepers	[ ]	[✓]
D13 Deception and Covert Research	[ ]	[✓]
D14 Debriefing and Closure	[ ]	[✓]
D15 Consent for Future Uses of Data	[ ]	[✓]

	YES	NO
The Management of Data		
E1 Secure Storage of Privileged Information	[ ]	[✓]
E2 Managed Access to Data	[ ]	[✓]
E3 Secondary Uses of Data	[ ]	[✓]
Dissemination		
F1 Intellectual Property Rights	[ ]	[✓]
F2 Cultural Copyright	[ ]	[✓]
F3 Acknowledgment of Participants or Collaborators	[ ]	[✓]
F4 Anonymity	[ ]	[✓]
F5 Confidentiality	[ ]	[✓]
F6 Visual Representations of Individuals or Social Groups	[ ]	[✓]
F7 The Public Exhibition of Research Outcomes	[ ]	[✓]
F8 Potential Harm to the Reputation of Participants or Third Parties	[ ]	[✓]
F9 Material and Other Benefits from Research	[ ]	[✓]

Step 1
Compare your proposed methodology against the Part A assessment checklist

Step 2
Complete Part B - Indicate potential ethical issues

Step 3
Part B - Describe your response to issues raised

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PART B – Respond to the issues you noted in Part A.

Research Activity	Category	Response to ethic issues raised	S/C
EXAMPLE: *Filming in a school*	*D12 Gatekeepers* *D4 Active Consent* *D5 Documenting Consent* *F7 The Public Exhibition of Research Outcomes* *E1 Secure Storage of Privileged Information* *C5 Sensitivity to the Needs and Expectations of Participants* *D8 Vulnerable Populations* *C1 Protection from Physical Harm (Health and Safety) **	*Seek written consent of school and parents/guardians.* *Make it clear from the outset to all involved what the intended outcome might be and whether there will be any public screening of the film.* *Consider anonymous contributions.* *Seek CRB check* *Complete risk assessment* *Consider policy for withdrawal of participants and storage of material*	
Produce a smart sustainable urban design framework and design proposal that provides conceptual solutions to shape the future of the historic center of Baghdad	A1 Potential Applications of Research	Will fill a gap related to the use of 'Smart and Sustainable City' methods in a historic environment by understanding a specific case study of a physical part of an existing city (old Rusafa in Baghdad). Also will add enough knowledge to the field to inform further study and potential implementation by the Municipality of Baghdad and develop new ways to explore complex urban territories in other historic areas.	
Regenerate the significant features in the historic part of Baghdad (the built environment).	A3 Impact on Third Parties or the Environment	The impact of this case study will improve the environmental conditions in the historic part.	
Interview	D4 Active Consent	A pre-planned structure interview will be used to collect data. The case study will be the old area of Rusafa (Baghdad) and this research will attempt to interview a number of policy makers, professionals and local residents, consequently, a structured interview is the preferred solution for collecting the data.	

S/C : √= Consent of Supervisor/Mentor/Research Centre Leader or R = refer to Head of Faculty Ethics

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PART C – OUTCOME *(TO BE COMPLETED BY MMU STAFF)*

Name of applicant (Principal Researcher): Mazin Mousa

Approval for the above named proposal **is** granted

I confirm that there are no ethical issues requiring further consideration.
(Any subsequent changes to the nature of the project will require a review of the ethical considerations.)

Signature of Supervisor, Mentor or Research Centre Leader

Date: 6/8/15

Additional comments (optional):

OR

Approval for the above named proposal is **NOT** granted.

I confirm that there are ethical issues requiring further consideration and will refer the project proposal to the Faculty Head of Academic ethics.

Signature of Supervisor, Mentor or Research Centre Leader

Date: _____

Additional comments (optional):

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Appendix:

RESEARCHER GUIDELINES ON ETHICAL ISSUES

A general summary of available/published MMU guidance

The following guidelines are intended to help you identify any potential ethical issues relating to project/research work you may be planning to undertake as part of your studies. Using these guidelines you should reflect upon how, and to what extent, your work may have ethical issues that require consideration and action. These guidelines cannot solve the ethical issues for you. They should instead be used in collaboration with the ethical reflection excercise and your supervisor or mentor to reflect upon the project/research work you plan to pursue. Obviously this thought and reflection must occur prior to starting the project/research work.

Occasionally ethical issues are identified which may require you to change, or even abandon, elements of your project. Additionally, you must continue to consider ethical issues throughout the duration of your project/research investigation including any analysis and/or writing up/photographic/video of your findings. In short, ethical considerations should be inherent in all aspects of the process, from first ideas to the final report or outcome of research/project.

It should be remembered that there is common arts principle of encouraging the articulation of an ethical defence rather than prescribing particular approaches. This said the following principles should be applied to your project/practical work, (including dissertations):

Principle 1: Health, Wellbeing and Dignity.

As a researcher you have a duty to avoid, prevent or minimise harm to yourself and others. Procedures and practices that might cause serious or lasting harm to participants must not be used. Consideration should also be given to both the physical and psychological/emotional wellbeing of participants. Whilst it is now a requirement that all research proposals are risk assessed at the outset practical projects such as filmmaking or workshop activities may require additional vocationally specific risk assessment. In these instances a full risk-assessment form must be submitted prior to the activity.
As researchers you should respect human dignity at all times. You should not attempt to discriminate against individuals or groups.
Respect should be given to the free and informed consent of participants. Only in exceptional circumstances where there is satisfactory justification (e.g. the likelihood of the end results being affected), should information be withheld. In practical terms, this principle translates into ensuring that everybody who assists you with your project does so willingly and is aware of the purpose for the project. For example, if you are taking a photograph of a person, make sure they are agreeable and you have documented consent. Consider consent for future uses of data and also whether it is appropriate to allow participants a right to withdraw. It is worth remembering that it is the University's default position that participants can withdraw themselves and their data from the academic activity at any time.

Particular care must be taken in the case of vulnerable populations such as children or adults with learning difficulties. Vulnerable persons are entitled to special protection against abuse, exploitation or discrimination.

The University also stipulates that the size of sample proposed for any group enquiry shall not be larger than justifiably necessary.

Principle 2: Reputation, Integrity and Dissemination.

Integrity demonstrated when reporting findings, acknowledging sources and avoiding conflicts of interest is central to academic research. A careful consideration of intellectual property rights, confidentiality and representation of individuals or groups is also key in establishing a strong research reputation. You are expected to adhere to these aims.

Any relationship, other than that required by the academic activity, between the researcher(s) and the participant(s) must be declared.

Participants should give their explicit consent except where there is satisfactory justification for not obtaining this consent.

Plagiarism, deception or the fabrication or falsification of results is regarded as serious professional misconduct and may result in the University invoking disciplinary procedures.
The contributions of formal collaborators and all others who directly assist or indirectly support the research should be properly acknowledged.

Where approaching groups (schools, museums, nursing home residents, societies etc.) it is often advisable to secure the written permission of a gatekeeper. You will need to make this clear in 'part B' of your ethics exercise paperwork.
You may need manage access to your research data, consider carefully any secondary uses for it and store/dispose of it securely. Never disclose personal information without permission. Be aware that sensitive personal data requires explicit written consent (see principle 3).

Principle 3: Legislation, Regulation and the General Good

From the beginning you are encouraged to ethically consider in impact of your research project on third parties and the environment. In addition together with your supervisor/mentor or research centre leader you will need to address the complex issue of the value of specific knowledge, its relevance and any potential applications of your research. As the RTI ethics project (2006)[1] outlined 'general good' does not imply that all research should have an immediate applied value beyond the context of the research, however it is legitimate from an ethical standpoint to ask whether a particular research question is sufficiently interesting and valuable to justify any investment and risk that answering it entails.

All researchers should be aware of any legal requirements that regulate their work. As a researcher, we have an expectation that your research activities will be undertaken with regard to with current UK legislation and regulation within the field.

If any academic activity is concerned with studies on activities which themselves raise questions of legality there must be a persuasive rationale which demonstrates to the satisfaction of the University that:

The risk to the University in terms of external (and internal) perceptions of the worthiness of the work has been assessed and is deemed acceptable; arrangements are in place which safeguard the interests of the researcher(s) being supervised in pursuit of the academic activity objectives; special arrangements have been made for the security of related documentation and artefacts.

In addition to the ethical considerations students/staff should be aware that information regarding any living person identifiable by data obtained in the University, for either, teaching, research or consultancy purposes, must be stored and used according to the (1998) Data Protection Act. This law makes those who hold this personal information/data, whether in a physical or electronic form, responsible for processing it in accordance with stated principles.

One of these principles is that the personal information must be obtained fairly and lawfully, which includes informing the provider about the purposes for which the data will be used. Another is that you must not disclose the identity of any individual who has provided you with data unless the provider has given you written consent to do so prior to disclosure. In brief, you should:

- Always explain why, where and how data will be used
- Always obtain consent
- Sensitive personal data requires explicit written consent.
- Never disclose personal information without permission
- Data subjects have the right of access to all data held on them
- Consent required for public displays of names/photographs
- Don't send personal data abroad without consent (This includes the Internet)
- All personal data must be kept and disposed of securely.

What sort of work requires referral to the Faculty Head of Academic Ethics?

Referral to the Faculty Head of Academic Ethics for ethical approval needs only be sought in instances when **a)** the person responsible for the research project judges that a significant ethical issue is likely to occur or **b)** a supervisor/mentor or research centre leader determines it appropriate after submission and appraisal of the ethics reflection exercise/checklist or **c)** where questionnaires or interviews target children, vulnerable adults or hospitalised patients. In this case ethical approval must be sought from the Faculty Head of Academic Ethics.
Whilst any of the issues noted in the ethics reflection exercise might lead to this need for further consideration, certain areas by their very nature will require greater focus and immediate referral, notably:

Issues highlighted by the project health and safety assessment.
Medically/NHS related studies.
Research activity conducted outside of the UK.

And

B4 Conflicts of interest
C1 Protection from Physical Harm (Health and Safety)
C2 Threats to Psychological Well-Being
C3 Sensitive issues
C6 Psychological impact on the researcher
D2 Payment
D12 Gatekeepers
D8 Vulnerable Populations (as mentioned above – also see glossary)
D13 Deception and Covert Research
F8 Potential Harm to the Reputation of Participants or Third Parties

[1] [http://www.biad.bcu.ac.uk/research/rti/ethics/about.html –06/05/14]

Questionnaires

The Faculty Head of Academic Ethics wishes to review questionnaires if people being asked to complete questionnaires are children, vulnerable adults or hospitalised patients. Researchers and their supervisor/mentor or research centre leader must review questionnaires and may have to be prepared to reconsider and or/remove questions that are sensitive or likely to significantly upset or disturb participants. Tutors and students must also ensure that individuals are prevented from: participating involuntarily; being intentionally misled; being identified or incriminating themselves.

Interviews

The interests of participants should be protected wherever possible. Acquiring informed consent from participants is normally a condition of implementing a planned interview.

Where informed consent for an interview cannot be obtained, even by proxy consent, it should be taken as read that people are not consciously or willingly participating in the inquiry and the interview should not be undertaken.
Only in exceptional circumstances with satisfactory justification for not obtaining this consent, with prior ethics committee approval can covert or deception activity be undertaken.

The interviewer's work must avoid either direct or indirect harm to participants. Interviewers should try to actively explore and anticipate any harmful consequences their work might have for participants.
As already described the Faculty Head of Academic Ethics wishes to review interview questions if the persons being interviewed are children, vulnerable adults or hospitalised patients.

Great care should be taken with questions of a sensitive nature likely to significantly upset and/or disturb someone. They should first be checked by a supervisor/mentor or research centre leader, who should exercise their professional judgment. If this person is unsure on this matter, then they should submit the questions to the Faculty Head of Academic Ethics for judgment.

Any University employee or registered student whose University work will require them to work with babies, children or young people under the age of 18 or vulnerable adults, will be required to undertake an enhanced Criminal Records Bureau disclosure (CRB) through the university's administration before the Faculty Head of Academic Ethics will consider their ethics application. Note that a Criminal Disclosure will take longer than one month.

Who should apply for ethics approval?

The applicant should apply through their supervisor/mentor or the research centre leader of the study as he/she retains responsibility for the content and conduct of the study. This should normally be a permanent employee of the university.
If the supervisor/mentor fails to apply, or the researcher fails to inform the supervisor/mentor of the project they are undertaking then, in addition to the moral issue of being involved in unethical studies, there is an increased risk in legal actions being taken against the researcher and/or supervisor/mentor by the general public for alleged misconduct.

Insurance

The University holds insurance policies in place to cover claims for negligence arising from the conduct of the University's normal business, which includes research carried out by staff and by undergraduate and postgraduate students as part of their course. This does not extend to clinical negligence.

In addition, the University has provision to award indemnity and/or compensation in the event of claims for non-negligent harm. This is on the condition that the project is accepted by the insurers prior to the commencement of the research project and approval has been granted for the project from a suitable ethics committee.
Research which is applicable to non-negligent harm cover involves humans and physical intervention which could give rise to a physical injury or illness which is outside the participants day to day activities. This includes strenuous exercise, ingestion of substances, injection of substances, topical application of any substances, insertion of instruments, blood/tissue sampling of participants and scanning of participants.

The following types of research are <u>not</u> covered automatically for non-negligent harm if they are classed as the activities above and they involve:

1) Anything that assists with and /or alters the process of contraception, or investigating or participating in methods of contraception
2) Anything involving genetic engineering other than research in which the medical purpose is treating or diagnosing disease
3) Where the substance under investigation has been designed and /or manufactured by MMU
4) Pregnant women
5) Drug trials

6) Research involving children under sixteen years of age
7) Professional sports persons and or elite athletes.
8) Overseas research

If the proposed project results in undertaking any research that includes any of the 8 points above or would not be considered as normal University business it should be approved by the University's insurance officer.

Glossary

Active consent
In all cases of research, researchers should inform participants of their right to refuse to participate or withdraw from the investigation whenever and for whatever reason they wish. There should be no coercion of research participants to take part in the research. There needs in all but the most exceptional cases to be active consent.
(Source: SRC Framework for Research Ethics (FRE) 2010. Updated Sept. 2012[2]).

Confidentiality
One of the central principles of research ethics as described by the Framework for Research Ethics (a publication of Economic and Social Research Council - the principal funding agency for UK social science research) is confidentiality. The framework states that "confidentiality of information supplied by research participants and the anonymity of respondents must be respected".

Confidentiality (limits to)
Researchers working with children, families and vulnerable populations should, when eliciting consent, make clear the limits to confidentiality. If for example an interview reveals that a participant or another person identified in the interview is in significant and immediate danger, the researcher will be obliged to take action in response to that disclosure. Before starting a project involving children, families or vulnerable populations, the principal researcher should have established a procedure and the necessary systems and identified contacts to activate help and support in the event of a disclosure. If the researcher feels it is necessary to break confidentiality, the participant will normally be informed what action is being taken by the researcher, unless to do so would increase risk to those concerned. In projects collecting data on criminal behaviour, it may be necessary to explain to participants that confidentiality will be preserved as far as the law permits.
(Source: SRC Framework for Research Ethics (FRE) 2010. Updated Sept. 2012).

Consent as process not event
Consent as a process requires valid consent to be the result of an open process or dialogue. It is not solely about a signature on a form. The central issue is whether the participant was given all the information they needed to make a considered decision. How was this recorded or documented?

Gatekeepers
In the research setting gatekeepers are those whose position affords them formal or informal power to influence researchers' access to a set population, The term is often though not exclusively connected to a group or individual considered vulnerable for example parents/guardians and children, teachers and school pupils, care home administrators and the elderly or health professionals and patients. The term might also encompass the roles of individuals such community leaders and possibly translators. Communicating with gatekeepers is important, as is recognising their potential to assist, influence or constrain the course of research.

Informed consent
'Informed consent entails giving sufficient information about the research and ensuring that there is no explicit or implicit coercion so that prospective participants can make an informed and free decision on their possible involvement. Typically, the information should be provided in written form, time should be allowed for the participants to consider their choices and the forms should be signed off by the research participants to indicate consent'.
(Source: SRC Framework for Research Ethics (FRE) 2010. Updated Sept. 2012).

Sensitive topics
The ESRC Framework for Research Ethics provides the examples of "participants' sexual behaviour, their illegal or political behaviour, their experience of violence, their abuse or exploitation, their mental health, or their gender or ethnic status".

Valid consent: For consent to be 'valid' the participant must be capable of understanding all the potential risks involved.
(Source: SRC Framework for Research Ethics (FRE) 2010. Updated Sept. 2012).

Vulnerable groups:
The ESRC Framework for Research Ethics provides examples of potentially vulnerable groups listing, "children and young people, those with a learning disability or cognitive impairment, or individuals in a dependent or unequal relationship".

[2] http://www.esrc.ac.uk/about-esrc/information/research-ethics.aspx (Accessed May 2014)

Resources

Intellectual property rights

http://www.ipo.gov.uk/ (Accessed May 2014)

Health and safety

Whilst the principles of health and safety assessment remain constant, it is worth noting that there is range of specific assessment paperwork produced to meet needs of differing creative disciplines. Below is a link to the current generic MMU form together with examples other areas within the creative industries.

MMU H&S Document:
http://www.artdes.mmu.ac.uk/resources/healthandsafety/riskassessments.php
(Accessed May 2014)

MMU policy (Central):
http://www.mmu.ac.uk/humanresources/health/policy/mmu-health-and-safety.pdf
(Accessed May 2014)

MMU policy (Art and Design):
http://www.artdes.mmu.ac.uk/resources/healthandsafety/
(Accessed May 2014)

BBC Director of Photography/Lighting Directors/Gaffer Risk Assessment Form:
http://downloads.bbc.co.uk/safety/documents/resources/forms/safety-dop-lighting-director-gaffer-ra.doc
(Accessed May 2014)

The Royal Parks – Photography
www.royalparks.org.uk/__documents/main/docs/risk-assessments.doc

MMU Ethical Framework document

http://www2.mmu.ac.uk/rke/ethics-forms/
(Accessed May 2014)

Consent sheets

Example:
http://www.hse.gov.uk/research/ethics/consent.htm (Accessed May 2014)

Consent sheets [MMU Art and Design example]

Information sheet and consent form examples (rollover).

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Appendix 3: The English Version of the Final Questionnaire

Research Information Sheet

You are being invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. We would like to stress that you do not have to accept this invitation and should only agree to take part if you want to.

This questionnaire survey has been approved by the Ethical Committee of the Manchester Metropolitan University on 06/08/2015.

Thank you for reading this.

Researcher: Mazin Al-Saffar (PhD Candidate)
Mobile:+447587602260
E-mail address: 12500256@stu.mmu.ac.uk, mazinalsaffar75@yahoo.com

Supervisor: Eamonn Canniffe M.A. Dip. Arch. (Cantab)
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Address: Manchester School of Architecture, Manchester Metropolitan University, Chatham 708, United Kingdom.

Supervisor: Professor Tom Jefferies Head of Manchester School of Architecture
Phone:+44 (0) 161 247 1706
E-mail address: t.jefferies@mmu.ac.uk
Address: Manchester School of Architecture, Manchester Metropolitan University, Chatham 208, United Kingdom.

I am very grateful for your participation in this research. I will inform you of the consensus outcome and the result of this questionnaire survey in due course, if you so wish. Your response will be treated in the strictest confidence and your participation will be. fully acknowledged at the conclusion of this work, but only with your approval. If you have any further questions about the questionnaire survey or seek clarification on any other aspects of this research, do not hesitate to contact us, on the above addresses please.

The following information briefly outlines the purposes of the RESEARCH PROJECT and its objective.

This research has been carrying out by the PhD candidate Mazin Al-Saffar, at Manchester Metropolitan University, Manchester School of Architecture, under the supervision of Eamonn Canniffe Director of Study and Prof. Tom Jefferies, the head of Manchester School of Architecture.

The main objective of this research are:

The first aim of this research is to produce a smart sustainable urban design framework and design proposal that provides conceptual solutions to shape the future of the historic center of Baghdad, which may be applicable to other historic cities. The second aim of this research is to provide a greater view and better understanding of what ICT & smart sustainable design could implement in an urban core of the Iraqi traditional urban areas as a base to resolve the conflicting values of the traditional urban form and modern design models. The third aim of this research is to fill a gap related to the use of 'Smart and Sustainable City' methods in a historic environment by understanding a specific case study of a physical part of an existing city (Old Rusafa) in order to add enough knowledge to the field to inform further study and potential implementation.

Research Methodology

The aim of this research is to assess the condition of the traditional urban fabric in Old Rusafa to find solutions and create a smart and sustainable urban design framework. Therefore, this research will be based on a combination of theoretical and empirical data to ensure that research questions are answered by using appropriate methodologies. The nature of this research can be called a multi-strategy research, where each method integrates and builds on the strength of the other. The researcher will apply mixed method, which are a combination of quantitative and qualitative method of analysis. The two different broad methodological approaches qualitative and quantitative will be used in order to achieve the objective of the research study. Moreover, the case study method will be used as research tool. The research will be categorised into five stages of work, in which different methodologies will be adopted in each study.

The Participants in this Study:

This research will attempt to interview a number of academics, policy makers, professionals and local residents. I will use the information from this study to write a PhD thesis and it will be read by my supervisor and other persons as required for the purposes of the research. It will become the property of Manchester Metropolitan University after the PhD examination and the University under its terms and conditions reserves the right to avail it on demand to any other person.

General Questions

The following general questions are related to your age group, gender, your professions, institutions, and areas of interest. Your responses will be treated in the strictest confidence and your participation will be fully acknowledged at the conclusion of this work, but only with your approval. The information collected from this general section will be used in order to classify the professional and institutions categories of the participants, when analysing the data.

1. Would you please tick your relevant age group?

- ◯ 20-30 year
- ◯ 31-40 year
- ◯ 41-50 year
- ◯ 51-60 year
- ◯ 61 year and above

2. Would you please indicate your qualification?

- ◯ Undergraduate
- ◯ Postgraduate
- ◯ High degree
- ◯ Other (please specify)

3. Would you please indicate your gender?

- ◯ Male
- ◯ Female

4. How would you classify your professional category?

- ◯ Academic
- ◯ Proficient
- ◯ Local resident
- ◯ policy maker
- ◯ Other (please specify)

Factors that represent the historic center of Baghdad (Old Rusafa)

5. How do you consider the historic center of Baghdad (Old Rusafa) as a place for

	Very good	Good	Satisfactory	Poor	Very Poor	I don't know
Living	○	○	○	○	○	○
Working	○	○	○	○	○	○
Shooping	○	○	○	○	○	○
Investing	○	○	○	○	○	○
Touring	○	○	○	○	○	○
Governing	○	○	○	○	○	○

6. How do you rate the main factors that represent the historic center of Baghdad (Old Rusafa)?

	Very good	Good	Satisfactory	Poor	Very poor	I don't know
Traditional social values Between neighbours	○	○	○	○	○	○
Quality of life	○	○	○	○	○	○
Equity	○	○	○	○	○	○
Cooperation and interaction between neighbours	○	○	○	○	○	○
Accessibility of shopping	○	○	○	○	○	○
Feeling safe in alleys, Traditional areas and open spaces	○	○	○	○	○	○
Human scale	○	○	○	○	○	○
Privacy	○	○	○	○	○	○
Natural shading	○	○	○	○	○	○
Walkable and natural environments	○	○	○	○	○	○

Accessibility, Infrastructures and Facilities

7. How would you rate the accessibility in the historic center of Baghdad (Old Rusafa)

	Very good	Good	Satisfactory	Poor	Very poor	I don't know
Public transport	○	○	○	○	○	○
Car	○	○	○	○	○	○
Motorcycle	○	○	○	○	○	○
Cycling	○	○	○	○	○	○
Walking	○	○	○	○	○	○

8. How would you evaluate infrastructures in the historic center (Old Rusafa)

	Very good	Good	Satisfactory	Poor	Very Poor	I don't know
Water	○	○	○	○	○	○
Energy	○	○	○	○	○	○
Sewage	○	○	○	○	○	○
Waste	○	○	○	○	○	○
Transportation	○	○	○	○	○	○

9. How would assess facilities in the historic center of Baghdad (Old Rusafa)

	Very goog	Good	Satisfactory	Poor	Very poor	I don't know
Healthcare facilities	○	○	○	○	○	○
Educational facilities	○	○	○	○	○	○
Religious facilities	○	○	○	○	○	○
Cultural facilities	○	○	○	○	○	○
Social and leisure facilities	○	○	○	○	○	○
Shopping facilities	○	○	○	○	○	○

Deterioration, Pollution and other problems in Old Rusafa

10. Would you please evaluate the deterioration rate in the main components of Old Rusafa

	Very high	High	Medium	Low	Very low	I don't know
Traditional urban fabric	○	○	○	○	○	○
Traditional Baghdadi houses	○	○	○	○	○	○
Rashid Street and Squares	○	○	○	○	○	○
Historical Spines	○	○	○	○	○	○
Tigris Riverfront	○	○	○	○	○	○
Traditional suqs	○	○	○	○	○	○

11. How do you evaluate the most tangible problems in the historic center of Baghdad in terms of

	Very high	High	Medium	Low	Very low	I don't know
Land use	○	○	○	○	○	○
Safety	○	○	○	○	○	○
Poverty	○	○	○	○	○	○
Household Overcrowding	○	○	○	○	○	○
Traffic congestion	○	○	○	○	○	○

12. Would you please indicate the rate of pollution in the physical environment of Old Rusafa

	Very high	High	Medium	Low	Very low	I don't know
Noise pollution	○	○	○	○	○	○
Visual pollution	○	○	○	○	○	○
Air pollution	○	○	○	○	○	○
Water pollution	○	○	○	○	○	○
Land pollution	○	○	○	○	○	○

Land management problems

13. How would you estimate the main land management problems in Old Rusafa

	Very high	High	Medium	Low	Very low	I don't know
Conflicting ownership of plots	○	○	○	○	○	○
Lack of maintained register of ownership	○	○	○	○	○	○
Lack of maps and plans	○	○	○	○	○	○
Lack of appropriate regulations for conserving heritage values	○	○	○	○	○	○
Lack of appropriate governmental planning methodologies for conserving heritage values	○	○	○	○	○	○
An appropriate identification of the cultural heritage values	○	○	○	○	○	○
Lack of local skilled experts in preserving heritage values	○	○	○	○	○	○
Lack of the participation of local communities in the documentation of the cultural heritage	○	○	○	○	○	○

14. How do you rate the attitude of the government towards participation of local citizen in conserving heritage values of Old Rusafa?

- ○ Very strong
- ○ Strong
- ○ Indifferent
- ○ Weak
- ○ Very weak
- ○ I don't know

15. How would you describe the government intention towards promoting cultural heritage area in Old Rusafa ?

- ◯ Very strong
- ◯ Strong
- ◯ Indifferent
- ◯ Weak
- ◯ Very weak
- ◯ I don't know

Sustainability Indicators

16. How do you rate the importance of quality of natural environment in the historic center (Old Rusafa) in terms of

	Highly important	Important	Moderately important	Slightly important	Not important	I don't know
Increasing of greenery and open spaces						
promoting opportunities for recycling						
Improving air quality						
lower gasoline consumption						
Resource efficiency						

17. How do you rate the importance of social interaction the historic center (Old Rusafa) in terms of

	Highly important	Important	Moderately important	slightly important	Not important	I don't know
Enhancing the sense of community						
Strengthen social interaction and civic life						
Standard of Living						
Equity						
Social participation						

18. How do you rate the importance of a better accessibility to services and facilities in the historic center (Old Rusafa)

	Highly important	Important	Moderately important	Slightly important	Not important	I don't know
Provide social equitable for services						
Reducing the need for people to travel						
Providing services locally and easy to walk						

19. How do you rate the importance of public health in the historic center (Old Rusafa) in terms of

	Highly important	important	Moderately imporatnt	Slightly important	Not important	I don't know
Decreases toxic and non toxic pollutants	○	○	○	○	○	○
Intensify existing life stresses	○	○	○	○	○	○
Reduce the stress for Individuals	○	○	○	○	○	○
Clear water, air and land	○	○	○	○	○	○

20. How do you rate the importance of economic viability in the historic center (Old Rusafa) in terms of

	Highly important	Imporant	Moderately important	Slightly important	Not important	I don't know
Increase land values for residential neighborhoods	○	○	○	○	○	○
Decrease the cost of Infrastructure	○	○	○	○	○	○
Urban maintenance	○	○	○	○	○	○
Poverty	○	○	○	○	○	○

Smart City characteristics

21. How do you evaluate the importance of smart governance in Old Rusafa in terms of

	Highly important	important	Moderately important	Slightly important	Not important	I don't know
E-services						
Interaction and collaboration with public						
Open data By using ICT						

22. How do you evaluate the importance of smart economy in the historic center (Old Rusafa) in terms of

	Highly important	Important	Moderately important	Slightly important	Not important	I don't know
E-business						
E-commerce						
Increased productivity						

23. How do you evaluate the importance of smart mobility in the historic center (Old Rusafa) in terms of

	Highly important	Important	Moderately important	Slightly important	Not important	I don't know
Integrated transport						
Clean and often non-motorised options						
Efficient commuting						
Reduce CO2 emissions						

24. How do you evaluate the importance of smart environment in the historic center (Old Rusafa) in terms of

	Highly important	Important	Moderately important	Slightly important	Not important	I don't know
Smart energy						
Pollution control and monitoring						
Green buildings						
Green urban planning						
Resource use efficiency						
Improve water quality						

25. How do you evaluate the importance of smart people in the historic center (Old Rusafa) in terms of

	Highly important	Important	Moderately important	Slightly important	Not important	I don't know
E-skills	○	○	○	○	○	○
E-working	○	○	○	○	○	○
E-education and training	○	○	○	○	○	○

26. How do you evaluate the importance of smart living in the historic center (Old Rusafa) in terms of

	Highly important	Imporatnt	Moderately imporatnt	Slightly important	Slightly important	I don't know
ICT-enabled life styles	○	○	○	○	○	○
Healthy living	○	○	○	○	○	○
Safe living	○	○	○	○	○	○
Diverse cultural facilities	○	○	○	○	○	○
Good quality housing and accommodation	○	○	○	○	○	○

CONSENT FORM

The following questions and requisites are related to the Ethics of this Questionnaire.

27. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my rights being affected.

- ◯ Yes
- ◯ No

28. I confirm that I have read and have understood the information sheet dated [01/04/2016] for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

- ◯ Yes
- ◯ No

29. I understand that, under the Data Protection Act, I can at any time ask for access to the information I provide and I can also request the destruction of that information if I wish.

- ◯ Yes
- ◯ No

30. I agree to take part in the above study.

- ◯ Yes
- ◯ No

31. Do you give permission to address your name and institution in this research?

- ◯ Yes
- ◯ No

32. Since a few questions raised in this survey are open questions, do you give permission to be identified when direct quotations are extracted from your answers to be employed as part of this research data?

- ◯ Yes
- ◯ No

33. Would you like to receive the final results of analysing the data collected by this questionnaire?

- ◯ Yes
- ◯ No

34. Would you like to receive the final results of this PhD research project?

- ◯ Yes
- ◯ No

35. Would you please write your name and your email address if you would like to receive the final results of this PhD research project.

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